THE

ASTRONOMICAL SOCIETY

OF

SOUTH AFRICA

HANDBOOK FOR

1952

ASTRONOMICAL SOCIETY OF SOUTH AFRICA
1951—1952

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The Astronomical Society of South Africa was formed in July, 1922, by the amalgamation of the Cape and Johannesburg Astronomical Associations which had been in active existence for several years. The declared objects of the Society are:—

(1) The encouragement and stimulation of the study of Astronomy in South Africa;

(2) The association of observers and their organisation in the work of astronomical observation and research;

(3) The dissemination throughout South Africa of such current astronomical information as may be helpful to observers;

(4) The publication from time to time of the results of the work accomplished by the Society.

Membership is open to all who are interested in Astronomy. The Society issues a series of duplicated notes monthly and distributes to each member a copy of *Sky and Telescope*, an illustrated monthly astronomical magazine published in America. There are also a number of autonomous local centres which hold regular meetings. Details of these will be found on the back cover.

All communications about the Society should be addressed to The Hon. Secretary, c/o The Royal Observatory, Observatory, Cape.

CONTENTS

PREFACE

THE chief credit for the Handbook is again due to the Editor of the Monthly Notes, Dr. R. H. Stoy, but several others have helped in its preparation. Dr. D. S. Evans contributed the article on the Calendar; Mr. A. J. Moran the Geocentric Longitudes of the Sun and the Planets; Mr. S. C. Venter the Meteor Calendar, while the planetary diagram was calculated by Mr. R. P. de Kock and drawn by Mr. H. C. Davies.

TIME

All the times given in this booklet are South African Standard Time, that is, mean solar time for a meridian 30° (or two hours) east of Greenwich.

To get the local mean time at other places in the Union the longitude difference shown in Table I must be applied to the ordinary S.A.S.T.

TABLE I

Correction for Longitude

Bloemfontein ...	−15 m.	Grahamstown ...	−14 m.
Cape Town ...	−46 ,,	Johannesburg ...	−08 ,,
Durban	+04 ,,	Port Elizabeth ...	−18 ,,
East London ...	−08 ,,	Pretoria	−07 ,,

Conversely, to get the S.A.S.T. from the local mean time these longitude corrections must be applied with the sign reversed. Thus, the S.A.S.T. of local mean noon (i.e., 12 h. 00 m. local mean time) at Port Elizabeth is 12 h. 18 m.

Owing to the fact that the earth does not go round the sun with uniform circular motion in the plane of the earth's equator, the local apparent solar time (i.e., the time shown by a sundial) differs from the local mean solar time by a quantity which is usually referred to as the "Equation of Time". The Equation of Time must be added to the mean solar time to give the apparent solar time. Its effect is shown in the third column of Table II which gives the S.A.S.T. of noon, that is, of the Sun's transit over the meridian.

Example: Find the S.A.S.T. of apparent noon at Port Elizabeth on November 1.

	hr.	min.
S.A.S.T. of noon at 30° E.... ...	11	44
Correction for longitude		18
S.A.S.T. of noon at Port Elizabeth ...	12	02

For many purposes *sidereal time*, that is, local time as measured by the stars, is extremely useful. The sidereal time can be found by applying the S.A.S.T. (on a 24-hour basis) to the corresponding "Sidereal Time at 0 hours S.A.S.T." which is given in the fourth column of Table II and correcting for longitude by means of Table I. A further small correction is needed to allow for the four minute difference in length between the solar and sidereal day. This correction is given below.

For times between S.A.S.T.:—

03.00	and	09.00	add 1	minutes
09.00	,,	15.00	,, 2	,,
15.00	,,	21.00	,, 2	,,
21.00	,,	23.59	,, 4	,,

Example: Find the sidereal time at 8.15 p.m. on October 4 at Port Elizabeth.

		hr.	min.
Sid. time at 00.00 S.A.S.T. on October 4 ...		00	50
S.A.S. Time		20	15
		21	05
Correction for longitude	−		18
Interval Correction	+		3
Required Sidereal Time		20	50

For recording the time of variable star observations, the *Julian Day* calendar is usually used. This numbers the days consecutively from the beginning of the Julian Era in 4713 B.C. The Julian Day begins at Greenwich mean noon, that is, at 14.00 (2 p.m.) S.A.S.T.

