ASTRONOMICAL
HANDBOOK FOR
SOUTHERN AFRICA

1982

published by the Astronomical Society of Southern Africa.

PREDICTED PERIHELION PASSAGES OF COMETS 1982.

Periodic Comet	Perihelion Date	Revolution Period Years	Perihelion Distance au
Grigg-Skjellerup	May 15	5.1	0.99
Perrine-Mrkos	May 16	6.8	1.30
Vaisala 1	Jul 30	10.9	1,80
d'Arrest	Sep 14	6.4	1.29
Tempel-Swift	Oct 22	6.4	1.60
Churyumov-Gerasimenko	Nov 12	6.6	1.31
Gunn	Nov 26	6.8	2.46
Neujmin 3	Dec 6	10.9	2.06

All these comets are very faint and unless they show unusual brightness will not reach better than mag 11.

ASTRONOMICAL HANDBOOK FOR SOUTHERN AFRICA 1982

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.

COMET 1965F IKEYA-SEKI

His wast of distance

the many

This photograph was taken in October 1965 by the Smithsunian Institution Baker-Nunn Camera at Olifantsfontein near Pretoria. On the original photograph the tail can be traced to three times the length of the tail shown here.

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NOTE

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 Ephememeris for 1982 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. Thanks are due to the British Astronomical Association for the charts on page 22.

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

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 enhand in research while many individuals have become enthusiastic amateur astronomers. Flanetaria and visiting highest 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 Fescarch 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. N. Feart. Its excellent observing site near Sutherland, in the Karroo, has rour instruments, namely the 1.8m, 1.0m, 0.75m and 0.5m telescopes. The Readquarters are in Cape Town, where also a limited amount of observing continues. Research is undertaken in many areas, with committee 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 0.67s 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 Harteleeshoek, near Krugersdorp, is, under the direction of Er. 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, 26 km from Bloemfontein, is noerated by the Department of Astronomy of the Universith 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 O.41m Nishimura Reflector. Research covers essentially the two areas of flare stars, and interferemetry 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 whould be nade to Sutherland prior to the intended visit.

Visiting shights at Boyder Ubservatory are generally held around the time of first quarter. Enquiries should be made to the Observatory. Numbers are restricted to twenty persons on math acception.

Plometaria

The major planetarium in South Africa is that situated on the grounds of the University of the Kitwatersrand (entrance in fale Road - alongside Mi). It is equipped with a highly complex less projector and seats over 199 persons.

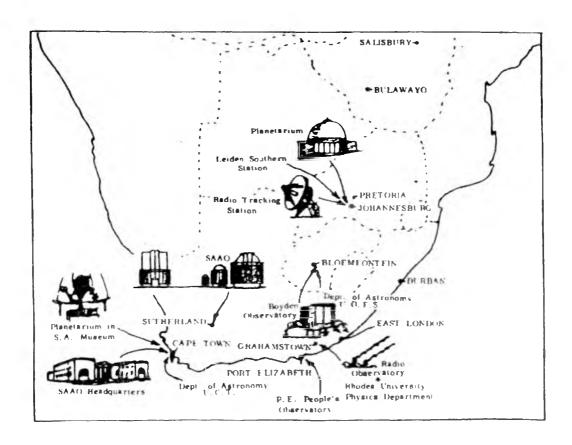
A small planetarium, with a Spitz projector and meating approximately 70, is located within the South African Museum, Cape Than. Shows are given each weekend, at 3.00 p.m. on Saturday, and 3.30 p.m. on Sunday, and at 11.00 m.m. and 3.30 p.m. on public nolidays. Further information can be obtained by proming the museum as 41-2660.

Teaching Departments

Both the University of Cape Town and University of the Oranne Free State have departments of astronomy at U.C.T. is occupied by Prof. Brian Marker, 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

Astronomy in Southern Africa

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 his its own observatory outside Grahamstewn. 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 ind 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 CENTRE 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 January and December) at the South African Astronomical Observatory at 8.00 p.m. The Centre possesses a small observatory housing the 30 cm Ron Atkins Telescope. There is also an active occultation section. Secretarial address: c/o S.A.A.O., P 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 20h00 when a formal lecture is delivered. On this site the Christos Papadopoulos dome houses a combined instrument, comprising of 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 20h00, and there are sections catering for the observation of variable stars and grazing occultations. Secretarial address: 6 Mill Manor, Dukes Avenue, Windsor Park, Randburg, 2195. Telephone: 678-5534

NATAL CENTRE (Durban) - Regular monthly meetings are held on the 3rd Wednesday of each month in St Paul's Church Hall, Church Street, Durban (opposite the GPO) at 7.45 p.m. Weather permitting, on the second Saturday following the regular meeting, viewing evenings are organised at various venues. The Natal Centre publishes a monthly booklet "NDABA", which contains news and views and current information on astronomical and related topics. Secretarial address: c/o P O Box 840, Durban, 4000. Telephone: 84-2321 (W) and 84-4751 (H).

NATAL MIDLANDS CENTRE (Pietermaritzburg) - Meetings are held on the 2nd Wednesday of the month (except January) at the College for Further Education and Training, Havelock Road at 7.45 p.m. and occasionally at private homes. Information on meetings and membership is available from The Secretary, 23 Munro Avenue, Pietermaritzburg. Telephone 24074 or 54038.

BLOEMFONTEIN CENTRE - Meetings are held every 3rd Wednesday of the month. For further information contact Mr F C Neser telephone 22-1142. 108 Japie Neser Street, Uitsig, Bloemfontein.

PRETORIA CENTRE - Meetings are held on the 4th Wednesday of each month (except December) at 8.00 p.m., the venue alternating between the Main Academic Building of the University of South Africa and the Christian Brothers' College, Silverton Road. The Centre's observatory containing a 32 cm reflector is situated on the latter site. For information contact the Secretary, Mr J C Bennett, 90 Malan Street, Riviera, Pretoria 0084.

SALISBURY CENTRE - The Centre holds fairly frequent meetings, usually at 8.00 p.m. 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 co-ordinate 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.

Comets and Meteors	see page 28
Grazing Occultations	see page 38
Nova Search Section	see page 33
Ordinary Occultations	see page 35
Variable Stars	see page 34

DIARY OF PHENOMENA, CONFIGURATIONS OF SUN, MOON AND PLANETS

		CONFIGURATIONS OF SUN	, MOO		PLANETS
JAN	UARY		APR	iL	
d	h		۵.	h	#1 A O A
	07	First Quarter	1	07 20	First Quarter Venus (-4.0) greatest elong W. (46°)
	13	Earth at perihelion		00	Pallas at opposition
	08 14	Saturn (0.9) 5° N of Spica (1.21)	5		Mars closest approach (0.64 a.u)
9	16	Moon at perigee Mercury (-0.7) 5° S of Venus (-3.9)		15	Mars 2° S of Moon
	22	FULL MOON Eclipse		12	FULL MOON
	21	Mars 3° S of Moon	8		Saturn 2° S of Moon
16	14	Mercury (-0.4) greatest elong E (19°)	9		Saturn at opposition
16	15	Saturn (0.9) 3° S of Moon		23	Jupiter 3° S of Moon
	02	Last Quarter	11		Mercury in superior conjunction
	22 03	Jupiter (-1.5) 4° S of Moon Uranus (5.8) 4° S of Moon	12		Uranus 3° S of Moon
	14	Moon at apogee	14		Moon at apogee Neptune 0°.4 S of Moon Occ ⁿ ,
21	12		15		Pluto at opposition
22	01	Venus in Inferior conjunction Neptune 1°.1 S of Moon Occ ⁿ .	16		Last Quarter
	08	Vesta (7.8) 0°.5 N of Moon Occn,	20		Venus 4° N of Moon
	20	Mercury stationary	23		NEW MOON
25	07	NEW MOON Eclipse	25		Moon at perigee
				02 01	Jupiter at opposition
FEB	RUARY			14	Juno stationary (10.6) First Quarter
					Tito dan on
1	06 07	Mercury in inferior conjunction Saturn stationary	MAY	,	
- i	16	First Quarter		07	Mars 3° S of Moon
	18	Pluto stationary		15	Saturn 3° S of Moon
5	16	Moon at perigee		23	Jupiter 4° S of Moon
	10	FULL MOON		03 02	FULL MOON Mercury (0.5) greatest elong E. (21°)
	16	Venus stationary		09	Uranus 3° S of Moon
	18	Mars 2° S of Hoon	10		Ceres at opposition (6.9)
	00	Saturn 3° S of Moon	10		Mercury (0.8) 8° N of Aldebaran (1.1)
14	11	Mercury (1.0) stationary Jupiter 4° S of Moon	- 11		Neptune 0°.3 S of Moon Occ.
	22	Last Quarter	11		Moon at apogee
	12	Uranus (5.8) 4° S of Moon	13		Mars stationary
	10	Moon at apogee	16 20		Last Quarter Venus 3° N of Moon
	11	Neptune (7.7) 1°.0 S of Moon Occn.	21		Mercury stationary (1.8)
20	18 07	Venus 7° N of Moon	22		Pallas stationary (8.8)
21	17	Mars (-0.2) stationary Mercury 2° N of Moon	23	07	NEW MOON
	23	NEW MOON	24		Moon at perigee
24	16	Jupiter stationary		05	Uranus at opposition (5.8)
	01	Pallas stationary		22 15	First Quarter Hars 5° 5 of Moon
	03	Venus greatest brilliancy (-4.3)			hers J J OI HOON
26	10 13	Saturn 5° N of Spica	JUN	E	
40	13	Mercury (0.3) greatest elong W. (27")	1	18	Saturn 3° 5 of Moon
				22	Mercury in inferior conjunction
MAR				23	Jupiter 4° S of Moon
	00	First Quarter		13	Branus 3° S of Moon
	07	Moon at perigee		18 15	FULL MOON Neptune 0°.3 S of Moon Occ".
	22 23	Uranus (5.8) stationary FULL MOGN		01	Moon at apogee
	00	Mars 2° S of Moon			Vesta (6.8) 0°.7 N of Moon Occ".
	07	Saturn 3° S of Moon	13		Mercury stationary
13	19	Jupiter 4° S of Moon		20	Last Quarter
15	21	Uranus 4° S of Moon	17		Neptune at opposition
	07	Moon at apogee	19	14	Venus 2° N of Moon Saturn stationary (0.9)
17	19	Last Quarter Neptune 0°.7 S of Moon Occ		04	Percury 1°.1 S of Moon Occ ⁿ .
17 21	20 01			14	NEW MOON Eclipse
21	16	Equinox Venus 5° N of Moon	21	14	Moon at perigee
23		Ceres stationary (7.4)		19	Solstice
24	03	Mercury 2" N of Moon		05	Mercury 1'.7 N of Aldebaran
25	12	HEM HOOM		0 8 16	Juno at opposition (10.0)
29	06	Moon at perigee		08	Mercury (0, 7) greatest elong, W. (22*) First Quarter
31	19 12	Reptune stationary Mars at opposition (-1.2)	28		Jupiter stationary (0.4)
٠,	16	mars at opposition (-1.2)	28	14	Mars 6° S of Moon
				23	Saturn 3° S of Moon
				23	Vesta stationary
			30	03	Jupiter 4'S of Moon

