ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1981

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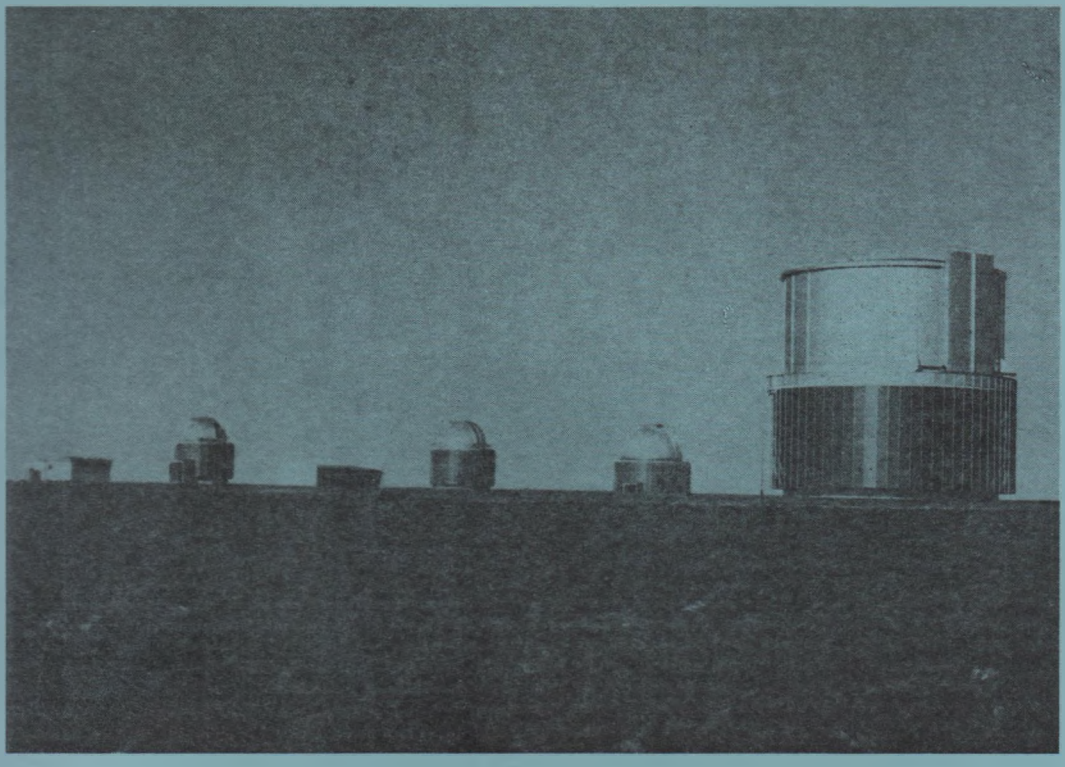

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PREDICTED PERIHELION PASSAGES OF COMETS, 1981

Periodic comet	Perihelion date	Revolution Period years	Perihelion Distance au
Reinmuth 2	Jan. 29	6·7	1·95
Borrelly	Feb. 20	6·8	1·32
Schwassmann-Wachmann 2	Mar. 17	6·5	2·14
West-Kohoutek-Ikemura	Apr. 12	6·1	1·40
Kohoutek	Apr. 17	6·2	1·57
Finlay	June 20	7·0	1·10
Longmore	Oct. 21	7·0	2·40
Gale	Oct. 27	11·1	1·20
Slaughter-Burnham	Nov. 16	11·6	2·54
Gehrels 2	Nov. 18	8·0	2·36
Swift-Gehrels	Nov. 27	9·3	1·36
Kearns-Kwee	Nov. 30	9·0	2·22

ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA

1981

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

The four Domes at the South African Astronomical Observatory at Sutherland

CONTENTS

NOTE

Unless stated otherwise, all times are SOUTH AFRICAN STANDARD TIME. In order to avoid confusion between a.m. and p.m., the 24-hour clock is used (e.g. 1800 hrs. is 6 p.m. and 2100 hrs. is 9 p.m.). Emphasis is given to phenomena visible in the evening sky - between sunset and midnight.

- This handbook is produced for the Astronomical Society of Southern Africa. Most of the data it contains have been adapted for Southern Africa from the "Astronomical Ephemeris for 1981 issued jointly by the Nautical Almanac Offices of the Royal Greenwich Observatory, Herstmonceux and the U.S. Naval Observatory, Washington D.C. Additional information has also been supplied direct from the Herstmonceux Office and from the Hydrographer, South African Navy.

All correspondence concerning this booklet should be addressed to the Handbook Editor, Astronomical Society of S.A 8 Glebe Road, Rondebosch 7700, Cape. Further copies can also be obtained from the same address. Enclose a postal order or cheque (in favour of the Astronomical Society of Southern Africa) for R1.50 per copy.

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

Dit is met spyt dat ons u meedeel dat as gevolg van beperkte fondse en produksiefasiliteite dit nie moontlik is om hierdie handboek in Afrikaans te laat druk nie.

R.F. HURLY
EDITOR

ASTRONOMY IN SOUTHERN AFRICA

As one of the few parts of the Earth having both access to the rich southern skies and a suitable climate, Southern Africa holds a favoured position in astronomy. Consequently, it has seen the establishment of a number of professional observatories engaged in research while many individuals have become enthusiastic amateur astronomers. Planetaria and visiting nights at observatories convey to the general public much of what goes on in this field.

Observatories

The South African Astronomical Observatory (S.A.A.O.), was established in 1972, as a joint venture between the Council for Scientific and Industrial Research of South Africa and the Science Research Council of Great Britain, combining the facilities of the former Royal, Republic and Radcliffe Observatories, and is directed by Dr. M. W. Feast. Its excellent observing site near Sutherland, in the Karroo, has four instruments, namely the 1.8m, 1.0m, 0.75m and 0.5m telescopes. The headquarters are in Cape Town, where also a limited amount of observing continues. Research is undertaken in many areas, with considerable effort being put into the study of variable stars, the Magellanic Clouds, the Galactic centre and globular clusters as well as optical studies of celestial X-ray sources. These studies involve the use of spectroscopic, photometric and infrared techniques. Besides providing research facilities for its own staff SAAO observing time is allocated to astronomers from Great Britain and from South African Universities.

The 0.67m visual reflector, of the former Republic Observatory, Johannesburg, is maintained by the National Institute for Telecommunications Research (N.I.T.R.).

The National Radio Astronomy Observatory at Hartebeeshoek, near Krugersdorp, is, under the direction of Dr. G. Nicolson, operated by the NITR. The telescope, a 26m dish, is used for observations of extragalactic radio objects such as quasars and X-ray sources. The Rhodes University Radio Astronomy Group led by Prof. E.E. Baart use this telescope, currently in a survey of the entire southern sky at 13cm wavelength.

Boyden Observatory, situated at Mazelspoort, 25 km from Bloemfontein, is operated by the Department of Astronomy of the University of the Orange Free State, under the leadership of Prof. A.H. Jarrett. The site offers good conditions, without being remote from a large centre, and observing facilities include the 1.52m Rockefeller Reflector, and the 0.41m Nishimura Reflector. Research covers essentially the two areas of flare stars, and interferometry of the sun.

In addition to the professional observatories mentioned above, South African and Zimbabwe have numerous private observatories, built and operated by amateur astronomers.

Observatories Open to the Public

S.A.A.O. Headquarters, Observatory, Cape are open to visitors on the second Saturday of each month at 8.00 p.m. It is unnecessary to give prior notification of intention to visit, unless there are more than ten persons in a party. Day visits are possible to the S.A.A.O. observing site near Sutherland, and enquiries should be made to Sutherland prior to the intended visit.

Visiting nights at Boyden Observatory are generally held around the time of first quarter. Enquiries should be made to the Observatory. Numbers are restricted to twenty persons on each occasion.

Planetaria

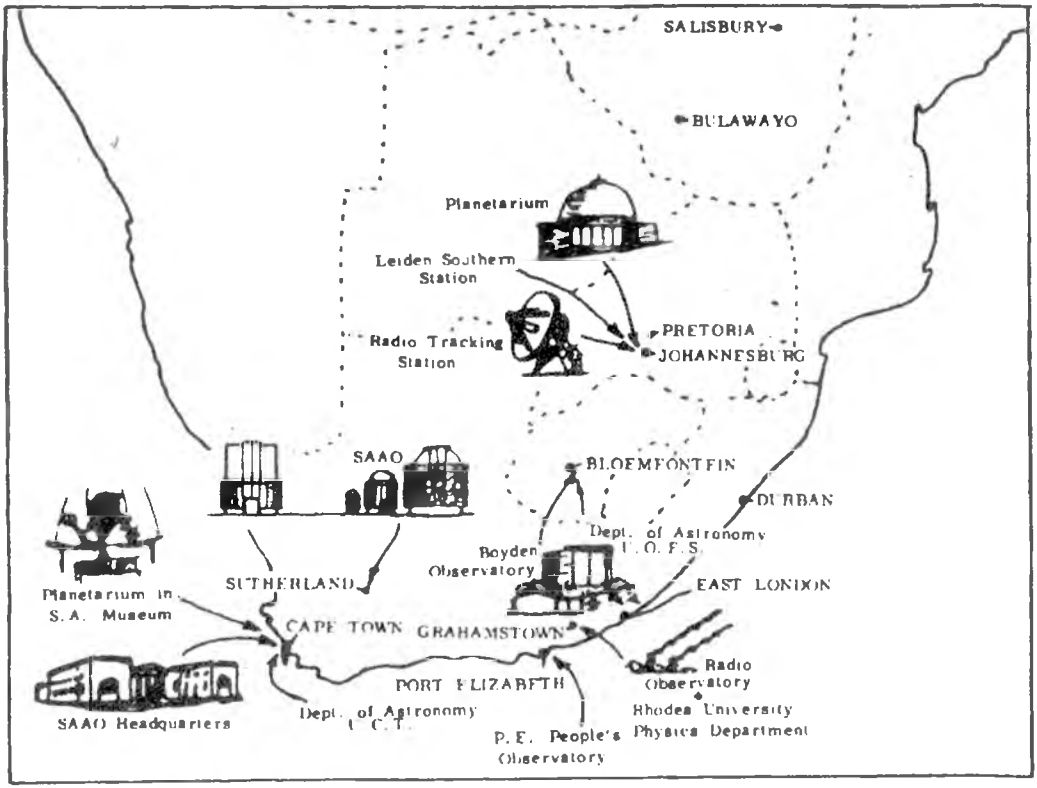
The major planetarium in South Africa is that situated on the grounds of the University of the Witwatersrand (entrance in Yale Road - alongside M1). It is equipped with a highly complex Zeiss projector and seats over 400 persons.

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

Teaching Departments

Both the University of Cape Town and University of the Orange Free State have departments of astronomy. The chair of astronomy at U.C.T. is occupied by Prof. Brian Warner, whose department uses the S.A.A.O. observing facilities at Sutherland. Professor G.F.R. Ellis of the Department of Applied Mathematics, U.C.T. heads a group carrying out

research in theoretical cosmology. The UOFS department, incorporated with the Boyden Observatory is headed by Prof. A.H. Jarrett. The Physics Department of Rhodes University specialises in radio astronomy, and has its own observatory outside Grahamstown. The Department of Mathematics, Applied Mathematics and Astronomy at U.N.I.S.A. offers a number of courses in astronomy and astrophysics.



THE 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 "The Monthly Notes of the Astronomical Society of Southern Africa" (MNASSA). 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 R 17.50 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.

LOCAL CENTRES OF THE SOCIETY

Autonomous local Centres of the Society hold regular meetings in Cape Town, Durban, Johannesburg, Bloemfontein, Pietermaritzburg, Pretoria and Salisbury. Visitors are very welcome at meetings and may, if they wish, join a Centre, without becoming a full member (i.e. receiving publications for R17.50 subscription of the Society.

CAPE CENTRE (Cape Town) - Meetings on 2nd Wednesday of the month (except Jan. and Dec.) at the South African Astronomical Observatory at 8.00p.m. The Centre possesses a small observatory housing the 30cm Ron Atkins Telescope. There is also an active occultation section. Secretarial address: c/o S.A.A.O. Box 9 Observatory 7935. Information on meetings also available from telephone (day time) 69-8531 ext. 256, 210-3814 evenings 65-6976.

TRANSVAAL CENTRE (Johannesburg) - General meetings are held on 2nd Wednesday of each month excluding December in the Sir Herbert Baker Building, Republic Observatory, Observatory at 20^h00 when a formal lecture is delivered. On this site the Christos Papadopoulos dome houses a combined instrument, comprising a 30 cm cassegrain telescope arranged for photo-electric photometry, and two refracting telescopes of 18 and 15 cm aperture, which is available to members of the Centre. Public observing evenings are held on the first Monday of each month at 20^h00, and there are sections catering for the observation of variable stars and grazing occultations. Secretarial address: P.O. Box 1595, Edenvale 1610. Telephone: 678 5534.

NATAL CENTRE (Durban) - Monthly meetings are held every third Wednesday at 7.45p.m. at St. Paula Church Hall, Church Street, Durban (near G.P.O.) and the Committee meets in private homes on the Monday evening after the general meeting. Secretarial address: c/o P O Box 840, Durban 4000. Telephone 842321 Office, 844751 Home.

NATAL MIDLANDS CENTRE (Pietermaritzburg) - Meetings are held monthly at various venues. Secretarial address: 23 Munro Avenue, Northern Park, Pietermaritzburg 3201. Telephone: 2-4074.

BLOEMFONTEIN CENTRE - Meetings are held every third Wednesday of the month. For further information contact Mr F.C. Neser telephone 22-1142, 108 Japie Neser St, Uitsig, Bloemfontein.

PRETORIA CENTRE - Meetings are held on the 4th Wednesday of each month (except December) at 8 p.m., the venue alternating between the University of South Africa and the Christian Brothers' College, Silverton Road. The Centre's observatory containing a 32cm reflector is situated on the latter site. For information contact the the Secretary, Mr J. Bennett, 90 Malan Street, Riviera, Pretoria 0084.

SALISBURY CENTRE - The Centre holds fairly frequent meetings, usually at eight 'o clock in the evening at which talks on various subjects are given and/or films shown. In addition, social "star-gazing" sessions are arranged at intervals, at which telescopes are set up by those members who possess them and made available for observing by all members present. The address of the Salisbury Centre is P O Box UA 428, Union Avenue, Salisbury and the Hon. Secretary (to whom communications should be addressed) is Mr W.L.Stedman.

OBSERVING SECTIONS OF THE SOCIETY.

These sections exist to coordinate and encourage constructive observing programmes. Mention of the type of observations and equipment involved are made in the appropriate parts of this handbook together with the names and addresses of the directors.

DIARY 1981

JANUARY

d	h	
2	00	Earth at perihelion
2	09	Uranus 5° S. of Moon
4	07	Venus 3° S. of Moon
4	10	Neptune 3° S. of Moon
5	20	Venus 0°.6 S. of Neptune
9	19	Mars 1°.6 S. of Moon
10	20	Ceres at opposition mag 7.1
11	22	Vesta stationary mag 7.2
14	06	Jupiter 1°.1 S. of Saturn
16	15	Aldebaran 0°.9 S. of Moon Occ^{n}.
19	18	Saturn stationary
20	06	FULL MOON Penumbral Eclipse
23	20	Mercury 0°.3 S. of Mars
25	08	Jupiter stationary mag 11.4
25	15	Saturn 2° S. of Moon
25	16	Jupiter 3° S. of Moon
29	19	Uranus 5° S. of Moon
31	21	Neptune 3° S. of Moon

FEBRUARY

1	23	Mercury greatest along. E. (18°)
1	23	Pluto stationary mag 14
3	15	Venus 1°.6 S. of Moon
4	20	NEW MOON Eclipse
5	18	Mars 0°.6 S. of Moon Occ^{n}.
6	02	Mercury 4° N. of Moon
7	20	Mercury stationary mag 0.1
10	16	Mercury 4° N. of Mars
12	20	Aldebaran 0°.9 S. of Moon Occ^{n}.
17	09	Mercury in inferior conjunction
19	05	Jupiter 1°.1 S. of Saturn
21	21	Vesta at opposition mag 6.8
21	22	Jupiter 3° S. of Moon
21	22	Saturn 2° S. of Moon
21	23	Mercury 5° N. of Venus
26	07	Uranus 5° S. of Moon
27	05	Ceres stationary mag 7.4
28	03	Juno stationary mag 10.9
28	07	Neptune 2° S. of Moon

MARCH

1	13	Mercury stationary mag 1.0
4	12	Mercury 2° N. of Moon
5	00	Uranus stationary mag 5.7
12	02	Aldebaran 1°.5 of Moon Occ^{n}.
15	23	Mercury greatest along. W. (28°)
20	15	Equinox
20	23	Jupiter 3° S. of Moon
21	02	Saturn 1°.7 S. of Moon
25	12	Uranus 5° S. of Moon
26	04	Jupiter at opposition mag -2.0
27	03	Saturn at opposition mag 0.6
27	05	Neptune stationary mag 7.7
27	16	Neptune 2° S. of Moon

APRIL

d	h	
2	12	Mars in conjunction with Sun
3	04	Mercury 1°.1 N. of Moon
7	07	Venus in superior conjunction mag - 3.4
11	12	Venta stationary mag 7.2
12	22	Pluto at opposition mag 14
16	23	Jupiter 3° S. of Moon
17	04	Saturn 1°.7 S. of Moon
19	23	Juno at opposition mag 10.6
20	14	Moon at apogee
21	17	Uranus 5° S. of Moon
23	22	Neptune 2° S. of Moon
27	14	Mercury in superior conjunction mag -1.7

MAY

13	23	Mercury 6° N. of Aldebaran
14	01	Jupiter 3° S. of Moon
14	07	Saturn 1°.9 S. of Moon
18	20	Uranus 5° S. of Moon
19	02	Uranus at opposition mag 5.7
20	04	Venus 6° N. of Aldebaran
21	02	Neptune 1°.9 S. of Moon
27	02	Mercury greatest elong. E. (23°) mag 0.6
28	07	Jupiter stationary mag -1.8