The position of a star in the sky is fixed by its *right ascension* and *declination*, much as the position of a point on the earth is fixed by its longitude and latitude. In fact the right ascension and declination of any star is the longitude and latitude of the point on the earth directly beneath it at zero hours sidereal time at Greenwich. Latitude and declination are always measured in degrees north or south of the equator. Longitude and right ascension are measured either in degrees or in time, 360° being equal to 24 hours (1° equals 4 minutes; 15′ equals 1 minute). Right ascension is always measured eastwards from the zero celestial meridian, and so is the equivalent of the longitude measured eastwards from the Greenwich meridian.

For considering the motions of the Sun, Moon and Planets, the system of co-ordinates known as *celestial latitude* and *longitude* is very convenient. These co-ordinates define the position of a celestial body with reference to the Ecliptic in exactly the same way as right ascension and declination define its position with reference to the Celestial Equator. The (celestial) latitude is the angular distance of the body north or south of the ecliptic, while the longitude is the distance from the Vernal Equinox as measured eastwards along the Ecliptic. Celestial latitude and longitude are usually measured in degrees.

The Ecliptic is defined by the apparent path of the sun about the earth. The latitude of the sun is therefore always (approximately) zero, whilst its longitude increases by approximately 1° per day.

TABLE II

Date	Julian Date of 14 hours	S.A.S.T. of Sun's Transit	Sidereal Time at 0 hrs.	Sidereal Time at 18 hrs.
January 1	2,434,013.0	12 03 12	06 38	00 41
,, 11	023	12 07 38	07 17	01 20
,, 21	033	12 11 08	07 57	02 00
February 1	044	12 13 34	08 40	02 43
,, 11	054	12 14 20	09 20	03 23
,, 21	064	12 13 49	09 59	04 02
March 1	073	12 12 26	10 34	04 37
,, 11	083	12 10 06	11 14	05 17
,, 21	093	12 07 15	11 53	05 56
April 1	2,434,104.0	12 03 55	12 37	06 40
,, 11	114	12 01 04	13 16	07 19
,, 21	124	11 58 42	13 56	07 59
May 1	134	11 57 03	14 35	08 38
,, 11	144	11 56 17	15 14	09 17
,, 21	154	11 56 29	15 54	09 57
June 1	165	11 57 42	16 37	10 40
,, 11	175	11 59 29	17 17	11 20
,, 21	185	12 01 37	17 56	11 59
July 1	2,434,195.0	12 03 42	18 35	12 38
,, 11	205	12 05 21	19 15	13 18
,, 21	215	12 06 17	19 54	13 57
August 1	226	12 06 13	20 38	14 41
,, 11	236	12 05 06	21 17	15 20
,, 21	246	12 03 04	21 57	16 00
September 1	257	11 59 57	22 40	16 43
,, 11	267	11 56 35	23 19	17 21
,, 21	277	11 53 04	23 59	18 02
October 1	2,434,287.0	11 49 40	00 38	18 41
,, 11	297	11 46 45	01 18	19 21
,, 21	307	11 44 39	01 57	20 00
November 1	318	11 43 37	02 40	20 43
,, 11	328	11 44 04	03 20	21 23
,, 21	338	11 45 55	03 59	22 02
December 1	348	11 49 05	04 39	22 42
,, 11	358	11 53 18	05 18	23 21
,, 21	2,434,368.0	11 58 10	05 58	00 01

THE SUN, MOON AND PLANETS

The Sun enters the Sign of—

Aries (Equinox)	...	March	20 d. 18 h.
Cancer (Solstice)	...	June	21 d. 13 h.
Libra (Equinox)	...	Sept.	23 d. 04 h.
Capricorn (Solstice)	...	Dec.	22 d. 00 h.

