ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1974

CALENDAR

JANUARY

S		6	13	20	27
M		7	14	21	28
T	1◑	8O	15◑	22	29
W	2	9	16	23●	30
T	3	10	17	24	31◑
F	4	11	18	25	
S	5	12	19	26	

FEBRUARY

S		3	10	17	24
M		4	11	18	25
T		5	12	19	26
W		6	13	20	27
T		7O	14◑	21	28
F	1	8	15	22●	
S	2	9	16	23	

MARCH

S		3	10	17	24	31◑
M		4	11	18	25	
T		5	12	19	26	
W		6	13	20	27	
T		7	14	21	28	
F	1◑	8O	15◑	22	29	
S	2	9	16	23●	30	

APRIL

S		7	14◑	21	28
M	1	8	15	22●	29◑
T	2	9	16	23	30
W	3	10	17	24	
T	4	11	18	25	
F	5	12	19	26	
S	6O	13	20	27	

MAY

S		5	12	19	26
M		6O	13	20	27
T		7	14◑	21●	28◑
W	1	8	15	22	29
T	2	9	16	23	30
F	3	10	17	24	31
S	4	11	18	25	

JUNE

S		2	9	16	23	30
M		3	10	17	24	
T		4	11	18	25	
W		5O	12	19	26◑	
T		6	13◑	20●	27	
F		7	14	21	28	
S	1	8	15	22	29	

JULY

S		7	14	21	28
M	1	8	15	22	29
T	2	9	16	23	30
W	3	10	17	24	31
T	4O	11	18	25	
F	5	12◑	19●	26◑	
S	6	13	20	27	

AUGUST

S		4	11◑	18	25
M		5	12	19	26
T		6	13	20	27
W		7	14	21	28
T	1	8	15	22	29
F	2	9	16	23	30
S	3O	10	17●	24◑	31

SEPTEMBER

S	1O	8	15	22	29
M	2	9◑	16●	23◑	30
T	3	10	17	24	
W	4	11	18	25	
T	5	12	19	26	
F	6	13	20	27	
S	7	14	21	28	

OCTOBER

S		6	13	20	27
M		7	14	21	28
T	1O	8◑	15●	22	29
W	2	9	16	23O	30
T	3	10	17	24	31O
F	4	11	18	25	
S	5	12	19	26	

NOVEMBER

S		3	10	17	24
M		4	11	18	25
T		5	12	19	26
W		6	13	20	27
T		7◑	14●	21	28
F	1	8	15	22◑	29O
S	2	9	16	23	30

DECEMBER

S	1	8	15	22	29O
M	2	9	16	23	30
T	3	10	17	24	31
W	4	11	18	25	
T	5	12	19	26	
F	6◑	13●	20	27	
S	7	14	21◑	28	

- ● New Moon
- ◑ First Quarter
- O Full Moon
- ◑ Last Quarter

JULIAN DATE - See Inside Back Cover

Front Cover - Top end of the Rockefeller Reflector, Boyden Observatory, Bloemfontein.

ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1974

This booklet is intended both as a handbook for the established amateur or professional astronomer and as an introduction to astronomy for the interested layman – even if his interest is only a passing one. Most of the information it contains is in the form of tables or diagrams, many of which will be familiar to persons already possessing astronomical knowledge, but for which explanations are given for the benefit of the beginner.   General astronomical information is also provided – although not to the extent of a textbook on the subject.

Times given in this handbook are in South African Standard Time – the standard time used in the Republic, Rhodesia and most neighbouring territories.   In order to avoid confusion between a.m. and p.m., the 24-hour clock is used – for example 1800 hours is 6 p.m. and 2100 hours is 9 p.m.   Emphasis is given to phenomena visible in the evening sky – between sunset and midnight.

CONTENTS

P & PDUCT

ASTRONOMY IN SOUTHERN AFRICA

The favourable climate of Southern Africa is highly conducive to observational astronomy. Few other developed parts of the world experience such generally clear skies combined with pleasant outdoor nighttime temperatures. In particular, the observing conditions in the high elevation semi-arid regions could not be bettered anywhere else in the world. Consequently a number of professional research institutions, equipped with large telescopes, have been established in the past and are still expanding today, while many laymen have become enthusiastic amateur astronomers. Southern Africa has already gained both a tradition and reputation in observational astronomy.

OBSERVATORIES

Boyden Observatory is situated at Mazelspoort, just outside Bloemfontein. It possesses a number of telescopes including the 1,5m Rockefeller Reflector (the second largest telescope in Southern Africa) and the 0,9m ADH Baker Schmidt. It is administered by an international consortium representing American, Belgian, West German, Swedish, Irish and South African interests. Observing time at Boyden is normally the perogative of members of the consortium. However non-members may apply for observing time. Further information is available from the Director, Professor A.H. Jarrett.

The South African Astronomical Observatory was formed in 1972 by merging the facilities of the Royal Observatory (operated by the British Science Research Council) in Cape Town and the Republic Observatory (operated by the Council for Scientific and Industrial Research) in Johannesburg. Since the sites of both these observatories have deteriorated with the development of the cities around them, their major instruments – the largest is a 1m reflector – have been moved to a new site near Sutherland in the Karroo. This new observatory was officially opened by the Prime Minister in March, 1973. The buildings of the Royal Observatory have become the SAAO Headquarters. The Director is Sir Richard Woolley, formerly Astronomer Royal of Britain.

The largest telescope in Southern Africa is the 1,9m Radcliffe Reflector on the outskirts of Pretoria. In 1974 it's ownership is to be transferred from the British Science Research Council to the Council for Scientific and Industrial Research and work is to commence on dismantling it for transfer to the more favourable Sutherland site.

The SAAO in Johannesburg also has a small outstation near Hartebeespoort, sharing the site with the Leiden Observatory Southern Station which has a 0,9m "light collector" reflector.

In the field of radio astronomy, the 25m dish of the Deep Space Tracking Station near Krugersdorp is used for research work when not required for tracking spacecraft, while the Rhodes University Radio Observatory just outside Grahamstown, has a number of arrays for receiving radio emission from the planet Jupiter.

In addition to the professional observatories listed above, South Africa and Rhodesia have numerous private observatories, built and operated by amateur astronomers.

OBSERVATORIES OPEN TO THE PUBLIC

Visiting nights at Boyden Observatory are held twice per month usually around the time of first quarter. Intending visitors should contact the Information Office in Hoffman Square, Bloemfontein for tickets (gratis). Numbers are restricted to twenty persons on each visiting night.

SAAO Headquarters, Observatory, Cape are open to visitors on the second Saturday each month at 8.00 p.m. No tickets are necessary but parties of more than ten persons should contact the observatory in advance.

Prospective visitors should be warned not to expect spectacular views through telescopes! Professional instruments intended primarily for carrying photographic plates or electronic apparatus do not necessarily provide a view better than smaller amateur instruments. The person with a genuine interest should find a visit very rewarding, but many others – especially children – may benefit more by a visit to the planetarium.

PLANETARIA

Unlike observatories (whose main purpose is to carry out research) planetaria are purely intended for the astronomical education of students or the public – in a rather pleasant and possibly entertaining atmosphere, namely under an artificial replica of the night sky. The sky is projected onto the inside of a dome by a projector and may be set for any particular place and any particular time.

The major planetarium in South Africa is that situated on the grounds of the University of the Witwatersrand (entrance in Yale Road – alongside M1). It is equipped with a highly complex Zeiss projector and seats over 400 persons.

A smaller planetarium, with a Spitz projector and seating approximately 70, is located within the South African Museum, Cape Town. Shows are given each Saturday at 3.00 p.m., each Sunday at 3.30 p.m., and at 11.00 a.m. and 3.00 p.m. on public and school holidays. Further information can be obtained by phoning the museum at 41-2668.

A similar planetarium is found at the Naval College in Gordons Bay. It is used for training naval personnel and is not open to the public.

TEACHING DEPARTMENTS

Both the University of the Orange Free State and the University of Cape Town have departments of astronomy – concerned with optical astronomy – while the Physics department of Rhodes University specialises in radio astronomy. The UOFS department is incorporated into Boyden Observatory and is headed by the director, Prof. A.H. Jarrett. Prof. Brian Warner occupies the Chair of Astronomy at UCT, his department makes use of the SAAO observing facilities at Sutherland. The Physics Department at Rhodes has its own radio observatory outside Grahamstown.

No major courses in Astronomy are offered for the B.Sc. degree. Persons wishing to make a career in the subject are advised to major in Physics and then to specialise in Astronomy from Honours level upwards. UCT does offer undergraduate courses at second year B.Sc. level intended for prospective science teachers or for general interest.

ASTRONOMICAL SOCIETY OF SOUTHERN AFRICA

The Astronomical Society of Southern Africa is a body consisting of both amateur and professional astronomers. Membership is open to all interested persons, regardless of knowledge or experience. In addition to this handbook, the Society issues twelve numbers of "The Monthly Notes of the Astronomical Society of Southern Africa" (MNASSA) each year. Members also receive copies of "Sky and Telescope", an excellent and very popular monthly magazine published in the United States. It provides up to date information on both professional and amateur activities, together with news of space research and other related

subjects. The society's annual subscription is R8.00 and there is an entrance fee of R2.50. Information can be obtained from the Honorary Secretary, Astronomical Society of Southern Africa, c/o The South African Astronomical Observatory, P. O. Box 9, Observatory 7935, Cape.

Autonomous local Centres of the Society exist in Cape Town, Bloemfontein, Durban, Johannesburg and Pretoria. These centres hold regular meetings. It is not necessary to hold full membership of the society to join these centres. An Associate Member or Student Member may take part in the activities of a Centre without paying any fees or subscriptions to the Society; although he then loses the right to receive the publications issued and distributed by the Society.

Three Observing Sections exist to coordinate and encourage constructive observing programmes; the Comet and Meteor Section, the Occultation Section and the Variable Star Section.

Further information on Centres and Observing Sections is given below.

NATAL CENTRE (Durban) - Meetings every 3rd Wednesday evening at 7:45 p.m., at Natal University, Howard College, Berea. Occultation and telescope making sessions. Secretarial address: 3 Robinson Rd., Pinetown 3600. Telephone (evenings) 72-3187.

TRANSVAAL CENTRE (Johannesburg) - Alternate lecture and observing meetings are held each month. There is a very enthusiastic Lunar occultation group which observes grazing occultations within a radius of approximately 250 km of Johannesburg. Mirror making classes are held at suitable intervals and the centre has its own aluminising plant at the planetarium. Further information can be obtained from Mr. G.J. Sizoo (46-7392).

CAPE CENTRE (Cape Town) - Meetings on 2nd Wednesday of the month (except Jan., Feb. and Dec.) at the South African Astronomical Headquarters at 8.00 p.m. The Centre possesses a small observatory housing the twelve inch Ron Atkins Telescope. There is also an active occultation section. Secretarial address: c/o 5 Rouwkoop Road, Rondebosch 7700. Information on meetings also available from Department of Astronomy, U.C.T. Telephone (day time) 69-8531 ex. 256.

FREE STATE CENTRE - Meetings on 2nd Thursday of the month at homes of members. For further information, contact Mr. G.J. Muller, 35 Wilcocks Road, Bloemfontein 9301. Telephone (evenings) 7-3442 or Mr. J. Rhodes, Telephone 7-1981 (day time). Associate members should endeavour to have communications in the hands of the secretary a week before the monthly meeting.

PRETORIA CENTRE - For information contact Mr. K.J. Sterling, 5 Hekla Road, Valhalla 0137 - Phone 71-3272.

Observing Sections of the Society

COMETS AND METEORS - Mr. J.C. Bennett, 90 Malan Street, Riviera 0002, Pretoria.

VARIABLE STARS - Mr. R.P. de Kock, The South African Astronomical Observatory, P.O. Box 9, Observatory 7935, Cape.

OCCULTATIONS - Mr. A.G.F. Morrisby, Department of Surveyor General, P.O. Box 8099, Causeway, Salisbury, Rhodesia. Coordinator for Grazing Occultations - Mr. J. Hers, 48 Central Road, Linden Extension, Randburg 2001.

THE CHANGING NIGHT SKY

This section provides a brief description of the changing appearance
of the evening sky throughout the year and lists events in chronological order.

The annual cycle of the starry skies visible in the evening forms the backdrop to the continually changing configurations of the Moon and planets. The maps in this section are highly simplified - they show only the visible planets and the most easily identified constellations - and are intended as an identification aid for the reader. The edge of each circular map approximately represents the horizon, the centre the point overhead. The maps are best used by holding the booklet up, rather than laying it flat, and rotating it to match the direction the reader is looking. If in doubt of direction - the best place to start is where the Sun went down - which obviously must be somewhere on the western horizon.
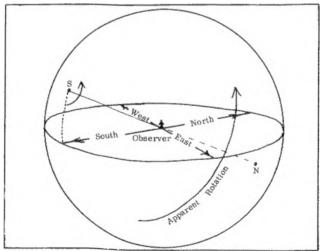
The Moon's movement in the evening sky is too rapid to be successfully represented on the maps but it will be seen as a crescent above western horizon a few days before First Quarter. At First Quarter it will be high in the western sky moving across to the eastern sky by Full Moon. Generally it disappears from the evening sky a few days after Full Moon. In this movement it often passes close to planets and details are given round the edge of the map. Events relating to configurations of planets in their orbit are listed below the maps - explanations of terms can be found in the Planets section (page 20).
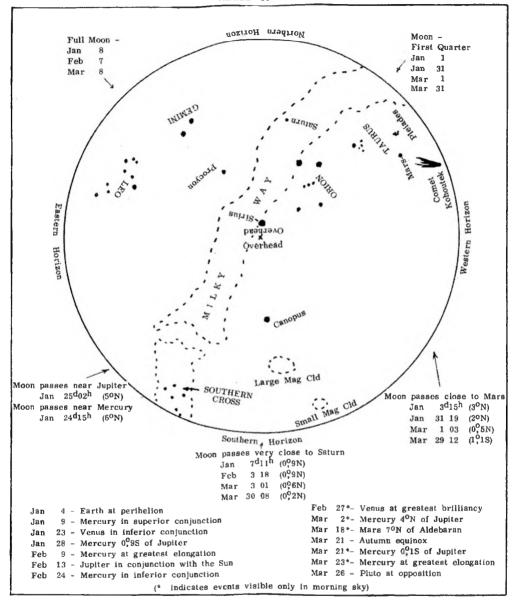
The Milky Way and Magellanic Clouds can only be seen if the observer's sky is reasonably dark - which is not usually the case in large cities.

EXPLANATION OF THE APPARENT MOVEMENT OF THE SKY
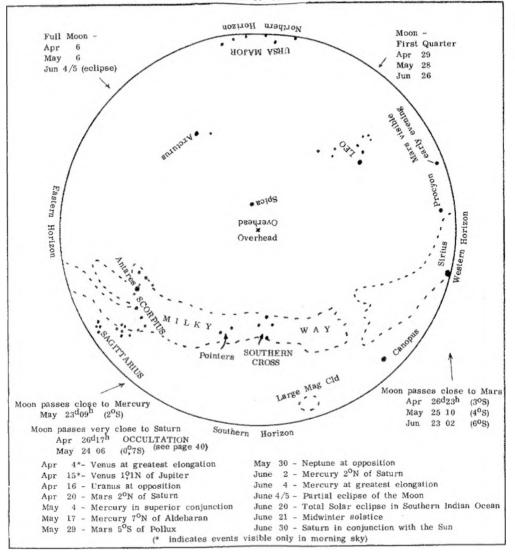
The most convenient representation of the sky is that of a sphere viewed from the inside by an observer at its centre. This is illustrated in the diagram below. If, as is usual, the observer stands on a flat surface (a local portion of the Earth's surface can be considered flat) - then his horizon divides the sphere into two halves - one which he can see, the other obscured by the ground beneath his feet.

The Earth, of course, rotates - but the observer is not aware of his rotation - and rather thinks that the whole sky is rotating instead. The sky therefore appears to rotate about the axis marked SN in the diagram - an axis parallel to the Earth's axis of rotation. Most of the sky as seen from Southern Africa rises above the eastern horizon and sets below the western horizon, but a portion above the southern horizon never sets and a portion below the northern horizon never rises.