JUNE

3	11	Venus 4° N. of Moon
3	21	Mercury 3° N. of Moon
6	00	Saturn stationary mag 1.1
9	06	Mercury stationary mag 1.9
9	09	Mercury 1°.7 S. of Venus
10	07	Jupiter 3° S. of Moon
10	12	Saturn 2° S. of Moon
14	14	Neptune at opposition mag 7.7
15	00	Uranus 5° S. of Moon
17	07	Neptune 1°.9 S. of Moon
17	11	Juno stationary mag 11.1
19	18	Mars 6° N. of Aldebaran
21	10	Solstice
21	23	Mercury in inferior conjunction
24	18	Venus 5° S. of Pollux
30	04	Mars 4° N. of Moon

JULY

d	h	
3	11	Venus 1°.3 N. of Moon
3	12	Mercury stationary
3	21	Earth at aphelion
7	18	Jupiter 4° S. of Moon
7	21	Saturn 2° S. of Moon
8	19	Pluto stationary mag 14
12	06	Uranus 5° S. of Moon
14	12	Mercury greatest elong. W. (21°) mag 0.5
14	13	Neptune 2° S. of Moon
17	03	FULL MOON Eclipse
21	12	Pallas in conjunction with Sun
23	19	Venus 1°.2 N. of Regulus
26	22	Mars 3° N. of Moon
29	17	Mercury 6° S. of Pollux
30	20	Jupiter 1°.2 S. of Saturn
31	02	NEW MOON Eclipse

AUGUST

2	11	Venus 7° S. of Moon
4	10	Jupiter 4° S. of Moon
4	10	Saturn 3° S. of Moon
4	13	Uranus stationary mag 5.7
8	13	Uranus 5° S. of Moon
10	04	Mercury in superior conjunction
10	20	Neptune 2° S. of Moon
23	15	Mars 6° S. of Pollux
25	20	Venus 2° S. of Saturn
26	13	Mars 1°.4 N. of Moon
27	23	Venus 0°.9 S. of Jupiter
30	21	Mercury 3° S. of Moon
31	23	Saturn 3° S. of Moon

SEPTEMBER

1	04	Jupiter 4° S. of Moon
1	11	Vesta 0°.2 N. of Moon
1	13	Venus 5° S. of Moon
3	11	Neptune stationary mag 7.7
4	22	Uranus 5° S. of Moon
6	19	Venus 1°.9 N. of Spica
7	04	Neptune 1°.9 S. of Moon
10	13	Mercury 4° S. of Saturn
13	17	Mercury 3° S. of Jupiter
15	10	Ceres in conjunction with Sun
20	17	Mercury mag - 0.8 0°.4 S of Spica mag. 1.2
23	01	Equinox
23	14	Mercury greatest elong. E. (26°) mag 0.3
24	03	Mars 0°.04 S. of Moon Occn.
29	23	Vesta 0°.4 S. of Moon Occn.
30	00	Mercury 9° S. of Moon

OCTOBER

d	h	
1	19	Venus 7° S. of Moon
2	08	Uranus 4° S. of Moon
4	12	Neptune 1°.7 S. of Moon
6	02	Saturn in conjunction with Sun
6	09	Mercury stationary mag 0.9
7	09	Venus 2° S. of Uranus
14	03	Jupiter in conjunction with Sun
17	04	Venus 1°.9 N. of Antares
17	16	Pluto in conjunction with Sun
18	09	Mercury in inferior conjunction
19	15	Mars mag 1.7 1°.1 N. of Regulus mag 1.3
22	15	Mars 1°.4 S. of Moon
21	02	Saturn 3° S. of Moon
26	19	Mercury stationary mag -0.9
29	18	Uranus 4° S. of Moon
29	23	Venus 5° S. of Neptune
30	10	Neptune 1°.4 S. of Moon

NOVEMBER

1	01	Venus 6° S. of Moon
2	23	Mercury mag -0.3 N. of Spica mag 1.2
3	02	Mercury greatest elong. W. (19°)
5	22	Mercury 1°.2 N. of Jupiter
11	00	Venus greatest elong. E. (47°)
12	09	Moon at perigee
14	22	Vesta in conjunction with Sun
20	02	Mars 2° S. of Moon
22	14	Saturn 3° S. of Moon
22	17	Uranus in conjunction with Sun
23	02	Juno in conjunction with Sun
23	11	Jupiter 4° S. of Moon
28	04	Neptune 1°.3 S. of Moon
30	18	Venus 3° S. of Moon
10	13	Mercury in superior conjunction
16	13	Neptune in conjunction with Sun
16	17	Venus greatest brilliancy mag -4.4
18	11	Mars 3° S. of Moon
20	01	Saturn 3° S. of Moon
21	04	Jupiter 4° S. of Moon
21	21	Solstice
23	13	Uranus 4° S. of Moon
24	14	Vesta 0°.1 S. of Moon Occn.
29	03	Venus 2° N. of Moon
30	06	Venus stationary mag -4.3

DECEMBER

10	17	Mercury in superior conjunction
16	17	Neptune in conjunction with Sun
16	21	Venus greatest brilliancy - 4.4
18	15	Mars 3° S. of Moon
20	05	Saturn 3° S of Moon
21	08	Jupiter 4° S. of Moon
22	01	Solstice
23	17	Uranus 4° S. of Moon
24	18	Vesta 0°.1 S. of Moon
29	07	Venus 2° N. of Moon
30	10	Venus Stationary

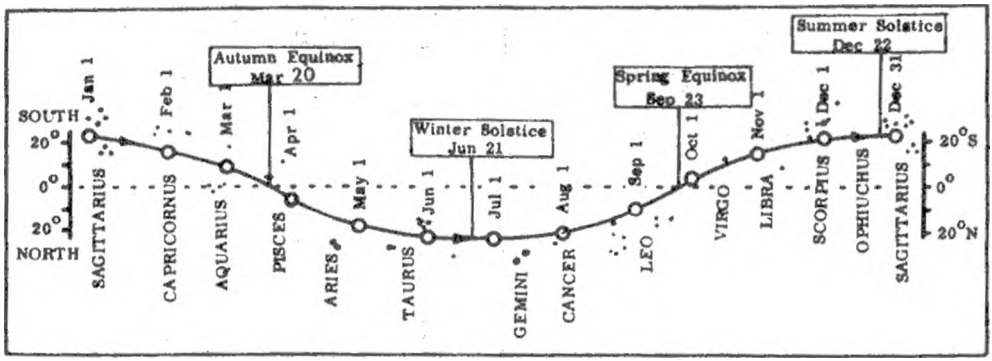
THE SUN 1981

BASIC DATA

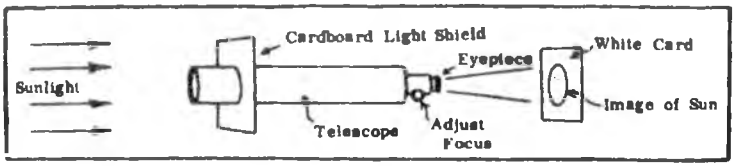
Diameter: 1 392 000 km (108 times Earth diameter)
Mass: $1,99 \times 10^{30}$ kg (330 000 times Earth Mass)
Surface Temperature: Approx. 6000°C
Temperature at centre: Approx. 10 million°C

The Sun is our nearest star. It is composed chiefly of hydrogen and is in a gaseous state throughout. So hot and dense is its interior that nuclear reactions occur there - thus producing the energy that is eventually radiated from its surface. At times its surface is disturbed by sunspots (which may persist for some weeks) and flares (short lived).

The Earth's orbit round the Sun is not quite circular. In 1981 we will be closest to the Sun on January 2 (perihelion - approx. distance 147 million km) and furthest from the Sun on July 4 (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.



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

SOLAR ECLIPSES

There will be two solar eclipses in 1981 neither visible from Africa. The annular eclipse on February 4-5 occurs at midnight our time and will be seen only from the Pacific Ocean.

The Total Eclipse early on July 31 will be seen on a path from the Black Sea across Asia, north of Japan and ending near Hawaii.

THE MOON 1981

BASIC DATA

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

PHASES AND VISIBILITY

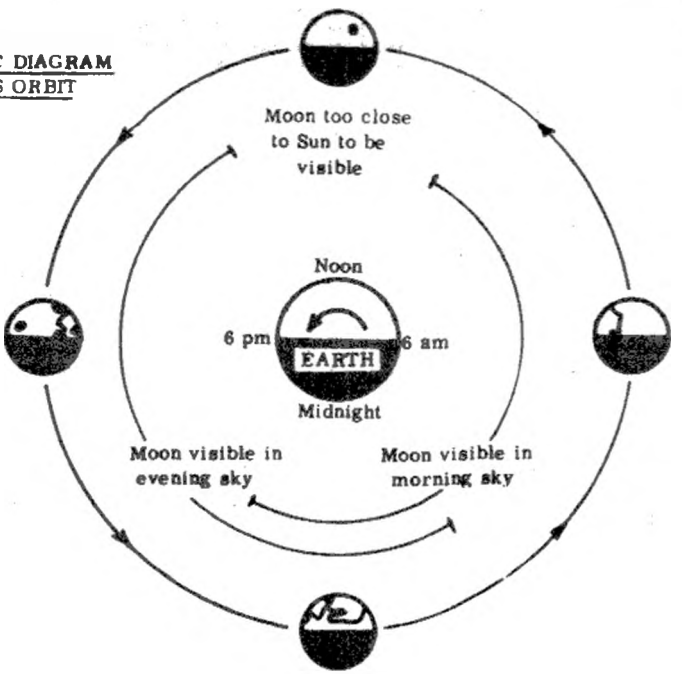
NEW MOON

Jan	$6^d09^h24^m$	May	$4^d06^h19^m$	Sep	$28^h06^h07^m$
Feb	5 00 14	Jun	2 13 32	Oct	27 22 13
Mar	6 12 31	Jul	31 05 52	Nov	26 16 38
Apr	4 22 19	Aug	29 16 43	Dec	26 12 10

SUNLIGHT

SUNLIGHT

SCHEMATIC DIAGRAM OF MOON'S ORBIT



FIRST QUARTER

Jan	$13^d12^h10^m$
Feb	11 19 49
Mar	13 03 50
Apr	11 13 11
May	11 00 22
Jun	9 13 33
Jul	9 04 39
Aug	7 21 26
Sep	6 15 26
Oct	6 09 45
Nov	5 03 09
Dec	4 18 22

LAST QUARTER

Jan	$28^d06^h19^m$
Feb	27 03 14
Mar	28 21 34
Apr	27 12 14
May	26 23 00
Jun	25 06 25
Jul	24 11 40
Aug	22 16 16
Sep	20 21 47
Oct	20 05 40
Nov	18 16 54
Dec	18 07 47

FULL MOON

Jan	$20^d09^h39^m$	May	$19^d02^h04^m$	Sep	$14^d05^h09^m$
Feb	19 00 58	Jun	17 17 04	Oct	13 14 49
Mar	20 17 22	Jul	17 06 39	Nov	12 00 26
Apr	19 09 59	Aug	15 18 37	Dec	11 10 41

THE MOON'S ORBIT

Dates of Apogee, when the Moon is furthest from the Earth (approx. 407 000 km) and of Perigee, when the Moon is closest to the Earth (approx. 357 000 km) are given below.

MOON AT PERIGEE

d h	d h	d h
Jan. 15 04	June 1 14	Oct. 15 02
Feb. 8 23	June 29 19	Nov. 12 11
Mar. 8 12	July 27 09	Dec. 11 00
Apr. 5 19	Aug. 21 21	Jan. 8 12
May 4 05	Sept. 17 04	

MOON AT APOGEE

d h	d h	d h
Dec. 30 23	May 17 18	Oct. 3 01
Jan. 27 20	June 14 03	Oct. 30 16
Feb. 24 17	July 11 18	Nov. 26 21
Mar. 24 09	Aug. 8 12	Dec. 23 23
Apr. 20 16	Sept. 5 07	

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 35) and close to visible planets (details given in Diary pages 4 and 5).

TIMES OF MOONRISE AND MOONSET

Times for Bloemfontein, Cape Town, Durban, Johannesburg and Port Elizabeth can be obtained from the tables on pages 11 to 16.

LUNAR ECLIPSE

The penumbral eclipse of the moon on January 20 begins at 07.36. This is after moon-set for Southern Africa so no part of the eclipse will be seen here. The partical

The partial eclipse on July 17 will be visible from Southern Africa until about mid-eclipse.

Moon enters penumbra	at	04^{h}05^{m}.2
Moon enters umbra	at	05 24.8
Mid eclipse	at	06 46.8
Moon leaves umbra	at	08 08.9
Moon leaves penumbra	at	09 28.4

THE SURFACE OF THE MOON

In common with the inner planets of our solar system, the Moon's surface suffered bombardment by numerous minor bodies during period 4,5 to 3,0 billion years ago. This has produced the heavily cratered topography now visible. Some particularly large impacts caused large circular depressions, which were flooded by molten lava from the Moon's interior. These are the maria basins which appear smoother and darker then the rest of the surface (the latin words mare and maria come from older times when they were mistaken for seas). The maria surfaces, being younger have fewer large craters, but the entire surface is peppered with tiny craters produced by tiny bodies which have also served to plough up the ground thus forming the regolith - a layer of loose material a metre or so deep.

MAP OF THE MOON'S NEAR SIDE

LIBRATIONS

Jan 1/28, Feb 25, Mar 24
Apr 20, May 17, Jun 13
Jul 10, Aug 7, Sep 3/30,
Oct 27, Nov 23, Dec 20

Jan 15, Feb 11, Mar 10
Apr 6, May 4/31, Jun 27
Jul 6, Aug 21, Sep 17
Oct 14, Nov 10, Dec 8

Dates of Maximum Exposure of Indicated Limbs

Jan 21, Feb 17, Mar 15
Apr 12, May 10, Jun 7
Jul 6, Aug 2/29, Sep 25
Oct 21, Nov 19, Dec 18

Jan 7, Feb 3, Mar 3/31
Apr 28, May 26, Jun 23
Jul 20, Aug 15, Sep 12
Oct 9, Nov 7, Dec 5

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

TIMES OF THE MOONRISE AND MOONSET

MARCH		APRIL		MAY		JUNE	
Rise	Set	Rise	Set	Rise	Set	Rise	Set
00^h59^m	14^h52^m	02^h29^m	15^h57^m	03^h18^m	16^h57^m	05^h21^m	16^h46^m
01 51	15 44	03 31	16 41	04 23	16 39	06 29	17 39
02 47	16 34	04 35	17 24	05 29	17 24	07 37	18 36
03 46	17 22	05 40	18 07	06 37	18 11	08 41	19 37
04 48	18 08	06 46	18 51	07 45	19 02	09 39	20 38
05 52	18 52	07 53	19 36	08 53	19 56	10 32	21 39
06 56	19 34	09 00	20 24	09 57	20 54	11 18	22 38
08 01	20 17	10 06	21 16	10 57	21 54	11 59	23 34
09 06	21 00	11 10	22 10	11 51	22 53	12 36	
10 11	21 45	12 10	23 06	12 39	23 51	13 10	00 28
11 15	22 33	13 06		13 21		13 44	01 20
12 18	23 23	13 55	00 02	14 00	00 48	14 16	02 12
13 18		14 40	01 01	14 35	01 42	14 50	03 03
14 16	00 17	15 21	01 58	15 09	02 34	15 25	03 54
15 08	01 13	15 58	02 53	15 42	03 26	16 03	04 45
15 56	02 09	16 33	03 46	16 15	04 16	16 44	05 38
16 40	03 06	17 06	04 38	16 49	05 07	17 28	06 30
17 19	04 02	17 39	05 29	17 25	05 59	18 16	07 22
17 56	04 57	18 13	06 20	18 03	06 50	19 08	08 13
18 31	05 50	18 48	07 11	18 45	07 43	20 03	09 02
19 05	06 43	19 25	08 03	19 31	08 35	21 00	09 48
19 38	07 34	20 04	08 55	20 20	09 26	21 58	10 31
20 12	08 25	20 47	09 46	21 13	10 16	22 56	11 12
20 48	09 16	21 34	10 38	22 08	11 03	23 56	11 51
21 26	10 08	22 24	11 29	23 05	11 48		12 30
22 07	10 59	23 18	12 18		12 31	00 56	13 10
22 51	11 51		13 05	00 04	13 12	01 59	13 51
23 40	12 43	00 15	13 50	01 04	13 52	03 03	14 36
	13 34	01 14	14 33	02 05	14 32	04 09	15 25
00 33	14 24	02 15	15 15	03 08	15 14	05 16	16 19
01 29	15 11			04 14	15 58		

	JULY		AUGUST	
	Rise	Set	Rise	Set
1	06h21m	17h17m	07h45m	19h06m
2	07 23	18 19	08 27	20 05
3	08 19	19 22	09 06	21 01
4	09 09	20 23	09 41	21 55
5	09 53	21 22	10 15	22 47
6	10 33	22 28	10 49	23 39
7	11 09	23 12	11 23	
8	11 44		11 59	00 30
9	12 17	00 04	12 37	01 22
10	12 50	00 56	13 18	02 14
11	13 25	01 47	14 03	03 07
12	14 01	02 38	14 53	03 59
13	14 41	03 31	15 46	04 50
14	15 24	04 23	16 43	05 39
15	16 11	05 16	17 42	06 25
16	17 02	06 08	18 42	07 09
17	17 57	06 58	19 43	07 51
18	18 54	07 45	20 44	08 31
19	19 52	08 30	21 45	09 10
20	20 51	09 12	22 47	09 50
21	21 50	09 52	23 50	10 32
22	22 50	10 31		11 16
23	23 51	11 10	00 53	12 04
24		11 50	01 57	12 56
25	00 53	12 32	02 58	13 53
26	01 57	13 18	03 56	14 52
27	03 01	14 08	04 50	15 53
28	04 05	15 03	05 38	16 53
29	05 07	16 02	06 22	17 52
30	06 05	17 04	07 01	18 49
31	06 58	18 06	07 38	19 44