The Earth is at Perihelion on January 4 and at Aphelion on July 3.

There will be four eclipses during 1952, two being of the Sun and two of the Moon.

The path of the total eclipse of the Sun on February 25 crosses Central Africa and Asia and passes through Libreville, Bangui, Khartoum, Port Sudan, Basra, Khiva and Semipalatinsk. This eclipse will be invisible from Cape Town, but from the northern parts of the Union a small, inconspicuous partial eclipse will be seen. At Johannesburg the greatest phase will be at 09 h. 58 m., but its magnitude will be only 0.04, that is, only 4 per cent. of the Sun will be obscured.

The path of the annular eclipse of the Sun on August 20 crosses South America from Lima to Uruguaiana. No part of this eclipse will be visible from South Africa.

Both the partial eclipses of the Moon on February 11 and on August 5 will be visible from South Africa, though neither of them will be of much interest. The circumstances of these eclipses are as follows:—

	d.	h.	m.	d.	h.	m.
Moon enters penumbra	Feb. 11	00	06.2	Aug. 5	19	26.6
Moon enters umbra ...		02	03.3		20	33.4
Middle of the eclipse ...		02	39.3		21	47.4
Moon leaves umbra ...		03	15.3		23	01.4
Moon leaves penumbra		05	12.4		24	08.2
P.A. of First Contact ...		187°			22°	
P.A. of Last Contact ...		222°			294°	
Magnitude of eclipse (Moon's diameter=1.0)		0.088°			0.538	

PHASES OF THE MOON

First Quarter	Full Moon	Last Quarter	New Moon
d. h. m.	d. h. m.	d. h. m.	d. h. m.
Jan. 4 06 42	Jan. 12 06 55	Jan. 20 08 09	Jan. 27 00 26
Feb. 2 22 01	Feb. 11 02 28	Feb. 18 20 01	Feb. 25 11 16
Mar. 3 15 43	Mar. 11 20 14	Mar. 19 04 40	Mar. 25 22 12
April 2 10 48	April 10 10 53	April 17 11 07	April 24 09 27
May 2 05 58	May 9 22 16	May 16 16 39	May 23 21 28
May 31 23 46	June 8 07 07	June 14 22 28	June 22 10 45
June 30 15 11	July 7 14 33	July 14 05 42	July 22 01 30
July 30 03 51	Aug. 5 21 40	Aug. 12 15 27	Aug. 20 17 20
Aug. 28 14 03	Sept' 4 05 19	Sept. 11 04 36	Sept. 19 09 22
Sept. 26 22 31	Oct. 3 14 15	Oct. 10 21 33	Oct. 19 00 42
Oct. 26 06 04	Nov. 2 01 10	Nov. 9 17 43	Nov. 17 14 56
Nov. 24 13 34	Dec. 1 14 41	Dec. 9 15 22	Dec. 17 04 02
Dec. 23 21 51	Dec. 31 07 05		

PERIGEE						APOGEE					
	d.	h.		d.	h.		d.	h.		d.	h.
Jan.	26	14	Aug.	5	22	Jan.	12	08	July	23	10
Feb.	24	00	Sept.	3	08	Feb.	8	11	Aug.	19	13
March	23	00	Oct.	1	15	March	7	01	Sept.	15	21
April	18	10	Oct.	29	08	April	3	20	Oct.	13	12
May	13	18	Nov.	23	10	May	1	16	Nov.	10	08
une	10	09	Dec.	19	23	May	29	10	Dec.	8	05
uly	8	13				June	26	01			

During its monthly journey round the earth, the Moon passes close to each of the planets in turn, and thus serves as a ready method of identifying them. The table shows when these conjunctions will take place.