Northern Horizon

Full Moon –
Jan   8
Feb   7
Mar   8

Moon –
First Quarter
Jan   1
Jan   31
Mar   1
Mar   31

GEMINI

Saturn

Pleiades

TAURUS

Mars

Comet Kohoutek

Procyon

ORION

LEO

MILKY   WAY

Sirius

Overhead
×
Overhead

Eastern Horizon

Western Horizon

Canopus

Large Mag Cld

SOUTHERN CROSS

Small Mag Cld

Moon passes near Jupiter
Jan 25^{d}02^h (5°N)
Moon passes near Mercury
Jan 24^{d}15^h (6°N)

Moon passes close to Mars
Jan   3^{d}15^h (3°N)
Jan   31 19   (2°N)
Mar   1 03   (0°5N)
Mar   29 12   (1°1S)

Southern   Horizon

Moon passes very close to Saturn
Jan   7^{d}11^h (0°9N)
Feb   3 18   (0°9N)
Mar   3 01   (0°6N)
Mar   30 08   (0°2N)

Jan 4 – Earth at perihelion	Feb 27*– Venus at greatest brilliancy
Jan 9 – Mercury in superior conjunction	Mar 2*– Mercury 4°N of Jupiter
Jan 23 – Venus in inferior conjunction	Mar 18*– Mars 7°N of Aldebaran
Jan 28 – Mercury 0°9S of Jupiter	Mar 21 – Autumn equinox
Feb 9 – Mercury at greatest elongation	Mar 21*– Mercury 0°1S of Jupiter
Feb 13 – Jupiter in conjunction with the Sun	Mar 23*– Mercury at greatest elongation
Feb 24 – Mercury in inferior conjunction	Mar 26 – Pluto at opposition

(* indicates events visible only in morning sky)

The map shows the sky for mid-January at 11 p.m., mid-February at 9 p.m. and mid-March at 7 p.m. For times earlier than these, the objects shown are displaced to the left (east) in the diagram, for later times to the right (west). By far the most exciting object visible should be Comet Kohoutek above the western horizon in January and early February. The most interesting part of the sky is that in the north-west including Orion and Taurus (see page 34) and the planet Saturn.

APRIL TO JUNE

Full Moon –
Apr   6
May   6
Jun 4/5 (eclipse)

Moon –
First Quarter
Apr   29
May   28
Jun   26

Northern Horizon

URSA MAJOR

Arcturus

LEO

Mars visible early evening

Procyon

Sirius

Western Horizon

Eastern Horizon

Spica

Overhead
x
Overhead

Antares SCORPIUS

M I L K Y   W A Y

SAGITTARIUS

Pointers   SOUTHERN
CROSS

Canopus

Large Mag Cld

Moon passes close to Mars
Apr 26^{d}23^h (3°S)
May 25 10   (4°S)
Jun 23 02   (6°S)

Moon passes close to Mercury
May 23^{d}09^h (2°S)

Moon passes very close to Saturn
Apr 26^{d}17^h OCCULTATION
May 24 06   (0°7S) (see page 40)

Southern   Horizon

Apr   4*– Venus at greatest elongation
Apr   15*– Venus 1°1N of Jupiter
Apr   16 – Uranus at opposition
Apr   20 – Mars 2°N of Saturn
May   4 – Mercury in superior conjunction
May   17 – Mercury 7°N of Aldebaran
May   29 – Mars 5°S of Pollux

May 30 – Neptune at opposition
June   2 – Mercury 2°N of Saturn
June   4 – Mercury at greatest elongation
June 4/5 – Partial eclipse of the Moon
June 20 – Total Solar eclipse in Southern Indian Ocean
June 21 – Midwinter solstice
June 30 – Saturn in conjunction with the Sun

(* indicates events visible only in morning sky)

The map shows the sky for mid-April at 11 p.m., mid-May at 9 p.m. and mid-June at 7 p.m.   (For earlier times, objects displaced to left, later times to right).   This is the time when the Southern Cross is at its highest in the sky (see page 35).   Observers in South West Africa and Rhodesia should be able to see Ursa Major (the Plough) above the northern horizon.   There is little to see in the way of planets.   The highlight of this period is the partial eclipse of the Moon on the night of June 4/5 – see page 19 for details.

Full Moon –
July   4
Aug   3
Sep   1

Moon –
First Quarter
July 26
Aug 24
Sep 23

Northern Horizon

CYGNUS

Vega

MILKY

Altair

WAY

Arcturus

Eastern Horizon

Jupiter rises

Overhead

SAGITTARIUS

SCORPIUS

Antares

Spica

Mars sets early evening

Western Horizon

GRUS

WAY

SOUTHERN CROSS

Moon passes near Jupiter
July 10^{d}09^h (7°N)
Aug   6 12 (7°N)
Sep   2 11 (7°N)
Sep 29 11 (7°N)

Small Mag Cld

Southern   Horizon

Moon passes near Mars
July 21^{d}17^h (6°S)
Aug 19 08 (7°S)

Moon passes near Mercury
Sep 17^{d}23^h (3°S)

July   4*– Venus 4°N of Aldebaran
July   5 – Earth at aphelion
July 22 – Mercury at greatest western elongation
July 24*– Mercury 1°2 south of Saturn
July 26 – Mars 0°7N of Regulus
July 31*– Venus 0°2N of Saturn
Aug   2*– Mercury 7°S of Pollux

Aug 10 – Venus 7°S of Pollux
Aug 17 – Mercury in superior conjunction
Sep   2 – Mercury 0°1S of Mars
Sep   5 – Jupiter at opposition
Sep   7*– Venus 0°7N of Regulus
Sep 22 – Mercury 0°3N of Spica
Sep 23 – Spring equinox

(* indicates events visible only in morning sky)

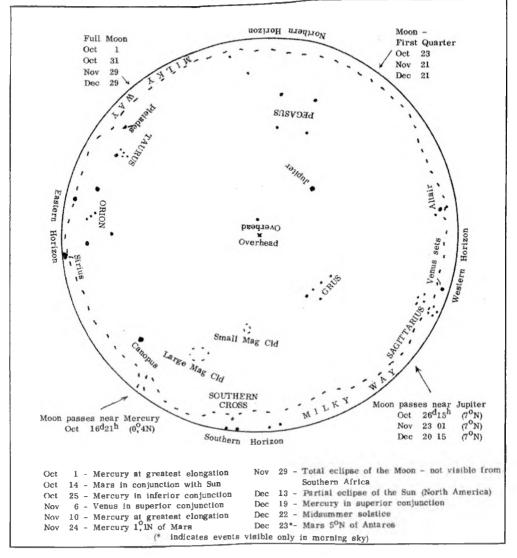The map shows the sky for mid-July at 11 p.m., mid-August at 9 p.m. and mid-September at 7 p.m. (For earlier times, objects displaced to the left, later times to the right). The centre of the galaxy lies in the direction of the Milky Way overhead and many globular clusters amongst other objects can be seen with small telescopes in the Scorpius region (see page 36). Antares is the brightest star overhead and conspicuous by its reddish colour. Vega is the bright star in the north. Jupiter is conspicuous in the east.

Full Moon
Oct   1
Oct 31
Nov 29
Dec 29

Moon –
First Quarter
Oct 23
Nov 21
Dec 21

Northern Horizon

PEGASUS

MILKY WAY

Pleiades

TAURUS

ORION

Jupiter

Eastern Horizon

Sirius

Overhead
×
Overhead

Altair

Venus sets

Western Horizon

GRUS

Canopus

Large Mag Cld

Small Mag Cld

SAGITTARIUS

MILKY WAY

SOUTHERN
CROSS

Moon passes near Mercury
Oct 16^{d}21^h (0°,4N)

Moon passes near Jupiter
Oct   26^{d}15^h (7°N)
Nov 23 01   (7°N)
Dec 20 15   (7°N)

Southern Horizon

Oct 1 – Mercury at greatest elongation	Nov 29 – Total eclipse of the Moon – not visible from
Oct 14 – Mars in conjunction with Sun	Southern Africa
Oct 25 – Mercury in inferior conjunction	Dec 13 – Partial eclipse of the Sun (North America)
Nov 6 – Venus in superior conjunction	Dec 19 – Mercury in superior conjunction
Nov 10 – Mercury at greatest elongation	Dec 22 – Midsummer solstice
Nov 24 – Mercury 1°,1N of Mars	Dec 23*– Mars 5°N of Antares

(* indicates events visible only in morning sky)

The map shows the sky for mid-October at 11 p.m., mid-November at 9 p.m. and mid-December at 7 p.m. (For earlier times, object displaced to the left, later times to right). The brightest object high in the sky is Jupiter. While Scorpius and Sagittarius disappear in the west, so Orion rises in the east.

COMET KOHOUTEK

As this Handbook goes to press, there is considerable excitement regarding prospects for Comet Kohoutek which will sweep around the Sun in late December 1973. Its brightness will increase dramatically as it approaches the Sun and original predictions suggested it would be clearly visible in daylight. However predictions of comet brightnesses are highly uncertain and the most recent observations indicate that it may well be much fainter, though still a spectacular sight in the night sky. The information below has been prepared by Mr. J. C. Bennett, head of the ASSA Comet and Meteor Section and discoverer of the brightest comet in recent years:

The comet made its long-awaited appearance in the morning sky at the end of September, and first reports from the United States and Japan gave magnitude estimates of about 10, indicating a brightness somewhat less than the more optimistic forecasts.

However, Mr. A. G. F. Morrisby of Salisbury, Rhodesia, a member of the Society's Comet and Meteor Section, picked up the comet with his 4-inch refractor on the morning of 1973 October 11 in spite of a low full moon and the beginning of twilight. (The comet was then 2,5 astronomical units or 374 million km from the earth). This fact alone indicates that it is a very considerable object and will undoubtedly provide a fine spectacle at and near its closest approach to the earth. If further proof were needed, observations with a 24-inch reflector in the United States in early October revealed that the comet had already developed a tail a few minutes of arc in length.

The story of the comet's discovery is a fascinating one. Dr. Lubos Kohoutek of the Hamburg observatory in West Germany found it on 1973 March 7 on plates exposed to re-observe asteroids he had discovered in 1971 while searching for the lost comet Biela in positions calculated by Dr. Brian Marsden of the Smithsonian Astrophysical Observatory in America.

It is interesting to recall that it was Dr. Marsden who in 1968 sent the writer his ephemeris of sungrazing comets, and this was being used on the night of the discovery of Comet Bennett 1969I (= 1970II), although of course that comet was found some distance from the predicted paths and was not a sungrazer.

The discovery of the great Kohoutek comet over $9\frac{1}{2}$ months before perihelion has made it possible for an accurate ephemeris to be prepared and has enabled astronomers, professionals and amateurs alike, to plan observational programmes well in advance. As a check on the ephemeris, Mr. Morrisby reports that the comet was very close to the predicted position - "possibly a shade behind schedule by a very few minutes of arc".

Among the highlights which can be expected are the following:

Early December: Comet passing through Virgo and Libra and attaining maximum morning brilliance, but fading later in the light of dawn.

Daylight

December 24: Comet visible together with Venus and Mercury at an annular eclipse of the sun in Northern Brazil and North Africa. (Not visible from South Africa).

December 28: Perihelion. Comet may be visible in daylight about this time. (Precautions should be taken to protect the eyes against the sun when observing).

Evening sky

Early January: Comet passing through Sagittarius, Capricornus and Aquarius, and attaining its greatest brilliance, especially after full moon on 8th January. The tail should be spectacular.
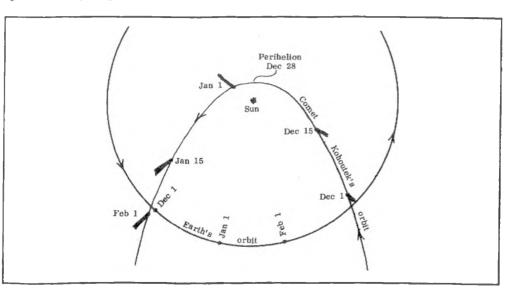
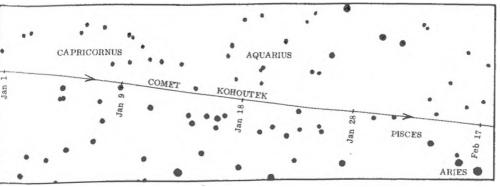Mid-January: Comet closest to the earth (120 million km.)

Mid-February: Comet still possibly visible to the naked eye.

The writer would be glad to receive reports of brightness estimates, length and position angle of the tail or tails, visibility of the comet in broad daylight, etc. Full details of any optical aid used should be given, as well as a description of observing conditions.

J. C. BENNETT
90 Malan Street, Riviera, Pretoria 0002

The diagrams below show the orbit of the comet relative to the Earth's orbit and its apparent movement against the starry background.
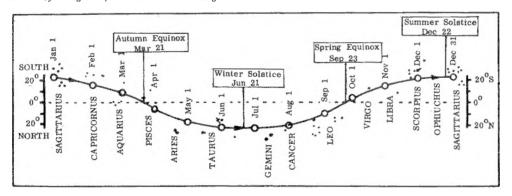
THE SUN
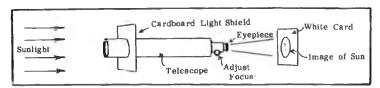
The Sun is our nearest star. It is composed chiefly of hydrogen and is in a gaseous state throughout. So hot and dense is its interior that nuclear reactions occur there – thus producing the energy that is eventually radiated from its surface. At times its surface is disturbed by sunspots (which may persist for some weeks) and flares (short lived).

The Earth's orbit round the Sun is not quite circular. In 1974 we will be closest to the Sun on January 4 (perihelion – approx. distance 147 million km) and furthest from the Sun on July 5 (aphelion – approx. 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 disk 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 disk – if monitored over a period of a week or so, the rotation of the Sun should be apparent.

During 1974, there will be one total solar eclipse – over the southern Indian Ocean on June 20 – and one partial solar eclipse – covering North America on December 13. Neither will be visible from Southern Africa.

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

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

THE MOON

MOON'S ORBIT AND PHASES

As the moon orbits the Earth so its phase changes through the well known cycle as indicated in the table below.

New Moon		First Quarter		Full Moon		Last Quarter	
		Jan	$1^d 20^h$	Jan	$8^d 15^h$	Jan	$15^d 09^h$
Jan	$23^d 13^h$	Jan	31 10	Feb	7 01	Feb	14 02
Feb	22 08	Mar	1 20	Mar	8 12	Mar	15 21
Mar	23 23	Mar	31 04	Apr	6 23	Apr	14 17
Apr	22 12	Apr	29 10	May	6 11	May	14 11
May	21 23	May	28 15	Jun	5 00	Jun	13 04
Jun	20 07	Jun	26 21	Jul	4 15	Jul	12 17
Jul	19 14	Jul	26 06	Aug	3 06	Aug	11 05
Aug	17 21	Aug	24 18	Sep	1 21	Sep	9 14
Sep	16 05	Sep	23 09	Oct	1 13	Oct	8 22
Oct	15 14	Oct	23 04	Oct	31 03	Nov	7 05
Nov	14 03	Nov	22 01	Nov	29 17	Dec	6 12
Dec	13 18	Dec	21 22	Dec	29 06		

The Moon is best placed for evening viewing from three or four days before First Quarter to shortly after Full Moon. Times of Moonrise and Moonset for Johannesburg and Cape Town on each day of 1974 are given in the tables on pages 15 to 18 Times for other places in the Transvaal, Free State, Natal and Rhodesia will not normally differ from the Johannesburg times by more than half an hour. Times for other places in the Cape Province can be estimated by comparing the times given for Johannesburg and Cape Town.

Dates of Perigee, when the Moon is closest to the Earth (approx. distance 357 000 km), are January 8, February 6, March 6, April 2, April 27, May 24, June 21, July 20, August 17, September 14, October 12, November 8, December 3 and December 31.

Dates of Apogee, when the Moon is furthest from the Earth (approx. 407 000 km), are January 22, February 18, March 18, April 15, May 12, June 9, July 6, August 3, August 30, September 26, October 24, November 21 and December 19.