– TIMES OF MOONRISE AND MOONSET

SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
Rise	Set	Rise	Set	Rise	Set	Rise	Set
08^h13^m	20^h37^m	07^h53^m	21^h05^m	08^h29^m	22^h26^m	08^h54^m	22^h45^m
08 47	21 29	08 29	21 57	09 16	23 15	09 48	23 28
09 21	22 21	09 08	22 49	10 07		10 44	
09 56	23 13	09 49	23 41	11 00	00 02	11 40	00 08
10 33		10 34		11 56	00 47	12 39	00 47
11 12	00 05	11 23	00 31	12 53	01 30	13 38	01 25
11 56	00 57	12 16	01 21	13 53	02 11	14 40	02 03
12 43	01 49	13 11	02 08	14 54	02 50	15 44	02 43
13 34	02 40	14 10	02 53	15 57	03 30	16 52	03 26
14 29	03 29	15 10	03 36	17 02	04 11	18 01	04 14
15 27	04 17	16 12	04 18	18 09	04 54	19 10	05 07
16 27	05 02	17 15	04 58	19 18	05 40	20 16	06 06
17 28	05 45	18 19	05 39	20 27	06 31	21 17	07 09
18 31	06 26	19 26	06 21	21 34	07 27	22 10	08 13
19 34	07 07	20 33	07 06	22 35	08 27	22 57	09 17
20 37	07 47	21 40	07 54	23 30	09 29	23 39	10 19
21 42	08 29	22 45	08 45		10 31		11 17
22 47	09 14	23 41	09 41	00 19	11 31	00 16	12 13
23 51	10 01		10 39	01 01	12 29	00 51	13 06
	10 53	00 43	11 39	01 40	13 25	01 24	13 58
00 53	11 48	01 34	12 39	02 15	14 19	01 57	14 50
01 52	12 46	02 19	13 38	02 49	15 11	02 30	15 42
02 46	13 45	03 00	14 34	03 21	16 03	03 06	16 34
03 35	14 44	03 37	15 29	03 55	16 55	03 44	17 26
04 19	15 43	04 12	16 23	04 29	17 46	04 25	18 18
04 59	16 39	04 46	17 15	05 05	18 39	05 10	19 19
05 36	17 35	05 19	18 07	05 45	19 31	05 58	19 58
06 11	18 28	05 53	18 59	06 27	20 22	06 50	20 44
06 45	19 21	06 28	19 51	07 13	21 12	07 44	21 28
07 19	20 13	07 06	20 43	08 02	22 00	08 39	22 09
		07 46	21 35			09 35	22 47

CAPE TOWN – TIMES OF MOONRISE AND MOONSET
FOR PORT ELIZABETH SUBTRACT 28 MINUTES

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	02^h15^m	15^h37^m	02^h45^m	17^h05^m	01^h22^m	15^h46^m	02^h55^m	16^h45^m	03^h53^m	16^h37^m	06^h09^m	17^h13^m
2	02 49	16 32	03 34	17 59	02 14	16 37	04 00	17 26	05 01	17 15	07 21	18 03
3	03 26	17 28	04 29	18 49	03 10	17 26	05 08	18 06	06 12	17 56	08 30	18 59
4	04 07	18 23	05 28	19 37	04 12	18 12	06 17	18 45	07 23	18 39	09 35	19 59
5	04 54	19 17	06 31	20 21	05 16	18 54	07 27	19 25	08 35	19 27	10 33	21 01
6	05 46	20 10	07 36	21 02	06 23	19 35	08 37	20 06	09 45	20 19	11 24	22 04
7	06 42	20 58	08 43	21 41	07 31	20 14	09 48	20 51	10 52	21 16	12 08	23 06
8	07 42	21 43	09 49	22 18	08 40	20 53	10 57	21 40	11 51	22 16	12 46	
9	08 45	22 25	10 55	22 56	09 49	21 32	12 03	22 33	12 44	23 17	13 20	00 05
10	09 49	23 04	12 01	23 35	10 57	22 14	13 04	23 29	13 30		13 52	01 02
11	10 53	23 41	13 07		12 04	22 59	13 59		14 10	00 18	14 22	01 58
12	11 58		14 12	00 16	13 10	23 47	14 48	00 27	14 46	01 17	14 51	02 52
13	13 02	00 17	15 16	01 01	14 12		15 30	01 27	15 18	02 14	15 22	03 46
14	14 08	00 55	16 17	01 50	15 09	00 40	16 08	02 25	15 49	03 09	15 54	04 40
15	15 14	01 34	17 13	02 44	16 01	01 35	16 43	03 23	16 18	04 04	16 29	05 34
16	16 20	02 17	18 04	03 41	16 48	02 33	17 14	04 19	16 48	04 58	17 08	06 29
17	17 24	03 04	18 49	04 40	17 29	03 32	17 45	05 14	17 20	05 52	17 51	07 23
18	18 25	03 56	19 30	05 40	18 06	04 31	18 15	06 09	17 53	06 46	18 39	08 16
19	19 21	04 52	20 07	06 39	18 40	05 28	18 46	07 03	18 29	07 40	19 31	09 07
20	20 11	05 52	20 40	07 37	19 12	06 25	19 18	07 57	19 09	08 35	20 27	09 55
21	20 55	06 53	21 12	08 33	19 43	07 20	19 52	08 51	19 54	09 28	21 26	10 39
22	21 34	07 53	21 42	09 29	20 13	08 15	20 30	09 45	20 42	10 20	22 26	11 20
23	22 09	08 52	22 13	10 23	20 44	09 09	21 11	10 39	21 36	11 10	23 28	11 58
24	22 42	09 49	22 45	11 17	21 17	10 03	21 57	11 32	22 32	11 56		12 34
25	23 13	10 45	23 19	12 11	21 53	10 57	22 47	12 23	23 32	12 39	00 31	13 10
26	23 43	11 39	23 56	13 05	22 32	11 51	23 42	13 11		13 19	01 36	13 45
27		12 33		13 59	23 15	12 44		13 57	00 33	13 57	02 42	14 23
28	00 14	13 26	00 37	14 53		13 37	00 40	14 40	01 37	14 33	03 50	15 04
29	00 46	14 21			00 03	14 28	01 42	15 20	02 42	15 10	04 59	15 50
30	01 22	15 15			00 56	15 16	02 46	15 59	03 49	15 48	06 08	16 42
31	02 01	16 11			01 54	16 02			04 58	16 28		

CAPE TOWN – TIMES OF MOONRISE AND MOONSET
FOR PORT ELIZABETH SUBTRACT 28 MINUTES

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	07h15m	17h40m	08h35m	19h34m	08h51m	21h17m	08h24m	21h53m	08h52m	23h21m	09h17m	23h38m
2	08 17	18 41	09 14	20 36	09 22	22 12	08 57	22 48	09 38		10 12	
3	09 12	19 45	09 49	21 35	09 53	23 07	09 33	23 42	10 29	00 10	11 11	00 19
4	10 00	20 49	10 22	22 32	10 25		10 13		11 23	00 56	12 10	00 56
5	10 42	21 51	10 53	23 28	11 00	00 02	10 57	00 35	12 21	01 40	13 12	01 32
6	11 19	22 51	11 23		11 37	00 56	11 45	01 26	13 21	02 20	14 15	02 06
7	11 52	23 48	11 54	00 23	12 19	01 50	12 38	02 15	14 24	02 57	15 21	02 41
8	12 23		12 27	01 17	13 05	02 43	13 36	03 01	15 29	03 34	16 29	03 17
9	12 53	00 44	13 03	02 12	13 56	03 34	14 36	03 44	16 36	04 10	17 40	03 56
10	13 23	01 38	13 42	03 06	14 52	04 23	15 40	04 24	17 45	04 46	18 53	04 40
11	13 55	02 32	14 26	04 00	15 52	05 09	16 45	05 03	18 56	05 25	20 04	05 31
12	14 29	03 27	15 15	04 53	16 55	05 51	17 52	05 40	20 09	06 08	21 11	06 27
13	15 06	04 21	16 09	05 44	18 00	06 31	19 01	06 17	21 21	06 56	22 11	07 20
14	15 47	05 16	17 07	06 32	19 06	07 09	20 11	06 55	22 29	07 49	23 03	08 36
15	16 33	06 10	18 09	07 16	20 13	07 46	21 22	07 36	23 30	08 48	23 47	09 42
16	17 24	07 02	19 12	07 57	21 21	08 23	22 32	08 20		09 51		10 47
17	18 20	07 51	20 16	08 36	22 29	09 01	23 39	09 09	00 24	10 54	00 26	11 49
18	19 19	08 38	21 20	09 13	23 37	09 42		10 03	01 19	11 57	01 00	12 48
19	20 20	09 20	22 26	09 48		10 26	00 42	11 01	01 50	12 59	01 31	13 45
20	21 22	09 59	23 31	10 25	00 43	11 16	01 38	12 02	02 25	13 58	02 01	14 40
21	22 25	10 36		11 03	01 47	12 10	02 27	13 04	02 57	14 55	02 31	15 35
22	23 28	11 12	00 38	11 44	02 46	13 08	03 10	14 05	03 28	15 51	03 01	16 30
23		11 47	01 44	12 29	03 40	14 08	03 48	15 05	03 57	16 46	03 34	17 24
24	00 33	12 23	02 50	13 19	04 27	15 10	04 22	16 03	04 27	17 40	04 09	18 19
25	01 38	13 02	03 52	14 15	05 08	16 11	04 53	17 00	04 59	18 35	04 48	19 12
26	02 45	13 45	04 50	15 14	05 46	17 11	05 24	17 56	05 32	19 30	05 32	20 04
27	03 53	14 32	05 43	16 17	06 19	18 10	05 54	18 51	06 09	20 24	06 20	20 53
28	04 59	15 26	06 29	17 20	06 51	19 07	06 25	19 46	06 50	21 17	07 12	21 38
29	06 02	16 25	07 10	18 21	07 22	20 03	06 57	20 41	07 35	22 07	08 07	22 20
30	06 59	17 27	07 46	19 22	07 52	20 58	07 32	21 35	08 24	22 55	09 05	22 58
31	07 50	18 31	08 20	20 20			08 10	22 29			10 04	23 33

DURBAN – TIMES OF MOONRISE AND MOONSET
FOR BLOEMFONTEIN ADD 19 MINUTES

	JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
1	01h27m	14h40m	02h01m	16h04m	00h39m	14h45m	02h10m	15h48m	03h02m	15h44m	05h11m	16h28m
2	02 03	15 33	02 51	16 58	01 30	15 37	03 13	16 31	04 08	16 25	05 20	17 19
3	02 41	16 28	03 45	17 49	02 26	16 26	04 18	17 12	05 16	17 07	07 29	18 15
4	03 23	17 22	04 44	18 38	03 27	17 13	05 25	17 53	06 26	17 53	08 33	19 15
5	04 10	18 16	05 45	19 23	04 30	17 58	06 32	18 35	07 36	18 42	09 32	20 17
6	05 02	19 09	06 49	20 06	05 35	18 40	07 41	19 19	08 44	19 36	10 24	21 19
7	05 58	19 58	07 53	20 47	06 41	19 22	08 49	20 06	09 50	20 33	11 09	22 19
8	06 57	20 45	08 57	21 27	07 47	20 02	09 57	20 56	10 50	21 33	11 49	23 17
9	07 59	21 28	10 01	22 06	08 53	20 44	11 02	21 49	11 44	22 33	12 25	
10	09 00	22 09	11 05	22 47	10 00	21 28	12 03	22 46	12 31	23 32	12 59	00 13
11	10 03	22 48	12 09	23 30	11 05	22 14	12 58	23 44	13 12		13 30	01 06
12	11 05	23 26	13 13		12 09	23 03	13 48		13 50	00 30	14 02	01 59
13	12 08		14 15	00 16	13 11	23 56	14 32	00 42	14 24	01 25	14 34	02 51
14	13 11	00 06	15 15	01 07	14 08		15 11	01 39	14 56	02 19	15 08	03 43
15	14 16	00 47	16 12	02 00	15 01	00 52	15 47	02 35	15 28	03 12	15 44	04 36
16	15 20	01 31	17 04	02 57	15 48	01 49	16 21	03 30	16 00	04 04	16 24	05 29
17	16 23	02 20	17 50	03 57	16 31	02 47	16 53	04 23	16 32	04 56	17 08	06 23
18	17 24	03 12	18 33	04 54	17 10	03 44	17 25	05 16	17 07	05 49	17 56	07 15
19	18 20	04 09	19 11	05 52	17 45	04 40	17 57	06 08	17 45	06 41	18 48	08 06
20	19 11	05 08	19 46	06 48	18 19	05 35	18 31	07 01	18 26	07 35	19 43	08 54
21	19 57	06 08	20 19	07 43	18 52	06 28	19 07	07 53	19 11	08 27	20 40	09 40
22	20 37	07 07	20 52	08 36	19 24	07 21	19 45	08 46	20 00	09 19	21 39	10 22
23	21 14	08 04	21 24	09 29	19 57	08 14	20 27	09 39	20 52	10 09	22 39	11 02
24	21 48	09 00	21 58	10 21	20 31	09 06	21 14	10 31	21 48	10 56	23 40	11 40
25	22 21	09 53	22 33	11 13	21 08	09 58	22 04	11 22	22 46	11 40		12 17
26	22 53	10 46	23 11	12 06	21 48	10 51	22 58	12 11	23 46	12 21	00 43	12 55
27	23 26	11 38	23 53	12 59	22 31	11 44	23 55	12 57		13 01	01 46	13 35
28		12 30		13 52	23 20	12 36		13 41	00 47	13 40	02 52	14 18
29	00 00	13 23				13 27	00 56	14 23	01 50	14 18	03 59	15 06
30	00 36	14 16			00 12	14 16	01 50	15 04	02 55	14 58	05 07	15 59
31	01 17	15 10			01 09	15 03			04 02	15 41		

DURBAN – TIMES OF MOONRISE AND MOONSET
FOR BLOEMFONTEIN ADD 19 MINUTES

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

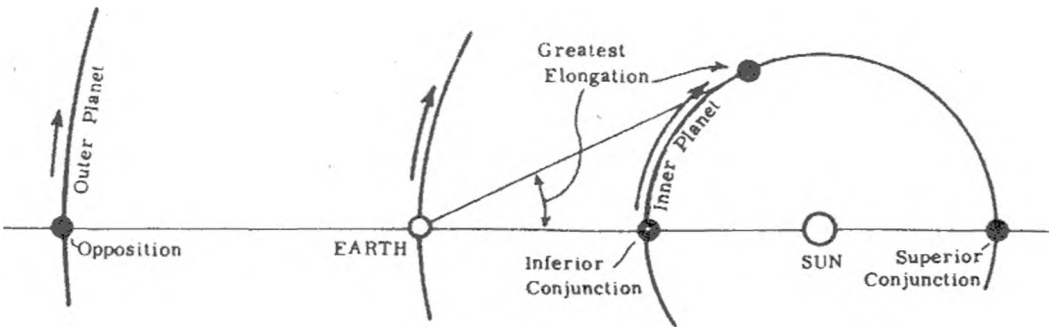
THE PLANETS 1981

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?	?	6d?	?

GENERAL

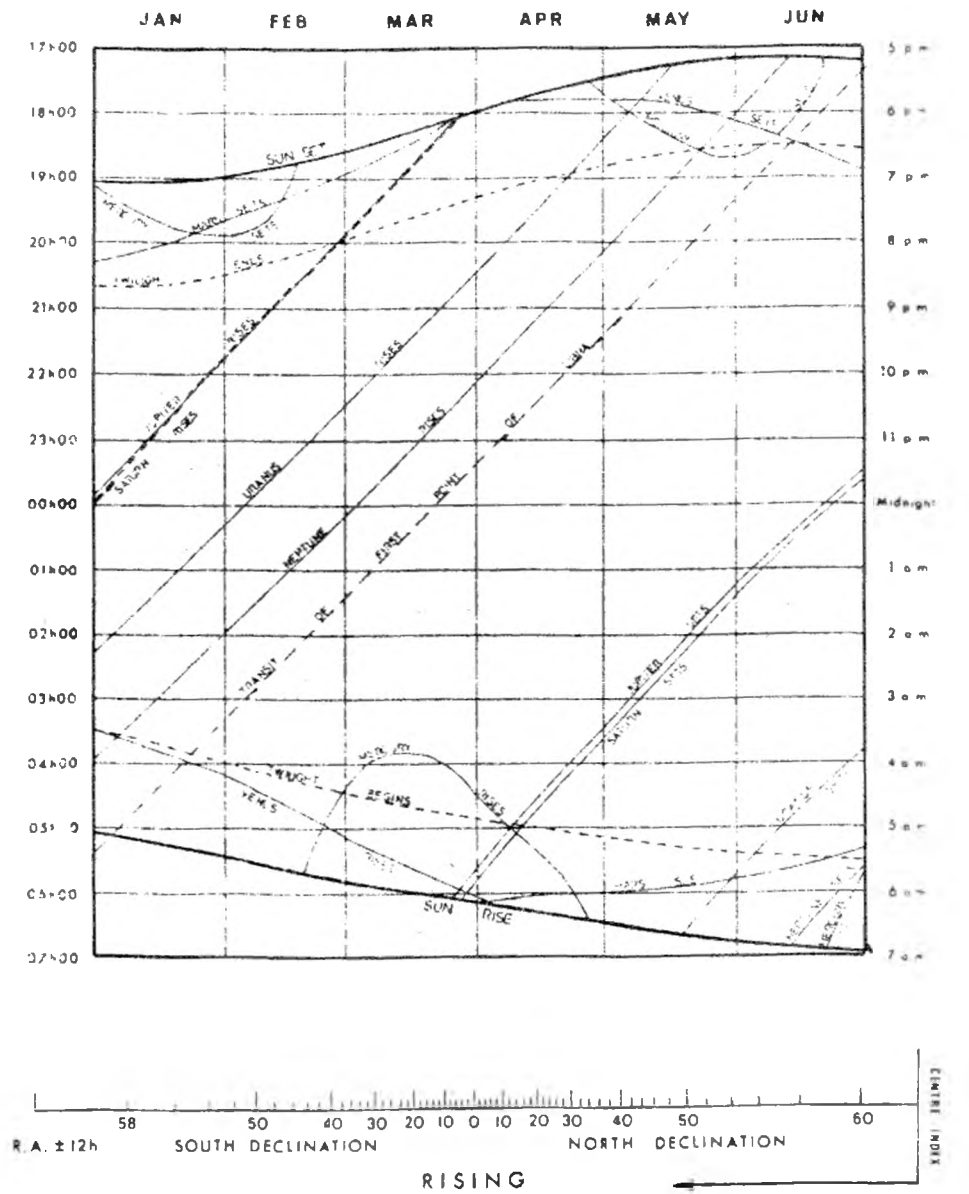
Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Unlike the distant stars, their relative positions do not remain fixed, but continually change as, like the Earth, they orbit around the Sun. Their apparent movements against the 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 occuring in 1981 are listed chronologically in the Diary (pages 4 and 5) and are also mentioned in the text below.