Mercury			Venus			Mars			Jupiter			Saturn		
	d.	h.		d.	h.		d.	h.		d.	h.		d.	h.
Jan.	25	18	Jan.	24	09	Jan.	20	14	Jan.	3	22	Jan.	19	11
									Jan.	31	14			
			Feb.	23	05	Feb.	17	17	Feb.	28	10	Feb.	15	16
Mar.	27	01	Mar.	24	04	Mar.	16	10	Mar.	27	07	Mar.	13	19
Apr.	22	18	Apr.	23	06	Apr.	12	13				Apr.	09	22
May	22	12				May	09	05	May	21	23	May	07	04
June	23	22				June	05	03	June	18	16	June	03	11
												June	30	20
July	24	06				July	02	18	July	16	06	July	28	06
						July	30	21						
Aug.	19	14	Aug.	22	08	Aug.	28	07	Aug.	12	19	Aug.	24	17
			Sept.	21	16	Sept.	25	20	Sept.	09	05	Sept.	21	04
Oct.	20	12	Oct.	21	17	Oct.	24	13	Oct.	06	12			
Nov.	19	05	Nov.	20	13	Nov.	22	07	Nov.	02	17	Nov.	15	08
									Nov.	29	19			
Dec.	15	16	Dec.	20	10	Dec.	21	04	Dec.	26	22	Dec.	12	22

OCCULTATIONS VISIBLE AT CAPE TOWN AND JOHANNESBURG

Date	N.Z.C.	Mag.	Phase	Cape Town			Johannesburg		
				Time		P.A.	Time		P.A.
				h.	m.	°	h.	m.	°
January 23	2366	1.2	D	03	57.0	82	No Occn.		
January 23	2366	1.2	R	04	49.4	316	No Occn.		
February 4	638	5.1	D	Graze			21	20.6	126
March 10	1487	1.3	D	01	57.9	128	02	15.9	82
March 10	1487	1.3	R	03	12.7	310	03	05.4	354
April 6	1547	3.8	D	21	50.0	97	No Occn.		
April 13	2366	1.2	D	23	13.4	98	23	20.1	56
April 13	2366	1.2	R	24	16.9	301	23	59.5	347
May 3	1487	1.3	D	16	11.8	164	16	00.8	143
May 3	1487	1.3	R	17	06.7	254	17	21.3	282
May 30	1466	5.2	D	21	12.5	135	21	23.0	93
June 3	1853	4.9	D	19	07.9	116	19	31.0	66
July 26	1685	4.5	D	No Occn.			19	01.5	181
August 1	2268	4.8	D	00	13.8	83	00	29.1	69
August 3	2750	2.1	D	No Occn.			17	46.5	114
Sept. 26	2650	4.7	D	Graze			23	11.7	144
Sept. 27	2809	4.9	D	20	15.5	122	20	36.7	108
October 21	2268	4.8	D	Sun			19	07.2	136
Nov. 18	2366	1.2	D	16	03.0	120	16	19.5	102
Nov. 18	2366	1.2	R	17	07.8	241	17	26.0	253
Nov. 28	288	5.2	D	20	23.4	71	20	43.8	72
Dec. 21	3269	4.3	D	20	44.3	0	21	06.0	352

Note: N.Z.C. 1487 is Regulus and N.Z.C. 2366 is Antares. N.Z.C. 2809 is a double star.

GRAZING OCCULTATIONS VISIBLE FROM CAPE TOWN

Date	N.Z.C.	Mag.	Disappearance			Reappearance		
			Time		P.A.	Time		P.A.
			h.	m.	°	h.	m.	°
February 4	638	5.1	21	20	166	21	25	173
February 7	1067	7.2	Just miss					
February 19	2312	5.6	4	36	196	4	43	206
April 19	3173	5.3	4	10	338	4	14	330
May 13	2673	6.3	4	49	4	5	12	331
June 11	3071	6.5	Just miss					
July 2	2045	6.4	21	35	41	21	54	15
August 25	1967	5.7	21	33	186	21	46	210
September 25	2476	6.9	22	28	353	22	32	346
September 26	2650	4.7	Very near miss					
December 6	1295	6.5	Very near miss					
December 25	243	6.9	Very near miss					

Just Miss.—Star at nearest approach is about 2′ of arc from the Limb of the Moon
Very Near Miss.—Star at nearest approach is about ½′ of arc from the Limb of the Moon.