As a result of its motion around the Earth, the Moon appears to make a complete circuit of the heavens in just under a month. It occasionally passes in front of bright stars (details given in Occultation section – page 39) and close to visible planets (details given in Changing Night Sky section – page 4).
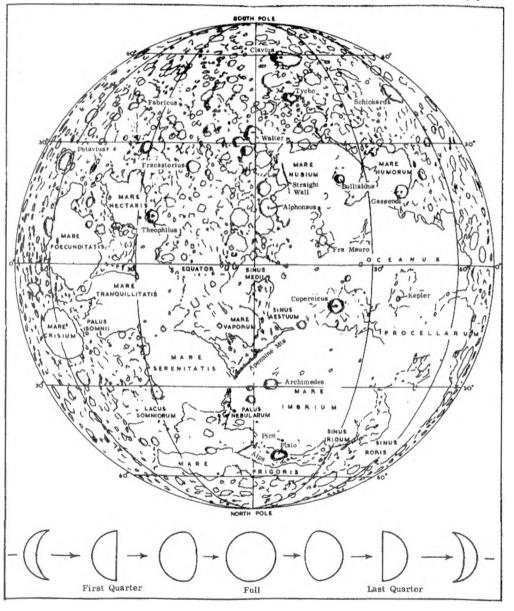
THE FACE OF THE MOON

A map of that side of the Moon always turned towards the Earth is provided on page 14 . The small diagrams below it indicate roughly what portion of it is illuminated according to the phase. The boundary between illuminated and dark portions is known as the terminator, and it is the illuminated areas nearest the terminator which appear best through a telescope since the features there are enhanced by their shadows.

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. Maximum exposure (maximum libration) of the southern limb (about 7 degrees) occurs on January 1, January 28, February 24, March 23, April 19, May 17, June 16, July 10, August 6, September 2, September 29, October 27, November 23 and December 20 and that of the northern limb on January 13, February 10, March 9, April 5, May 2, May 29, June 26, July 23, August 19, September 16, October 13, November 9 and December 11. Maximum exposure of the left hand limb (in diagram) occurs on January 15, February 12, March 12, April 9,

May 6, June 1, June 28, July 26, August 23, September 20, October 13, November 9 and December 11, and that of the right hand limb (in diagram) on January 2, January 31, February 27, March 25, April 21, May 19, June 16, July 14, August 11, September 8, October 5, October 31, November 28 and December 25.   The magnitude of the east-west librations is smallest in May and November (about 5 degrees) and largest in January and August (nearly 8 degrees).

JOHANNESBURG AREA – APPROXIMATE TIME OF MOONRISE

Times are given as hours and minutes (h m).

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	12 00	13 40	12 40	14 10	14 10	14 50	15 10	16 20	17 50	18 20	20 00	20 40
2	12 50	14 50	13 40	15 00	14 50	15 30	15 50	17 20	18 40	19 10	21 00	21 30
3	13 50	15 50	14 30	15 40	15 30	16 20	16 40	18 10	19 30	20 10	22 00	22 20
4	14 50	16 50	15 30	16 10	16 10	17 00	17 30	19 00	20 20	21 10	22 50	23 00
5	16 00	17 40	16 20	16 50	16 50	17 50	18 30	19 50	21 20	22 10	23 40	23 40
6	17 10	18 30	17 00	17 30	17 30	18 50	19 20	20 40	22 20	23 10	......	......
7	18 10	19 10	17 40	18 10	18 20	19 40	20 10	21 30	23 10	24 00	00 20	00 20
8	19 00	19 50	18 20	18 50	19 10	20 30	21 00	22 30	......	......	01 00	01 00
9	20 00	20 30	19 00	19 40	20 00	21 20	21 50	23 20	00 10	00 50	01 40	01 40
10	20 40	21 10	19 40	20 30	20 50	22 20	22 50	......	01 10	01 40	02 20	02 20
11	21 20	21 50	20 20	21 20	21 50	23 10	23 40	00 20	02 10	02 20	03 00	03 10
12	22 00	22 30	21 00	22 10	22 40	......	......	01 20	03 10	03 10	03 40	04 00
13	22 30	23 10	21 50	23 00	23 30	00 00	00 40	02 20	03 50	03 50	04 30	04 50
14	23 10	24 00	22 40	24 00	00 00	00 50	01 30	03 20	04 30	04 30	05 20	05 50
15	23 50	......	23 30	......	00 20	01 50	02 30	04 20	05 10	05 10	06 10	06 40
16	......	00 40	......	00 50	01 20	02 50	03 40	05 10	05 50	05 50	07 00	07 30
17	00 30	01 40	00 20	01 40	02 10	03 50	04 40	06 00	06 40	06 40	07 50	08 20
18	01 10	02 30	01 10	02 30	03 00	04 50	05 40	06 40	07 20	07 30	08 50	09 20
19	02 00	03 20	02 10	03 30	04 00	06 00	06 30	07 20	08 00	08 20	09 40	10 10
20	02 50	04 10	03 00	04 20	05 00	07 00	07 20	08 00	08 40	09 10	10 30	11 00
21	03 40	05 10	03 50	05 20	06 10	07 50	08 10	08 40	09 40	10 00	11 20	11 50
22	04 30	06 10	04 40	06 20	07 10	08 40	08 50	09 30	10 40	11 00	12 10	12 40
23	05 30	06 50	05 40	07 20	08 10	09 30	09 30	10 10	11 20	11 50	13 10	13 30
24	06 20	07 50	06 30	08 20	09 10	10 10	10 10	11 00	12 10	12 40	14 00	14 30
25	07 10	08 40	07 30	09 20	10 10	10 50	10 50	11 40	13 00	13 30	14 50	15 30
26	08 00	09 40	08 30	10 20	10 50	11 30	11 30	12 30	14 00	14 20	15 50	16 30
27	09 00	10 40	09 30	11 20	11 40	12 10	12 10	13 10	14 50	15 20	16 50	17 30
28	09 50	11 40	10 30	12 10	12 30	12 50	13 00	14 10	15 40	16 10	17 50	18 30
29	10 40		11 30	12 50	13 30	13 30	13 50	15 10	16 30	17 00	18 50	19 20
30	11 40		12 30	13 40	14 10	14 10	14 50	16 00	17 20	18 00	19 50	20 10
31	12 40		13 20				15 30	17 00		19 00		21 00

JOHANNESBURG AREA – APPROXIMATE TIME OF MOONSET

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	23 00	·····	23 30	00 20	01 30	03 20	04 10	05 20	05 50	05 20	06 10	06 40
2	23 40	00 40	·····	01 30	02 30	04 20	05 00	06 00	06 20	06 00	06 50	07 50
3	·····	01 30	00 30	02 40	03 30	05 20	05 50	06 40	06 50	06 40	07 50	08 50
4	00 20	02 40	01 30	03 40	04 30	06 10	06 40	07 10	07 20	07 20	08 50	09 50
5	01 00	03 50	02 40	04 40	05 30	07 10	07 20	07 40	08 00	08 10	09 50	11 00
6	01 50	05 00	03 50	05 40	06 30	08 00	08 00	08 20	08 40	09 00	11 00	12 00
7	02 50	06 10	04 50	06 40	07 30	08 40	08 40	08 50	09 20	10 00	12 00	13 00
8	03 50	07 10	06 00	07 40	08 20	09 20	09 10	09 20	10 10	11 00	13 00	14 00
9	05 10	08 20	07 00	08 40	09 00	10 00	09 40	10 00	11 00	12 10	14 00	15 00
10	06 20	09 20	08 00	09 40	10 00	10 30	10 10	10 40	12 00	13 20	15 00	15 50
11	08 30	10 20	09 00	10 30	10 50	11 10	10 40	11 20	13 10	14 20	16 10	17 50
12	09 30	11 20	10 00	11 20	11 20	11 40	11 20	12 10	14 10	15 20	17 10	18 50
13	10 30	12 10	11 00	12 10	12 00	12 10	11 60	13 10	15 20	16 20	18 10	19 40
14	11 30	13 10	11 50	12 50	12 30	12 50	12 40	14 10	16 20	17 30	19 10	20 20
15	12 30	14 00	12 40	13 30	13 10	13 20	13 30	15 20	17 30	18 20	20 00	21 00
16	13 30	14 50	13 30	14 00	13 40	14 00	14 30	16 30	18 40	19 20	21 00	21 40
17	14 20	15 30	14 20	14 40	14 10	14 50	15 30	17 40	19 40	20 10	22 10	22 10
18	15 10	16 20	14 50	15 10	14 50	15 50	16 40	18 50	20 40	21 00	23 10	22 50
19	15 50	17 00	15 30	15 40	15 30	16 50	17 50	19 50	21 40	22 30	·····	23 20
20	16 40	17 30	16 10	16 20	16 20	17 50	19 00	20 50	22 40	23 10	00 20	23 20
21	17 20	18 10	16 40	17 00	17 10	19 00	20 00	22 00	23 40	24 00	00 50	·····
22	18 20	18 40	17 10	17 40	18 00	20 10	21 10	23 00	·····	·····	01 20	00 30
23	19 00	19 10	17 50	18 20	19 10	21 20	22 10	·····	00 30	00 30	01 50	01 00
24	19 30	19 50	18 20	19 10	20 10	22 20	23 10	00 00	01 20	01 10	02 50	01 40
25	20 00	20 00	19 00	20 10	21 10	·····	·····	00 50	02 00	02 40	03 30	02 30
26	20 40	21 20	19 40	21 20	22 20	00 20	00 10	01 50	02 40	02 20	04 10	03 20
27	21 10	21 40	20 30	21 20	23 20	01 20	01 10	02 30	03 10	03 50	04 00	04 20
28	21 40	22 30	21 20	23 30	·····	02 20	02 10	03 20	03 50	03 20	04 50	05 30
29	22 20		22 20	·····	00 30	02 20	03 00	04 00	04 20	04 00	05 40	06 30
30	23 00		22 20	00 30	01 30	03 10	03 50	04 40	04 50	04 40	05 40	07 40
31	23 40		23 20		02 20		04 40	05 10		05 20		07 40

CAPE TOWN AREA – APPROXIMATE TIME OF MOONRISE

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
1	12^{h}40^m	14^{h}40^m	13^{h}40^m	15^{h}00^m	15^{h}00^m	15^{h}10^m	15^{h}20^m	16^{h}40^m	18^{h}20^m	19^{h}00^m	21^{h}00^m	21^{h}40^m
2	13 40	15 50	14 40	15 40	15 30	15 50	16 00	17 40	19 20	20 00	22 00	22 20
3	14 40	16 50	15 30	16 20	16 00	16 40	17 00	18 40	20 10	21 00	22 50	23 10
4	15 50	17 50	16 20	17 00	16 40	17 20	18 00	19 30	21 10	22 00	23 40	23 50
5	17 00	18 40	17 10	17 30	17 20	18 20	18 50	20 30	22 10	23 00	......	......
6	18 10	19 20	17 50	18 00	18 00	19 20	19 50	21 20	23 10	......	00 30	00 20
7	19 10	20 00	18 20	18 40	18 40	20 00	20 40	22 20	......	00 00	01 10	01 00
8	20 00	20 30	19 00	19 20	19 30	21 00	21 40	23 20	00 10	00 50	01 50	01 40
9	20 50	21 10	19 30	20 00	20 10	22 00	22 30	......	01 10	01 50	02 20	02 10
10	21 30	21 40	20 10	20 50	21 10	22 50	23 30	00 20	02 10	02 30	03 00	02 50
11	22 00	22 10	20 50	21 40	22 10	23 50	......	01 20	03 00	03 10	03 30	03 30
12	22 40	22 50	21 30	22 30	23 10	......	00 30	02 20	03 50	03 50	04 10	04 20
13	23 10	23 30	22 10	23 30	......	00 40	01 20	03 20	04 40	04 20	04 50	05 10
14	23 40	......	23 00	......	00 00	01 40	02 20	04 20	05 20	05 00	05 40	06 00
15	......	00 20	23 50	00 30	01 00	02 40	03 30	05 10	06 20	05 40	06 30	06 50
16	00 20	01 10	......	01 20	02 00	03 40	04 30	06 00	06 30	06 20	07 20	07 40
17	00 50	02 00	00 40	02 10	02 50	04 40	05 40	06 40	07 10	07 00	08 10	08 50
18	01 30	02 50	01 40	03 10	03 50	05 50	06 40	07 20	07 50	07 50	09 10	09 40
19	02 20	03 40	02 30	04 10	04 50	07 00	07 30	08 00	08 30	08 40	10 10	10 40
20	03 10	04 40	03 30	05 10	06 00	08 00	08 10	08 40	09 10	09 30	11 00	11 30
21	04 00	05 40	04 20	06 10	07 00	08 50	09 00	09 10	10 00	10 20	11 50	12 30
22	05 00	06 30	05 20	07 10	08 10	09 40	09 30	09 50	10 50	11 20	12 50	13 20
23	06 00	07 30	06 20	08 20	09 10	10 20	10 10	10 30	11 40	12 20	13 40	14 20
24	06 50	08 30	07 20	09 20	10 10	11 00	10 40	11 20	12 30	13 10	14 40	15 20
25	07 40	09 30	08 20	10 20	11 00	11 30	11 20	12 00	13 30	14 00	15 40	16 20
26	08 40	10 30	09 30	11 20	11 40	12 10	12 00	12 50	14 30	15 00	16 40	17 20
27	09 40	11 30	10 30	12 20	12 20	12 30	12 30	13 50	15 20	16 00	17 40	18 20
28	10 40	12 40	11 30	13 10	13 00	13 20	13 20	14 40	16 20	17 00	18 40	19 20
29	11 30		12 30	13 40	13 30	13 50	14 10	15 40	17 10	17 50	19 40	20 20
30	12 30		13 30	14 20	14 00	14 30	15 00	16 30	18 00	18 50	20 40	21 00
31	13 40		14 20		14 40		15 50	17 30		20 00		21 50

CAPE TOWN AREA – APPROXIMATE TIME OF MOONSET

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m	h m
1	....	00 10	23 50	00 50	02 00	04 10	05 10	06 20	06 30	06 00	05 20	07 00
2	00 10	01 00	....	02 00	03 10	05 20	06 00	06 50	07 00	06 30	07 10	08 10
3	00 50	02 00	00 50	03 10	04 20	06 20	06 50	07 20	07 30	07 10	08 10	09 20
4	01 30	03 10	01 50	04 10	05 20	07 10	07 40	08 00	08 00	07 20	09 10	10 20
5	02 10	04 30	03 00	05 20	06 30	08 10	08 20	08 30	08 30	08 30	10 20	11 30
6	03 10	05 40	04 20	06 30	07 30	09 00	08 50	08 50	09 00	09 20	11 20	12 40
7	04 20	06 50	05 20	07 30	08 20	09 40	09 50	09 20	09 40	10 20	12 30	13 40
8	05 30	08 00	06 30	08 30	09 20	10 10	10 20	09 50	10 30	11 30	13 40	14 50
9	06 40	09 10	07 40	09 40	10 10	10 50	10 50	10 30	11 20	12 20	14 40	15 50
10	07 50	10 10	08 50	10 40	11 00	11 20	11 20	11 00	12 30	13 30	15 50	17 00
11	09 00	11 10	09 50	11 30	11 50	11 50	11 50	11 40	13 20	14 30	17 00	18 00
12	10 10	12 10	11 00	12 20	12 20	12 20	12 30	12 00	14 30	15 00	18 10	18 50
13	11 20	13 10	11 50	13 10	12 50	12 50	13 00	12 30	15 50	16 20	19 10	19 50
14	12 20	14 00	12 50	13 50	13 20	13 30	13 50	13 30	17 00	17 20	20 10	20 40
15	13 20	15 00	13 40	14 50	13 50	14 10	14 50	14 30	18 10	18 20	21 00	21 20
16	14 20	15 50	14 30	15 20	14 20	15 00	15 50	15 00	19 20	19 20	21 50	21 50
17	15 20	16 30	15 10	15 50	14 50	16 10	17 00	17 10	20 30	20 20	22 40	22 30
18	16 20	17 20	15 50	16 20	15 20	17 10	18 10	18 20	21 30	21 20	23 20	23 00
19	17 10	18 10	16 20	16 50	16 00	18 10	19 20	19 30	22 30	22 20	23 20	23 30
20	17 50	18 50	16 50	17 20	16 40	19 20	20 30	20 40	23 40	23 20	....	....
21	18 40	19 30	17 20	18 00	17 30	20 40	21 40	21 50	....	....	00 00	00 00
22	19 20	20 20	17 50	18 40	18 20	21 50	22 50	22 50	00 40	00 10	00 30	00 30
23	19 50	20 50	18 20	19 40	19 20	....	....	....	00 30	00 50	01 00	01 00
24	20 20	21 30	18 50	20 40	20 30	00 00	00 00	00 50	01 10	01 20	01 30	01 30
25	20 50	22 10	19 30	20 40	21 40	01 00	01 00	01 50	01 50	02 00	02 00	02 10
26	21 20	22 50	20 00	21 40	22 50	02 10	02 00	02 40	02 30	02 00	02 30	02 50
27	21 50		20 50	22 40	....	03 10	03 00	03 30	03 00	03 30	03 00	03 30
28	22 20		21 40	23 50	00 00	04 10	04 00	04 20	04 00	03 00	04 40	04 40
29	22 50		22 40	....	01 00		04 50	04 50	04 30	04 30	05 20	05 50
30	23 20		23 40	01 00	02 10		05 30	05 30	05 30	04 00	06 00	06 50
31	23 30		23 40		03 10			06 00		05 40		08 10

THE SURFACE OF THE MOON

As the Moon does not possess an atmosphere, its surface has remained virtually undisturbed for thousands of millions of years. The only erosive force has come from the sporadic impact of tiny meteorites which have ploughed up the surface to form the regolith – a layer of loose material a metre or so deep. In its ancient history, the Moon underwent a period of intense cratering – from the impact of large meteorites, some of which apparently caused circular depressions hundred of kilometres in diameter and into which molten lava from the interior flowed – thus making the maria areas, which are darker and smoother than the other areas.