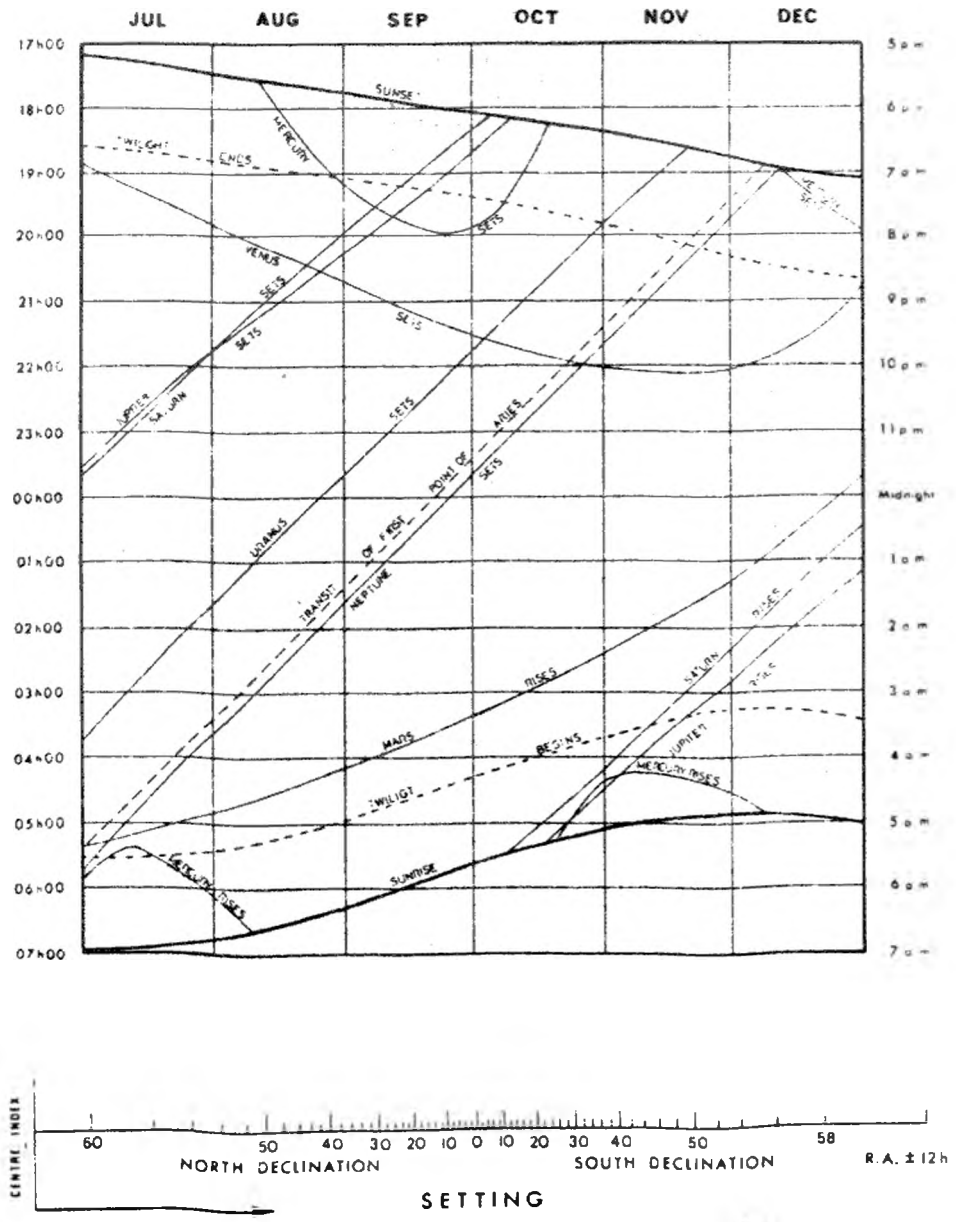
TIMES OF RISING AND SETTING

The times of rising and setting given by the diagram are accurate for position 30° East. 30° South, and approximately correct for other places in Southern Africa. Strictly speaking, corrections for latitude and longitude should be applied, but the latitude correction is, in general sufficiently small to be ignored and in no case will exceed 15 minutes. Longitude corrections are given on page 44.

The scales at the bottom of these pages are for finding rising or setting times of any object of which the right ascension and declination are known. Set dividers or a strip of paper from the index at the centre of the scale to the object's declination and in the direction desired for either



rising or setting. Measure this same distance and direction along the midnight line, beginning at the objects right ascension indicated by the numerals. (Should this end point fall outside the chart, 12 hours should be added to or subtracted from the right ascension. Reset the dividers using the end of the scale instead of the centre index, and measure in the opposite direction to that first used). Through the point established draw a line parallel to the First Point of Aries transit line (indicated by the dashed line on the chart).



OBSERVING THE PLANETS

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 their disks. The disks of Mercury and Venus are only seen fully illuminated when they are furthest from us - as they draw closer, their disks grow larger but the phase changes to a crescent as we see more of their dark hemispheres. In contrast, the disks of the outer planets are always seen fully or near fully illuminated.

MERCURY

The innermost plane, Mercury, revolves around the Sun faster than any of the other planets. Being close to the Sun it can only be seen just after sunset or just before sunrise, when it is near greatest elongation (greatest angle between Mercury and Sun as seen from the Earth). Except when in transit, it can never be seen near inferior conjunction (passing between Earth and Sun) or near superior conjunction (passing round the far side of the Sun). The angular diameter of Mercury's disc rarely exceeds 10 seconds of arc so it is difficult to make out any features on the disc, but phases (like those of the Moon) might just be visible. Close up photography by the Mariner 10 spacecraft has shown that the planet's surface is incredibly similar to

Greatest elongation East	Feb	2	05(18°)	May	27	06(23°)	Sep	23 18(26°)
Stationary	Feb	7	04	Jun	9	10	Oct	6 11
Inferior conjunction	Feb	17	13	Jun	22	03	Oct	18 13
Stationary	Mar	1	17	Jul	3	16	Oct	26 23
Greatest elongation West	Mar	16	03(28°)	Jul	14	16(21°)	Nov	3 06(19°)
Superior conjunction	Apr	27	18	Aug	10	08	Dec	10 17

VENUS

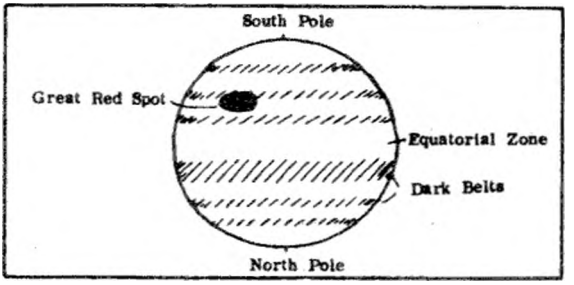
Venus will be seen in the morning sky until mid-February but after that it will be too close to the sun for viewing until late May when it will be in the evening sky until the end of the year. Its apparent diameter will change from about 10" in January to 50" at the end of the year. It will be at about mag. -3.4 until early September when it brightens rapidly reaching -4.4 in mid-December.

MARS

Mars is visible low in the evening sky in January (mag. +1.4) and will not be seen again until it appears in the morning sky in mid-June. It will fade to mag. +1.8 in August at 2.3 A.U. and then brighten to mag. +1.0 at the end of December (at 1.3 A.U.).

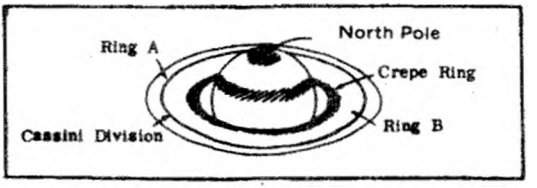
JUPITER

Jupiter (mag. -1.6, diam. 35" at 5.3 A.U.) rises at midnight at the beginning of the year and moves slowly into the evening sky before being lost in the twilight in late September. It brightens to mag. -2.0, (diam. 43", 4.5 A.U.) at opposition on March 26 and fades to -1.2 in October (diam. 30", 6.4 A.U.) from late October to the end of the year it will be in the morning sky. Jupiter makes an excellent object for a small telescope. It is often possible to see features on the disc: 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 now always visible because of the rotation of the planet. Also clearly visible are four of Jupiter's fifteen or sixteen moons. An entire section of this handbook is devoted to the movements of these satellites and the phenomena associated with them (see page 23). Jupiter is now known to have a ring similar to those of Saturn and Uranus.



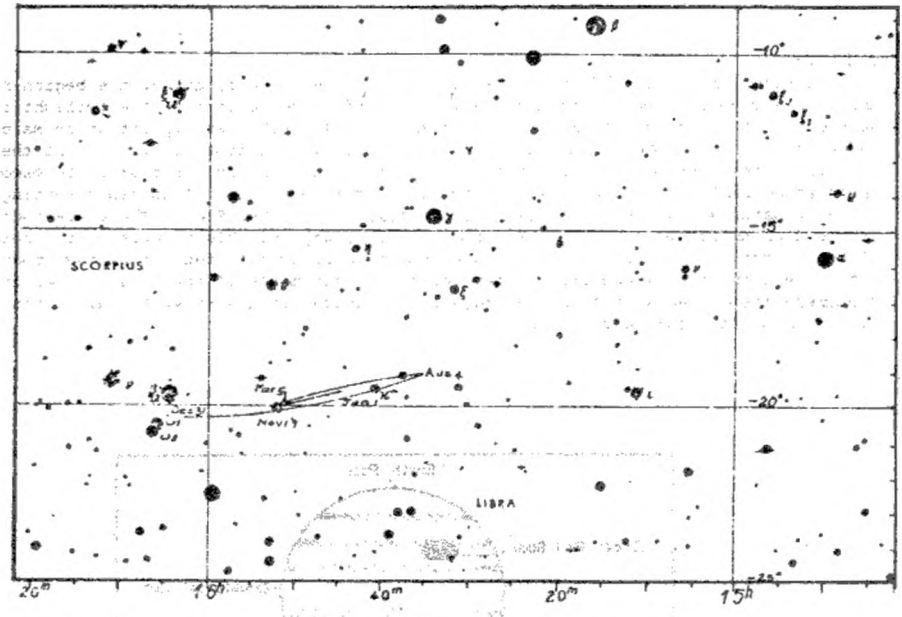
SATURN

Saturn, like Jupiter, is in the constellation of Virgo throughout the year. It will be clearly seen in the evening sky until late September and in the morning sky from late October until the end of the year. It is at its greatest brightness (mag. 0.6, at 8.6 A.U.) at opposition on March 27 but will fade to 1.2 in August and brighten up to 0.9 in December. The diagram below shows its appearance through a small telescope (the scale is the same as for the Jupiter diagram) - including the spectacular ring system. The rings are seen at an angle which varies from 7° in January of 4° in May and 12° in December. This year the northern side of the rings is visible. Saturn, for long known to have ten moons, is now known to have several more and the most recent satellite photographs have shown the ring system to have nearly 100 components.



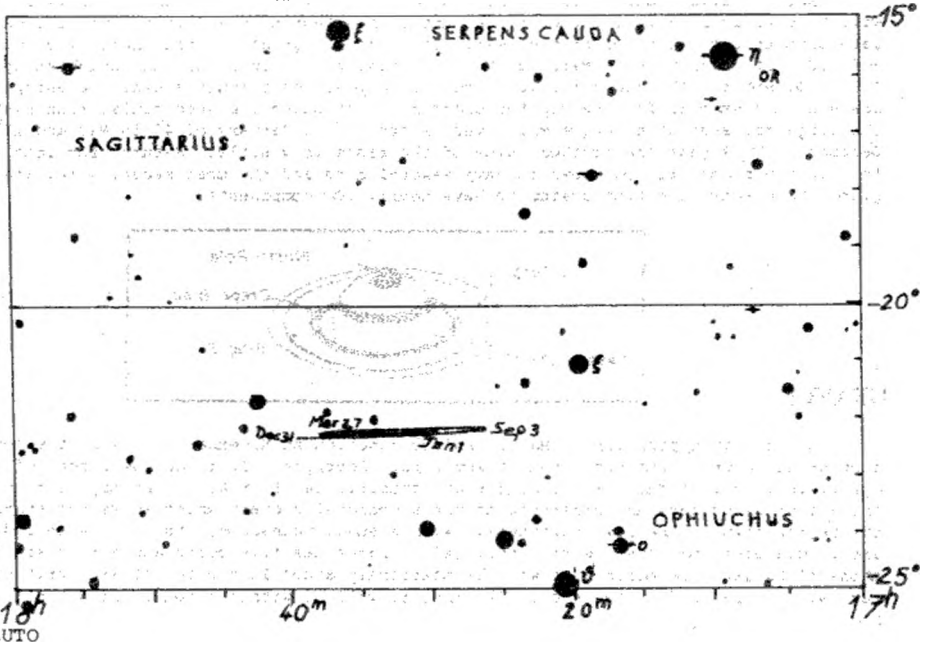
URANUS

Uranus, at opposition on May 19 and conjunction on November 22, is in the constellation of Libra until December when it moves into Scorpius. It is on the border of naked eye visibility in a dark sky (mag. 5.8 at opposition at 17.8 A.U.) and may be found with the aid of binoculars and reference to the accompanying chart which shows the stars in the region down to the same faintness. With a small telescope, its disc, 4 seconds of arc in diameter, may just be distinguished. Uranus has five moons and a ring similar to those of Saturn. On March 5 it will be stationary about 10 minutes of arc north of 5th mag gamma Librae and at the end of December it will be within a degree of 4th mag Omega Sco.



NEPTUNE

Neptune lies in the constellation of Ophiucus just east of the conspicuous constellation of Scorpius. It is far too faint to be seen with the naked eye - mag. 7.7 at opposition on June 14 at 29.3 A.U. but may be located using the chart below (which shows all stars down to mag. 7.7) and a small telescope. Its angular diameter is only 2.3 seconds of arc, but its non-stellar appearance should aid in identification.



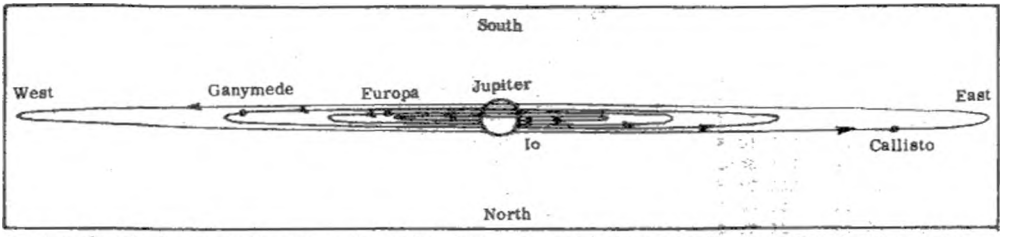
PLUTO

Pluto is in the constellation of Virgo and moves between R.A. 13^h53^m and 13^h43^m and Dec $+5^o40'$ and $+7^o55'$.