DIARY OF PHENOMENA, 1982 CONFIGURATIONS OF SUN, MOON AND PLANETS

			-	OBER	
JULY d	h		d	h	
1 2		Ceres 0°.2 N of Moon Occ ^{ff} . Ceres stationary (7.6)	2	07 03	Mercury in inferior conjunction FULL MOON
ž	17	Uranus 4° S of Moon	3	03	
4	03	Venus (0.0) 4° N of Aldebaran (1.1)	9 10	03 01	Moon at perigee Last Quarter
4	15	Earth at aphelion Neptune 0°.3 S of Moon Occ ⁿ .	10	15	
5		Moon at apogee	15	13	Hercury 4° S of Moon
.6		FULL MOON Eclipse	17 18	20 17	Mercury (-0.3) greatest elong, W. (18°) Jupiter 3° S of Moon
10 11	02 18	Mars (0.5) 3° S of Saturn (1.0) Pluto stationary	18	23	
14		Last Quarter	20		Uranus 3°S of Moon
18	21	Venus 0°.6 N of Moon Occ ⁿ .	20 21	16	Plute in conjunction with Sun Mars 3° S of Moon
19 20	23	Moon at perigee NEW MOON Eclipse	22	00	
21		Mars (0.6) 1°.6 N of Spica (1.2)	23	17	
25		Mercury in superior conjunction	25 25		First Quarter Mars (1.2) 3° S of Neptune (7.7)
26 27	09	Saturn 3° S of Moon Mars 6° S of Moon	29		Mercury (0.8) 4° N of Spica (1.2)
27	12	Jupiter 4° S of Moon			
27 29		First Quarter Uranus 4° S of Moon			
43	23	oranus 4 3 or noon			
AUGU	ST		YOM	EMBE	R
1	01	Neptune 0°.4 S of Moon Occ ⁿ .	1	80	Mercury (- 0.9) 0°.7 S of Saturn (0.9)
i		Moon at apogee	1		FULL MOON
5		FULL MOON	4	04 12	Venus in superior conjunction Moon at perigee
8	14	Mercury (-0.6) 1°.0 N of Regulus (1.3) Uranus stationary	8	09	
ģ	18	Venus (-3.4) 7° S of Pollux (1.21)	13	16	
10	03	Mars (0.8) 2° S of Jupiter (-1.5)	13 15	17 17	Saturn 3° S of Moon NEW MOON
10 12	13	Vesta at opposition (6.1) Last Quarter	18	10	Neptune 0°.4 N of Moon Occ ⁿ .
17	04	Moon at perigee	19 19	20	
17 19	16 05	Venus 1°.4 S of Moon NEW MOON	20		Mars 0°.5 S of Moon Occ ⁿ . Moon at apogee
19	21	Juno stationary	23	22	First Quarter
20	17	Mercury 5° S of Moon	26 27		Pallas in conjunction with Sun Uranus in conjunction with Sun
22 24	03	Saturn 3° S of Moon Jupiter 4° S of Moon		13	Grenas in conjunction with san
24	17	Hars 6° S of Moon			
26	06	Uranus 3° S of Moon			
26 28	12 07	First Quarter Neptune 0°,3 S of Moon Occ ⁿ .			
29		Moon at apogee			
SEPT	EMBE	R	DEC	EMBE	R
3	14	FULL MOON	Ì		FULL MOON
6	03	Neptune stationary (7.7)	2 7		Moon at perigee Last Quarter
6	11	Mercury (0.5) greatest elong. E (27°) Wenus (-3.4) 0°.7 N of Regulus (1.3)	8	15	Mercury (-0.6) 3° S of Meptune (7.7)
10		Last Quarter	11 13	04	Saturn 3° S of Moon Jupiter 2° S of Moon
13		Moon at periges	14	00	Uranus 2° S of Moon
17 19	00	NEW MOON Mercury 10° S of Moon	15	-11	NEW MOON Eclipse
19		Mercury stationary (1.0)	18 19	04	Moon at apogee Neptune in conjunction with Sun
19	12	Saturn (1,0) 3° 5 of Moon	19		Mars 1°.6 N of Moon
20 21	21 06	Jupiter (-1.3) 4° S of Moon Saturn 5° N of Spica (1.2)	22	07	Solstice
22	15	Mars (1.0) 1".5 S of Uranus (6.8)	23 30	01	First Quarter Ceres in conjunction with Sun
22	16	Mars 5° S of Moon Uranus 3° S of Moon	30	14	FULL MOON Eclipse
22 23	16	Ednivox	30	21	
23	15	Vesta stationary	31	00	Moon at perigee
24 25	15	Neptune 0'.07 S of Moon Occ.			
25	21				
		· •			

THE SUN 1982

BASIC DATA

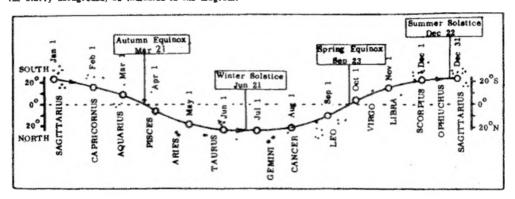
Diameter: 1 392 000 km (100 times Earth diameter) Mass: 1,98 x 10^{30} kg (320 000 times Earth Mass)

Surface Temperature: Approx. 8000°C

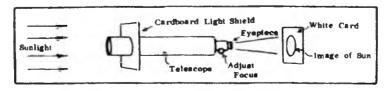
Temperature at centra: Approx. 10 million C

The Sun is our pearest 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 parsist for some weeks) and flares (abort lived).

The Earth's orbit round the Sum is not quite circular. In 1982 we will be closest to the Sun on January 4 (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 Bun. 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. Thy 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

			CAPI	TOV	M		DUI	RBAN		B	LOEM	FONT	EIN	30	HANN	ESB	JRG		SALIS	BURY	
		SU	NR ISE	at	NEET	801	NA ISE	80	NBET	au	NRISE	\$ U	NEET	SU	RISE	SU	NSET	SUN	RISE	801	NSET
Jan	1	08	38 m	20h	01ª	04 h	58 m	10 ^b	01 ^m	os ^h	21 ^{IM}	10h	18 ^m	95 ^h	18 ^m	19 ^h	04 m	osh	24 Pm	14	35 m
	11.	95	46	20	02	04	06	19	02	05	29	10	38	05	25	19	05	05	29	18	37
	21	96	5.5	19	58	04	14	19	00	05	37	19	17	05	33	19	04	05	37	18	38
Feb	1	04	07	10	52	06	24	18	55	05	44	19	13	05	42	19	00	05	42	110	36
	11	06	17	19	44	06	33	18	48	0.5	84	18	06	55	49	18	55	85	47	18	32
	21	06	26	19	33	06	41	18	38	04	02	18	87	- 05	58	18	47	05	52	18	27
Mer	1	04	33	19	23	06	46	18	30	06	00	18	48	06	00	18	39	05	5.5	16	21
	11	06	41	10	11	06	5.3	18	19	06	13	18	38	06	04	18	29	0.5	57	18	15
	21	06	49	18	3.0	06	5.9	18	06	06	18	16	27	04	12	18	19	06	00	18	04
Apr	1	06	58	18	41	04	04	17	53	06	25	18	13	.04	17	18	96	06	02	17	57
	11	07	04	18	30	08	11	17	43	04	20	18	63	96	21	17	56	06	04	17	50
	21	97	13	18	17	06	17	17	31	04	25	17	52	96	25	17	47	06	67	27	43
May	1	67	20	18	96	96	34	17	22	06	42	27	4	04	31	17	36	06	10	17	37
	11	07	28	17	67	04	31	17	14	04	49	11	36	06	37	17	31	86	13	17	32
	21	07	34	17	80	64	24	17	96	06	54	17	30	96	41	17	26	046	16	17	29
Aug.	1	07	43	17	48	04	43	17	04	07	01	37	27	-	47	17	23	06	20	17	28
	11	07	48	17	44	04	48	17	63	07	95	37	26	04	52	17	22	06	23	17	27
	21	07	81	17	44	06	51	17	04	07	98	17	27	648	55	17	24	06	26	17	29
Jul	1	07	83	17	46	08	53	17	07	07	10	17	34	66	67	17	27	06	27	17	32
	11	07	51	17	52	06	61	17	11	07	06	17	34	08	8.5	17	30	96	27	17	25
	21	07	47	17	8.6	04	48	17	14	97	66	17	39	96	5.3	17	35	06	24	17	40
Aug	1	07	39	18	06	08	42	17	22	07	90	17	45	96	48	17	41	06	23	17	42
-	11	07	30	18	13	00	34	17	29	00	53	17	53	94	41	17	46	96	18	17	48
	21	07	39	18	20	08	24	17	38	06	48	17	68	Dek	\$2	17	50	06	11	17	48
See	1	07	06	18	27	05	12	17	40	98	31	18	63	66	21	17	54	06	04	17	49
	11	08	52	18	34	08	00	17	46	06	19	18	06	06	13	17	59	05	55	17	51
	21	90	38	18	41	08	48	17	81	04	07	18	10	05	59	18	03	05	46	17	52
Oct	1	06	25	18	48	06	37	17	57	05	57	18	16	98	80	18	08	05	39	17	54
	11	06	12	10	55	36	25	18	83	05	48	18	32	96	29	18	12	05	30	17	57
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SOLAR ECLIPSES

During 1982 there will be four partial eclipses of the Sun.