THE PLANETS

The chart shows the S.A.S.T. of the rising and setting of the Sun and Planets at a place whose latitude and longitude are 30° S, 30° E. The approximate times for other places can be found by applying the longitude differences shown in Table I with the sign reversed, e.g., for Cape Town add 46 minutes to the times given by the chart, for Durban subtract 4 minutes. The correction for latitude will, in general, be sufficiently small to be ignored and in no case will it exceed 15 minutes.

Mercury moves from the morning to the evening sky with great rapidity. The only occasions on which Mercury is likely to be seen is near the time of an elongation. In 1952 these are as follows:—

Eastern (Evening Star)			Western (Morning Star)		
Date	*Elong.*	*Mag.*	*Date*	*Elong.*	*Mag.*
March 18 ...	19°	0.0	January 6 ...	23°	0.0
July 15	27	+0.7	May 3 ...	27	+0.7
November 10 ...	23	0.0	August 30 ...	18	0.0
			December 18 ...	22	0.0

Mercury will be at Superior Conjunction on February 22, June 9 and September 24; at Inferior Conjunction on April 5, August 12 and November 30; at Stationary Points on March 26, April 17, July 28, August 21, November 20 and December 10.

Mercury will be in Conjunction with Venus on April 16 at 21 hrs., and on August 4 at 20 hrs.; with Jupiter on May 17 at 04 hrs.; with Uranus on June 21 at 00 hrs.; with the bright star Regulus on September 6 at 22 hrs., when the two objects will be less than one degree apart.

Venus is a brilliant morning star from the beginning of the year until its Superior Conjunction with the Sun on June 24. Thereafter it will get gradually higher and higher in the evening sky until the end of the year. There will be little variation in the brightness (from −3.3 m. to −3.8 m.) and there are no Greatest Elongations or Stationary Points in 1952.

Venus will be in Conjunction with Jupiter on May 5 at 16 hrs.; with Saturn on September 16 at 01 hrs., and with Neptune on September 20 at 11 hrs. The minimum separation for the conjunction with Jupiter is only 0.3°, so that early risers at that time will be rewarded by seeing a splendid visual double composed of the two brightest planets in the sky.

Mars is in Opposition with the Sun on May 1 and is suitably placed for observation from about March to July. The minimum distance from the Earth at this opposition is 52,000,000 miles, which is rather large when compared with a really favourable opposition when this distance is only 34,500,000 miles. The greatest apparent diameter of Mars during 1952 is 16.8″, that is, a little over one quarter of minute of arc and its greatest brightness is −1.5m. This may be compared with Jupiter which at opposition in 1952 has an apparent diameter of 49.3″ and a brightness of −2.4 m.

At the beginning of the year Mars rises just after midnight and has a brightness of +1.3 m. It is in Virgo, but moves steadily eastwards into Libra until the Stationary Point on March 25. From March 25 until the next Stationary Point on June 11, Mars retrogrades back into Virgo, but after June 11 it resumes a steady eastwards course through Libra, Scorpio, Ophiuchus, Sagittarius and by the end of the year has entered Capricornus and its brightness has fallen to +1.2 m.

Mars is in Conjunction with Neptune on January 2 at 19 hrs.

Jupiter at the beginning of the year is a conspicuous object (magnitude −2.0) in the early evening sky. It is in Pisces and sets before midnight. After Conjunction with the Sun on April 17, Jupiter becomes a morning star. It is still in Pisces, but shortly afterwards it will cross into Aries where it will continue its steady easterly motion until the Stationary Point on September 10. From then till the end of 1952, Jupiter will retrograde but will not pass out of Aries.

Opposition with the Sun is on November 8 and Jupiter will be a conspicuous object in the eastern evening sky during November and December.

Saturn at the beginning of the year is in Virgo and almost diametrically opposite to Jupiter, so that as Jupiter sets in the West, Saturn rises in the East. Saturn will be easily observable in the evening from March to September. Opposition with the Sun is on April 1 and Conjunction on October 11. After Conjunction, Saturn will be a morning star but not easily visible as such until December. The Stationary Points, between which Saturn will retrograde slowly, are reached on January 25 and June 11.