THE MOONS OF JUPITER AND SATURN 1981

MOONS OF JUPITER

One of the most popular sights for an observer with a small telescope is Jupiter and its Moons. Four of the fifteen - 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



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 26 and 27 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

Jan	6	23h41m	III	Ec D
	8	23 57	I	Sh I
	10	23 59	IV	Sh E
	17	23 41	I	Tr E
	18	23 54	II	Ec D
	24	23 20	I	Tr I
	27	22 54	II	Tr I
	27	23 25	II	Sh E
Feb	3	23 16	II	Sh I
	4	22 24	III	Oc R
	5	23 02	II	Oc R
	8	23 06	I	Ec D
	9	22 41	I	Sh E
		23 35	I	Tr E
	11	22 30	III	Ec R
		23 16	III	Oc D
	16	22 21	I	Sh I
		23 10	I	Tr I
	17	22 29	I	Oc R
	18	23 26	III	Ec D
	19	23 31	II	Ec D
	24	21 21	I	Ec D
	25	21 33	I	Tr E
	28	21 27	II	Tr I
		22 58	II	Sh E

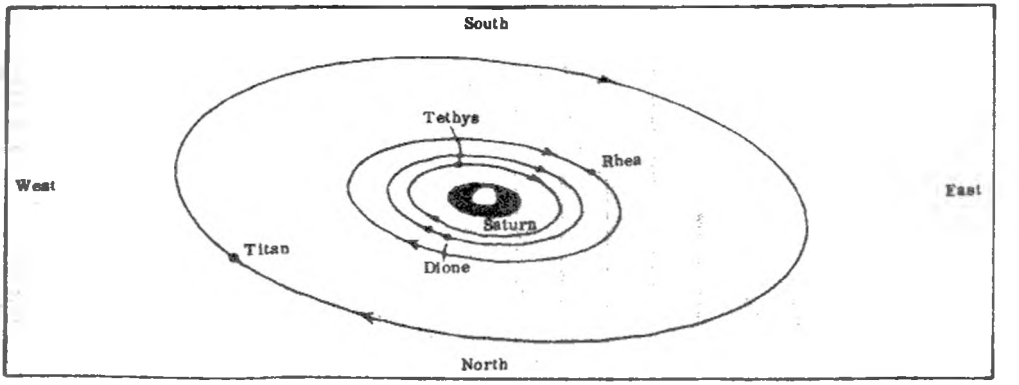
Mar	1	22h30m	III	Tr E
	3	23 15	I	Ec D
	4	20 36	I	Sh I
		21 07	I	Tr I
		22 49	I	Sh E
		23 18	I	Tr E
	5	20 25	I	Oc R
	7	22 49	II	Sh I
		23 44	II	Tr I
	8	21 23	III	Sh I
		23 12	III	Tr I
	9	21 25	II	Oc R
	11	22 30	I	Sh I
		22 51	I	Tr I
	12	22 09	I	Oc R
	12	19 37	I	Ec D
		22 09	I	Oc R
	13	19 29	I	Tr E
	16	20 33	II	Ec D
		23 40	II	Oc R
	19	21 31	I	Ec D
		23 53	I	Oc R
	20	21 05	I	Sh E
		21 12	I	Tr E
	23	23 08	II	Ec D
	25	19 59	II	Tr E
		20 00	II	Sh E

	26	19h17m	III	Ec D
		22 14	III	Ec R
		23 25	I	Oc D
	27	20 44	I	Tr I
		20 46	I	Sh I
		22 56	I	Tr E
		22 59	I	Sh E
		20 07	I	Ec R
Apr	1	19 35	II	Tr I
		19 53	II	Sh I
		22 k4	II	Tr E
		22 35	II	Sh E
	2	22 37	III	Oc D
	3	22 28	I	Tr I
Apr	3	22 0	I	Sh I
	4	19 35	I	Oc D
		22 02	I	Ec R
	5	19 06	I	Tr E
		19 21	I	Sh E
	8	21 50	II	Tr I
		22 29	II	Sh I
	10	20 16	II	Ec R
	11	21 19	I	Oc D
		23 56	I	Ec R

	12	19h 02m	I Sh I
		20 50	I Tr E
		21 15	I Sh E
	13	18 20	III Tr E
		18 25	I Ec R
		20 10	III Sh E
	17	19 07	II Oc D
		22 50	II Ec R
	18	23 04	I Oc D
	19	20 23	I Tr I
		20 57	I Sh I
		22 35	I Tr E
		23 09	I Sh E
	20	18 54	III Tr I
		20 19	I Ec R
		21 14	III Sh L
		21 41	III Tr E
	24	21 24	II Oc D
	25	19 15	II Tr E
		19 42	II Sh E
		22 09	I Tr I
		22 51	I Sh I
	27	19 16	I Oc D
		22 14	I Ec R
		22 16	III Tr I
	28	18 48	I Tr E
		19 32	I Sh E
May	1	23 42	II Oc D
	3	19 37	II Sh I
		20 37	II Tr E
		22 18	II Sh E
		23 56	I Tr I
	4	21 03	I Oc D
	5	18 23	I Tr I
		19 14	I Sh I
		20 35	I Tr E
		21 26	I Sh E
	8	18 21	III Oc R
		19 11	III Ec D
		22 03	III Ec R
	10	20 18	II Tr I
		22 14	II Sh I
		23 00	II Tr E
	11	22 52	I Oc D
	12	19 50	II Ec R
		20 11	I Tr I
		21 09	I Sh I
		22 23	I Tr E
		23 20	I Sh E
	13	20h 32m	I Ec R
	15	19 00	III Oc D
		21 55	III Oc R
		23 10	III Ec D
	17	22 43	II Tr I
	19	22 00	I Tr I
		22 24	II Ec R
		23 03	I Sh I
May	20	19 08	I Oc D
		22 27	I Ec R
	21	18 39	I Tr E
		19 43	I Sh E
	22	22 37	III Oc D
	26	19 57	III Sh E
		20 03	II Oc D
		23 50	I Tr I
	27	20 59	I Oc D
	28	18 18	I Tr I
		19 26	I Sh I
		19 27	II Sh E
		20 30	I Tr E
		21 38	I Sh E
Jun	2	19 10	III Tr E
		21 09	III Sh I
		22 31	II Oc D
		23 35	II Sh E
	3	22 51	I Oc D
	4	19 24	II Sh I
		19 38	II Tr E
		20 09	I Tr I
		21 21	I Sh I
		22 04	II Sh E
		22 21	I Tr E
		23 32	I Sh E
	5	20 47	I Ec R
	9	20 02	III Tr I
		23 00	III Tr E
	11	19 28	II Tr I
		22 02	I Tr I
		22 02	II Sh I
		23 15	I Sh I
	13	16 42	I Tr E
		19 24	II Ec R
		19 55	I Sh E
	16	23 54	III Tr I
	18	22 03	II Tr I
		23 55	I Tr I
	19	21 07	I Oc D
	20	18 24	I Tr I
		19 08	III Ec D
		19 39	I Sh I
		20 36	I Tr E
		21 50	I Sh E
		21 55	III Ec R
		21 59	II Ec R
	21	19h 06m	I Ec R
	26	23 02	I Oc D
	27	19 24	II Oc D
		20 19	I Tr I
		20 54	III Oc R
		21 33	I Sh I
		22 31	I Tr E
		23 07	III Ec D
		23 44	I Sh E
	28	21 01	I Ec R
	29	18 18	I Sh E
		19 15	II Sh E
Jul	4	21 55	III Oc D
		22 00	II Oc D
		22 14	I Tr I
	5	19 27	I Oc D
		22 56	I Ec R
	6	18 55	I Tr E
		19 14	II Sh E
	6	19 24	II Tr E
		20 07	I Sh E
		21 52	II Sh E
	8	19 48	III Sh E
	12	21 24	I Oc D
	13	18 40	I Tr I
		19 22	II Tr I
		19 51	I Sh I
		20 52	I Tr E
		21 52	II Sh I
		22 02	I Sh E
		22 06	II Tr E
	14	19 20	I Ec R
	15	18 59	II Ec R
		19 05	III Tr E
		21 04	III Sh I
	20	20 37	I Tr I
		21 46	I Sh I
		22 05	II Tr I
	21	21 15	I Ec R
		18 25	I Sh E
		20 16	III Tr I
		21 33	II Ec R
	28	19 51	I Tr E
	29	19 17	I Tr E
		19 20	II Oc D
		20 20	I Sh E
	31	19 02	II Sh E
Aug	2	19 05	III Oc D
	5	19 03	I Tr I
	6	19 34	I Ec R

SATURN'S MOONS

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

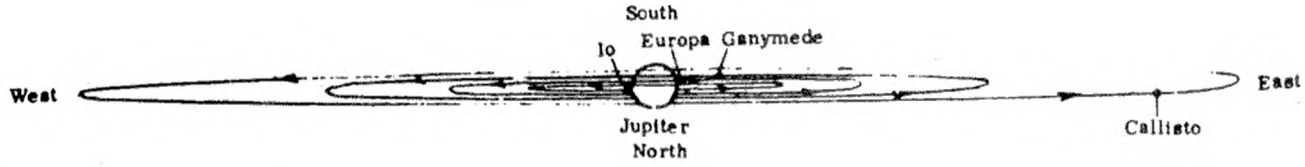


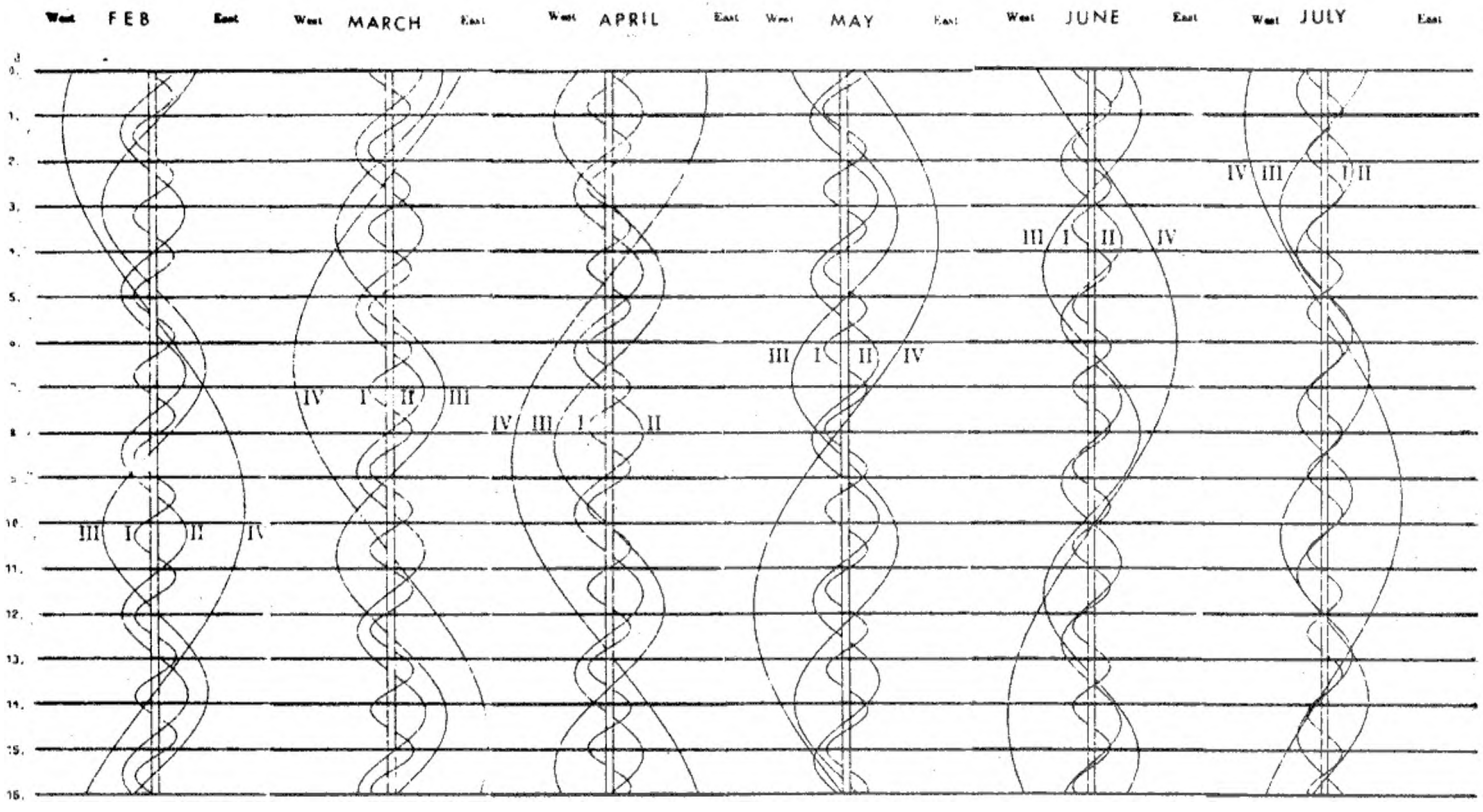
and the information in the table below (which covers the period when Saturn is clearly visible in the evening sky).

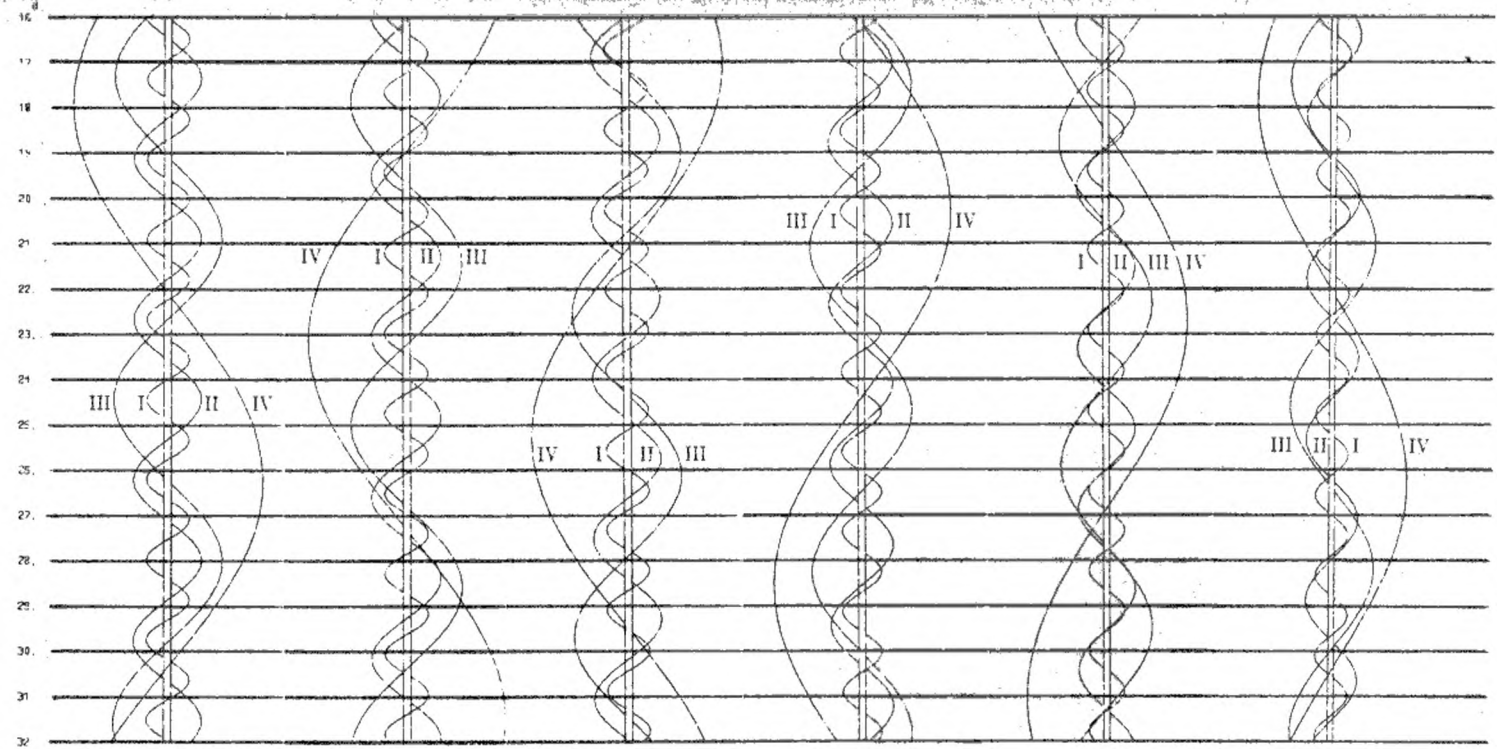
TITAN UNIVERSAL TIME

Eastern Elongation		Inferior Conjunction		Western Elongation		Superior Conjunction	
	d h		d h		d h		d h
				Jan.	2 11.5	Jan.	6 16.2
Jan.	10 15.9	Jan	14 10.8		18 10.4		22 15.0
	26 14.6		30 09.4	Feb.	3 08.8	Feb.	7 13.4
Feb.	11 12.8	Feb.	15 07.5		19 06.9		23 11.3
	27 10.8	Mar.	3 05.4	Mar.	7 04.6	Mar.	11 09.0
Mar.	15 08.5		19 03.0		23 02.1		27 06.5
	31 06.0	Apr.	4 00.6	Apr.	7 23.6	Apr.	12 04.0
Apr.	16 03.7		19 22.2		23 21.2		28 01.6
May	2 01.5	May	5 20.1	May	9 19.1	May	13 23.6
	17 23.5		21 18.3		25 17.3		29 21.9
June	2 22.0	June	6 16.8	June	10 15.9	June	14 20.6
	18 20.8		22 15.8		26 15.0		30 19.8
July	4 20.0	July	8 15.1	July	12 14.4	July	16 19.3
	20 19.6		24 14.7		28 14.2	Aug.	1 19.2
Aug.	5 19.5	Aug.	9 14.7	Aug.	13 14.3		17 19.4
	21 19.6		25 14.8		29 14.7	Sept.	2 19.8
Sept.	6 20.0	Sept.	10 15.2	Sept.	14 15.2		18 20.4
	22 20.4		26 15.7		30 15.9	Oct.	4 21.1
Oct.	8 20.9	Oct.	12 16.2	Oct.	16 16.6		20 21.7
	24 21.4		28 16.7	Nov.	1 17.2	Nov.	5 22.4
Nov.	9 21.9	Nov.	13 17.1		17 17.7		21 22.8
	25 22.1		29 17.3	Dec.	3 18.0	Dec.	7 23.0
Dec.	11 22.2	Dec.	15 17.3		19 18.0		23 23.0
	27 21.9		31 17.0		35 17.7		

CHANGING CONFIGURATIONS OF JUPITER'S MOONS







The four bright moons of Jupiter always appear close to a straight line passing through the planet since, as shown in the drawing at the top, their orbits are seen nearby edge on. The main part of the diagram then shows how their positions along such a straight line chang during the five months when Jupiter is prominent in the evening sky. For each month, time increases downward; the disk of Jupiter is stretched to make the central column and horizontal lines, representing 2 a.m. (0 hrs. Universal time), are shown for every day of the month. The wavy lines show how the Moons appear to oscillate from one side of the planet to the other.

COMETS AND METEORS

COMETS

Comets are celestial bodies moving around the sun, mostly in very elongated orbits. The typical comet consists of a nucleus surrounded by a hazy aura of gas and dust called the coma, and in many cases there is a tail stretching away from the sun. Faint comets, several of which are discovered each year, usually appear only as fuzzy patches without nucleus or tail, though there may be a central condensation.

While they are believed to be true members of the solar system, comets differ radically from the planets in that their orbits, besides being highly eccentric, are inclined at all angles to the plane of the ecliptic, and their motion may be direct (like that of the planets) or retrograde. Compared with that of a planet, a comet's mass is almost negligible; nearly all this mass is concentrated in the nucleus, which is believed to be not one solid piece but composed of many separate particles of various sizes.

Comets are the most mysterious and capricious of solar system objects and the nature of the physical changes which they exhibit is still not fully understood.

Observers with quite modest equipment, say a refracting telescope of not less than 7.5 cm, or in the case of bright comets, a good pair of binoculars, can do useful work by following known comets and reporting on their appearance. The ability to make accurate brightness estimates is especially useful and well worth cultivating. Sweeping the sky for new comets, though requiring considerable patience and perseverance, is also within the scope of the equipment mentioned.

Many of the fainter comets are undoubtedly escaping detection, particularly in the Southern skies which are not being as intensively searched as the Northern. There is a need for more amateurs to undertake this work.

Interested persons are asked to contact the Director of the Comet and Meteor Section at 90 Malan Street, Riviera, Pretoria 0084.