On January 25, Antarctica and most of New Zealand will see an eclipse of magnitude 0.566 with greatest obscuration at 6.42 S A S T.

On June 21, observers south of a line stretching from 19° South on the West Coast of Africa to 25° South on the East coast will see a partial eclipse of the Sun. Maximum eclipse (o.617), will occur far to the South of the Continent. Times for Cape Town and Johannesburg are as follows:

	Start	End	Magnitude
Cape Town	13 ^h 32 ^m	15 ^h 25 ^m	0.3
Johannesburg	14 20	15 21	0.1
Durban	14 12	15 25	0.2

On July 20, at $20^{h}30^{m}$ a maximum eclipse of 0.464 will be seen from high Northern latitudes.

On December 15, a partial eclipse (maximum eclipse of 0.735) will be seen from Europe and the western part of Asia at about 11 am.

THE MOON 1982

BASIC DATA

Diameter: 3 480 km (0,27 of Earth)

Mass: 7,35 x 10 kg (1/81 of Earth) Surface Gravity: 0,16 of Earth

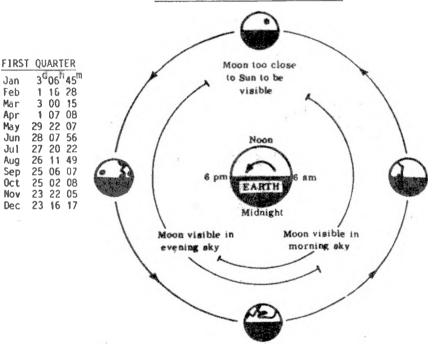
Average distance from Earth L 384 000 km

PHASES AND VISIBILITY

23 ^d 06 ^h 40 ^m 21 13 52 20 20 57	Oct Nov	17 ^d 14 ^h 09 ^m 17 02 04 15 17 10 15 11 18
	21 13 52	21 13 52 Oct 20 20 57 Nov

SUNLIGHT

SCHEMATIC DIAGRAM OF MODN'S ORBIT



LAST	QUA	RTE	R
Jan	170	01	58 ^m
Feb	15	22	21
Mar	17	19	15
Apr	16	14	42
May	16	07	11
Jun	14	20	06
Jul	14	05	47
Aug	12	13	80
Sep	10	19	19
0ct	10	01	26
Nov	8	80	38
Dec	7	17	53

		Full M			
Jan Feb Mar Apr	9 ^d 21 ^h 53 ^m 8 09 57 9 22 45 8 12 18	May Jun Jul Aug	8 ^d 02 ^h 45 ^m 6 17 59 6 09 32 5 00 34	Sep Oct Nov Dec Dec	3 ^d 14 ^h 28 ^m 3 03 08 1 14 21 1 02 21 30 13 33

THE MOON'S ORBIT

Dates of Apogee, when the Moon is furthest from the Earth (approx. 407000km) and of Perigee, when the Moon is closest to the Earth (approx. 357000km) are given below.

Moon	at Pe	rigee						M	oon	at Apo	je e				
	d	h		d	h	d	h		d	ħ	d	h		d	h
Jan	8	14	Mav	24	15 Oct	- 9	3	Dec	24	1 Ma	y 11	17	Sep	25	21
Feb	5	16	Jun	21	14 Nov	4	12	Jan	20	14 Jui	n 8	01	0ct	23	17
Mar	4	7	Jul	19	23 Dec	2	13	Feb	17	10 Ju	1 5	03	Nov	20	13
Mar	29	8	Aug		4 Dec							12	Dec	18	4
Apr	25	23	Sep		20					2 Au		2			

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 ECLIPSES

On January 9, there will be a Total Eclipse of the Moon visible from Southern Africa. The magnitude of the eclipse will be 1.337. Moon enters penumbra 19h14.8 m. Moon enters umbra 20h13.6 m. Total eclipse begins 21h16.6 m. Middle of the eclipse 21h55.8 m. Total eclipse ends 22h35.0 m. Moon leaves umbra 23h38.1 m. Moon leaves penumbra 24h36.9 m.

The total eclipse of the Moon on July 6 will occur after moonset in Southern Africa but in the extreme west of the area entry into pen-umbra and umbra at 0.22.2 and 7h32.8 m can be observed.

The total eclipse of the Moon on December 30 occurs at local mid-day and will therefore not be seen in Southern Africa.

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 a period 4,5 to 3,0 billion years ago. This has produced the heavily cratered topgraphy 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 than 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 tinycraters 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.









Jan 16, Feb 13, Mar 12 Apr 8, May 5, Jun 1/28 Jul 26, Aug 22, Sep 18 Oct 15, Nov 12, Dec 6



Jan 4/31, Feb 27, Mar 26 Apr 22, May 20, Jun 16 Jul 13, Aug 9, Sep 5 Oct 3/30, Nov 26, Dec 23

Jan 14, Feb 11, Mar 11 Apr 6, May 3/30 Jun 27 Jul 26, Aug 23, Sep 20 Oct 17, Nov 12, Dec 9





TIMES OF MOONRISE AND MOON

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MOON SET - JOHANNE

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

	JANUAR	RY	FEBRUARY	ARY	MARCH		APRIL		MAY		JUNE	
	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set	Rise	Set
	4	E	13 ^h 08 ^m	4	12h07m	23 ^h 08 ^m	14hl9m	E	14h45m	00h35m	15 ^h 03 ^m	02,36
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	9	02 30	00	03 51	17 16	02 42	17 55	04 48	17 30	05 39	17 48	07 19
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CAPE TOWN - TIMES OF MOONRISE AND MOONSET FOR PORT ELIZABETH SUBTRACT 28 MINUTES

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	JULY	λ.	AUGUST		SEPIEN	BEK	OCTOBER		NOVEMB		פרירויים.	,
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DURBAN - TIMES OF MOONRISE AND MOONSET FOR BLOEMFONTEIN ADD 19 MINUTES

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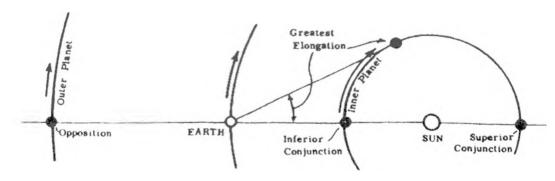
THE PLANETS 1982

BA			

	Dist from Sun	Period of Revolution	Mass	Diameter	Rotation Period	Inclination of Equator
	10 ⁶ km	years	(Earth = 1)	10 ³ km		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 56 m	23 [°] 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	27 53
Neptune	4494	164.8	17,3	44,6	14 ?	28 48
Pluto	5896	247,6	0,9?	?	6d?	7

GENERAL

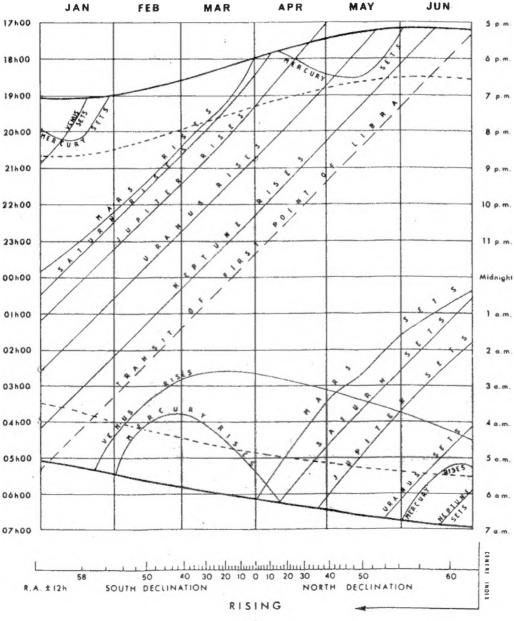
Apart from Uranus, Neptune and Pluto, the planets of our solar system are amongst the brightest objects in the night sky. Unlike the distant stars, their relative positions do not remain fixed, but continually change as, like the Earth, they orbit around the Sun. Their apparent movements against the 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 1982 are listed chronologically in the Diary (pages 4 and 5) and are also mentioned in the text below.