LUNAR ECLIPSES

An eclipse of the Moon occurs when it passes through the Earth's shadow which consists of an outer penumbra (where the Sun is partially obscured by the Earth) and an inner umbra (Sun completely obscured by Earth). The penumbra causes a dimming of the Moon, but it is not easily noticeable to the eye. The umbra, on the other hand, appears to bite away the Moon, although the eclipsed portion will still be seen faintly.

A partial eclipse will occur during the night of June 4 - 5 and circumstances are:

Moon enters penumbra	June $4^d 21^h 24^m$
Moon enters umbra	22 39 at 58° east of north point
Middle of eclipse	5 00 16 (83% of diameter covered)
Moon leaves umbra	01 53 at 56° west of north point
Moon leaves penumbra	03 08

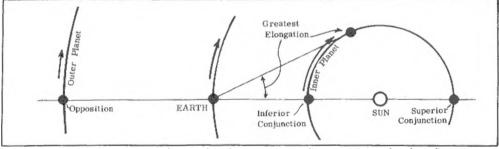A total eclipse of the Moon will occur on November 29 but it will not be visible from Southern Africa.

THE PLANETS

BASIC DATA

	Dist from Sun 10^6 km	Period of Revolution years	Mass (Earth = 1)	Diameter 10^3 km	Rotation Period	Inclination of Equator to Orbit
Mercury	58	0,24	0,056	4,98	59d	?
Venus	108	0,62	0,817	12,4	244	?
Earth	150	1,00	1,000	12,8	$23^h 56^m$	$23^o 27'$
Mars	228	1.88	0,108	6,76	24 37	23 59
Jupiter	778	11,9	318,0	142,7	09 51	03 04
Saturn	1426	29,5	95,2	120,8	10 14	26 44
Uranus	2868	84,0	14,6	47,1	10 49	97 53
Neptune	4494	164,8	17,3	44,6	14 ?	28 48
Pluto	5896	247,6	0,9?	?	?	?

GENERAL

Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Unlike the distant stars, their relative positions do not remain fixed, but continually change as, like the Earth, they orbit around the Sun. Their apparent movements against the starry background are complicated as they result from a combination of their own motion and the Earth's motion. Their brightnesses also vary considerably, as both their distances from the Earth and the visible portions of their sunlit hemispheres change. Since the period of a planet increases with increasing distance from the Sun, so we find that the inner planets – Mercury and Venus – appear to "overtake" the Earth in their orbits, while the Earth in turn "overtakes" the outer planets – Mars, Jupiter and Saturn. The terms given in astronomy to the various

Sun-Earth-Planet configurations are illustrated in the accompanying diagram. Dates of such configurations occurring in 1974 are listed chronologically in the Changing Night Sky Section (page 4) and are also mentioned in the text below.

VISIBILITY AND IDENTIFICATION

To determine whether a particular planet is visible, the diagram for times of rising and setting (pages 22 and 23) should be consulted. Quite often the time of rising or setting is sufficient to identify a planet, but the sky maps (pages 5 to 8) can also be used. Where the information given in those maps is still considered insufficient, further finding aids are provided in the information for individual planets below. Planets can often be distinguished from stars as, due to their greater angular diameters, they do not twinkle.
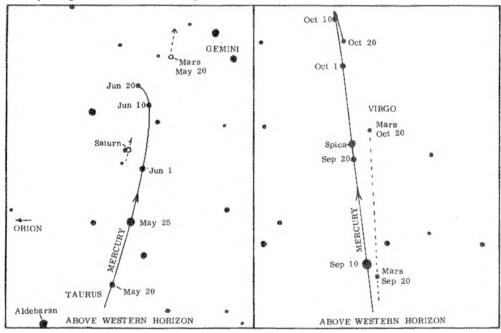
To the naked eye, planets appear as virtually pinpoint sources of light. However, their disks can be readily resolved with the aid of a small telescope. Even so, their angular diameters are of the order of 10 seconds of arc - roughly 1/200 of the Moon's angular diameter - so it is not always possible to distinguish details on the disk.

MERCURY

Being closest to the Sun, Mercury revolves faster than any other planet. In 1974, it appears to make slightly more than three complete circuits:

Superior Conjunction	Jan 9	May 4	Aug 17	Dec 19
Greatest Eastern Elongation	Feb 9 (18°)	June 4 (24°)	Oct 1 (26°)	
Inferior Conjunction	Feb 24	June 30	Oct 25	
Greatest Western Elongation	Mar 23 (28°)	Jul 22 (20°)	Nov 10 (19°)	

Mercury is difficult to observe because of its proximity to the Sun. It can only be seen in the evening sky when it is near Greatest Eastern Elongation. The Eastern Elongation in late January/early February is not favourable; those in June and October are better, but even so one has to contend with a certain amount of twilight (see diagram for times of rising and setting). The accompanying diagrams may be used for finding Mercury during the June and October elongations - the planet is brightest at the start of the periods indicated.

Mercury passes close to other planets and bright stars as follows:

Near Jupiter:	Jan 28 (0°9S), Mar 2* (4°N), Mar 21* (0°1S)
Near Aldebaran:	May 17 (7°N)
Near Saturn:	Jun 2 (2°N), Jul 24* (1°2S)
Near Pollux:	Aug 2* (7°S)
Near Mars:	Sep 2 (0°1S), Nov 24* (1°1N)
Near Spica:	Sep 22 (0°3N)

(* indicates only visible in morning sky before dawn).

The angular diameter of Mercury's disk rarely exceeds 10 seconds of arc, so it is difficult to make out much detail with a small telescope, but phases (like those of the Moon) might just be visible.
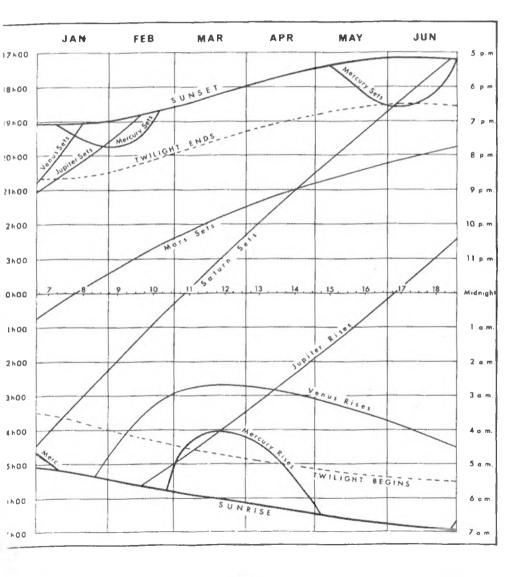
VENUS

During the latter part of 1973, Venus was the most brilliant object (aside from the Moon) in the evening sky. While it is still just visible after sunset in early January, it soon reaches the point where it passes

TIMES OF RISING AND SETTING 1974
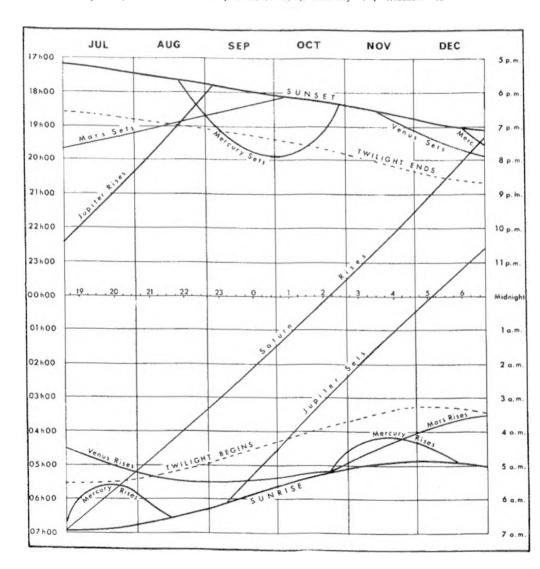
To find the times of rising and setting of the planets for any particular night of the year, place a ruler or suitable edge) vertically on the diagram according to the date given by the horizontal scale. The inter-section of the ruler with the lines of rising and setting then give the appropriate times which can be read off against the vertical scale (24 hour clock on the left hand side, or conventional 12 hour clock on the right hand ide).

TIMES OF RISING AND SETTING 1974

The times of rising and setting given by this diagram are accurate for position 30° East, 30° South, and approximately correct for other places in Southern Africa. Strictly speaking, corrections for latitude and longitude should be applied, but the latitude correction is, in general, sufficiently small to be ignored and in no case will exceed 15 minutes. Longitude corrections (in minutes) for the main cities are: Bloemfontein $+15^m$; Bulawayo $+6^m$; Cape Town $+46^m$; Durban -4^m; East London $+8^m$; Grahamstown $+14^m$; Johannesburg $+8^m$; Kimberley $+21^m$; Port Elizabeth $+18^m$; Pretoria $+7^m$; Salisbury -4^m; Windhoek $+52^m$.

between the Earth and Sun (on January 23) and thereafter appears as the most brilliant object in the morning sky. As Venus revolves faster around the Sun than does the Earth, it draws ahead of us until on November 6 it reaches the far side of the Sun. After this it will once again be seen in the evening sky. During its period in the morning sky, it attains greatest brilliancy on February 27 (magnitude -4,3) and greatest elongation on April 4. If observed with a telescope over this period, its phase will be seen to increase (as we look upon more of the sunlite side) but its angular diameter will decrease (as it draws away from us).
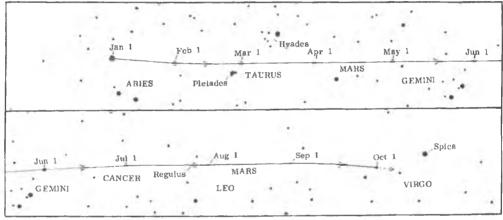
Venus passes close to other planets and bright stars as follows:

Near Jupiter:	Apr 15* $(1^0_.1N)$
Near Aldebaran:	Jul 4* (4^0N)
Near Saturn:	Jul 31* $(0^0_.2N)$
Near Pollux:	Aug 10* (7^0S)
Near Regulus:	Sep 7* $(0^0_.7N)$

(* indicates only visible in morning sky)

MARS

The Earth "overtook" Mars in October 1973, at which time Mars appeared as a brilliant object in the night sky. Since then we have been gradually drawing ahead of the red planet and while it remains visible in the evening sky until September, it fades drastically over this period. The accompanying diagram should

aid in its identification; in addition Mars can be distinguished by its reddish colour. On October 14, the Earth is exactly on the opposite side of the Sun to Mars. After that we gradually start to catch up to it again and at the end of the year it will be visible in the early morning sky.

Mars passes close to other planets/bright stars as follows:

Near Aldebaran:	Mar 18 (7^0N)
Near Saturn:	Apr 20 (2^0N)
Near Pollux:	May 29 (5^0S)
Near Regulus:	Jul 26 $(0^0_.7N)$
Near Mercury:	Nov 24* $(1^0_.1S)$
Near Antares:	Dec 23* (5^0N)

(* indicates only visible in morning sky before dawn)

During 1974 Mars is a very disappointing object for a small telescope because it is generally so far from the Earth. Even at the start of the year, its angular diameter is only 10 seconds of arc.

JUPITER
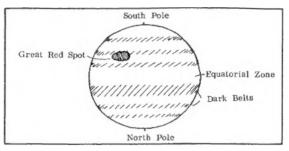
In January, Jupiter may be seen low in the west during the evening twilight. Thereafter it is too close to the Sun to be seen but it reappears to become a prominent evening object for the latter part of the year. It is at its brightest (magnitude -2,5) at opposition on September 5.

Other planets pass close to Jupiter as follows:

Mercury:	Jan 28 $(0^0_.9S)$, Mar 2* (4^0N), Mar 21* $(0^0_.1S)$
Venus:	Apr 15* $(1^0_.1N)$

(* indicates only visible in morning sky)

Jupiter makes an excellent object for a small telescope. It is often possible to see features on the disk: dark and light cloud bands, running parallel to the equator, and spots, in particular the famous Great Red Spot.
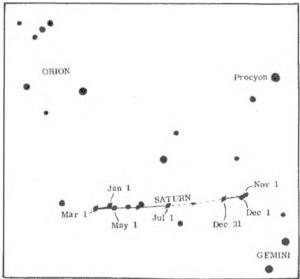
These are indicated in the diagram below. The Great Red Spot is not always visible because of the rotation of the planet.

Also clearly visible are four of Jupiter's twelve Moons; details for observing them are given on pages 27 to 31

SATURN

Saturn will be seen in the evening sky for the first five months of the year and again in December. Its position is shown on the sky map on page 5, but should there be any doubt about its identification the map below may be used. It is at its greatest brightness (magnitude 0,3) at the beginning and end of the year (oppositions in late 1973 and early 1975).
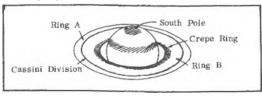
Other planets pass close to Saturn as follows:

Mercury:	Jun 2 (2^ON), Jul 24* ($1^O_,2$S)
Venus:	Jul 31* (0, 2^ON)
Mars:	Apr 20 (2^ON)
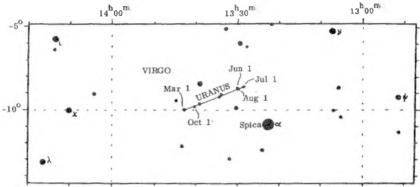
(* indicates only visible in morning sky)

The famous rings of Saturn can be distinguished with the aid of a small telescope – their angular diameter is about 45 seconds of arc. As the diagram shows, they are presently tilted so that the north pole of Saturn is just hidden. Saturn possesses ten moons; details for observing some of them are given on page 31.

URANUS
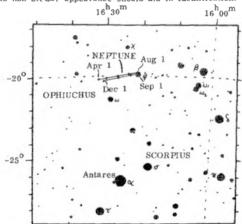
Uranus, at opposition on April 16, lies close to the bright star Spica (shown on the night sky maps, pages 6 and 7) in the constellation of Virgo. It is on the borderline of naked eye visibility (magnitude 5,7) and may be found with the aid of binoculars and reference to the accompanying finding chart, which shows all

stars in the region down to the same faintness. With a small telescope, its disk (angular diameter 4 seconds of arc) may just be distinguished.

NEPTUNE

Neptune lies in the constellation of Ophiuchus very close to the conspicuous constellation of Scorpius. It is far too faint to be seen with the naked eye – magnitude 7,7 at opposition on May 30 – but may be located using the finding chart below (which shows all stars down to magnitude 7,7) and a small telescope. It should be easiest to find near August, when it is very close to the star ψ Ophiuchi. Its angular diameter is only 2,5 seconds of arc, but its non-stellar appearance should aid in identification.
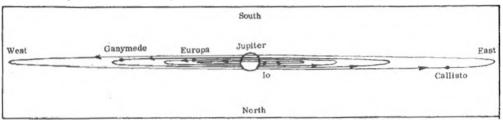
PLUTO

Pluto lies in the Virgo/Coma region (at approximately R.A. $= 12^h 45^m$, Decl. $= +13°$). Since it is very faint (14th magnitude), it can only be found using a large telescope and specially prepared finding charts.