METEORS

Meteors or "shooting stars" result from small bodies entering the Earth's upper atmosphere, and 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, such a shower can be expected. A list of these predicted showers is given in the table opposite.

The term "shower" is perhaps misleading (as the table indicates); the most prolific of these showers normally yields an average of less than one meteor per minute. On rare occasions however, as in the case of Leonids, there is a phenomenal rise in the number of meteors observed.

There is always the possibility of new showers occurring, and any large-scale meteor activity observed on dates other than those mentioned should be reported without delay.

Reports by a reliable observer of the number of meteors seen coming from a particular radiant in a given period are always useful, but the best work is done by organised teams making a full sky coverage. In the latter case, care must be taken to avoid the overlapping of individual reports, i.e. where more than one observer reports the same meteor(s), giving a false total for the group.

"Fireballs" are meteors of a luminosity equalling or exceeding that of the brightest planets. Accurate reports of their path among the stars, or their altitude and azimuth, at specific times, are of great value, particularly if made by observers at different places along the trajectory. Details of brightness (compared with Venus, Moon etc.) size and form, colours and any train or wake, are also important.

PREDICTED METEOR SHOWERS 1981

	Shower	Radiant R.A.	Radiant Dec.	Date	Maximum Hourly Rate	Transit of Radiant (approx.)	Recommended Time of Watch	Conditions at Maximum
Mar 14 - Mar 18	Corona Australids	16^h20^m	-48^o	Mar 16	5	04^h45^m	03h-dawn	Favourable
Apr 19 - Apr 24	April Lyrids	18 08	+32	Apr 22	15	04 15	03h-dawn	Unfavourable
May 1 - May 12	Eta Aquarids	22 24	00	May 5	18	07 30	02h-dawn	Favourable
Apr 20 - Jul 30	Sco-Sgr System	18 00	-30	Jun 14	?	00 30	03h-dawn	Unfavourable
Jun 10 - Jun 21	June Lyrids	18 32	+35	Jun 16	8	01 00	———	Unfavourable
Jun 17 - Jun 26	Ophiuchids	17 20	-20	Jun 20	8	23 30	19h-20h	Unfavourable
*Jun 26 - Jun 29	Cetids (New)	+02 00	-15	Jun 28	?	07 40	03h-dawn	Favourable
Jul 10 - Aug 5	Capricornids	21 00	-15	Jul 25	8	00 50	22h-01h	Favourable
Jul 15 - Aug 15	Delta Aquarids	22 36	(-17 (00	Jul 28	35	02 10	00h-04h	Favourable
Jul 15 - Aug 20	Pisces Australids	22 40	-30	Jul 30	11	02 10	00h-04h	Favourable
Jul 15 - Aug 25	Alpha Capricornids	20 36	-10	Aug 2	10	00 00	22h-02h	Favourable
Jul 15 - Aug 24	Iota Aquarids	(22 04 (22 32	- 6 -15	Aug 6	12	(01 10 (01 40	00h-04h	Favourable
Oct 16 - Oct 27	Orionids	06 24	+15	Oct 21	35	04 30	23h-02h	Unfavourable
Oct 10 - Dec 5	Taurids	(03 44 (03 44	+14 +21	Nov 8	16	(00 50 (00 50	———	Unfavourable
Nov 14 - Nov 20	Leonids	10 08	+22	Nov 17	10	06 30	———	Unfavourable
Dec 3 - Dec 5	Phoenicids	01 00	-55	Dec 4	?	20 10	00h-02h	Unfavourable
Dec 7 - Dec 15	Geminids	07 28	+32	Dec 14	55	02 00	———	Unfavourable
Dec 5 - Jan 7	Velaids	09 56	-51	Dec 29	?	03 00	00h-dawn	Favourable

THE STARS

CONSTELLATIONS

Apart from our Sun all the stars that we see are so incredibly distant that, despite their high speed motions, their apparent positions change by only minute amounts each year. Consequently the patterns that they form appear unchanged. The Greeks and other ancient civilisations identified these patterns, or constellations, with various mythological characters and creatures, and most of the names they gave are still used today.

In all there are 88 constellations, roughly one half of which would be above the horizon at any one time. Some contain distinctive patterns of bright stars and are relatively easy to find; others are difficult to locate, even with suitable maps. The Southern Cross and Centaurus, Orion and Taurus, Scorpius and Sagittarius, are featured later in this section. Detailed information on other constellations is beyond the scope of this handbook and interested observers are advised to obtain a suitable star atlas.

STAR NAMES

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

STELLAR MAGNITUDES

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.

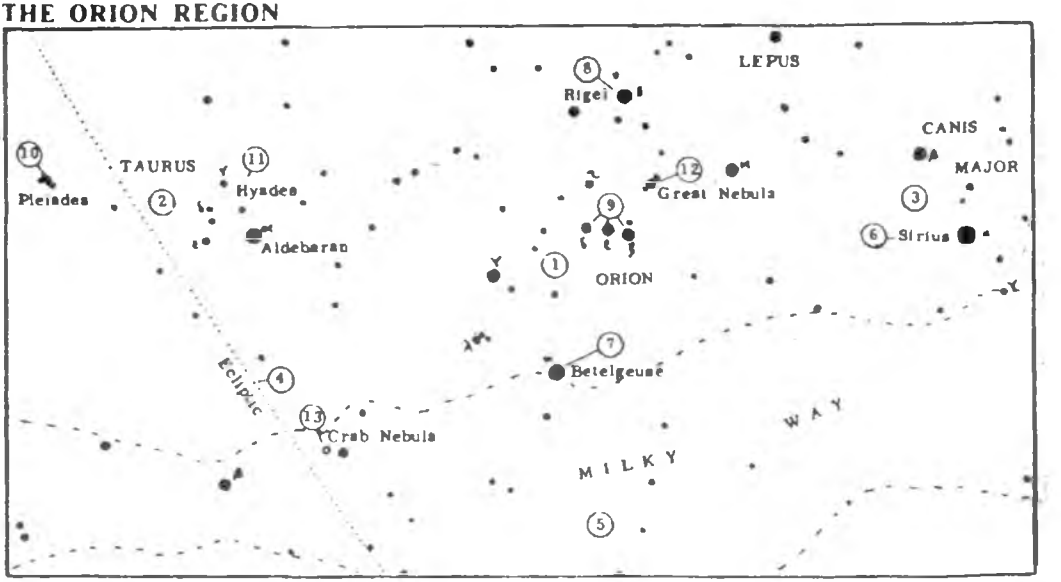
NEBULAE

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. 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 - ζ the belt, and β and κ the legs. Orion forms part of the "great hunting scene" in which he faces the onslaught of (2) Taurus, the bull. Only the forepart of the bull is depicted and, like Orion, it is upside down. α and ε are the eyes, γ the nose. Orion is accompanied by (3) Canis major, the large dog, and the small dog (off map) while Lepus, the hare, crouches at his feet.

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

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

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

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

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

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

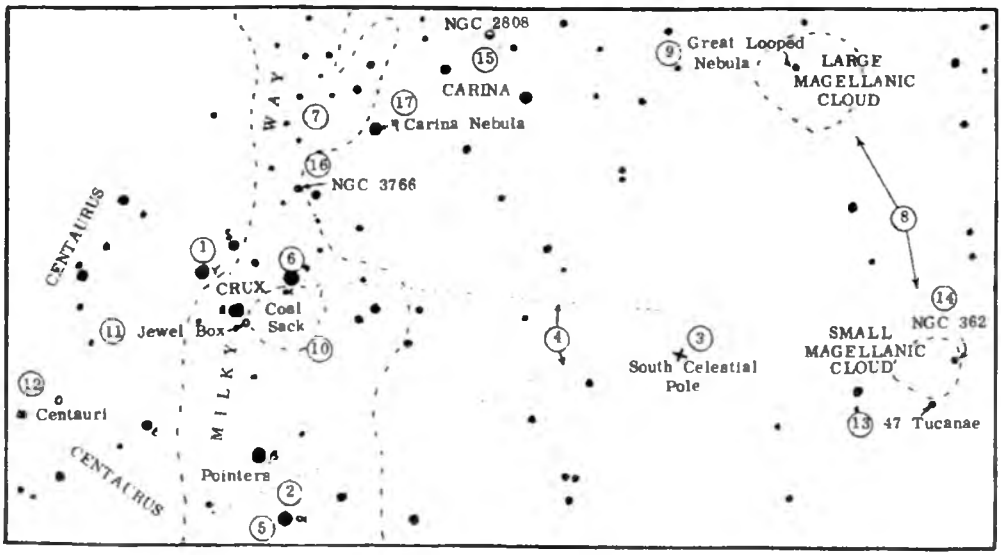
(10) The Pleiades or Seven Sisters form the best known nearby star cluster. Six or seven stars are visible to the naked eye, binoculars or a small telescope show more.

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

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

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

THE 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).

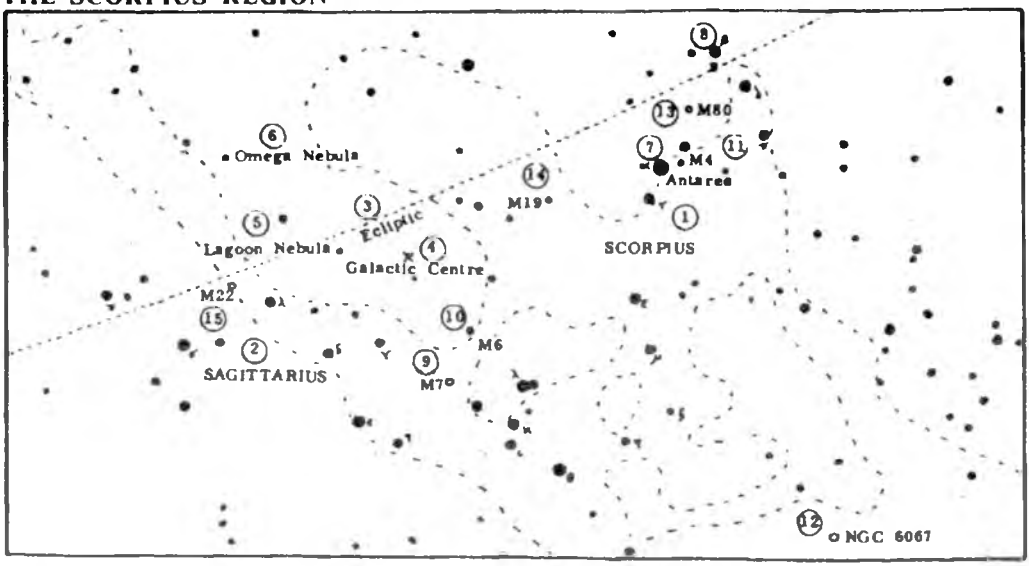
(11) Herschel's "Jewel Box" - a galactic cluster containing stars of different colours. (Small telescope or binoculars).

(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 π the claws. The distinctive tail ε — ζ — θ curls round to the sting λ

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

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

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

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

(8) 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.

NOVA SEARCHING

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

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

Interested persons should contact the Director of the Nova Search Section, Mr. J.C. Bennett, 90 Malan Street, Riviera, Pretoria 0084.

VARIABLE STAR OBSERVING

The "General Catalogue of Variable Stars" by Kukarkin and Parenago lists some 20 000 stars. Professional observatories cannot possibly monitor all of these, and this makes the observation of variable stars a field in which amateurs can make a real contribution to astronomical knowledge.

Of the 20 000 stars, at least 2000 are suitable for visual monitoring in the southern hemisphere. However, the number of active observers in this part of the world remains woefully small, and scarcely 200 variables are at present being observed from South Africa.

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

Visual estimates of magnitude are made by comparing the variable with two or more comparison stars, respectively brighter and fainter than the unknown variable. Suitable comparison stars are shown on special charts, which have been prepared for each variable, mainly by the two variable star organisations mentioned above. The use of these charts is essential for accurate, standardized observations, and intending new observers are therefore advised to obtain the necessary data by contacting the Director of the Variable Star Section, Mr. J. Hers, P.O. Box 48, Sedgefield, 6573, Telephone (04455)736. They will then be sent charts of a few easy objects, and data on stars which may be observed with the equipment at their disposal.

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

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

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

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

Typical examples include:

		Approx. magnitude range
021403	o Ceti Mira	2.0-10.1
092962	R Carinae	3.9-10.0
100661	S Carinae	4.5- 9.9

Among the eruptive variables, two groups are of special importance:

U Geminorum type. These are dwarf novae which have long periods of apparent quiescence at minimum, with sudden rises to maximum. A typical representative in the southern hemisphere is 040971 VW Hydri.

R Coronae borealis type. These are high luminosity variables with slow, non-periodic drops in brightness. A typical representative is 191033 RY Sagittarii.

Eclipsing Binary Stars have orbital planes which lie close to the line of sight of the observer. The two components periodically eclipse each other, thus causing variations in the apparent brightness of the system. Periods are generally short, of the order of hours, so that observational programmes need very careful planning. Monitoring these interesting stars is therefore for experienced observers only.

ORDINARY 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 1580, Bulawayo, Zimbabwe).

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:

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

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

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. No.	Mag.	P.	El. of Moon	CAPE TOWN E. 18.500, S. 33.900 U.T.	a	b	P	JOHANNESBURG E. 28.000, S. 26.200 U.T.	a	b	P	SALISBURY E. 31.100, S. 17.700 U.T.	a	b	P
				°	h m	m	m	°	h m	m	m	°	h m	m	m	°
Jan. 11	12	6.3	1	69	19 59.1	-0.4	+2.2	39		A				D		
11	13	6.3	1	69	20 19.5	-0.2	+2.5	27		A				D		
12	128	7.3	1	81		S			18 14.5	-1.6	+1.5	65	18 33.7	-1.2	+2.0	47
16	718	6.1	1	136	20 47.0	-2.0	+1.3	57	21 21.1	-2.1	+2.6	38		D		
16	726	6.8	1	136	22 08.5	-1.7	+0.9	85	22 33.9	-1.5	+1.7	62	22 59.3	-2.0	+3.8	27
16	730	5.1	1	137	23 37.1	-1.1	+1.4	74		A				D		
Feb. 7	3503	7.4	1	37		S			17 28.8	-0.3	+2.2	37	17 50.9	+0.2	+3.4	9
12	648	3.9	1	103		S				S			16 45.6	-1.4	+3.7	19
12	653	4.8	1	104		S				S			17 07.3	-2.6	+1.1	65
14	9894	6.6	1	131		G			21 11.7	-1.6	-0.7	126	21 15.3	-1.9	+0.2	97
15	1127	5.9	1	144		D				D			22 22.8	.	.	175
25	2133	5.6	2	249		D				D			2 13.6	.	.	250
25	2137	6.4	2	250	2 59.1	-2.6	-0.6	278		D			2 43.7	.	.	357
25	2141d	6.0	2	250	3 28.8	-2.2	-1.3	298		S				D		
26	2372d	4.4	1	271	23 28.8	-0.2	-1.4	104	23 25.7	-0.9	-0.3	73		D		
27	2372d	4.4	2	271	0 34.0	-0.5	-1.8	295	0 20.5	-0.2	-2.9	329		D		
Mar. 2	2798d	6.3	2	306	1 19.0	0.0	-1.1	273	1 07.2	+0.2	-1.9	306		D		
8	192	5.3	1	32		S			17 21.2	-0.5	+0.2	110		A		
9	327	4.5	1	46		S			16 59.9	-1.0	+2.2	41	17 27.0	-0.8	+4.3	9
10	464	6.4	1	60		D			17 36.6	-1.3	-0.7	126	17 39.9	-1.2	+0.4	97
11	609	7.5	1	73		D				D			16 49.2	-2.5	-1.0	119
11	620	6.3	1	74	19 01.9	-1.4	+2.0	52	19 37.1	.	.	14		D		
12	769	6.6	1	87	17 56.4	.	.	15		S				D		
13	935	6.9	1	101	19 38.9	-1.7	+0.1	112	19 58.5	-1.6	+1.0	85	20 16.5	-2.0	+2.3	53
14	1086	6.5	1	113	20 00.2	-2.6	+1.9	56		D				D		
16	1340	6.6	1	137	17 41.5	-1.7	+0.7	50		D				D		
16	1343	6.6	1	137	18 06.2	-2.0	-0.6	85	18 29.9	-3.1	+1.0	62		D		
19	1576	5.3	1	162	0 16.6	-0.9	-1.1	144	0 24.2	-1.3	+0.2	106	0 37.6	-2.1	+2.2	67
26	2441	6.5	2	251		G			21 49.5	-0.7	-0.5	257	21 44.0	-0.4	-1.1	286
26	2734d	5.4	2	274	1 10.8	-1.3	-0.3	248	1 18.5	-1.3	-1.4	284	1 02.2	-0.7	-3.0	320
30	2386	5.4	2	287	2 28.4	-1.6	+0.4	235	2 42.7	-1.8	-0.8	271	2 35.2	-1.7	-2.5	306
31	3017	5.3	2	298	1 25.4	.	.	192	1 43.0	-1.0	+0.1	244	1 44.3	-0.9	-0.9	277
Apr. 8	718	6.1	1	55		S				S			16 16.0	-1.9	+0.5	89
8	726	6.8	1	55		D			17 37.7	-0.5	-1.5	141	17 35.5	-0.9	0.0	106
9	881d	5.9	1	69		G			16 46.0	-2.2	+1.2	73	17 08.4	-2.6	+2.8	43
10	1051d	6.7	1	83	19 54.9	-0.6	-0.3	132	20 03.0	-0.7	+0.6	97	20 14.8	-1.1	+1.6	63
12	1312	6.8	1	107	18 04.6	-2.3	-0.5	106	18 30.7	-3.0	+1.0	76		D		
12	1321d	6.7	1	108		D				A			22 02.6	-0.3	-0.3	116
13	1418	5.9	1	119	17 06.0	.	.	50		D				D		
22	2399	5.0	2	220		D			19 24.8	-0.8	+0.3	239	19 24.1	-0.4	-0.7	271
24	2666d	5.0	2	242		S			20 29.2	-0.8	+0.9	226	20 31.6	-0.3	-0.4	262
25	2697	6.5	2	244		D			3 01.1	-2.8	+1.7	244	3 17.3	-3.1	0.0	275
27	2963d	5.3	2	267	0 28.9	-1.3	+0.7	227	0 41.4	-1.5	-0.6	264	0 35.3	-1.3	-2.0	298
May 6	808	6.8	1	37	17 10.9	-1.1	+1.7	63		A				D		
7	984	6.6	1	50		S			16 31.3	-2.0	+2.0	56		D		
8	1129d	5.3	1	63	16 31.7	-2.2	+0.9	78	17 12.2	.	.	35		D		
10	1395	6.3	1	89		D			19 57.3	-0.4	-1.0	142	19 55.0	-0.9	-0.1	109
11	1504	5.7	1	101	18 54.9	-2.3	+0.2	99		G				D		
21	2638	5.4	2	213	22 11.9	.	.	224	22 38.7	-2.5	-0.5	268	22 35.4	-2.3	-2.1	301
21	2639d	6.0	2	213	22 15.0	-1.0	-2.6	310		D				D		
22	2797	3.0	1	225		D			22 35.0	.	.	148	22 17.2	-1.7	-1.4	109
22	2797	3.0	2	225		D			23 28.9	.	.	221	23 49.6	-3.0	+0.3	260
24	3058	5.9	2	248	22 28.9	-0.8	+0.3	231	22 34.6	-0.9	-0.8	267	22 25.7	-0.7	-2.1	301
25	3071	6.5	2	249	2 17.3	-2.3	-0.6	271	2 35.2	-3.4	-1.9	295		D		
25	3079	4.2	1	250	4 26.5	-2.2	+1.1	73		S				S		
27	3347	6.2	2	274	3 12.6	-1.8	+0.1	250	3 33.6	-2.7	-0.2	266		S		
31	3634	6.3	2	329	4 41.2	-0.2	+1.2	206		S				S		
June 6	1343	6.6	1	56		D				D			16 12.7	-0.3	-3.0	163
7	1459	7.5	1	69		D				D			18 03.3	-0.1	-2.6	162
12	2005	7.0	1	128		D				D			22 59.1	-0.5	-3.2	163
18	2759	3.6	1	196	23 56.1	.	.	146	24 04.9	-3.0	-1.0	112	24 13.2	-2.9	+0.7	82
19	2757	5.1	2	196	0 24.9	.	.	337		D				D		
19	2759	3.6	2	196	0 45.5	.	.	209	1 27.9	-1.6	+2.4	235	1 47.4	-1.9	+1.0	261
21	3041	6.4	2	220	3 48.6	-2.1	+0.5	278		S				S		
26	170	6.2	2	282	2 29.4	-1.4	-0.8	264	2 38.7	-2.4	-1.3	280		D		