TIMES OF RISING AND SETTING

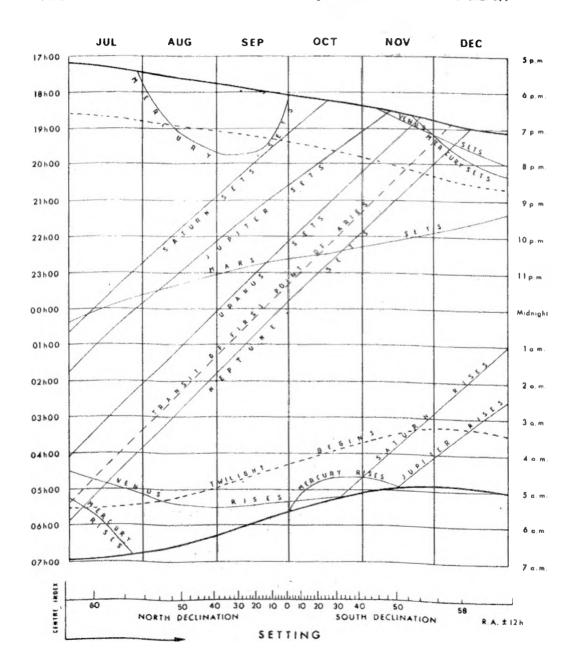
The times of rising and setting given by the diagram are accurate for position 30° East. 30° South, and approximately correct for other places in Southern Africa. Strictly speaking, corrections for latitude and longitude should be applied, but the latitude correction is, in general sufficiently small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



THE PLANETS 1982

rising or setting. Measure the 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).



The Planets 1982

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 planet, Mercury, appears to move very rapidly among the stars either in the early evening or just before dawn. Its greatest angular distance from the Sun is 28° but at some elongations it is as little as 18°. Best times for viewing the planet are a few days on either side of the following dates. In the evenings, Jan 16, Jun 1. Sep 6 and mornings Feb 26, Dec 30.

Greatest Elongation East Stationary	Jan	22 20	May	21 12	Sep Sep	36 29 (20°)
Inferior conjunction Stationary	Feb	1 06	Jun	1 22	Oct	2 07
	Feb	13 00	Jun	13 23	Oct	10 15
Greatest Elongation West	Feb	26 13(27°)	Jun	26 16(22°)	Oct	17 20(18°)
Superior conjunction	Apr	11 20	Jul	25 10	Nov	19 20

VENUS

Venus will be in the evening sky in early January but will move rapidly into the twilight reaching inferior conjunction on Jan 21. From then on till Nov 4, it will be in the morning sky reaching greatest elongation west of the Sun on Apr 1.

Its magnitude varies from -4.3 at the begining of the year to -3.2 on Jan 21 and then brightens to -4.3 on Feb 25, fades to -3.3 in June and stays at that level for the rest of the year.

Venus can be seen during the daytime with the unaided eye and if the Moon is near the planet, noting the relative positions in the pre-dawn sky will α greatly help to locate the planet later in the day.

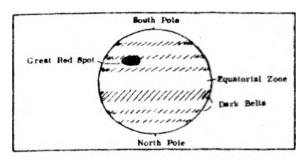
MARS

Mars at the beginning of the year rises at midnight and is relatively faint at mag 1.1 in the constellation of Virgo.

It rises earlier each night till at opposition on March 31 it rises at sunset and is visible all night. By this time it has brightened to -1.2 after which it slowly fades back to 1.3 at the end of the year. On July 26, it will be at mag 0.7 when it passes 1°.6 North of Spica (mag 1.2). In mld-August It passes into Libra and then into Scorpius, Ophiuchus and Sagittarius. On the morning of October 3, Mars (mag 1.1) passes 3° North of the equally red star Antares (mag 1.2). On July 10, Mars will be 3° South of Saturn and on Aug 10, it will be 2° South of Jupiter.

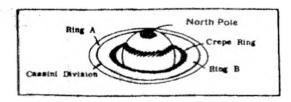
JUPITER

Jupiter (mag -1.4) only rises well after midnight at the beginning of the year. It is at opposition on April 26, by which time it can be seen all through the hours of darkness. It has brightened to -2.0 at this time. It will move forward steadily until it disappears into the evening twilight in late October. On Nov 13, it will be in conjunction with the Sun and from late Nov, it will be seen in the morning sky. The gap between Jupiter and Saturn will widen from 13° in Jan to 20° in April, narrow to 15° in July and widen to 28° at the end of the year.



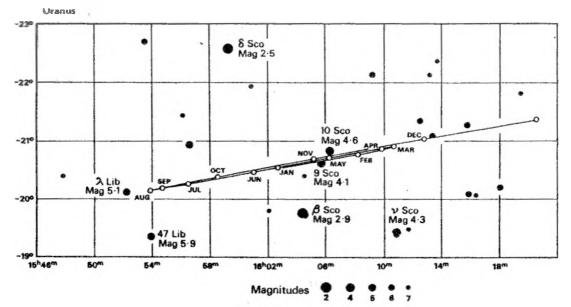
SATURN

Saturn (mag 1.0) rises shortly after midnight at the beginning of the year in Virgo and remains in this constellation throughout the year (passing 5°N. of Spica, mag 0.5, on January 8, February 25 and again on September 21). Saturn is at opposition on April 9 when it can be seen throughout the night, and from early July until the beginning of October it is visible only the in evening sky. It then becomes too close to the Sun for observation until early November, after which it can be seen in the morning sky for the rest of the year. Saturn (mag 1.0) is in conjunction with Mars (mag 0.5) and with Mercury (mag -0.9) on November 1.



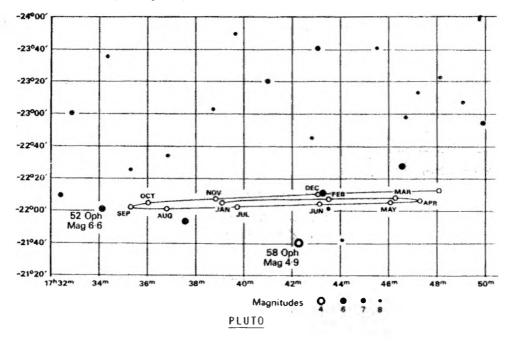
URANUS

Uranus (mag 5.8) rises well before sunrise at the beginning of the year in Scorpius and is at opposition on May 24. From late June until late September it is in Libra, and for the rest of the year it is in Scorpius. Uranus is in conjuction with the Sun on November 27.



NEPTUNE

Neptune at magnitude 7.7 can be detected using binoculars in the constellation of Ophiuchus. Its diameter is 2.5. and its apparent size will help in identifying the planet. In mid-January and mid-June it will be about 0.4°. South of 58 Oph (mag 4.9)

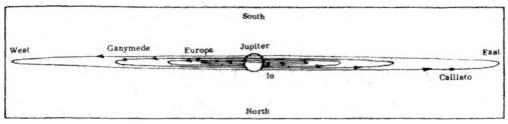


Pluto at mag 14 can only be detected with a large telescope. It varies in R A from 13^h53^m to $14^{l}10^m$ and in Dec from +4°53' to +6°53'. Its distance from the earth varies from 29 to 31 A U.

THE MOONS OF JUPITER AND SATURN 1982

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 2 am each day.

When the moons pass in front and behind the planet, transits, occultations and eclipses occur. Details of such phenomena occuring 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 1 - Io III - Ganymede

II - Europa IV - Callisto

Phenomena - the abbreviations used are:

Ec. - Eclipse: the satellite passes through the shadow of JupiterOc. - Occultation: the satellite is obscured by the disk of Jupiter

D. - DisappearanceR - Reappearance

Tr. - Transit: the satellite crosses the disk of Jupiter

Sh. - Shadow Transit: the shadow of the satellite transits the disk

I - Ingress
E - Egress

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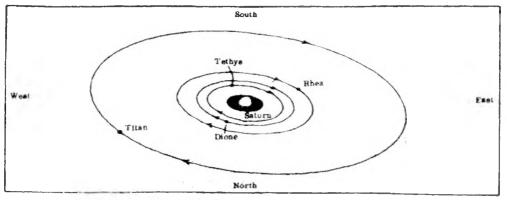
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THE MOONS OF JUPITER AND SATURN 1982

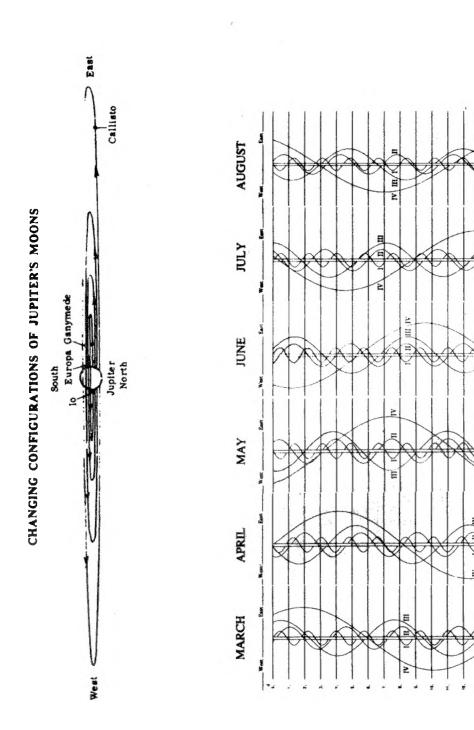
SATURN'S MOONS

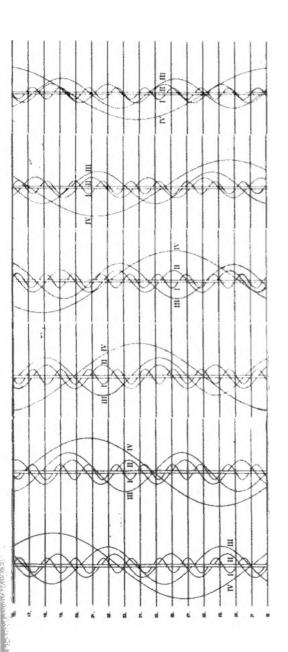
Saturn's moons are considerably fainter than the four Galilean moons of Jupiter. The diagram shows the orbits of four of Saturn's ten moons. The easiest to find is Titan (magnitude 8,5), according to the diagram and the information in the table below.