In 1952, the rings present their northern face towards the Earth. In January, their apparent inclination is 9°.6, but this decreases to 6°.7 at the end of May and then increases to 14°.4 in December. The total brightness of Saturn plus rings increases from +1.0 m. in January to +0.6 m. at the time of Opposition and then fades to +1.1 m. at the time of Conjunction.

Uranus (magnitude 5.8) is in Gemini and is in Opposition on January 3. It is in Conjunction with the Sun on July 6 and at its Stationary Points on March 18 and October 24.

The most suitable time for observation is the beginning of the year when its position is as follows:—

January 1	...	06h.	52.6m.	+23° 17′
February 1	...	06	47.1	+23 24
March 1	...	06	43.8	+23 27

Neptune (magnitude 7.7) is in Virgo and is in Opposition with the Sun on April 10 and in Conjunction on October 14. The Stationary Points are on January 24 and June 30. The best months for observing Neptune are April, May and June when its position is as follows:—

April 1	...	13h.	18.7m.	−06° 28′
May 1	...	13	15.7	−06 10
June 1	...	13	13.3	−05 56

At the time of opposition, Neptune is about 6° north-north west of Spica and not a great distance from Saturn with which there is a close conjunction on November 18 at 04 hrs. The two planets will hen be only 0.°7 apart.

GEOCENTRIC LONGITUDES OF SUN AND BRIGHT PLANETS FOR 1952

	Sun	Mercury	Venus	Mars	Jupiter	Saturn
Jan. 1	280°	258°	241°	201°	006°	194°
Jan. 31	310	295	274	215	010	195
Mar. 1	340	347	311	225	016	194
Mar. 31	010	019	348	228	023	192
April 30	040	013	018	221	030	189
May 30	068	057	061	212	037	188
June 29	097	118	098	213	043	188
July 29	126	147	135	224	048	190
Aug. 28	155	147	172	240	051	193
Sept. 27	184	186	209	259	051	196
Oct. 27	213	233	246	281	048	200
Nov. 26	244	254	282	303	044	203
Dec. 26	274	254	318	326	041	206