Date	Z.C. No.	Mag.	P.	El. of Moon	CAPE TOWN E. 18.500, S. 33.900 U.T.	a	b	P	JOHANNESBURG E. 28.000, S. 26.200 U.T.	a	b	P	SALISBURY E. 31.100, S. 17.700 U.T.	a	b	P
				°	h m	m	m	°	h m	m	m	°	h m	m	m	°
July 7	1755	6.8	1	75	20 31.2	-0.8	+1.6	81		N				N		
11	2194	7.0	1	120		N			22 41.9	-1.0	-1.2	140	22 40.0	-0.8	-0.1	108
18	3120	4.3	1	200	22 11.4	-2.0	-1.9	109	22 26.0	-2.6	-0.1	83	22 40.7	-2.6	+1.7	55
18	3120	4.3	2	200	23 22.6	-1.9	+2.2	219	23 56.9	-2.3	+1.7	238	24 14.9	-2.9	+0.7	261
20	3275	6.1	2	213		N				G			2 06.9	-0.8	+3.4	202
25	401	6.3	2	278	1 22.2	-0.9	-0.9	264	1 26.3	-1.7	-1.3	279		N		
Aug. 3	1702	4.2	1	41		S			15 46.6	-2.5	+1.9	73		N		
7	2133	5.6	1	88	19 39.3	-1.4	-1.7	146	19 46.4	-1.3	-0.1	114	19 54.3	-1.2	+1.1	82
7	2137	6.4	1	88	20 30.4	-1.2	+4.0	52		N				N		
9	2245	6.4	1	99		N				N			19 52.0	-1.8	-1.9	138
10	2407d	6.6	1	121	17 22.1	-2.3	-0.6	90	18 01.2	.	.	43		N		
11	2632	7.2	1	132	16 53.8	-2.1	+0.1	66		N				N		
11	2633d	4.0	1	132		N				N			18 42.7	-3.0	-2.3	126
11	2638	5.4	1	133	19 08.2	-2.4	-1.0	106	19 34.0	-2.9	+1.1	75	20 04.5	.	.	36
11	2642	7.1	1	133	20 16.1	-2.5	+2.4	55		G				N		
12	2666d	5.0	1	135	1 25.5	-0.1	+1.2	84		A				A		
12	2797	3.0	1	144	19 49.2	-2.3	-3.5	137	19 59.7	-2.9	-0.8	104	20 10.3	-3.0	+1.1	74
12	2797	3.0	2	144	20 50.7	-2.2	+3.5	218	21 30.6	-2.1	+1.9	244	21 47.4	-2.4	+0.5	270
21	365d	6.3	2	248	1 17.9	-0.5	+2.1	197	1 41.5	-1.1	+2.2	205	2 02.7	-1.9	+1.8	224
23	648	3.9	1	275		A			0 38.4	-1.2	-1.1	96	0 37.8	-1.0	+0.1	72
23	648	3.9	2	275	1 27.4	-0.1	+1.2	208	1 39.9	-0.7	+1.1	218	1 50.9	-1.5	+0.7	240
23	653	4.8	2	275		N				N			2 03.0	.	.	187
23	658d	4.2	1	275	1 57.0	-1.2	-0.6	78	2 07.8	-1.6	0.0	70	2 17.3	-1.5	+1.1	50
23	658d	4.2	2	275	3 09.3	-1.4	+0.3	238	3 28.9	-2.0	+0.6	246	3 39.9	-2.8	+0.2	262
24	798	6.4	2	288		N				N			0 56.5	0.0	+1.5	214
26	1125	6.4	2	315	3 54.2	-0.8	-0.9	264		S				S		
26	1129d	5.3	2	315	4 17.0	-0.7	-0.2	241		S				S		
Sept. 1	4014	8.0	1	33	13 24.9	.	.	174	13 18.5	-2.1	-1.6	130	13 18.8	-3.3	-0.2	98
6	2448	6.4	1	90	17 34.3	-2.5	0.0	97	18 07.0	-2.4	+2.2	66		N		
7	2591	6.5	1	102	22 14.6	-0.4	+1.8	69	22 30.3	+0.2	+2.0	55		A		
8	2717	7.4	1	112		S			16 33.4	.	.	39		N		
8	2720	6.4	1	112	17 12.8	-2.4	-0.5	91	17 43.8	-2.9	+2.0	59		N		
9	2757	5.1	1	115	0 36.2	+0.2	+1.3	77		A				A		
16	192	5.3	2	204	2 10.6	-1.9	+1.1	258	2 35.8	-1.7	+1.0	264	2 45.9	-1.9	-0.1	285
17	322	5.7	2	217	0 52.3	-2.4	-0.1	270	1 17.6	-2.8	+0.1	274	1 22.9	.	.	298
17	327	4.5	1	217	0 57.3	-1.0	+2.2	21	1 26.4	-1.0	+3.0	17		G		
17	327	4.5	2	217	1 59.9	-2.6	0.0	279	2 25.1	-2.6	-0.1	285		G		
17	454	5.8	2	230	23 40.4	.	.	304		N				N		
19	610d	6.2	2	245	1 53.5	-2.2	-0.4	267	2 15.1	-2.8	-0.2	273	2 19.0	-3.7	-1.6	296
20	760d	6.5	2	258	0 35.0	-0.7	+0.1	233	0 45.9	-1.3	+0.3	241	0 52.0	-2.0	-0.1	261
Oct. 2	2280d	6.8	1	48	18 50.5	.	.	165	18 47.0	-0.7	-0.8	135		A		
5	2679	7.4	1	82	20 04.6	-0.7	+2.1	63	20 25.6	0.0	+2.3	49	20 50.9	.	.	13
6	2829	6.9	1	93	20 38.9	.	.	13		N				N		
8	3086	6.0	1	116	18 49.9	-1.8	+2.5	39	19 27.9	-1.0	+3.7	24		K		
9	3237	4.4	1	130	21 51.1	-1.7	+1.2	78	22 15.3	-1.2	+1.4	74	22 31.2	-0.8	+1.7	56
9	3245	6.9	1	130	23 44.2	+0.2	+3.1	16	24 05.9	+0.8	+3.9	3		N		
15	523	6.5	2	211	20 33.5	-0.9	-1.4	280	20 32.8	-1.9	-2.2	296		N		
Nov. 1	2614	6.2	1	50		N				S			16 26.5	-2.1	-0.4	110
1	2618	6.6	1	50		N				G			17 25.2	-1.7	-0.7	120
1	2633d	4.0	1	51	19 44.5	-0.2	+1.1	89		A				A		
2	2778d	6.9	1	62		N			19 40.9	-1.6	-1.9	143	19 37.8	-0.6	-0.1	111
6	3303	6.2	1	108		N				G			16 44.3	-3.5	-0.6	97
9	170	6.2	1	148		S			17 05.8	-0.9	+1.2	39	17 25.6	-0.4	+3.2	11
9	192	5.3	1	150	21 42.1	-1.4	+1.7	43	22 10.5	-1.3	+2.1	40	22 35.3	-0.9	+3.0	20
10	327	4.5	1	163	20 43.8	-1.2	+1.3	37	21 09.1	-1.4	+2.0	34	21 34.6	-0.9	+3.3	14
14	976d	3.2	1	221		A			21 36.8	.	.	17		N		
14	976d	3.2	2	221	22 10.1	-1.8	-2.3	306	22 11.0	.	.	320		N		
17	1277	5.5	2	249	1 16.2	-1.6	+0.5	232	1 38.9	-2.5	+0.2	253	1 46.3	-2.8	-0.5	277
Dec. 3	3256	6.2	1	77		S				S			16 47.5	-2.3	+1.5	67
3	3275	6.1	1	78	20 36.7	-0.7	+1.4	82	20 51.2	-0.2	+1.3	75		A		
7	249	4.7	1	128		S			17 35.5	-1.6	+1.3	47	17 55.5	-1.3	+2.4	28
14	1224	5.4	2	216	1 40.9	-2.3	+0.3	265	2 02.0	-2.0	-0.3	293	1 59.3	-1.5	-1.8	322
16	1479	6.3	2	242	1 54.0	-2.1	-1.7	289	2 03.6	-2.0	-1.8	316	1 46.4	.	.	348
17	1598	6.4	2	255	2 20.8	-1.3	-2.7	337		N				N		

GRAZING OCCULTATIONS

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

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

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

The equipment needed is similar to that used for ordinary (or 'total') occultations, but must, of course, be portable. A 75mm refractor is ideal for average events, but better instruments with a larger aperture have often shown their superiority under difficult conditions. Timing is best carried out with a portable tape recorder and radio receiver tuned to ZUO or other time signal station.

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

Interested observers - especially those living in the more distant regions - who wish to be informed of favourable grazes occurring in their neighbourhood, are therefore invited to contact the co-ordinator for grazing occultations: Mr. J. Hers, P.O. Box 48, Sedgefield 6573. Telephone: 113.
N.B. After switch over to automatic: Phone No. 04455 736

EXPLANATION OF COLUMN HEADINGS IN TABLES

No. - the number of the track on the map. An asterisk denotes that the same is double - notes are given below.

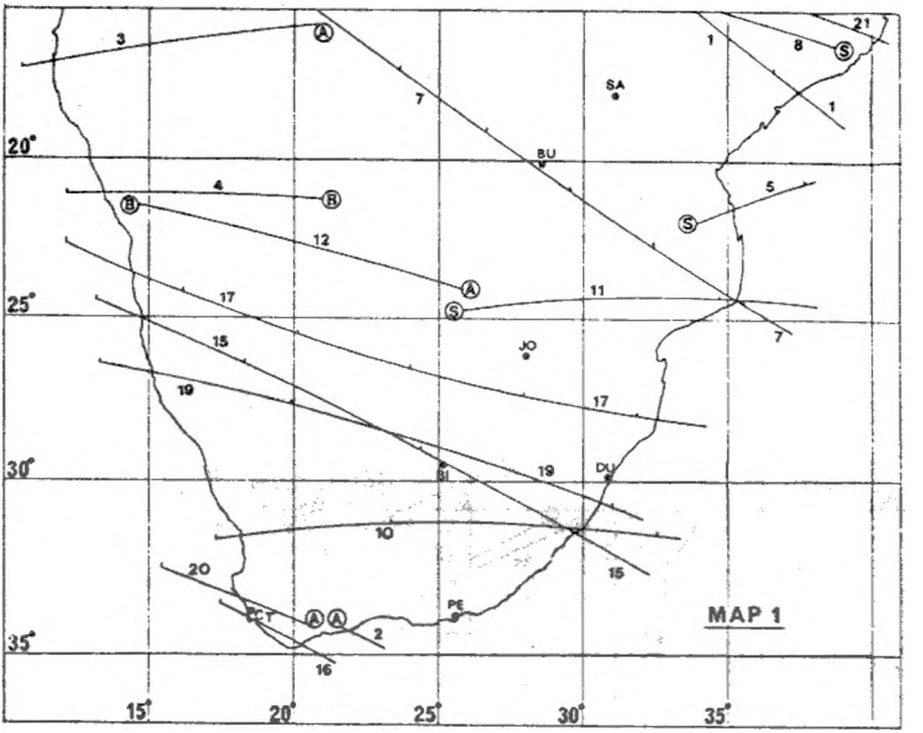
Z.C. - the number of the star in the Zodiacal Catalogue.

Date

Beginning - an arbitrary time of the beginning of the track in the west.

Sunlit - the percentage of the Moon's disk lit by the Sun

Limit - N = northern limit (a complete occultation takes place south of the track)
S = southern limit (complete occultation north of the track)



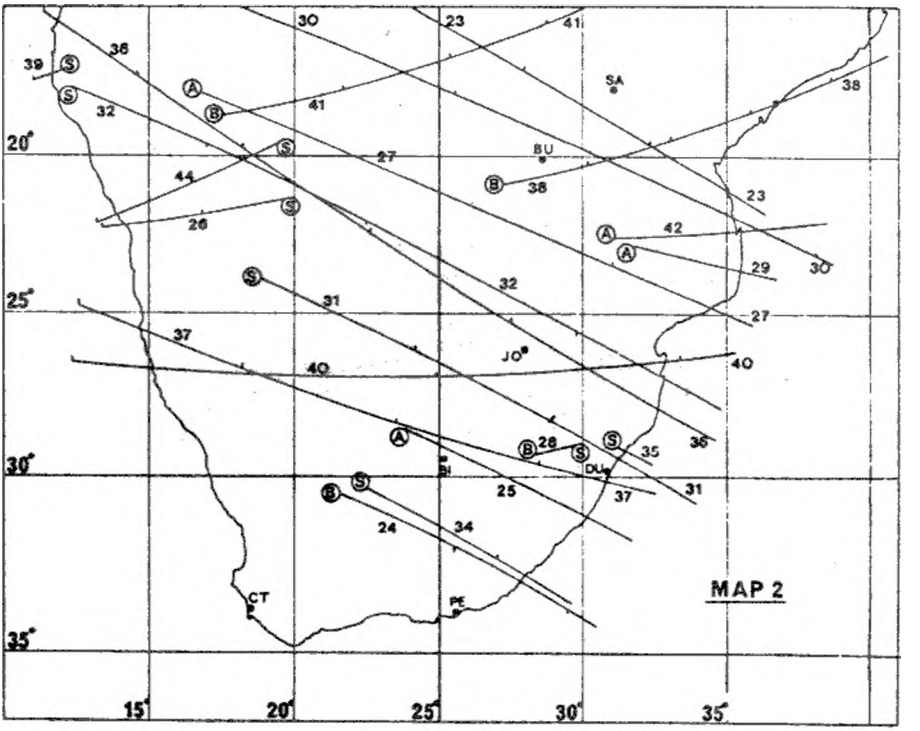
GRAZING OCCULTATIONS 1981

KEY TO MAP 1

	EC	MAG.	TIME (U.T.) AT THE BEGINNING OF THE TRACK IN THE WEST			PERCENT SUBLITE S	N OR S LIMIT	ASTRER NO.
				HR	MIN			
1 e	1856	6.6	JANUARY	26	1 52	69	S	8768
2	2710	6.8	FEBRUARY	2	2 19	8	S	
3	95	7.1	FEBRUARY	8	19 14	19	S	
4	249	6.7	FEBRUARY	9	20 21	29	S	
5 e	368	6.3	FEBRUARY	10	16 50	39	S	1896
7	2133	5.6	FEBRUARY	25	1 14	67	S	
8	2940	7.3	MARCH	3	2 59	12	S	
10	464	6.4	MARCH	10	17 35	25	S	
11	608	7.5	MARCH	11	17 0	36	S	
12	620	6.3	MARCH	11	19 42	37	S	
15	1086	6.5	MARCH	14	20 21	70	S	
16	2441	6.5	MARCH	26	21 32	66	S	
17	2591	6.5	MARCH	28	2 31	55	S	
19 e	726	6.8	APRIL	8	17 34	22	S	
20	730	5.1	APRIL	8	18 57	22	S	
21 e	881	5.9	APRIL	9	17 44	32	S	4392