TITAN UNIVERSAL TIME

Eastern Elongation			Infe	rior	Conjunction	West	ern El	ongation	Super	rior (Conjunction		
	d	h	Jan	d 0	h 17.0	Jan	d 4	h 17.7	Jan	d 8	h 22.5		
Jan	12	21.3		16	16.3		20	16.9	Van	24	21.6		
	28	20.3	Feb	1	15.2	Feb	5	15.7	Feb	9	20.2		
Feb	13	18.8		17	13.6		21	14.0		25	18.4		
Mar	1	16.9	Mar	5	11.7	Mar	9	11.9	Mar	13	16.2		
	17	14.7		21	09.4		25	09.5		29	17.8		
Apr	2	12.3	Apr	6	07.0	Apr	10	06.9	Apr	14	11.2		
	18	09.9		22	04.5		26	04.4		30	08.7		
May	4	07.5	May-	. 8	02.1	May	12	02.0	May	16	06.4		
	20	05.4		24	0.00		27	23.9	Jun	1	04.5		
Jun	5	03.6	Jun	8	22.3	Jun	12	22.3		17	02.9		
	21	02.2		24	21.0		28	21.1	Jul	17	01.8		
Jul	7	01.1	Jul	10	20.1	Jul	14	20.2		19	01.1		
	23	00.5		26	19.5		30	19.8	Aug	4	00.8		
Aug	8	00.2	Aug	11	19.3	Aug	15	19.8		20	00.8		
	24	00.1		27	19.3		31	20.0	Sep	5	01.1		
Sep	9	00.4	Sep	12	19.6	Nov	19	23.3	Nov	24	04.2		
Nov	28	02.8	Dec	1	22.2	Dec	5	23.8	flec	10	04.7		
Dec	14	03.0		17	22.4		22	00.1		26	04.8		
	30	03.0									00		





and horizontal lines, representing 2 a.m. (O hrs. Universal time), are shown for every day. The wavy lines show how the Moons appear to oscillate from each side of the planet to the other. shows how their positions along such a straight line change 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 the four bright moons of Jupiter always appear close to a straight line passing through the planet since, central column of the month.

COMETS AND METEORS

COMETS

Comets are essential 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 nucleas 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.

	Conditions	at Maximum	Unfavourable	Favourable	Unfavourable	Favourable	Favourable	Favourable	Favourable	Favourable	Favourable	Unfavourable	Unfavourable	Unfavourable	Favourable	Unfavourable	Unfavourable	Unfavourable	Favourable	Unfavourable	
	Recommended	Time of Watch	1	02h-dawn	D4h-dawn	20h-03h	20h-01h	20h-02h	03h-dawn	23h-04h	02h-dawn	04h-daim	,		01h-dawn	20h-22h	02h-dawn	214-234	21h - 03h		
	fant pprox	Red	04"45"	15	30	30	8	30	40	50	0	10	00	10 40	30	50	30	10	00	00	
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	пит: √{ ті		ĸ	15	18	2	80	80	2	60	35	11	10	12	35	91	10	~	55	6~	
	e.		9	22	s)	14	9	20	28	52	59	31	2	9	21	4	17	4	4	53	
	Date		Mar	Apr	May	Jun	Jun	Jun	Jun	Jul	Jul 2	Jul	Aug	Aug	Oct 2	Nov	Nov	Dec	Dec	Dec 2	
			ē					95											-	_	
	Radiant	Dec	-48	+32	00	-30	+35	-20	-15	-15	1-17	-30	-10	-15	+15	+14	+22	-55	+35	-51	
	Rad		m02	8	4	00	32	20	8	8	36	40	36	4.5	24	44	80	00	28	99	
		R.A.	16 h 20 m	18 08	22 24	18	18	17	+02 00	21 (22	22 (20	(22 (22)	90	(03 4	10	10	07 2	60	
	Shower		Corona Australids	April Lyrids	Eta Aquarids	Sco-Sgr System	June Lyrids	Ophiuchids	Cetids (new)	Capricornids	Delta Aquarids	Pisces Australids	Alpha Capricornids	lota Aquarids	Ortonids	Taurids	Leonids	Phoenicids	Geminids	Velaids	
			18	24	12	30	21	56	59	2	15	20	52	54	27	2	20	s	15	1	
			Mar									Aug			177	Dec			Dec		
					7									15 - 1		1	1	3 - 6	-		
												15	15	15		9					
			Mar	Apr	May	Apr	Jun	Sun	Jun	Sul	Jul	30	34	Jul	Oct	Oct	Nov	Dec	Dec	Dec	

* Uncertain - observations will be welcome

29

THE STARS

CONSTELLATIONS

Apart from our Sun all the stars that we see are so incredibly distant that, despite their high speed velocities, their apparent positions change by only minute amounts each year. Consequently the patterns that they form appear unchanged. The Greeks and other ancient civilisations identified these patters, 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 a(Alpha), the next B(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

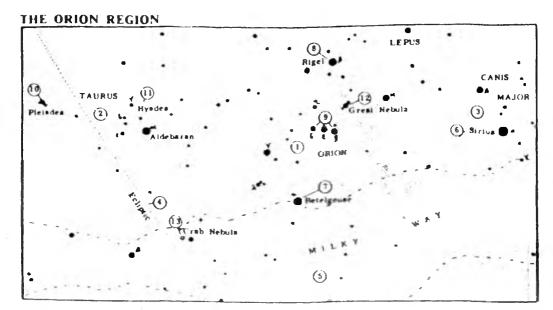
These are of two completely different sorts. Galactic clusters, having of the order of 100 stars, are found close to the plane of the Milky Way. The ones we can see are relatively nearby. Globular clusters are much larger and far more distant. They contain of the order of 100 000 stars each and are seen 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).

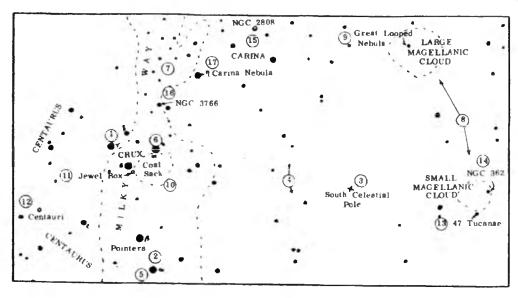
THREE POPULAR REGIONS

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.



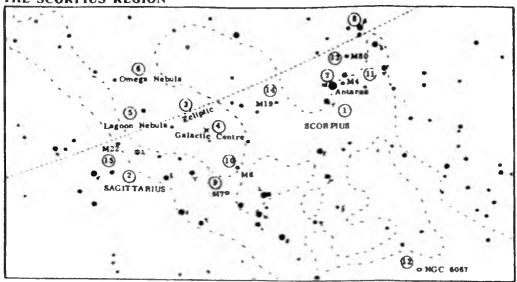
- 1) The constellation of Orion. The figure of the legendary hunter of Greek mythology is unfortunately upside down when seen from Southern Africa. The faint stars by λ represent the head, α and γ the shoulders. δ ϵ ζ the belt, and β and κ the legs. Orion forms part of the "great hunting scene" in which 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 tepus, 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) Beteigeuse 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 \$20 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 Oriom'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.
- The Hyades is another nearby galactic cluster, but Aldebaran is not a member (it lies closer to us).
- 12) The Great Nebula im 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 Nobula, the remnant of a supernova recorded by the Chinese in 1054, requires a moderate sized telescope for observation. In its heart is located the extraodinary pulsar which emits a double flash of light 30 times every second. The current belief is that it is a rapidly rotating neutron star a star with the mass of our sun but with a diameter of only 10 km.

THE SOUTHERN CROSS REGION



- 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 morthern 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) CL Centauri has the distinction of being the closest star to our solar system at a distance of approximately 40 \times 10 $^{\circ}$ km or 4,3 light years. A small telescope readily shows that it is a double star the two components take 80 years to resolve about one another. A much fainter third star also belongs to the system.
- 6) Of Crucis can also be respired as a double star by a small telescope (separation 5 sec of arc).
- 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).

THE SCORPIUS REGION



- 1) The constellation of Scorpius. The creature is depicted with α in the centre of the body and β and if the claws. The distinctive tail $\epsilon \zeta \theta$ 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 glant, 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 91 M7, 101 M8, 111 M4 and 121 NGC 6D67, (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 maked 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 07104 L2 Puppis, are so bright that they may be observed without optical aid whatever.

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

campies	include:	
		Approx. magnitude range
0214 <u>03</u>	o Ceti Mira	2.0-10.1
0929 <u>62</u>	R Carinae	3.9 -10.0
100661	S Carinae	4.5-9.9
1006 <u>61</u>	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 give predictions for three stations, namely,

	Longitude	Latitude
Cape Town	- 18°,475	-33°,933
Johannesburg	- 28°,075	-26°,182
Salisbury	- 31°,040	-17°,788

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

Approximate time = predicted time + $a \cdot \Delta \lambda + b \cdot \Delta \phi$

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).