THE MOONS OF JUPITER AND SATURN

One of the most popular sights for an observer with a small telescope is Jupiter and its Moons. Four of the twelve - Io, Europa, Ganymede and Callisto - are generally clearly visible - they would just be visible to the naked eye were it not for the glare from the mother planet. As the diagram below indicates, the system

```
                                    South

West       Ganymede        Europa      Jupiter                             East
                                         Io                      Callisto

                                    North
```

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, alternatively passing in front and behind the planet. This motion is represented in the diagrams on pages 28 and 29 which cover the period when Jupiter is clearly visible in the evening sky. The horizontal lines show their relative configurations at 9 p.m. each night.

When the moons pass in front and behind the planet, transits, occultations and eclipses occur. Details of such phenomena occurring between the end of astronomical twilight and just after midnight (and when the planet is above the horizon in Southern Africa) are given in the table below.

Explanation of Table:

Date and predicted times are given - these are for mid-phenomena and are not instantaneous.

The moons concerned are   I - Io   III - Ganymede
                          II - Europa   IV - Callisto

Phenomena - the abbreviations used are:

Ec. - Eclipse: the satellite passes through the shadow of Jupiter   D - Disappearance
Oc. - Occultation: the satellite is obscured by the disk of Jupiter   R - Reappearance
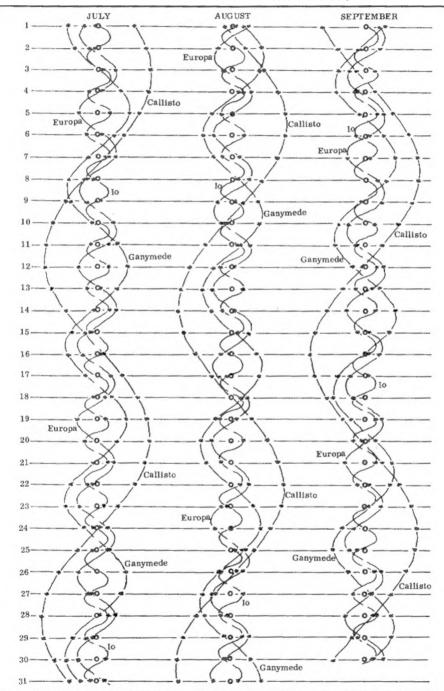
Tr. - Transit: the satellite crosses the disk of Jupiter   I - Ingress
Sh. - Shadow transit: the shadow of the satellite transits the disk   E - Egress
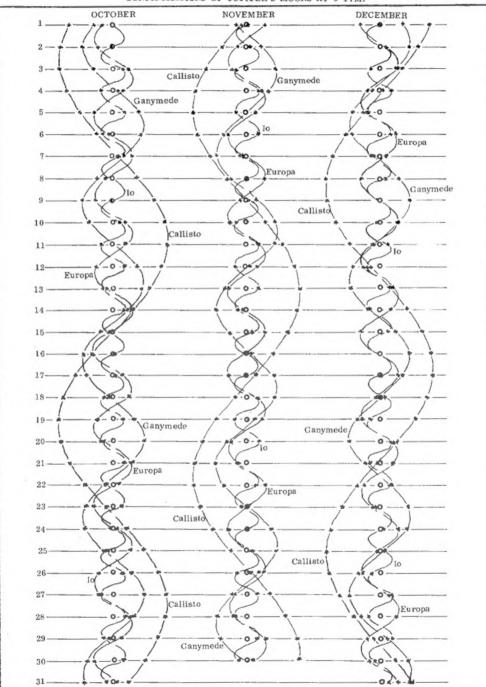
JUPITER'S MOONS - PHENOMENA

July	1	24^h02^m	I	Oc R	July 17	23 23	III	Ec D	Aug	1	20 32	I	Tr I
	3	23 55	III	Oc R	20	23 56	II	Oc R			21 58	I	Sh E
	4	22 29	II	Sh E	23	23 19	I	Sh I			22 47	I	Tr E
	8	22 22	I	Ec D		24 19	I	Tr I			23 56	IV	Ec R
	9	22 57	I	Tr E	24	21 00	IV	Tr I		2	20 07	I	Oc R
	10	22 53	III	Ec R		23 49	IV	Tr E		3	24 10	II	Ec D
	10	24 18	III	Oc D		23 54	I	Oc R		4	21 24	III	Sh I
	11	22 14	II	Sh I	25	21 00	I	Tr E			24 38	III	Tr I
		24 37	II	Tr I	27	21 35	II	Ec D		5	20 53	II	Tr I
	15	24 16	I	Ec D	28	20 51	III	Sh E			22 11	II	Sh E
	16	20 32	I	Tr I		21 11	III	Tr I			23 40	II	Tr E
		23 41	I	Sh E		24 26	III	Tr E		8	21 36	I	Sh I
	17	22 07	I	Oc R	29	21 21	II	Tr E			22 17	I	Tr I

CONFIGURATIONS OF JUPITER'S MOONS AT 9 P.M.

CONFIGURATIONS OF JUPITER'S MOONS AT 9 P.M.

Date	Time	Moon	Event
Aug 8	23 52	I	Sh E
	24 32	I	Tr E
9	21 52	I	Oc R
12	21 56	II	Sh I
	23 10	II	Tr I
	24 47	II	Sh E
14	20 03	II	Oc R
15	20 58	III	Oc R
	23 30	I	Sh I
	24 02	I	Tr I
16	20 50	I	Ec D
	23 37	I	Oc R
17	18 28	I	Tr I
	20 15	I	Sh E
	20 43	I	Tr E
18	18 53	IV	Oc D
	21 52	IV	Oc R
21	22 19	II	Oc R
22	19 27	III	Ec D
	24 17	III	Oc R
23	22 45	I	Ec D
24	19 53	I	Sh I
	20 12	I	Tr I
	22 10	I	Sh E
	22 28	I	Tr E
25	19 47	I	Oc R
26	23 29	IV	Sh I
28	21 18	II	Ec D
	24 34	II	Oc R
29	23 29	III	Ec D
30	19 16	II	Sh E
	19 34	II	Tr E
	24 39	I	Ec D
31	21 47	I	Sh I
	21 56	I	Tr I
	24 04	I	Sh E
	24 11	I	Tr E
Sep 1	19 08	I	Ec D
	21 30	I	Oc D
4	23 55	II	Ec D
6	19 00	II	Tr I
	19 02	II	Sh I
	21 48	II	Tr E
	21 52	II	Sh E
7	23 39	I	Tr I
	23 42	I	Sh I
8	23 19	I	Ec R
9	20 21	I	Tr E
	20 25	III	Tr E
	20 28	I	Sh E
	20 53	III	Sh E
12	21 26	IV	Sh E
13	21 14	II	Tr I
	21 38	II	Sh I
	24 01	II	Tr E
	24 27	II	Sh E
15	22 42	I	Oc D
16	19 49	I	Tr I
	20 06	I	Sh I
	20 24	III	Tr I
	21 30	III	Sh I
	22 05	I	Tr E
	23 42	III	Tr E
17	19 42	I	Ec R
20	23 09	IV	Oc D
	23 29	II	Tr I
Sep 20	24 15	II	Sh I
22	21 21	II	Ec R
	24 20	I	Oc D
23	21 34	I	Tr I
	22 01	I	Sh I
	23 42	III	Tr I
	23 50	I	Tr E
	24 18	I	Sh E
24	21 37	I	Ec R
27	18 58	III	Ec R
29	19 53	II	Oc D
	23 59	II	Ec R
30	23 19	I	Tr I
	23 57	I	Sh I
Oct 1	20 38	I	Oc D
	23 32	I	Ec R
2	20 02	I	Tr E
	20 42	I	Sh E
4	22 59	III	Ec R
6	22 12	II	Oc D
7	20 53	IV	Ec D
	24 26	IV	Ec R
8	19 57	II	Tr E
	21 31	II	Sh E
	22 24	I	Oc D
9	19 32	I	Tr I
	20 21	I	Sh I
	21 48	I	Tr E
	22 37	I	Sh E
10	19 55	I	Ec R
11	20 08	III	Oc D
	23 31	III	Oc R
	23 38	III	Ec D
13	24 32	II	Oc D
15	19 31	II	Tr I
	21 21	II	Sh I
	21 27	IV	Tr I
	22 17	II	Tr E
	24 07	II	Sh E
	24 10	I	Oc D
	24 52	IV	Tr E
16	21 20	I	Tr I
	22 17	I	Sh I
	23 36	I	Tr E
	24 33	I	Sh E
17	21 50	I	Ec R
18	23 39	III	Oc D
22	21 00	III	Sh E
	21 53	II	Tr I
	23 57	II	Sh I
	24 39	II	Tr E
23	23 09	I	Tr I
	24 12	I	Sh I
24	20 26	I	Oc D
	21 14	II	Ec R
	23 45	I	Ec R
25	19 52	I	Tr E
	20 57	I	Sh E
29	20 26	III	Tr E
	21 43	III	Sh I
	24 17	II	Tr I
31	22 16	I	Oc D
	23 53	II	Ec R
Nov 1	20 37	I	Sh I
	21 43	I	Tr E
	22 53	I	Sh E
Nov 2	20 09	I	Ec R
5	20 46	III	Tr I
	24 09	III	Tr E
7	21 05	II	Oc D
	24 07	I	Oc D
8	21 18	I	Tr I
	22 53	I	Sh I
	23 35	I	Tr E
9	21 11	II	Sh E
	21 27	IV	Oc D
	22 05	I	Ec R
14	23 38	II	Oc D
15	23 11	I	Tr I
	24 29	I	Sh I
16	19 48	III	Ec D
	20 27	I	Oc D
	21 03	II	Sh I
	21 15	II	Tr E
	23 07	III	Ec R
	23 47	II	Sh E
	24 00	I	Ec R
17	19 56	I	Tr E
	21 14	I	Sh E
18	22 08	IV	Sh E
23	21 01	II	Tr I
	21 47	III	Oc R
	22 21	I	Oc D
	23 39	II	Sh I
	23 47	II	Tr E
	23 51	III	Ec D
24	20 54	I	Sh I
	21 50	I	Tr E
	23 10	I	Sh E
25	20 24	I	Ec R
	21 09	II	Ec R
30	22 20	III	Oc D
	23 36	II	Tr I
	24 15	I	Oc D
Dec 1	21 30	I	Tr I
	22 51	I	Sh I
	23 46	I	Tr E
2	22 19	I	Ec R
	23 47	II	Ec R
4	21 10	III	Sh E
	24 13	IV	Tr I
8	23 26	I	Tr I
9	20 40	I	Oc D
	20 49	II	Oc D
10	20 12	I	Tr E
	21 31	I	Sh E
11	20 53	II	Sh E
	21 59	III	Sh I
13	22 12	IV	Ec D
16	22 37	I	Oc D
17	21 12	I	Sh I
	22 10	I	Tr E
18	20 39	I	Ec R
	20 42	III	Tr I
	20 45	II	Sh I
	20 58	II	Tr E
21	22 51	IV	Tr E
24	21 52	I	Tr I
25	20 53	II	Tr I
	22 34	I	Ec R
27	21 04	II	Ec R

MOONS OF SATURN
    Saturn's moons are considerably fainter than the four Galilean moons of Jupiter. The diagram shows the orbits of four of Saturn's ten moons. The easiest to find is Titan (magnitude 8,5), according to the diagram

and the information in the table below (which covers the period when Saturn is clearly visible in the evening sky).

TITAN

Eastern Elongation	Inferior Conjunction	Western Elongation	Superior Conjunction
		Jan 4	Jan 7
Jan 12	Jan 16	Jan 19	Jan 23
Jan 28	Feb 1	Feb 4	Feb 8
Feb 12	Feb 16	Feb 20	Feb 24
Feb 28	Mar 4	Mar 8	Mar 12
Mar 16	Mar 20	Mar 24	Mar 28
Apr 1	Apr 5	Apr 9	Apr 13
Apr 17	Apr 21	Apr 25	Apr 29
Nov 27	Dec 1	Dec 5	Dec 9
Dec 13	Dec 17	Dec 21	Dec 25
Dec 29			

    Tethys and Dione are visible in a 100 mm telescope and Rhea is, when suitably placed, an easy object for a 75 mm telescope.

METEORS

Meteors, or shooting stars, (resulting from small bodies entering the Earth's upper atmosphere) are generally seen in greater abundance after midnight (due to the direction of the Earth's motion) than in the early evening. There are two categories of meteors - the sporadic ones, and the showers. A meteor shower comes from a certain direction in space (the Radiant) and is thought to be associated with the remains of a comet. When the Earth passes close to the comet's original orbit, a shower can be expected. A list of these predicted showers is given in the table below.

Date	Shower	Radiant		Maximum		Transit Radiant (approx)	Recommended Time of Watch		Conditions at Maximum
		R.A. 16^h20^m	Dec. -48°	Date	Hourly Rate	04^h45^m			
Mar 14 - Mar 18	Corona Australids	16 20	-48	Mar 16	5	04 45	02h30m	- dawn	Unfavourable
Mar 12 - Apr 25	Hydraids	12 16	-27	Mar 25	?	00 10	22h	- 02h	Favourable
Apr 19 - Apr 24	April Lyrids	18 08	+32	Apr 21	15	04 15	02h	- dawn	Favourable
May 1 - May 8	Eta Aquarids	22 24	00	May 5	18	07 30	03h	- dawn	Unfavourable
Apr 20 - July 30	Sco-Sgr System	18 00	-30	Jun 14	?	00 30	20h	- 24h	Favourable
Jun 10 - Jun 21	June Lyrids	18 32	-35	Jun 16	10	01 00	00h	- 03h	Favourable
Jun 17 - Jun 26	Ophiuchids	17 20	-20	Jun 20	9	23 30	21h	-02h	Favourable
Jul 10 - Aug 5	Capricornids	21 00	-15	Jul 25	8	00 50	23h	-02h	Favourable
Jul 15 - Aug 15	Delta Aquarids	22 36	-17 00	Jul 29	35	02 10	00h	-04h	Unfavourable
Jul 15 - Aug 20	Pisces Australids	22 40	-30	Jul 30	11	02 10	00h	-04h	Unfavourable
Jul 15 - Aug 25	Alpha Capricornids	20 36	-10	Aug 2	10	00 00	20h	-02h	Unfavourable
Jul 15 - Aug 24	Iota Aquarids	22 04 / 22 32	-6 / -15	Aug 6	12	01 10 / 01 40	00h	-03h	Unfavourable
Oct 16 - Oct 27	Orionids	06 24	+15	Oct 21	35	04 30	02h	-dawn	Favourable
Oct 10 - Dec 5	Taurids	03 44 / 03 44	+14 / +21	Nov 8	16	00 50 / 00 50	23h	-02h	Unfavourable
Nov 14 - Nov 20	Leonids	10 08	+22	Nov 17	10	06 30	02h	-dawn	Favourable
Dec 5	Phoenicids	01 00	-55	Dec 5	?	20 10	19h	-23h	Favourable
Dec 7 - Dec 15	Geminids	07 28	+32	Dec 13	55	02 00	00h	-03h	Favourable
Dec 5 - Jan 7	Velaids	09 56	-51	Dec 29	?	03 30	23h	-03h30m	Unfavourable

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 Changing Night Sky Section (page 4) gives information for finding some of the best known constellations – those easy to identify. Of those, the Southern Cross and Centaurus, Orion and Taurus, Scorpius and Sagittarius, are featured later in this section. Detailed information on other constellations is beyond the scope of this handbook and interested observers are advised to obtain a suitable star atlas.

STAR NAMES

    Within each constellation, the brightest star is generally labelled α (Alpha), the next β (Beta) and so on through the Greek alphabet. Most of the brightest stars also have their own names – usually of arabic origin. For example α Canis Majoris, otherwise known as Sirius, is the brightest star in the constellation Canis Major.

STELLAR MAGNITUDES

    The apparent brightness of a star – which depends both on its true luminosity and its distance – is indicated by its magnitude. Equal intervals of magnitude represent equal ratios in light intensity. A star of magnitude 1,0 (typical of the brightest stars in the night sky) would be exactly one hundred times more luminous than a star of magnitude 6,0 (about the limit of visibility to the naked eye). The maps in this section show stars down to magnitude 4,5.

STELLAR DISTANCES

    Distances are often expressed in units of light years – the distance light would travel in a year (equal to $9,5 \times 10^{12}$ km).