THE TICKS ARE AT 10 MINUTE INTERVALS

APRIL TO MAY



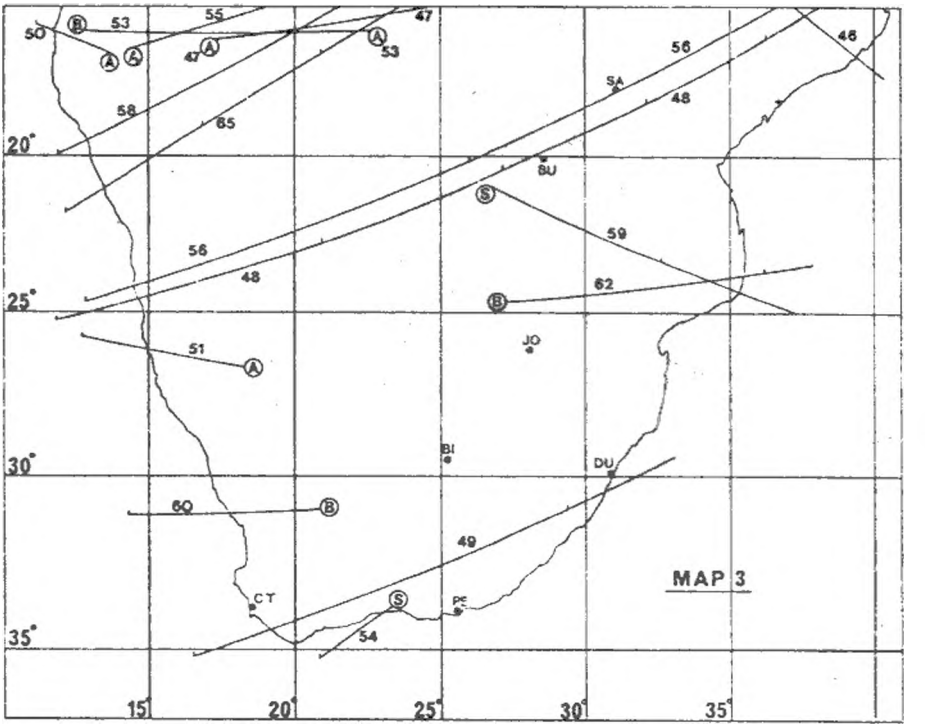
GRAZING OCCULTATIONS 1981

KEY TO MAP 2

	ZC	MAG.	TIME (U.T.) AT THE BEGINNING OF THE TRACK IS THE WEST			PERCENT SUNLIT %	B OR S LIMIT	ATTKEN NO.
				HR	MIN			
23	1312	6.8	APRIL	12	18 53	65	B	
24	1618	5.9	APRIL	13	17 32	74	B	
25 *	2656	5.0	APRIL	24	20 15	73	S	11323
26	2738	5.9	APRIL	25	4 15	71	B	
27	2829	6.9	APRIL	25	22 16	63	B	
28	3118	6.9	APRIL	28	3 57	41	B	
29	3237	4.4	APRIL	28	23 34	32	S	
30	984	6.6	MAY	7	16 49	18	B	
31	1125	6.4	MAY	8	16 37	28	B	
32 *	1129	5.3	MAY	8	16 58	28	S	6086
34	1261	7.2	MAY	9	16 14	38	B	
35	1383	6.6	MAY	10	15 39	48	B	
36	1504	5.7	MAY	11	19 7	60	B	
37	2797	3.0	MAY	22	22 35	85	B	
38	3071	6.5	MAY	25	1 59	67	B	
39	3079	4.2	MAY	25	5 21	66	B	
40	3339	6.7	MAY	27	0 47	47	S	
41	3347	6.2	MAY	27	2 36	46	B	
42	66	6.8	MAY	29	0 42	25	S	
44 *	83	6.0	MAY	29	4 29	24	B	534

* THE TICKS ARE AT 10 MINUTE INTERVALS..

JUNE TO AUGUST



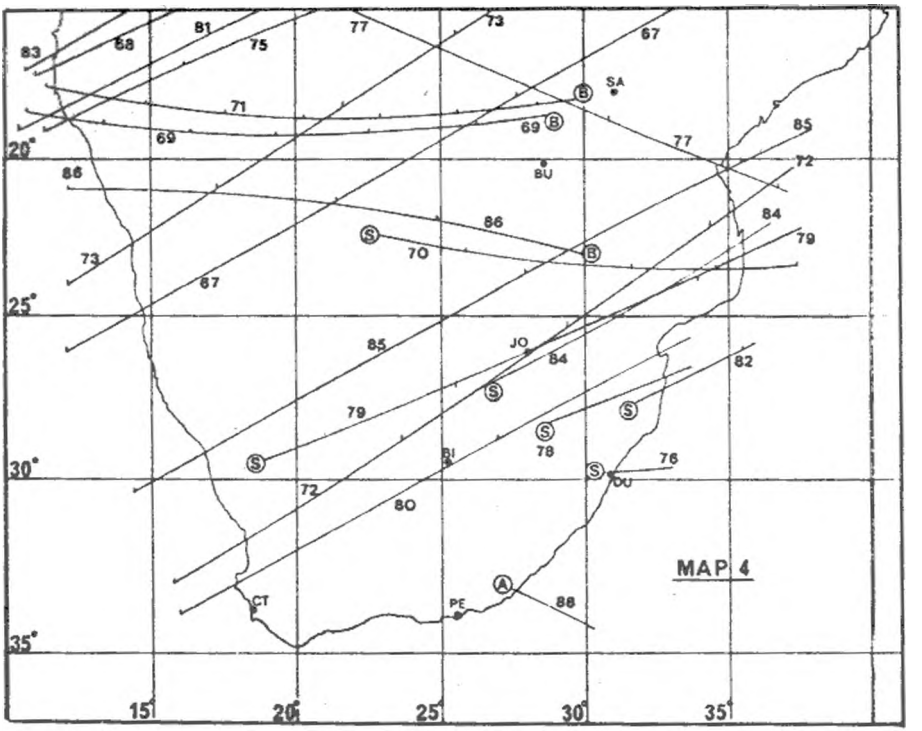
GRAZING OCCULTATIONS 1981

KEY TO MAP 3

	ZC	MAG.	TIME (U.T.) AT THE BEGINNING OF THE TRACK IN THE WEST			PERCENT ILLUM.	N OR S LIMIT	ASTEROID NO.
				HR	MIN	%		
46	1773	5.1	JUNE	10	15 50	60	N	
47	165	6.7	JUNE	26	0 26	40	N	
48	170	6.2	JUNE	26	1 51	39	N	
49	303	6.6	JUNE	27	2 17	28	N	
50	1618	5.9	JULY	4	18 42	11	N	
51	1755	6.8	JULY	7	20 55	37	N	
53	1965	6.5	JULY	9	22 21	57	S	
54	3421	5.1	JULY	21	5 8	83	N	
55	398	6.7	JULY	25	0 29	43	N	
56	401	6.3	JULY	25	0 48	43	N	
58	710	7.1	JULY	27	3 25	20	N	
59	1702	4.2	AUGUST	3	16 7	13	N	
60	2137	6.4	AUGUST	7	20 47	49	N	
62	2245	6.4	AUGUST	8	20 19	58	S	
65m	663	6.9	AUGUST	23	3 28	44	N	3206

THE TICKS ARE AT 10 MINUTE INTERVALS.

AUGUST TO DECEMBER



GRAZING OCCULTATIONS 1981

KEY TO MAP 4

IC	MAG.	TIME (U.T.) AT THE BEGINNING OF THE TRACK IN THE WEST					PERCENT SUNLIT	N OR S LIMIT	AITKEN NO.
					HR	MIN	%		
67	818	6.8	AUGUST	24	2	41	36	N	
68	984	6.6	AUGUST	25	2	38	23	N	
69	2448	6.4	SEPTEMBER	6	17	55	50	N	
70	2717	7.4	SEPTEMBER	8	16	44	69	N	
71	2720	6.4	SEPTEMBER	8	17	32	69	N	
72	454	5.8	SEPTEMBER	17	23	21	82	N	
73a	610	6.2	SEPTEMBER	19	1	9	71	N	3006
75	939	7.0	SEPTEMBER	21	3	11	48	N	
76	2396	6.6	OCTOBER	3	16	24	24	N	
77	2797	3.0	OCTOBER	6	11	56	51	N	
78	2514	6.2	NOVEMBER	1	16	50	18	S	
79	2618	6.6	NOVEMBER	1	17	31	18	S	
80a	2778	6.9	NOVEMBER	2	19	40	27	S	11989
81	2779	3.9	NOVEMBER	2	20	0	27	S	11996
82	3026	7.3	NOVEMBER	4	16	39	45	S	
83	3035	6.8	NOVEMBER	4	19	2	46	S	
84	3303	6.2	NOVEMBER	6	17	0	66	S	
85	976	3.2	NOVEMBER	14	21	42	88	N	4990
86	1739	6.5	NOVEMBER	21	2	13	26	N	
88	2231	6.9	DECEMBER	23	1	52	10	N	

: THE TICKS ARE AT 10 MINUTE INTERVALS.

TIME SYSTEMS AND TELESCOPE SETTINGS

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

TIME SIGNALS FROM RADIO STATION SUO

Radio signals of mean solar time are generated by the Precise Physical Measurements Division of the National Physical Research Laboratory in Pretoria. They are broadcast by the Post Office, the 2.5 and 5 MHz signals from Olifantsfontein, and the 100 MHz signals from Johannesburg.

Carrier Frequency	Radiated Power	Time of Transmission
2,5 MHz	4 Kw	2000 - 0600 SAST
5 MHz	4 Kw	Continuous
100 MHz	80 w	Continuous

The signals consist of one pulse per second, each pulse consisting of 5 cycles of 1000 Hz tone. The first pulse in every minute is lengthened to 500 milliseconds. Morse code announcements are made during the minute preceding every fifth minute. They consist of the call sign ZUO (repeated 3 times) and the Universal Time (formally known as Greenwich Mean Time) at the next minute. (A special coding indicating UT1 minus UTC is also indicated in the first 15 seconds of the minute by slightly lengthened second pulses)

SOUTH AFRICAN STANDARD TIME

South African Standard Time (as in everyday use) is mean solar time for the 30° East meridian (which runs east of Johannesburg and just west of Durban) and is exactly 2 hours ahead of Universal Time.

TIME OF SUN'S TRANSIT OVER 30° MERIDIAN

The table below gives the SAST when the Sun transits the 30° meridian - and a sundial on that meridian reads noon.

Jan	1	$12^h03^m35^s$	May	11	$11^h56^m19^s$	Sep	18	$11^h54^m08^s$
	11	12 07 58		21	11 56 30		28	11 50 40
	21	12 11 21		31	11 57 34	Oct	8	11 47 35
	31	12 13 29	Jun	10	11 59 19		18	11 45 11
Feb	10	12 14 17		20	12 01 26		28	11 43 49
	20	12 13 47		30	12 03 32	Nov	7	11 43 43
Mar	2	12 12 11	Jul	10	12 05 16		17	11 44 58
	12	12 09 49		20	12 06 18		27	11 47 37
	22	12 06 56		30	12 06 21	Dec	7	11 51 28
Apr	1	12 03 54	Aug	9	12 05 26		17	11 56 06
	11	12 01 05		19	12 03 35		27	12 01 04
	21	11 58 42		29	12 00 55		31	12 03 01
May	1	11 57 04	Sep	8	11 57 40			

SIDEREAL TIME ON THE 30° MERIDIAN

		At 0 hrs SAST	At 21 hrs SAST			At 0 hrs SAST	At 21 hrs SAST			0 hrs SAST	21 hrs SAST
Jan	1	6^h42^m	3^h45^m	May	11	15^h14^m	12^h18^m	Sep	18	23^h47^m	20^h50^m
	11	7 21	4 25		21	15 54	12 57		28	0 26	21 30
	21	8 00	5 04		31	16 33	13 37	Oct	8	1 06	22 09
	31	8 40	5 44	Jun	10	17 13	14 16		18	1 45	22 49
Feb	10	9 19	6 23		20	17 52	14 56		28	2 25	23 28
	20	9 59	7 02		30	18 32	15 35	Nov	7	3 04	0 08
Mar	2	10 38	7 42	Jul	10	19 11	16 14		17	3 44	0 47
	12	11 18	8 21		20	19 50	16 54		27	4 23	1 26
	22	11 57	9 01		30	20 30	17 33	Dec	7	5 02	2 06
Apr	1	12 37	9 40	Aug	9	21 09	18 13		17	5 42	2 45
	11	13 16	10 20		19	21 49	18 52		27	6 21	3 25
	21	13 56	10 59		29	22 28	19 32		31	6 37	3 40
May	1	14 35	11 38	Sep	8	23 08	20 11				

CORRECTION FOR PLACES NOT ON THE 30° MERIDIAN

Approximate longitude corrections from the 30° East Meridian are provided below.

To find time of Sun's transit over local meridian, apply the longitude corrections to the data in the table above.

To find the sidereal times at SAST 0 hrs and SAST 21 hrs apply the corrections with the sign reversed to the data in the table.

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

TELESCOPE SETTING

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

A LIST OF BRIGHT STARS FOR CHECKING TELESCOPE CIRCLES

Star	R.A.	Dec.	Mag.	Sp.	Star	R.A.	Dec.	Mag.	Sp.
Achernar	$1^h37^m.0$	$-57^o20'$	0,6	B5	Procyon	$7^h38^m.3$	$+ 5^o16'$	0,5	F5
Aldebaran	4 31,8	+16 28	1,1	K5	Regulus	10 07,4	+12 03	1,3	B8
Rigel	5 13,5	- 8 13	0,3	B8	Spica	13 24,2	-11 04	1,2	B2
Betelgeuse	5 54,2	+ 7 24	0,4	M0	Arcturus	14 14,8	+19 17	0,2	K0
Canopus	6 23,5	-52 41	-0,9	F0	Antares	16 28,3	-26 24	1,2	M1
Sirius	6 44,3	-16 41	-1,6	A0	Altair	19 49,48	+ 8 49	0,9	A5

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1941-42	H. Knox Shaw	1961-62	M.D. Overbeek		

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1957	W.P. Hirst	1963	A.W.J. Cousins	1970	J.C. Bennett
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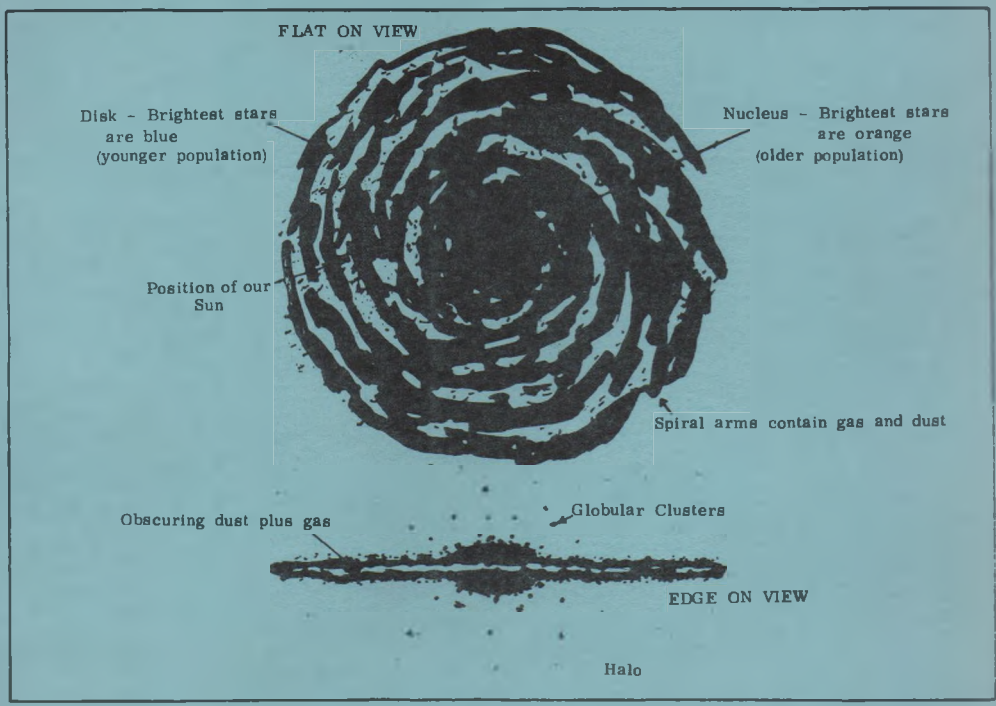
JULIAN DATE AT 1400 HOURS - 1981

	Jan.	Feb.	Mar.	Apr.	May.	Jun.	Jul.	Aug.	Sep.	Oct.	Nov.	Dec.
					2444000 — PLUS							
1	606	637	665	696	726	757	787	818	849	879	910	940
2	607	638	666	697	727	758	788	819	850	880	911	941
3	608	639	667	698	728	759	789	820	841	881	912	942
4	609	640	668	699	729	760	790	821	842	872	913	943
5	610	641	669	700	730	761	791	822	843	873	914	944
6	611	642	670	701	731	762	792	813	844	874	915	945
7	612	643	671	702	732	763	793	824	845	875	916	946
8	613	644	672	703	733	764	794	825	846	876	917	947
9	614	645	673	704	734	765	795	826	847	877	918	948
10	615	646	674	705	735	766	796	827	348	878	919	949
11	616	647	675	706	736	767	797	828	849	879	920	950
12	617	648	676	707	737	768	798	829	850	880	921	951
13	618	649	677	708	738	769	799	830	851	881	922	952
14	619	650	678	709	739	770	800	831	852	882	923	953
15	620	651	679	710	740	771	801	832	853	883	924	954
16	621	652	680	711	741	772	802	833	854	884	925	955
17	622	653	681	712	742	773	803	834	855	885	926	956
18	623	654	682	713	743	774	804	835	856	886	927	957
19	624	655	683	714	744	775	805	836	857	887	928	958
20	625	656	684	715	745	776	806	837	858	888	929	959
21	626	657	685	716	746	777	807	838	859	889	930	960
22	627	658	686	717	747	778	808	839	860	890	931	961
23	628	659	687	718	748	779	809	840	861	891	932	962
24	629	660	688	719	749	780	810	841	862	892	933	963
25	630	661	689	720	750	781	811	842	863	893	934	964
26	631	662	690	721	751	782	812	843	864	894	935	965
27	632	663	691	722	752	783	813	844	865	895	936	966
28	633	664	692	723	753	784	814	845	866	896	937	967
29	634	665	693	724	754	785	815	846	867	097	938	968
30	635	666	694	725	755	786	816	847	868	898	939	969
31	636		695		756		817	848		899		970

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



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.