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

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
- the spectral classification of the star
- Mag the visual magnitude
 Ph the Phase: D = Disappearance, R = Reappearance
 h.m. the time of the occultation in U I
- 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

Lunar Occultations 1982

							C/	APE	TOWN			JO	HIAR	INE SB	URG			SALI	SBURY		
	Date	ZC No	Mag.	Ph	El of	ñ		8	b	PA	U	Ŧ		a	b	PA	U	ſ	ð	Ь	PA
Jan		66	6.0	D	Monn 84	h	M	N)	m		h_	m	-	m	m		h	M 15 4	m 2 0	-0,6	
Jan	2 5	66 475	6.8 7.4	C	125												22			~0.9	110 123
	6	629	7.5	D	139	21	49.5	5 -1.	9 +0.8	85	22	14	1.6	-1.6	+1.4	69				+2.3	43
	10 12	1277 1544	5.5 5.7	R R	195 222	22	36.0	3		351							"	38.0	-	-	216
	21	2448	6.4	R	315	2	25.7	2 +0.	2 -2.2	318							l				
ŀ	30 30	165 170	6.7	D D	66 67	18	24.5	5 -1.	8 +0.6	106	18	43	3.4	-1.1	+0.8	94				+0.3	97 73
	31	298	7.2	D	80	18	39.9	9 -1.	1 42.6	26	19	12	0.5	-0.8	+3.7	11			•.0		,,
Feb	31 2	303 581	6.6 6.9	D D	80 107		18.2			135 145					+0.4	108 115	20	33 A	-1 4	+0.6	89
1.05	4	911	6.3	D	135	23	20.4	-}.	8 +2.7	40							10	33.7	- 1 , 4	٠٠.٥	09
ĺ	5 6	1078 1224	5.9 5.4	D D	149 162				6 +0.6 9 -0.2	97 110	23				+1.8	63 79	22	35.1			31
	6	1224	5.4	R	162	1		, ,.	, 0.2				.,	· L. J	*1-0	,,		52.6			4
	11 13	1813	6.0	R R	226 250	23	20 8	s -0	3 -2.7	332	20	26	.0			221	20	33.0	-0.9	-0.3	260
Mar	13	523	6.5	Ď	76	"	25.0	, -0.	J - L.1	332							19	27.1		220	151
İ	3	843	7.2	D	103				1 +2.0	45	1	,					١.,				
ļ	3	851 1014	6.3	D D	103 115		44.1		2 +0.5	106	121	b	.8	-1.1	+1.2	77	21	25.1	-1.5	÷2.5	43
	5	1152	6.9	D	129				2 -1.5	122	18	0	.6	-2.5	-0.8	106	18	5.7	-2.8	+0.1	84
ì	5 14	1167 2223	6.3 4.0	D		21	9,.	3 -2.	2 +1.1	75	23	33	1.3	-0.8	-2.7	145	23	18.5	-1.6	-1.6	116
	15	2223	4.0	R	242										-0.8	275	0	48.0	-2.1	-2.1	306
	16 18	2361 2614	4.8 6.2	R R		2	0.8	3 -1.	2 -1.6	284	١,	54	1	-0.9	-3,3	323	3	7.2			240
	22	3171	3,8	D	322	3	15.3	3 -0.	2 -1.8	109					-0.4	75	3	19.6	-1.4	+1.7	39
	22	3171 3303	3.B 6.2	R R		4	14.0) -1.	1 +0.4	231	1 2	17	5	-0.1	-2.2	298	1				
ł	29	629	7.5	Ď	58						ا ا	"		0.1		230	18	4.8	-0.4	-1.4	134
	29 31	639 946	6.0 3.2	D R		18	41.6	5 -0.	B +0.9	95							1,6	- 2	2.0	. 2.4	222
	31	976	3.2	Ď							19	50	1.2	+0.2	-2.1	154	16			+2.4	223 116
Apr	1	1118 1269	6.0 7.0	D 0					3 +0.7 5 +0.8	80		10				44	1				
	3	1392	7.1	Ð		"	12.1	-1.	3 70.0	94	21	42		-0.9	-1.2	46 141	21	1.1	-1.7	-0.3	110
	11 13	2291 2436	5.5 6.3	R R		١,	2 .	. 1	6 -2.5	212	20	27	. 3	-1.1	-0.6	260	20	22.1	-0.7	-1.2	258
l	15	2838	5.6	R				9 0.0		313 265	22	22	.5	+0.2	-1.7	299	1				
İ	18	3113	5.4	D		,			2 1 0	267		32		~ -		355					
	18 25	3113 577	5.4 6.0	R D		1,	1.0	o -).	3 -1.9	287	'	4 }	.9			342	16	4.1	-1.2	12.5	36
1	27	907	6.9	Đ		16	51.8	3 -1.	7 +1.1	77	17	21	.6	-1.9	+2.6	45					
	27 29	911 1215	6.8	D D							16	12	.2	-2.0	-1.6	137				-0.5	124 110
	29	1222	7.2	D	81	17	33.1			38	"	-									
May	29 1	1224 1479	5.4 6.3	D D		20	16.0	0 -0.	9 -1.1	146	20	23	1.4	-1.4	+0.1	107				-2.3 +1.8	158 70
"	1	1485	7.2	D	108											X				-1.2	143
l	2	1586 1586	7.5	D R		16	53.6	5 -2.	1 -0.8	89		26 51				47 14	{				
	2	1598	6.4	Đ	120		3.8			64	1					U. '	1				
İ	11	1813 2635	6.0 5.7	D R					4 -0.1 5 -2.2	101 316											
ł	16	3197	6.5	R	270	1	0		J E.E	310							2	20.2	-2.1	+3.8	204
	26 27	1167 1315	6.3	D D							16	52		-1 1	-0.9	125				-2.5	159
	29	1569	6.8	D		20	49.8	8 -0.	B +0.4	109					+2.4	135 64	10	34.4	-1.7	0.0	104
Jun	30	1589	5.5	D						50		22		2.0	. 0 3	71					
Jun	1	1897 2005	7.4 7.0	D D		100	37.4	1.	9 -0.4	116					+2.3	71 172	21	33.4	-1.8	-1.5	133
	8 8	2747	5.0	R		21	57 1	1 -2	2 .1 7	220	21	36	.6	-2.6	+0.6	246	21	42.3	-2.5	-1.0	280
	9	2749 2762	5.0 6.0	R R					5 +1.3 6 -0.5	230 279					-0.6 -2.3	270 308	122	19.0	-2.5	-2.4	304
	9	2769	6.3	R	206				4 +3.3		3	12	.5	-1,1	+2.1	239	3	29.0	-1.3	+1.0	262
	19 19	523 523	6.5	D R								46 57				144 163					
	23	1253	7.4	D	30				1 +1.0	90	1										
	25 28	1514 1854	6.1	D 0					4 -0.2	120 156					+1.4	78 116	1.9	12 A	-3 E	+1.3	79
	29	1965	6.5	Ď		T.				. 50	Ľ	J	. 1		٠.,	. 10			-3.5		179

Lunar Occultations 1982

			-				PE TO			Г		INNESE	URG			SAL	ISBUE		
	Date	ZC No Ma	g. Ph	El of Moon	U	T	A m	m b	PA	U	n n	8	þ	PA		J T	a	b	PA
Jul	4	2547 4.5	9 D	163				-				-0.3		141			-0.9	n (a	110
	10 12	3356 5.9 3506 6.3		231 244		48.3 37.9			261 236	21	45.9	-1.1	-2.3	293 240	١.		-2.8		256
	17 23	610 6.2 1586 7.5	5 n	308 38		58.2			69									+3.3	185
	25 27 28	1813 6.0 2035 7.1	l D	88		27.5			129			-1.7		89		57.2			185
	29 30	2158 7.3 2271 4.3 2391 7.1	3 D	101 112 122	21	3.6 45.8	-1.2		134		15.5	-0.9 	+0.3				-0.6 -1.6		74 125
Aug	8	3478 6.5 49 6.3	5 R	214	2	23.7	-1.7	+1.8	234			-1.5 -2.7		235 280	3	12.6	-1.7	+1.4	251
	10 23	170 6.2 2005 7.0		238 58		55.3 22.8			282 157	- 1	14.2			291 125					
	26 27	2361 4.8 2498 4.5	5 0	92 104		29.4 53.5			72 138			-0.1 -0.4		45 122					
	28 28	2604 6.6 2604 6.6	5 R	113											18				169 206
	29 29 29	2747 5.0 2749 5.0 2754 5.9	Ō	124 124 124						16	49.7	-2.9	+1.1	63	18	16.0	-3.5	+2.4	50 154
	29 29	2762 6.0 2762 6.0) D	125 125		4.4			50	20 20	9.4 24.7			1 344	,,,	1.0			134
	29 30	2769 6.3 2785 6.8	3 0	126 127	0	17.8	-0.7	+0.5	104	21 0		-1.7 -0.2		90 101	21	56.1	-1.1	+1.6	67
Sep	2 6 9	3171 3.8 249 4.7 654 6.0	R	160 219 258		29.7 54.4		-0.2	354 244	20	59.1	-1.1	-0.6	262			-2.1		295
	9	668 3.6 668 3.6	D	259 259								-1.7 +0.3			23	11.2	-0.8 -1.1 -0.7	-0.6	272 90 219
	11 11	817 4.8 828 6.5		272 273	1	42.0	-1.7	-1.8	292	0	9.3	-0.4	+0.2	238			-1.0		260
	23	2180 7.0 2425 5.9	0	49 71	23	20.7				17	1.8	-2.4	-1.0	122			-1.0 -2.4		137 91
	23 24 24	2446 7.2 2549 6.6 2557 6.2	D	73 82 83	21	20.7	-0.3	40.6	108	16	37.9	-2.9	-0.4	103			-2.9		71
	25 25	2709 6.8 2709 6.8	3 0	94 94						19 19	6.9			157 188			-2.4 -2.7		114
	25 26	2725 5.8 2873 7.2	? D	96 107	23	9.0 41.5			5 71										
0	27 30	2988 6.8 3356 5.9	D	117	17	23.8	-1.2	-0.3	69	17	38.6	-0.9 -1.6	+1.4	44	18	6.2	-0.4	**	
0ct	5 8 9	354 5.5 784 6.2 956 6.3	R	203 243 256	1	12.7 36.7 32.1	-2.4	-0.9	266 283 267	3	55.3	-1.8 -3.0 -2.4	-1.0	275 291 274	1	48.2	-2.0		301 322 295
	22	2661 7.1 2793 6.5	0	63 73		15.5			100			-0.5			19	39.6		+1.3	67 47
	26 27	3197 6.5 3327 6.8	3 D	108 121		12.6			35			+0.2		28		14.3		**	129
Nov	6 9	1070 5.2 1484 3.6	D	239 279		15.0 35.2			262 113	24	2.0	-2.5 -2.1	-0.9	274 94			-2.9 -2.7		296 68
	18 18 18	2595 5.7 2604 6.6 2608 6.9	0	32 33 33		15.2 49.2			96 132	'	32.1	-0.3	+0.7	96					
	19	2754 5.9 2684 7.4	- B	:44. 54.		47.2			95			0.0		87 103	17	25.7	-1.2	+1.0	82
	21 23	3014 7.3 3271 7.1	D D	65 88	18	44.0 59.0	-0.7	+3.0	102 28	19 19	2.5 26.7	-1.0 -0.3	+0.7 +2.9	96	19	12.5	-0.5 +0.8	+1.0	78 3
	24 26 28	3392 7.1 95 7.1 354 5.5	D	99 124	55	26.8			47 356			-1.0		Ì	20	17.4	-0.4	+2.6	29
Dec	3 12	354 5.5 1015 6.4 1023 6.5	R	149 206 207	0	1.5 42.0 49.5			350 314 317	20	29.5			347					
	21	3356 5.9 3478 6.5	D	69 80	21	20.2	-0.1	+1-2	89 27	19	14.0	-0.4	+2.8	24	19	41.6	+0.4	+4.1	ı
	23 24	49 6.3 165 6.7	D D	92 103	20	19.2	-0.7	+2.4	34	20	43.8	-0.4	42.6		21	11.2	-2.5		358 61
	24 25 26	170 6.2 298 7.2	. 0	103	19	39.0 58.9			84 123	20	23.3	-2.3 -2.8	-0.5	115	19 20	25.7 31.4	-1.9 -2.1	+1.4	67 92
	26 	437 7.4 	0	130	22	30.4	-1.4	11.1	88	22	51.6	-1.0	+1.4	72	23	8.1	-0.9	+1.9	48