DOUBLE STARS

    It now appears that single stars such as our Sun are the exception, the majority of stars being double or multiple – two or more suns in orbit around one another.

STAR CLUSTERS

    These are of two completely different sorts. Galactic clusters, having of the order of 100 stars, are found close to the plane of the Milky Way. The ones we can see are relatively nearby. Globular clusters are much larger and far more distant. They contain of the order of 100 000 stars each and are seen above and below the Milky Way on that side of the sky towards the centre of our galaxy. So great is their distance that small telescopes fail to resolve individual stars – instead they appear as fuzzy balls.
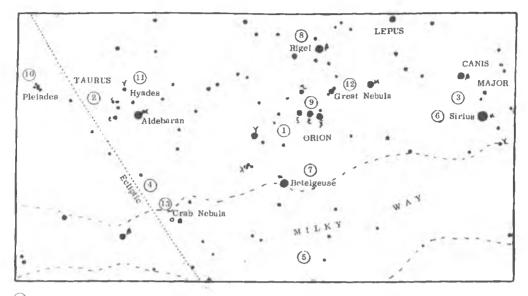
NEBULAE

    Possibly one third of the matter in our region of the Galaxy is in the form of gas and dust (the remainder being contained in stars, plus a tiny amount in planets). Condensations of this material are called nebulae, some of which are illuminated by nearby stars while others are dark. They are usually referred to by their numbers in Messier's catalogue (M) or the New General Catalogue (NGC).

THREE POPULAR REGIONS
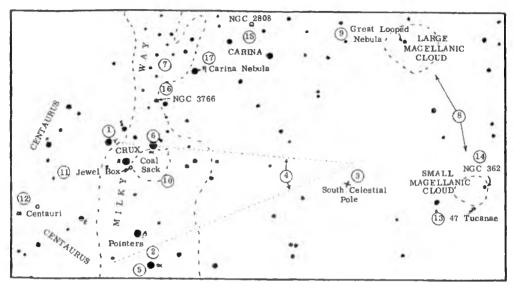
    The dominating constellation of the summer skies is Orion, that of the winter skies is Scorpius, while the Southern Cross is conspicuous for most of the year. They can be found with the aid of the maps in the Changing Night Sky section (pages 4 to 8). The regions around these constellations are also rich in interesting objects – visible either to the naked eye, or with the aid of binoculars or a small telescope – and are featured in the maps and text below. It may be necessary to rotate the maps to match the orientation of the constellations in the sky.

THE ORION REGION
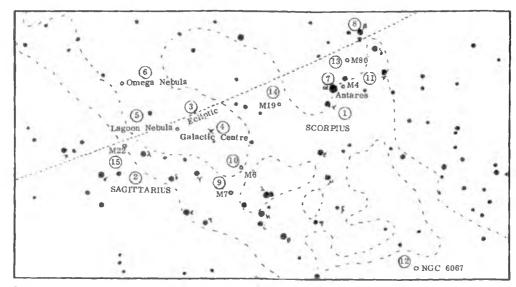
(1) The constellation of Orion. The figure of the legendary hunter of Greek mythology is unfortunately upside down when seen from Southern Africa. The faint stars by λ represent the head, α and γ the shoulders, δ - ε - η the belt, and β and κ the legs. Orion forms part of the "great hunting scene" in which he faces the onslaught of (2) Taurus, the bull. Only the forepart of the bull is depicted and, like Orion, it is upside down. α and ε are the eyes, γ the nose. Orion is accompanied by (3) Canis major, the large dog, and the small dog (off map) while Lepus, the hare, crouches at his feet.

(4) A section of the Ecliptic - a line encircling the entire sky and representing the plane of the Earth's orbit. As the Earth revolves around the Sun, the Sun appears to move along the ecliptic through the constellations of the Zodiac, of which Taurus is one.

(5) A portion of the Milky Way (looking out towards the edge of our Galaxy).

(6) Sirius - the brightest star in the night sky. It is somewhat brighter than our Sun and relatively close by - at a distance of 9 light years. It is a double star but the companion is a white dwarf (only slightly larger than the Earth, and with a mass comparable to our Sun) and is only visible through a large telescope.

(7) Betelgeuse - most famous of the red giant stars. Its diameter is of the order of the size of the Earth's orbit and its luminosity is nearly 10 000 times that of our Sun. Its red colour should be obvious to the eye. It is 520 light years distant.

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

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

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

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

(12) The Great Nebula in Orion, just visible to the naked eye, shows up as a fan shaped mass of luminous gas through binoculars or a telescope. A telescope will also show a tiny "Trapezium" of four stars in the centre.

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

THE SOUTHERN CROSS REGION

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

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

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

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

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

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

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

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

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

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

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

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

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

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

THE SCORPIUS REGION

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

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

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

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

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

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

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

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

STELLAR COORDINATES

The complete sky can be represented by the inside surface of a sphere (the Celestial Sphere) centred on the Earth. The position of a star on this sphere is given by two coordinates that correspond to latitude and longitude on Earth. That equivalent to latitude is Declination, measured from $+90°$ (at the North Celestial Pole) through $0°$ (the Celestial Equator) to $-90°$ (at the South Celestial Pole). Right Ascension, corresponding to longitude, is measured eastwards in units of time – 24 hours being equal to $360°$. Many telescopes are equipped with R.A. and Decl. setting circles which considerably reduce the time spent in aiming them.

STELLAR SPECTRAL TYPES AND COLOURS

The codes O, B, A, F, G, K, M, based on the spectra exhibited by stars are a sequence representing decreasing surface temperature. For example the surface of an O star is at approximately $50\,000°C$ and appears distinctly blue in colour, while a red M star has a surface temperature of approximately $2000°C$. Our Sun is classified as G0 (G-zero – the second digit is a further subdivision) – surface temperature $6000°C$.

A LIST OF BRIGHT STARS

The list below gives coordinates, magnitudes, spectral types and distances (in light years) for 54 of the brightest stars in the sky, including at least two for each hour of Right Ascension

Star		R.A.		Dec.		Mag.	Sp.	Dist.	Star		R.A.		Dec.		Mag.	Sp.	Dist.
α	And	1^h	07.1	$+28^o$	56'	2.1	B9	90	δ	Leo	11^h	12.8	$+20^o$	39'	2.6	A4	82
β	Hyi	0	24.4	-77	23	2.8	G1	21	λ	Cen	11	34.6	-62	53	3.2	B9	370
β	Phe*	1	04.9	-46	51	3.3	G8	190	α	Cru*	12	25.2	-62	58	1.4	B1	370
β	And	1	08.3	+35	30	2.0	M0	76	α	CVn*	12	54.9	+38	27	2.9	B9	118
α	Eri	1	36.8	-57	21	0.5	B5	118	ε	Vir	13	00.9	+11	06	2.9	G9	90
α	Ari	2	05.8	+23	20	2.0	K2	76	α	Vir	13	23.8	-11	02	0.9	B1	220
θ	Eri*	2	57.3	-40	24	2.9	A3	65	α	Boo	14	14.5	+19	19	-0.1	K2	36
α	Per	3	22.6	+49	46	1.8	F5	570	α	Cen*	14	38.0	-60	44	0.3	G2	4.3
γ	Eri	3	56.8	-13	35	3.0	M0	160	α	CrB	15	33.6	-26	48	2.2	A0	76
α	Dor	4	33.4	-55	05	3.3	A0	260	δ	Sco	15	58.9	-22	33	2.3	B0	590
α	Tau*	4	34.5	+16	28	0.9	K5	68	α	Sco	16	27.9	-26	23	0.9	M1	520
β	Ori	5	13.3	- 8	14	0.1	B8	900	β	Her	16	29.1	+21	32	2.8	G8	103
α	Aur	5	14.9	+45	58	0.1	G8	45	λ	Sco	17	31.9	-37	05	1.6	B1	310
α	Ori	5	53.8	+ 7	24	0.4	M2	520	α	Oph	17	33.7	+12	35	2.1	A5	58
β	CMa	6	21.6	-17	56	2.0	B1	750	κ	Sco	17	40.7	-39	01	2.4	B2	470
α	Car	6	23.4	-52	41	-0.7	F0	98	μ	Her*	17	45.5	+27	45	3.4	G5	30
α	CMa	6	44.0	-16	41	-1.4	A1	8.7	ε	Sgt	18	22.5	-34	24	1.8	B9	124
δ	CMa	7	07.4	-26	21	1.9	F8	2100	α	Lyr	18	36.1	+38	45	0.0	A0	27
α	Gem*	7	33.0	+31	57	1.6	A	45	ζ	Sgt*	19	01.0	-29	55	2.6	A2	140
α	CMi*	7	38.0	+ 5	17	0.4	F5	11	α	Aql	19	49.5	+ 8	48	0.8	A7	17
β	Gem	7	43.8	+28	06	1.2	K0	35	α	Pav	20	23.7	-56	49	2.0	B3	310
ρ	Pup	8	06.5	-24	14	2.8	F6	105	α	Cyg	20	40.6	+45	11	1.3	A2	1600
ε	Hya*	8	45.5	+ 6	30	3.4	G0	140	ε	Peg*	21	42.9	- 9	46	2.3	K2	780
β	Car	9	06.9	-69	37	1.7	A0	86	γ	Gru	21	52.4	-37	29	3.0	B8	540
α	Hya	9	26.3	- 8	33	2.0	K4	94	α	Gru	22	06.6	-47	06	1.8	B5	64
α	Leo*	10	07.1	+12	06	1.4	B7	84	α	PsA	22	56.9	-29	45	1.2	A3	23
μ	Vel*	10	45.7	-49	17	2.7	G5	108	α	Peg	23	03.5	+15	04	2.5	B9	109

* double stars

SIDEREAL TIME

Sidereal time, or "star time" is given by the line of Right Ascension that passes through the point directly overhead. Sidereal time runs at a slightly faster rate than standard time - so as to gain 24 hours (one whole circuit of the heavens) over the course of a year. The table below gives Sidereal time (for longitude 30°E) at 0 hrs standard time (midnight) and 2100 hrs (9 p.m.). It is tabulated at 10 day intervals. For intermediate dates, a difference of 4 minutes a day needs to be taken into account (24 hours of sidereal time are 4 minutes shorter than 24 hours of standard time).

1974		At 0 hrs	At 21 hrs			At 0 hrs	At 21 hrs			At 0 hrs	At 21 hrs
Jan	1	6^h37^m	3^h40^m		11	15^h14^m	12^h17^m		18	23^h46^m	20^h49^m
	11	7 20	4 23		21	15 53	12 56		28	0 26	21 29
	21	8 00	5 03		31	16 32	13 35	Oct	8	1 05	22 08
	31	8 39	5 42	June	10	17 12	14 15		18	1 44	22 47
Feb	10	9 19	6 22		20	17 51	14 54		28	2 24	23 27
	20	9 58	7 01		30	18 31	15 34	Nov	7	3 03	0 06
Mar	2	10 38	7 41	July	10	19 10	16 13		17	3 43	0 46
	12	11 17	8 20		20	19 50	16 53		27	4 22	1 25
	22	11 56	8 59		30	20 29	17 32	Dec	7	5 02	2 05
Apr	1	12 36	9 39	Aug	9	21 08	18 11		17	5 41	2 44
	11	13 15	10 18		19	21 48	18 51		27	6 20	3 23
	21	13 55	10 58		29	22 27	19 30	* Also shown on planetary diagram,			
May	1	14 34	11 37	Sept	8	23 07	20 10	pages 22 and 23			
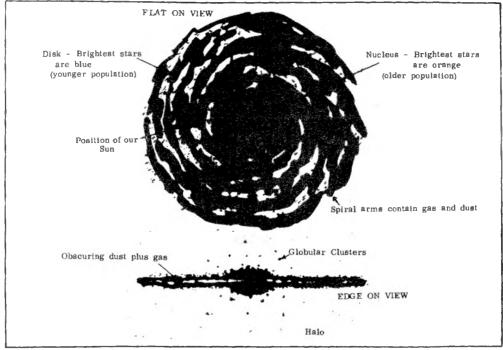
To obtain the sidereal time at places not at Longitude 30°E, a correction must be applied. Values of the correction for the main cities are Bloemfontein -15^m, Bulawayo -6^m, Cape Town -46^m, Durban +4^m, East London -8^m, Grahamstown -14^m, Johannesburg -8^m, Kimberley -21^m, Port Elizabeth -18^m, Pretoria -7^m, Salisbury +4^m, Windhoek -52^m. The sidereal time so found serves for setting telescope circles and as an indication as to what part of the sky is accessible.

The four maps in the Changing Night Sky section (pages 4 to 8) show the approximate sky for sidereal times: 6^h30^m, 12^h30^m, 18^h30^m and 0^h30^m.

OUR GALAXY AND OTHERS

This section is put in for the benefit of the reader without a knowledge of Astronomy.

Our Sun is one amongst some 100 000 million other stars in our disk-shaped galaxy. As the diagram below shows, the Sun is situated towards the edge of the system and apparently orbits around the centre once in about 200 million years. We see the galaxy stretching round us as the Milky Way, but even with optical telescopes we can only see that portion closest to us as the remainder is obscured by dust and gas. However

FLAT ON VIEW

Disk - Brightest stars
are blue
(younger population)

Nucleus - Brightest stars
are orange
(older population)

Position of our
Sun

Spiral arms contain gas and dust

Obscuring dust plus gas

Globular Clusters

EDGE ON VIEW

Halo

when we look above or below the plane of the Milky Way, we can see an indefinite distance into extragalactic space. Thus we have found the universe to be populated by millions of other galaxies akin to ours. Our galaxy is a member of a rather poor cluster of galaxies which includes the Magellanic Clouds (our nearest neighbours) and the Great Galaxy in Andromeda (a large spiral that is very similar to our own galaxy). Spectral features in the light of distant galaxies are redshifted. This is usually interpreted as an overall expansion of the universe - the further one looks the faster the galaxies are receding.

OCCULTATIONS

This section and that following concern a specialised branch of observational astronomy in which both professional and amateur participate. The tables of predictions must necessarily occupy a number of pages as this handbook is the sole published source for Southern Africa. They will undoubtedly appear complicated to the layman.

An occultation occurs when the disk of the Moon moves in front of a star. Timings of occultations, to a precision of one-tenth of a second if possible, are very valuable for studies of the Moon's shape and motion. Since only very modest equipment is required, amateurs can make important contributions in this field. Persons interested in making and reporting occultation observations are urged to contact the Director of the Society's Occultation Section, Mr. A.G.F. Morrisby (c/o Dept. of Surveyor General, P. O. Box 8099, Causeway, Salisbury, Rhodesia).

Predictions of occultations of all stars brighter than magnitude 7,5, supplied by H.M. Nautical Almanac Office, are given below. The main set of tables gives predictions for three stations, namely,

	Longitude	Latitude
Cape Town	$- 18^{o},475$	$-33^{o},933$
Johannesburg	$- 28^{o},075$	$-26^{o},182$
Salisbury	$- 31^{o},040$	$-17^{o},788$

This does not restrict its use to observers at 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:

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

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

Occulted stars have been identified by their Z.C. numbers, that is their numbers in the "Catalogue of 3539 Zodiacal Stars for the Equinox 1950.0" by James Robertson (U.S. Naval Observatory, 1939). An index is also provided on page 42.