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 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.

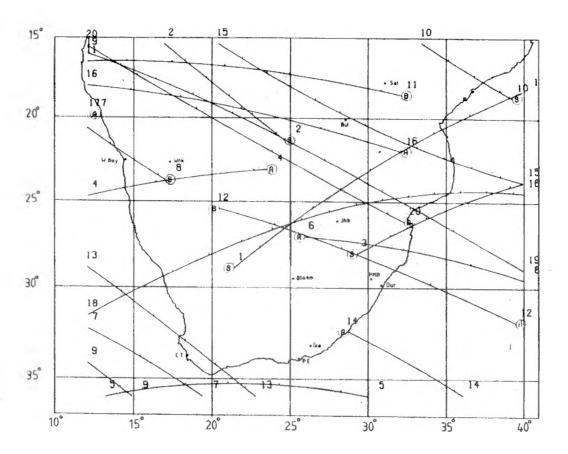
Date

Beginning: an arbitrary time (U T) of the beginning of the track in the west.

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

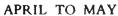
Limit - N = northern limit (a complete occultation takes place south of track).

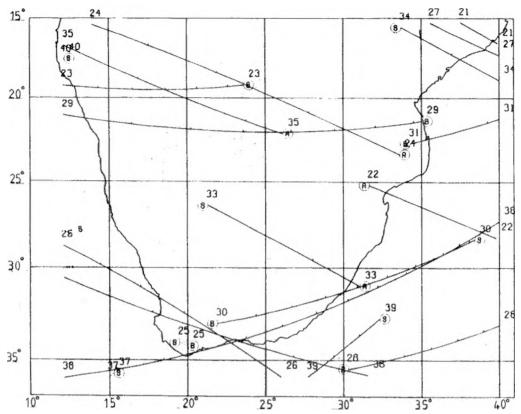
S = southern limit (complete occultation north of the track).



GRAZING OCCULTATIONS 1982 KEY TO MAP ?

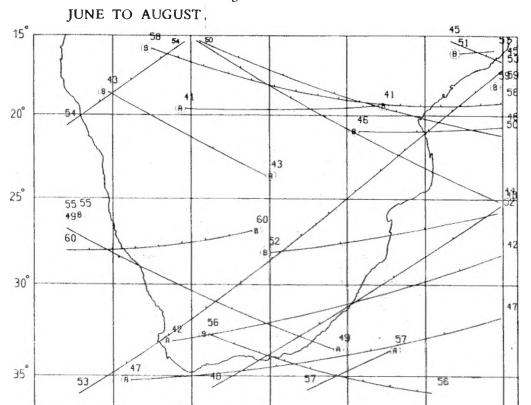
	ZC	MAG.	TIME (U,T			BEGIKNING West Win	PERCENT SUNL IT	N OR S LIMIT	AITKEN NO.
1	66	6.8	JANUARY	2	18	4	45	S	
2	1773	5.1	JANUARY	15	3	15	68	S	
3	165	6.7	JANUARY	30	17	25	30	s	
4	178	6.8	JANUARY	36	19	59	31	S	
5	501	6.9	FEBRUARY	Z	20	17	65	S	
6	1813	6.0	FEBRUARY	11	20	16	85	s	
7	2048	7.2	FEBRUARY	13	23	20	66	S	
8	2167	7.5	FEBRUARY	15	3	59	55	s	
9	2280	6.8	FEBRUARY	16	2	27	46	S	9848
10	2408	6.9	FEBRUARY	17	2	37	37	5	
- 11	523	6.5	MARCH	1	19	10	38	S	
12	843	7.2	MARCH	3	19	58	61	N	4200
13	2223	4.0	MARCH	14	23	54	73	S	9704
14	2341	7.2	MARCH	15	20	54	65	S	
15	2361	4.8	MARCH	16	2	6	63	s	
16	629	7.5	MARCH	29	17	58	24	s	
17	643	6.7	MARCH	29	19	50	25	5	
18	946	3.2	MARCH	31	14	43	45	S	4841
19	1118	6.0	APRIL	1	19	0	58	N	
20	1269	7.0	APRIL	2	21	39	70	N	The field are at 10 minute into
						39	_		The ticks are at 10 minute into





GRAZING OCCULTATIONS 1982 KEY 10 MAP 2

				NET	10	MAP Z			
	ZC	MAG.	TIME (U. OF THE T			BEGINNING WEST MIM	PERCENT SUNLIT	N OR S LIMIT	AITKEN NO.
21	2547	4.9	APRIL	13	22	2	72	\$	
22	2964	6.6	APRIL	16	22	39	44	S	
23	2988	6.8	APRIL	17	3	46	42	S	
24	907	6.9	APRIL	27	17	32	21	N	
25	1215	6.8	APRIL	29	16	29	42	S	
26	1222	7.2	APRIL	29	17	36	43	N	
27	1479	6.3	MAY	1	21	2	66	N	
28	3069	6.2	MAY	15	2	28	59	N	
29	3197	6.5	MAY	16	1	19	50	\$	
30	3327	6.8	MAY	17	2	56	39	8	
31	178	6.8	MAY	20	2	45	12	Ħ	
32	322	5,7	MAY	21	5	23	5	N	
33	1017	6.8	MAY	25	16	17	9	N	
34	1161	6.2	HAY	26	15	44	17	K	
35	1569	6.8	YAH	29	21	14	51	N	
36	1689	5.5	MAY	30	21	57	62	N	
37	3171	3.8	JUNE	12	5	52	74	N	
38	3409	7.0	JUNE	14	- 1	30	56	N	
39	3419	4,5	JUNE	14	4	25	55	N	16633
40	3425	4.6	JUNE	14	5	28	55	N	



GRAZING	OCCUL.	TATIO	HS	1982
KΕ	f TO	MAP	3	

25°

30°

35°

400

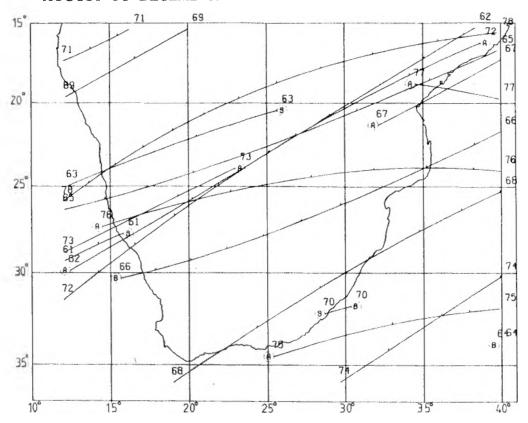
				KŁY	10	MAP 3			
	ZC	KAG.	TIME (U.	T.) AT RACK IN	THE F	BEGINNING WEST	PERCENT SUNLIT	N OR S LIMIT	AITKEN NO.
41	3529	6.8	JUNE	14	HR 23	MIN 44	1 46	s	
42	249	4.7	JUNE	17	1	24	25	N	
43	1253	7.4	JUNE	23	16	58	7	N	
44	1514	6.1	JUNE	25	17	26	24	N	
45	1854	6.9	JUNE	28	18	50	55	K	
46	3356	5.9	JULY	10	21	20	B1	N	
47	66	6.8	JUI Y	12	22	48	62	N	
48	617	6.6	JULY	17	3	16	18	N	
49	1586	7.5	JULY	23	17	12	11	N	
50	1813	6.02	JULY	25	17	56	29	N	
51	2043	6.6	JUL Y	27	20	42	50	S	
52	2271	4.3	JULY	29	21	28	69	S	
53	298	7.2	AUGUST	11	1	28	66	N	
54	577	6.0	AUGUST	13	3	55	43	N	
55	2361	4.8	AUG/IST	26	21	1	53	N	
56	2465	7.4	AUGUST	27	16	40	61	N	
57	2498	4.5	AUGUST	27	23	13	63	5	
58	2749	5.0	AUGHST	29	16	53	79	N	
59	2754	5.9	AUGUST	29	18	49	79	s	
60	2762	6.0	AUGUST	29	19	24	79	N	