Explanations of Abbreviations used in Tables

Z.C.	-	the number of the star in the Zodiacal Catalogue. An "m" following the number indicates the star is not single
Sp	-	the spectral classification of the star
Mag	-	the visual magnitude
Ph	-	the Phase: D - Disappearance, R Reappearance
h.m.	-	the time of the occultation is SAST
a, b	-	parameters in minutes for predicting times other than at standard stations (explained above in text)
P.A.	-	the Position Angle on the Moon's limb measured eastward from the north point
N	-	no occultation
S	-	sunlight interferes
A	-	moon at very low altitude
G	-	grazing occultation

Date	Z.C.	Mag.	Sp.	Ph.	Cape Town					Johannesburg					Salisbury				
					h	m	a	b	P.A.	h	m	a	b	P.A.	h	m	a	b	P.A.
Jan.																			
1	70	6,8	G5	D	21	13,9	-1,2	+2,5	29	21	46,4	-1,0	+3,4	15			N		
5	652m	6,4	B8	D	22	20,9	-2,3	-0,2	101	22	44,1	-2,3	+0,6	84	23	00,0	-2,6	+1,5	60
7	839	5,3	B3	D			N					N			01	53,8	-0,5	-1,1	136
10	1428m	3,8	F5,A3	D			N			22	33,6	-0,9	-2,8	158	22	17,2	-1,0	-1,9	132
10	1428m	3,8	F5,A3	R			N			23	24,9	-1,8	-0,1	252	23	26,1	-1,8	-0,9	279
12	1662	6,3	K0	R			N			23	16,9			230	23	20,7	-0,9	-0,5	265
16	2018	6,4	A2	R	2	31,9	+0,4	-3,0	344			N					N		
28	31	6,2	G5	D			S					S			18	59,5	-0,8	+4,1	9
29	160	6,2	G5	D			S					S			19	28,5	-1,8	+1,6	63
31	440m	4,6	A2	D	22	31,1	-1,4	+1,8	61			A					N		
Feb.																			
1	584	6,0	B9	D			N					N			22	20,7	-0,9	-1,1	131
2	740	6,3	F0	D			S			19	55,8	-2,5	+0,3	76	20	11,6	-2,8	+1,6	54
3	923	6,9	K0	D	23	31,1			168	23	30,3	-1,3	-0,5	125	23	33,8	-1,8	+0,2	97
4	929m	5,8	B1	D			N					N			1	33,5			175
4	1086	6,5	G5	D			N			23	14,3			174	22	58,2	-1,7	-1,5	137
9	1623	5,4	A0	R	5	24,9	-0,9	-1,1	323			N					N		
11	1845m	6,5	K0	R			N			0	29,0	-1,9	-0,6	263	0	25,4	-1,4	-1,4	292
27	399m	5,7	A0	D	20	58,8	-0,9	+1,1	91			A					A		
28	534	6,6	A0	D	20	40,1	-1,5	+0,7	99	21	01,2	-1,3	+1,4	73	21	22,0	-1,8	+2,8	39
Mar.																			
2	853	7,0	F2	D	20	17,5	-2,3	+0,2	90	20	47,1	-2,7	+1,6	62			N		
6	1428m	3,8	F5,A3	D	21	07,8			182	20	55,4	-1,4	-2,2	145	20	44,9	-2,0	-1,5	120
11	2029	5,1	M0	R	22	14,2	+0,2	-2,1	322	21	48,4			3			N		
15	2434	5,6	A0	R	0	53,7	-1,0	+0,2	232	0	57,8	-0,7	-0,9	271	0	48,4	-0,3	-1,7	301
18	2863	6,1	A5	R	4	11,3	-0,7	-1,5	277	3	58,9	-0,4	-4,4	319			N		
30	976m	3,2	M0	D			N					N			19	47,9	-0,6	-2,7	157
30	976m	3,2	M0	R			N					N			20	40,4	-2,7	+2,1	240
31	1113m	5,2	K2	D			S					S			18	14,8	-2,8	-0,6	102
31	1123m	7,2	A5	D	20	06,4	-2,5	+0,5	81			N					N		
31	1127	5,9	F0	D	20	58,4	-1,9	+0,1	104	21	26,4	-2,8	+2,2	62			N		
31	1135	6,8	K0	D			N			22	59,7	-0,3	-0,7	137	22	58,9	-0,7	+0,1	104
31	1138	7,1	G0	D	23	02,7	-0,7	0,0	121	23	15,3	-1,0	+1,2	82			N		
Apr.																			
1	1258	6,7	K0	D			N					N			20	28,9			190
5	1623	5,4	A0	D	0	05,4	-1,8	-0,7	118	0	30,0	-3,0	+2,0	72			N		
9	2228	5,9	K0	R	22	52,2	-0,3	-2,0	304	22	32,5	+0,6	-3,8	345			N		
26	916	4,3	G5	D			S					S			17	51,9			39
26	Saturn	0,4		D			N					N			18	22,7			167
26	Saturn	0,4		R			N					N			19	00,3			227
26	929m	5,8	B1	D	20	11,0	-1,5	+1,7	70			N					N		
26	931m	6,7	B9	D	20	31,6	-1,0	+1,2	86			A					N		
30	1457	6,7	K0	D			N					N			18	45,4			197
May																			
2	1705	7,5	F2	D	22	23,0	-1,8	-1,0	122	22	45,2	-3,1	+1,4	78			N		
11	2757	5,1	A0	R	1	37,7	-2,0	+1,4	225	2	03,7	-2,5	+0,1	257	2	06,4	-3,0	-1,7	289
27	1440	6,7	F0	D	21	03,0	-1,0	-0,3	124	21	17,6	-1,4	+1,2	83			N		
29	1566	6,6	K2	D	0	07,4	-0,3	+0,3	114			A					N		
29	1662	6,3	K0	D	18	21,0	-1,5	-1,7	128	18	32,7	-3,0	-0,3	91			N		
June																			
1	2018	6,4	A2	D	20	27,6	-1,5	-1,9	123	20	40,4	-3,1	+0,1	83			N		
7	2720	6,4	F5	R	5	23,2	-0,1	+3,8	201	5	49,3	+0,1	+3,0	209			S		
8	2865	5,9	K0	R	6	43,7	-0,8	+2,0	239			S					S		
10	3093	4,5	K0	D	3	25,5	-1,9	+1,5	46	3	59,3	-1,8	-2,6	36	4	31,1	-0,9	+3,9	15
10	3093	4,5	K0	R	4	56,9	-2,4	+1,0	252	5	29,3	-2,4	+1,3	255	5	45,2	-3,1	-0,4	273

Date	Z.C.	Mag.	Sp.	Ph.	Cape Town					Johannesburg					Salisbury				
					h	m	a	b	P.A.	h	m	a	b	P.A.	h	m	a	b	P.A.
June																			
25	1623	5,4	A0	D	18	19,3	-3,5	+1,6	70		N					N			
26	1743	6,8	M0	D	18	31,4	-1,5	-1,8	137	18	43,5	-2,7	-0,1	97		N			
29	2099	7,0	K0	D		N					N				20	30,9			180
July																			
8	3272	5,8	G5	R		N					A				21	52,9	-0,5	+0,5	241
15	486	5,2	B3	R	4	40,6	0,0	+1,0	209	4	50,3	-0,5	+1,0	219	4	59,6	-1,3	+0,6	240
28	2212	6,1	A2	D	0	39,5	-0,3	+1,9	68	0	55,3	+0,3	+2,2	52		N			
28	2333	7,1	B9	D	18	39,3	-1,0	-3,6	147	18	37,7	-2,4	-1,3	107	18	43,7	-3,4	+0,8	72
31	2635	5,7	K0	D	3	02,3	-0,7	+1,1	92	3	14,6	-0,2	+1,0	85		A			
31	2757	5,1	A0	D	21	25,3	-2,3	-3,4	127	21	36,2	-3,0	-0,7	97	21	47,8	-3,1	+1,2	68
Aug.																			
1	2791	5,4	B3	D	5	15,7			2		N					N			
6	3376	6,4	K0	R	6	34,5			316		N					N			
10	317	6,4	F5	R	5	48,2	-1,5	+2,0	209		S					S			
12	582	5,8	F0	R	3	51,3	-1,1	-0,8	262	3	58,7	-1,7	-0,7	269	3	56,3	-2,6	-1,6	291
14	916	4,3	G5	D	5	23,8	+0,1	+1,3	30		N					N			
14	916	4,3	G5	R	5	59,9	-2,1	-3,2	326		N					N			
19	1662	6,3	K0	D	19	23,9	-0,4	+0,8	98		A					N			
20	1778	7,1	K0	D	19	49,9	-0,6	+1,2	88		A					H			
22	2029	5,1	M0	D	19	24,2	-1,9	+2,6	63		N					N			
23	2172m	4,7	A0p	D	23	08,8	-0,3	-1,2	87		A					A			
23	2175	6,0	A2	D	23	47,3	+0,5	+2,6	47		A					N			
26	2557	6,2	K0	D	19	03,7	-2,2	-2,9	128	19	16,9	-3,0	-0,5	96	19	30,9	-3,1	+1,5	66
27	2580	6,6	A0	D	0	45,4	-0,8	+1,2	89	0	59,1	-0,3	+1,1	82	1	09,6	+0,2	+1,4	62
27	2708	5,9	G5	D		S				18	35,6	-2,6	+1,3	57	19	14,6			11
27	2717	7,4	K0	D	21	45,1	-2,9	-0,6	105	22	12,1	-2,6	+0,6	91	22	28,2	-2,0	+1,5	69
27	2720	6,4	F5	D		N					N				23	54,5			138
28	2729	6,9	B9	D	1	01,7	-0,2	+2,7	38	1	21,8	+0,3	+2,7	30	1	49,8			355
28	2734m	5,4	K0	D	1	50,0	-0,5	+1,3	83	2	02,8	-0,1	+1,2	76		A			
29	2865	5,9	K0	D	0	18,1	-2,1	-0,7	95	0	42,2	-1,5	+0,9	90	0	55,5	-1,0	+1,3	72
30	3093	4,5	K0	D	22	30,6	-1,6	+2,4	33	23	06,6	-1,3	+3,3	24	23	43,4			0
Sept.																			
9	709	4,3	B5	D		N					N				5	16,2	-3,2	-1,8	125
10	859	6,5	B9	R	5	44,1	-2,2	-1,2	293		S					S			
20	2228	5,9	K0	D		N				18	42,7	-2,1	-1,6	135	18	43,0	-1,9	0,0	104
22	2529	6,6	A0	D	22	15,5	-1,0	+1,1	91	22	30,9	-0,4	+1,1	82	22	42,4	0,0	+1,4	61
23	2535	6,7	G0	D	0	00,7	-0,2	+0,9	99		A					A			
23	2679	7,4	A0	D	23	25,3	-1,3	+0,2	116	23	37,1	-0,7	+0,4	108	23	43,2	-0,2	+0,7	87
24	2814	5,0	K0	D	21	26,9	-1,8	+1,9	62	21	56,8	-1,2	+2,1	55	22	19,7	-0,5	+2,7	35
24	2816	6,8	B9	D	21	54,7	-1,4	+2,2	54	22	23,0	-0,8	+2,3	48	22	46,4	0,0	+2,9	28
26	3051	7,0	K2	D		N					N				20	46,8			123
27	3065	7,5	K0	D	0	47,2	-0,8	+2,2	50	1	09,0	-0,3	+2,1	45	1	28,9	+0,2	+2,6	25
27	3075	7,1	F5	D	3	05,2	-0,2	+1,0	99		A					A			
29	3309	6,3	K0	D	2	58,3	-0,1	+3,4	9		N					N			
Oct.																			
5	487	5,2	K0	R	1	07,5	-1,1	+0,7	224	1	27,8	-1,8	+1,1	230	1	42,3	-2,6	+0,7	249
5	492	5,9	B9	R	2	01,1	-1,0	+1,9	204	2	30,1	-1,9	+2,2	214	2	53,3	-2,7	+1,6	236
6	660	4,4	A5	D	3	56,5	-2,4	-0,2	91	4	22,5	-2,6	+0,7	77	4	42,2	-3,0	+2,1	52
6	660	4,4	A5	R	5	25,1	-2,3	+0,8	258		S					S			
11	1381	0,3	A0	R	4	29,0	-0,8	-0,3	243	4	35,2	-1,3	-0,7	265	4	31,8	-1,5	-1,2	288
18	2327	6,7	G0	D		S				19	37,6	-0,2	+1,4	71	19	52,2	+0,4	+2,2	45
18	2337	6,4	B9	D	10	58,0	+0,1	+1,5	71		A					A			
20	2614	6,2	A1	D		N				21	32,5	-1,4	-1,3	136	21	31,7	-0,5	0,0	107
21	2763	6,7	M0	D	21	33,4	+0,1	+3,3	25	21	55,4	+0,7	+3,5	15		N			
21	2773	6,1	G0	D	21	14,0	-0,2	+1,2	89		A					A			
21	2774	6,3	F6	D	21	10,8	+0,1	+1,8	58		A					A			

Date	Z.C.	Mag.	Sp.Ph.		Cape Town					Johannesburg					Salisbury			
				h	m	a	b	P.A.	h	m	a	b	P.A.	h	m	a	b	P.A.
Oct																		
22	2889	7,1	M0 D	19	38,6	-1,8	+2,1	54	20	10,7	-1,3	+2,4	48	20	36,4	-0,5	+3,1	28
24	3133	5,8	A2 D		G				23	01,3			126	23	05,3	-1,5	+0,3	99
26	3260	6,4	F5 D	0	33,1	-0,5	+2,6	33	0	56,3	-0,1	+2,8	23		A			
26	3263	7,3	K0 D	1	42,6			353		N					N			
27	3376	6,4	K0 D	2	29,2	-0,3	+2,3	38		A					N			
Nov.																		
2	599	4,5	K0 D	0	51,5	-2,8	-1,7	122	1	08,4	-2,9	-0,9	110	1	13,8	-3,0	0,0	89
2	599	4,5	K0 R	1	54,1	-1,8	+1,8	215	2	29,2	-2,5	+1,7	232	2	48,6	-2,6	+0,9	257
4	911	6,3	B8 R	0	27,1	-1,2	-1,0	268	0	33,6	-1,8	-1,0	279	0	28,8	-2,4	-1,8	301
5	1077m	3,7-4,1	G0p D		A				0	50,9	-1,0	+0,4	56		N			
5	1077m	3,7-4,1	G0p R	1	48,1	-1,6	-1,8	301	1	50,2	-2,1	-2,4	318		N			
8	1207	5,8	K0 R		A				1	08,2	-1,1	-1,2	284	0	59,4	-1,4	-1,8	306
16	2547	4,9	F5 D	19	41,3	-1,1	-0,1	124	19	49,0	-0,5	+0,2	113		A			
17	2710	6,8	A5 D	21	04,9	-0,3	+1,1	92		A					A			
19	2968m	6,2	B9 D		N				22	04,7	-1,1	-1,1	131		A			
Dec.																		
3	1175	5,0	K2 R	1	26,1	-1,6	-3,2	341		N					N			
7	1662	6,3	K0 R		N				2	57,5			228	3	06,1	-1,8	-0,5	268
26	599	4,5	K0 D		S					S				19	06,5	-1,3	+0,8	56
26	601	6,0	G5 D		S					S				19	23,2	-2,0	-0,1	80
28	621	6,2	B8 D	23	44,5	-2,2	+0,3	97	24	10,0	-2,1	+1,1	76	24	31,1	-2,5	+2,5	47
31	1381	6,3	A0 R	23	42,2	-1,1	-1,3	280	23	43,5	-1,6	-1,6	299	23	31,7	-1,4	-2,4	324

Z.C.		Z.C.		Z.C.		Z.C.	
31	36 Pisc	976	13 μ Gemi	2172	24C Libr	2757	36 Sgtr
65	+80° 64	984	14 Gemi	2175	25 Libr	2760	-20° 5344
70	91G Pisc	997	+22° 1352	2212	147B Libr	2763	-19° 5255
160	75 Pisc	1021	+22° 1416	2216	-21° 4135	2773	171B Sgtr
317	20H Arie	1077	43 ζ Gemi	2226	-21° 4152	2774	173B Sgtr
336	+17° 339	1086	120B Gemi	2228	172B Libr	2791	190B Sgtr
399	34 μ Arie	1109	+19° 1685	2290	δ Scor	2814	43 d Sgtr
425	+19° 432	1113	66 Gemi	2327	83B Scor	2816	-19° 5837
440	48 ε Arie	1123	+20° 1798 pr	2333	-22° 4127	2825	226B Sgtr
486	61 τ Arie	1127	61 Gemi	2337	51G Scor	2833	-18° 5356
487	63 Arie	1135	+19° 1743	2351	-22° 4159	2846	246B Sgtr
492	65 Arie	1138	+20° 1822	2357	-23° 12860	2863	266B Sgtr
524	+22° 523	1175	81 g Gemi	2359	ρ Ophi	2865	267B Sgtr
563	+22° 572	1207	3 Canc	2403	-22° 4196	2889	-17° 5746
582	32 Taur	1258	+16° 1704	2434	24 Ophi	2968	16B Capr
584	33 Taur	1381	222B Canc	2507	-23° 13366	2969	β Capr
599	37 A Taur	1428	14 o Leon	2529	52 Ophi	3045	84B Capr
601	39 Taur	1429	+9° 2226	2535	158G Ophi	3051	87B Capr
621	192B Taur	1440	+9° 2239	2547	58 Ophi	3065	-12° 5876
652	62 Taur	1457	+8° 2289	2557	-22° 4423	3075	35B Aqar
660	69 υ Taur	1566	36 Sext	2580	11G Sgtr	3093	13 ν Aqar
693	284B Taur	1623	69 p⁵ Leon	2614	30G Sgtr	3133	19 Aqar
709	94 τ Taur	1662	388B Leon	2618	42B Sgtr	3260	138B Aqar
740	315B Taur	1705	-2° 3411	2635	14 Sgtr	3263	-5° 5738
839	121 Taur	1743	44B Virg	2679	-21° 5025	3272	44 Aqar
853	+24° 909	1778	127B Virg	2704	115B Sgtr	3309	187B Aqar
859	+23° 1007	1788	163B Virg	2708	121B Sgtr	3376	3 Pisc
911	141 (Taur)	1845	343B Virg	2710	87G Sgtr	3417	+0° 4982
916	1 Gemi	2018	124G Virg	2717	-21° 5118	3452	+1° 4724
923	2 Gemi	2029	40H Virg	2720	128B Sgtr		
929	3 Gemi	2099	-18° 3882	2729	133B Sgtr		
931	4 Gemi	2129	-19° 3979	2734	29 Sgtr		

GRAZING OCCULTATIONS

Like the previous section, the material presented here is of a specialised
nature and will appear complicated to the layman.