10°

15°

20°

AUGUST TO DECEMBER



GRAZING OCCULTATIONS 1982

				KEY	TO	ISP 4			
	ZC	MAG.	TIME (U.T. OF THE 1RA			BEGINNING WEST MIN	PERCENT SHILL IT	N OR S LEMET	NO.
61	404	5.2	SEPTEMBER	8	4	45	78	K	
62	828	6.5	SEPTEMBER	11	- 1	9	47	Ħ	
63	1308	4.7	SEPTEMBER	14	3	55	15	R	
64	2425	5.9	SEPTEMBER	23	17	54	35	S	
65	2557	6.2	SEPTEMBER	24	19	18	44	\$	
66	2709	6.8	SEPTEMBER	25	18	51	54	S	
67	766	6.0	OCTOBER	7	21	18	74	N	
68	954	6.1	OCTOBER	9	0	43	62	N	
69	956	6.3	OCTOBER	9	0	43	62	N	
70	2509	6.0	OCTOBER	21	16	47	19	N	10522
71	2928	6.5	OC10BFR	24	18	16	46	2	
72	3197	6.5	OCTOBER	26	21	52	66	S	
73	2597	7.0	NOVERBER	18	18	28	8	S	10991
74	2884	7.4	NOVEMBER	20	17	35	21	\$	
75	1435	6.6	DECEMBER	5	22	54	69	M	
76	1436	6.9	DECEMBER	5	23	20	69	N	
77	1897	7.4	DECEMBER	10	0	21	26	\$	
78	178	6.8	DECEMBER	24	20	24	62	S	

: THE TICKS ARE AT 5 MINUTE INTERVALS.
THE TRACKS WERE CALCULATED AT 10 SECOND 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 ZUG

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 Olifantsfantein, and the 100 MHz signals from Johannesburg.

Carrier	Frequency	Radia	ited Power	Time of	Transmission
2,5	MHz	4	Kw	2000	- 0600 SAST
5	MHz	4	Kw	Conti	Zutuln
100	MHz	80	W	Conti	mpous

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 UTI 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 $30\,^{\rm o}$ meridian and a sundial on that meridian reads noon.

Jan	1 11 21 31	12 ^h 03 ^m 29 ^s 12 07 52 12 11 16 12 13 27	May 11 21 31 Jun 10	11 ^h 56 ^m 20 ^s 11 56 30 11 57 34 11 59 17	Sep Oct	18 28 8 18	11 ^h 54 ^m 15 ⁵ 11 50 46 11 47 38 11 45 14
Feb	10 20	12 14 16 12 13 48	20 30	12 01 24 12 03 31	Nov	28 7	11 43 51 11 43 41
Mar	2 12 22	12 12 15 12 09 52 12 07 00	Jul 10 20 30	12 05 14 12 06 16 12 06 24	Dec	17 27 7	11 44 56 11 47 32 11 51 20
Apr	1 11 21	12 03 59 12 01 08 11 58 45	Aug 9 19 29	12 05 29 12 03 3 9 12 01 00		17 27 31	11 56 00 12 00 56 12 02 53
May	1	11 57 07	Sep 8	11 57 46			

Time Systems

SIDEREAL TIME ON THE 30° MERIDIAN

		At O hrs SAST	At 21 hrs SAST			At O hrs SAST	At 21 hrs SAST			0 hrs SAST	21 hrs SAST
Jan	1 11 21 31	6 ^h 41 ^m 7 20 8 00 8 39	3 ^h 44 ^m 4 24 5 03 5 43	May Jun	11 21 31 10	15 ^h 13 ^m 15 53 16 32 17 12	12 ^h 17 ^m 12 56 13 36 14 15	Sep Oct	18 28 8 18	23 ^h 46 ^m 0 25 1 05 1 44	20 ^h 49 ^m 21 29 22 08 22 48
Feb	10 20	9 19 9 58	6 22 7 02		20 30	17 51 18 31	14 55 15 34	Nov	28 7	2 24 3 03	23 27 0 07
Mar	2 12 22	10 37 11 17 11 56	7 41 8 20 9 00	Jul	10 20 30	19 10 19 49 20 29	16 13 16 53 17 32	Dec	17 27 7	3 43 4 22 5 01	0 46 1 25 2 05
Apr	1 11 21	12 36 13 15 13 55	9 39 10 19 10 58	Aug	9 19 29	21 08 21 48 22 27	18 12 18 51 19 31		17 27 31	5 41 6 20 6 36	2 44 3 24 3 39
May	1	14 34	11 37	Sep	8	23 07	20 10				

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.

Durban	- 4 ^m	Kimberley	+21 ^m	Windhoek	+52111
Cape Town	+46 ^m	Johannes burg	+ 8 ^m	Salisbury	- 4 ^m
Bulawayo	+ 6 ^m	Grahamstown	+14 ^m	Pretoria	+ 7 ^m
Bloemfontein	+15 ^m	East London	+ 8 ^m	Port Elizabeth	+18 ^m

TELESCOPE SETTING

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

T. 11 68 ...

A LIST OF BRIGHT STARS FOR CHECKING TELESCOPE CIRCLES

Star	R.A.	Dec.	Mag.	Sp.	Star	R.A.	Dec.	Mag.	Sp.
Achernar	1 h 37 n 0	-57°20'	0,6	B5	Procyon	7 ^h 38 ^m 3	+ 5°16'	0,5	F5
Aldebaran	4 34,8	+16 28	1,1	K5	Regulus	10 07.4	+12 03	1,3	88
Rigel	5 13,5	- 8 13	0,3	88	Spica	13 24,2	-11 04	1,2	B 2
Betelgeuse	5 54,2	+ 7 24	0,4	MO	Arcturus	14 14,8	+19 17	0,2	K0
Canopus	6 23,5	-52 41	-0,9	FO	Antares	16 28,3	-26 24	1,2	M1
Sirius	6 44,3	-16 41	-1,6	AO	Altair	19 49,48	+ 8 49	0,9	A 5

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1956	H Knox Shaw	1963	A W J Cousins	1976	A D Thackeray
1957	W P Hirst	1 9 65	R H Stoy	1981	C Papadopoulos
1958	J Jackson	1967	¥ S Finsen		
1960	W H wan den Ros	1970	I C Bennett		

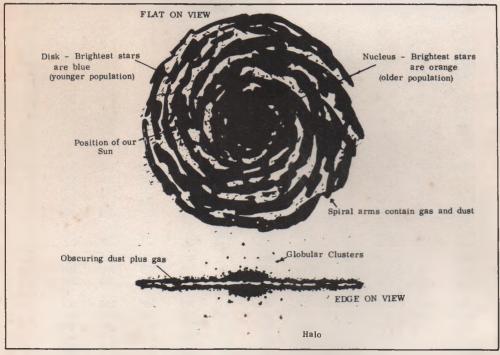
JULIAN DATE AT 1400 HOURS - 1982

	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.
	244	2445	2445	2445	2445	2445	2445	2445	2445	2445	2445	2445
1	4971	002	030	061	091	122	152	183	214	244	275	305
2	4972	003	031	062	092	123	153	184	215	245	276	306
3	4973	004	032	063	093	124	154	185	216	246	277	307
4	4974	005	033	064	094	125	155	186	217	247	278	308
5	4975	006	034	065	095	126	156	187	218	248	279	309
6	4976	007	035	066	096	127	157	188	219	249	280	310
7	4977	008	036	067	097	128	158	189	220	250	281	311
8	4978	009	037	068	098	129	159	190	221	251	282	312
9	4979	010	038	069	099	130	160	191	222	252	283	313
10	4980	011	039	070	100	131	161	192	223	253	284	314
11	4981	012	040	071	101	132	162	193	224	254	285	315
12	4982	013	041	072	102	133	163	194	225	255	286	316
13	4983	014	042	073	103	134	164	195	226	256	287	317
14	4984	015	043	074	104	135	165	196	227	257	288	318
15	4985	016	044	075	105	136	166	197	228	258	289	319
16	4986	017	045	076	106	137	167	198	229	259	290	320
17	4987	018	046	077	107	138	168	199	230	260	291	321
18	4988	019	047	078	108	139	169	200	231	261	292	322
19	4989	020	048	079	109	140	170	201	232	262	293	323
20	4990	021	049	080	110	141	171	202	233	263	294	324
21	4991	022	050	081	111	142	172	203	234	264	295	325
22	4992	023	051	082	112	143	173	204	235	265	296	326
23	4993	024	052	083	113	144	174	205	236	266	297	327
24	4994	025	053	084	114	145	175	206	237	267	298	328
25	4995	-026	054	085	115	146	176	207	238	268	299	329
26 27 28 29 30 31	4996 4997 4998 4999 5000 5001	027 028 029	055 056 057 058 059 060	086 087 088 089 090	116 117 118 119 120 121	147 148 149 150 151	177 178 179 180 181 182	208 209 210 211 212 213	239 240 241 242 243	269 270 271 272 273 274	300 301 302 303 304	330 331 332 333 334 335

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.