The maps 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 10^0 above the observer's horizon. (2^0 in the
in the case of bright stars). Each track starts in the West at some arbitrary time given in the key and ends
beyond the area of interest, except where the letters "A", "B" or "S" are given. "A" denotes that the Moon
is at a low altitude, "B" that the bright limb interferes, and "S" that sunlight interferes. The tick marks
along the tracks denote 5 minute intervals of time which, when added to the time at the beginning of the track,
give the approximate time of the graze at places along the tracks.
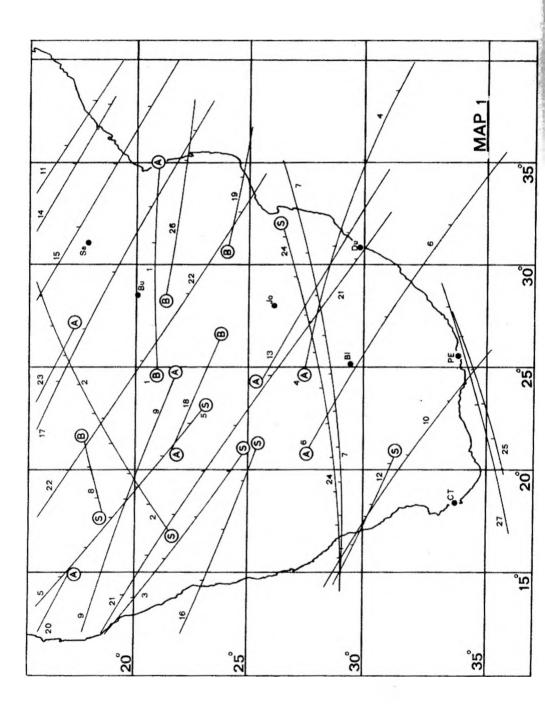
Observers positioned on, or very near, one of these tracks will probably see the star disappear and
reappear several times at the edge of features on the limb of the Moon. The recorded times of these events
(to a precision of a second, if possible) are very valuable in the study of the shape and motion of the Moon
currently being investigated at the Royal Greenwich Observatory and the U.S. Naval Observatory. The Society
Coordinator for Grazing Occultations is Mr. J. Hers, 48 Central Road, Linden Extension, Randburg 2001.
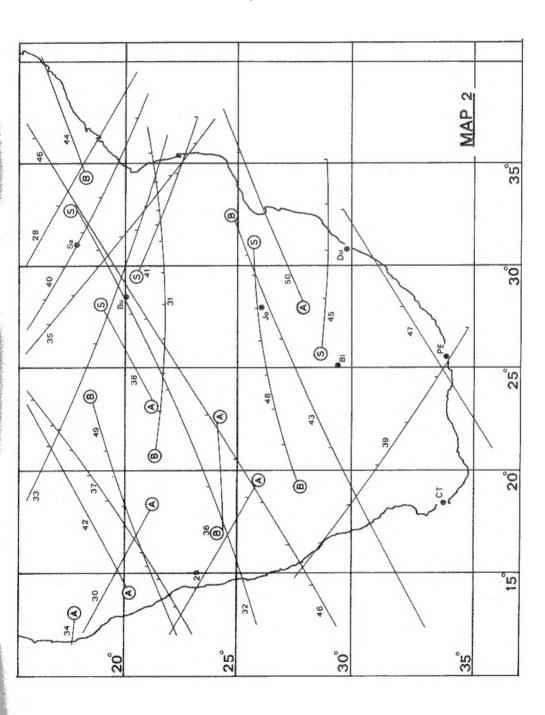
KEY TO MAP 1
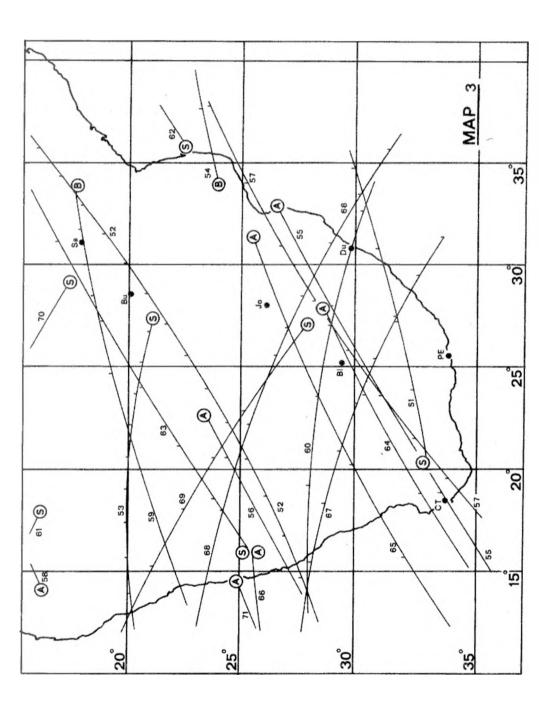
No.	Z.C.	Mag	Date		Beginning	Sunlit %	Limit
1	70	6.8	Jan	1	$22^h 14^m$	60	N
2	336	7.4	Jan	3	20 06	71	S
3	1566	6.6	Jan	12	5 13	82	S
4	1662	6.3	Jan	12	23 06	74	S
5	1788	6.7	Jan	14	4 56	62	S
6	2129	7.4	Jan	16	1 57	32	S
7*	2290	2.5	Jan	18	10 01	21	N
8	425	7.0	Jan	31	19 56	55	S
9*	440	4.6	Jan	31	23 14	57	N
10*	1845	6.5	Feb	10	23 55	79	S
11	2216	7.0	Feb	14	2 25	48	S
12	2226	7.0	Feb	14	5 34	47	S
13*	2351	7.4	Feb	14	1 13	39	S
14*	2357	6.6	Feb	15	2 29	38	S
15*	2359	4.8	Feb	15	2 31	38	S
16	2507	6.7	Feb	16	5 38	28	S
17	853	7.0	Mar	2	21 07	63	N
18	2029	5.1	Mar	11	21 33	84	N
19	2863	6.1	Mar	18	3 40	27	N
20	997	6.8	Mar	30	23 25	49	N
21*	1223	7.2	Mar	31	20 19	59	N
22	1127	5.9	Mar	31	21 29	60	N
23	1138	7.1	Mar	31	23 38	60	N
24	2403	7.5	Apr	11	4 52	80	N
25	2626	6.4	Apr	14	5 42	53	N
26	3031	7.0	Apr	18	2 04	35	N
27	3417	6.8	Apr	19	5 49	10	N

KEY TO MAP 2

No.	Z.C.	Mag	Date		Beginning	Sunlit %	Limit
28*	916	4.3	Apr	26	18 05	22	N
29*	929	5.8	Apr	26	20 36	23	N
30*	931	6.7	Apr	26	21 02	23	N
31	2760	6.7	May	10	1 41	79	N
32	65	7.3	May	18	5 19	15	N
33	1440	6.7	May	27	21 30	42	N
34	1566	6.6	May	28	0 34	55	N
35	1662	6.3	May	29	18 44	64	N
36	1788	6.7	May	30	1 42	76	S
37	3093	4.5	Jun	10	4 10	77	N
38	563	6.9	Jun	18	6 05	5	N
39	1623	5.4	Jun	25	18 28	38	N
40	1743	6.8	Jun	26	19 05	49	N
41	1705	7.5	Jul	23	18 02	23	N
42	582	5.8	Aug	12	3 11	40	N
43*	916	4.3	Aug	14	5 35	19	N
44	1077	3.7-4.1	Aug	15	4 24	11	S
45	2704	5.8	Aug	27	18 24	77	S
46	2720	6.4	Aug	27	23 24	78	S
47	693	6.0	Sep	9	2 18	56	N
48*	709	4.3	Sep	9	5 18	55	S
49	859	6.5	Sep	10	4 49	44	N
50	1021	6.3	Sep	11	3 17	34	N

* See notes on page 47

MAP 1

MAP 2

MAP 3

KEY TO MAP 3

No.	Z.C.	Mag.	Date		Beginning		Sunlit	Limit
51	2228	5.9	Sep	20	18	57	23%	S
52	3051	7.0	Sep	26	20	10	80	S
53	984	6.6	Oct	8	4	37	59	S
54	1109	7.3	Oct	9	2	25	49	S
55	2614	6.2	Oct	20	21	30	27	S
56	2618	6.6	Oct	20	22	23	27	S
57	3133	5.6	Oct	24	22	48	65	S
58	911	6.3	Nov	3	23	37	84	N
59	1077	3.7-4.1	Nov	4	0	59	74	N
60	1457	6.7	Nov	8	3	02	40	S
61	1705	7.5	Nov	10	5	43	18	S
62	2833	7.0	Nov	18	18	24	20	S
63	2846	6.9	Nov	18	19	49	20	S
64*	2968	6.2	Nov	19	22	01	29	S
65*	2969	3.2	Nov	19	22	08	29	S
66	3452	6.8	Nov	23	01	19	68	S
67	1429	6.8	Dec	5	2	05	66	S
68	1662	6.3	Dec	7	2	29	43	S
69	1778	7.1	Dec	8	4	13	32	S
70	2029	5.1	Dec	10	5	07	13	S
71	3045	6.0	Dec	17	21	38	15	S

NOTES

Track No.	ZC	
7	2290	is a spectroscopic binary. (Note graze occurs in daylight).
9	440	is the mean of the double star Aitken 2257. The components are both 5th magnitude; separation 1$''$4 in p.a. 207^0.
10	1845	is the brighter component of the double star Aitken 8684. The companion is 9th magnitude; separation 30$''$ in p.a. 300^0.
13	2351	is the mean of the double star Aitken 10024. The components are 7,7 and 9,2. magnitude; separation 1$''$ in p.a. 320^0.
14	2357	is the mean of the double star Aitken 10045. The components are 8,1 and 9,2 magnitude; separation 0$''$8 in p.a. 17^0.
15	2359	is the mean of the two bright components, 5,3 and 5,9 magnitude, separation 3$''$2 in p.a. 346^0, of the system Aitken 10049. There is another component of 8th magnitude at approximately 150$''$ distance in p.a. 0^0. The close double at 150$''$ distance in p.a. 250^0 is Z.C. 2357 (see graze track No. 14).
21	1123	is the brighter component of the double star Aitken 6060. The companion is 8,1 magnitude; separation 6$''$4 in p.a. 44^0.
28,43	916	is a spectroscopic binary
29	929	is the mean of the two bright components of the double star Aitken 4751. The components are 6,0 and 10th magnitude; separation 0$''$5 in p.a. 339^0.
30	931	is the mean of the double star Aitken 4768. The components are 7,3 and 7,6 magnitude; separation 0$''$3 in p.a. 252^0.
48	709	is a spectroscopic binary.
64	2968	is the brighter component of the double star Aitken 13717. The components are 6,2 and 10th magnitude; separation 0$''$8 in p.a. 89^0
65	2969	is a spectroscopic binary

ASSA OFFICE BEARERS

The Julian Calendar is generally used for recording the time of variable star observations. It numbers the days consecutively from the beginning of the Julian era in 4713 B.C. The Julian day begins at Greenwich mean noon, that is, at 1400 hrs. (2 p.m.) SAST. The Julian date on 1974 Jan. 1, at 1400 hrs. is 2442 049,0 - the first digits are not repeated for each entry in the table below.

Day	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
	2442	2442	2442	2442	2442	2442	2442	2442	2442	2442	2442	2442
1	049,0	080,0	108,0	139,0	169,0	200,0	230,0	261,0	292,0	322,0	353,0	383,0
2	050,0	081,0	109,0	140,0	170,0	201,0	231,0	262,0	293,0	323,0	354,0	384,0
3	051,0	082,0	110,0	141,0	171,0	202,0	232,0	263,0	294,0	324,0	355,0	385,0
4	052,0	083,0	111,0	142,0	172,0	203,0	233,0	264,0	295,0	325,0	356,0	386,0
5	053,0	084,0	112,0	143,0	173,0	204,0	234,0	265,0	296,0	326,0	357,0	387,0
6	054,0	085,0	113,0	144,0	174,0	205,0	235,0	266,0	297,0	327,0	358,0	388,0
7	055,0	086,0	114,0	145,0	175,0	206,0	236,0	267,0	298,0	328,0	359,0	389,0
8	056,0	087,0	115,0	146,0	176,0	207,0	237,0	268,0	299,0	329,0	360,0	390,0
9	057,0	088,0	116,0	147,0	177,0	208,0	238,0	269,0	300,0	330,0	361,0	391,0
10	058,0	089,0	117,0	148,0	178,0	209,0	239,0	270,0	301,0	331,0	362,0	392,0
11	059,0	090,0	118,0	149,0	179,0	210,0	240,0	271,0	302,0	332,0	363,0	393,0
12	060,0	091,0	119,0	150,0	180,0	211,0	241,0	272,0	303,0	333,0	364,0	394,0
13	061,0	092,0	120,0	151,0	181,0	212,0	242,0	273,0	304,0	334,0	365,0	395,0
14	062,0	093,0	121,0	152,0	182,0	213,0	243,0	274,0	305,0	335,0	366,0	396,0
15	063,0	094,0	122,0	153,0	183,0	214,0	244,0	275,0	306,0	336,0	367,0	397,0
16	064,0	095,0	123,0	154,0	184,0	215,0	245,0	276,0	307,0	337,0	368,0	398,0
17	065,0	096,0	124,0	155,0	185,0	216,0	246,0	277,0	308,0	338,0	369,0	399,0
18	066,0	097,0	125,0	156,0	186,0	217,0	247,0	278,0	309,0	339,0	370,0	400,0
19	067,0	098,0	126,0	157,0	187,0	218,0	248,0	279,0	310,0	340,0	371,0	401,0
20	068,0	099,0	127,0	158,0	188,0	219,0	249,0	280,0	311,0	341,0	372,0	402,0
21	069,0	100,0	128,0	159,0	189,0	220,0	250,0	281,0	312,0	342,0	373,0	403,0
22	070,0	101,0	129,0	160,0	190,0	221,0	251,0	282,0	313,0	343,0	374,0	404,0
23	071,0	102,0	130,0	16 ,0	191,0	222,0	252,0	283,0	314,0	344,0	375,0	405,0
24	072,0	103,0	131,0	162,0	192,0	223,0	253,0	284,0	315,0	345,0	376,0	406,0
25	073,0	104,0	132,0	163,0	193,0	224,0	254,0	285,0	316,0	346,0	377,0	407,0
26	074,0	105,0	133,0	164,0	194,0	225,0	255,0	286,0	317,0	347,0	378,0	408,0
27	075,0	106,0	134,0	165,0	195,0	226,0	256,0	287,0	318,0	348,0	379,0	409,0
28	076,0	107,0	135,0	166,0	196,0	227,0	257,0	288,0	319,0	349,0	380,0	410,0
29	077,0		136,0	167,0	197,0	228,0	258,0	289,0	320,0	350,0	381,0	411,0
30	078,0		137,0	168,0	198,0	229,0	259,0	290,0	321,0	351,0	382,0	412,0
31	079,0		138,0		199,0		260,0	291,0		352,0		413,0