METEOR CALENDAR, 1952

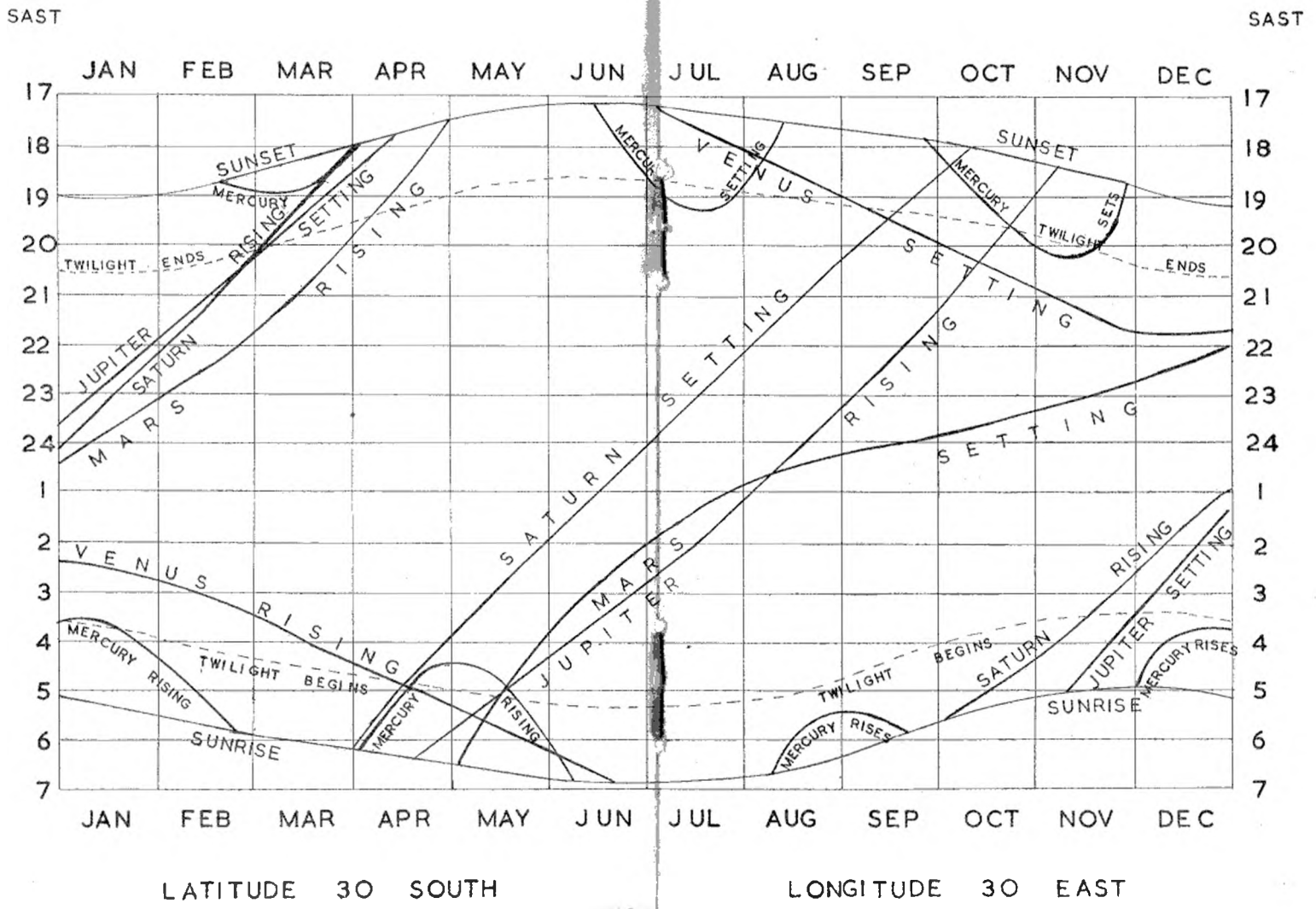
Date	Shower	Radiant	Maximum			Nature of Current
			Date	Rate	Time of Transit	
					h	
Jan. 3 ...	Quadrantids	227° +46°	Jan. 3 ...	40	08.5	Unknown.
March 12—April 25	Hydraids	184° −27°	March 25	?	00.0	Unknown.
March 1—May 10	Virginids	200° − 6°	April 3	?	00.0	Ecliptical.
April 12-24	Lyrids ...	273° +35°	April 22 ...	12	04.0	Cometary: Comet 1861 I.
April 29—May 21	Eta Aquarids	338° − 1°	May 5 ...	10	05.1	Cometary: Halley.
April 20—July 30	Sco-Sgr. System	270° −30°	June 14 ...	?	00.5	Ecliptical.
July 25—Aug. 10	Delta Aquarids	343° −17°	Aug. 3 ...	20	02.0	Ecliptical.
July 20—Aug. 19	Perseids	43° +56°	Aug. 11 ...	50	05.6	Cometary: Comet 1862 III
July 25—Sept. 8	Cygnids	324° +51°	Aug. 16 ...	?	00.0	Unknown.
Aug. 16—Oct. 8	Piscids	0° + 4°	Sept. 12 ...	?	22.0	Ecliptical.
Oct. 11—30	Orionids*	94° +16°	Oct. 19 ...	20	04.4	Cometary: Halley.
Sept. 24—Dec. 10	Taurids	58° +21°	Nov. 13 ...	6	00.6	Elciptical.
Nov. 16 ...	Leonids ...	151° +21°	Nov. 16 ...	6	06.5	Cometary: Comet 1866 I.
Dec. 5—19	Geminids	113° +30°	Dec. 12 ...	30	02.0	Ecliptical.
Dec. 5—Jan. 7	Velaids ...	149° −51°	Dec. 29 ...	?	03.5	Unknown.

*According to Prentice (Director of the Meteor Section of the B.A.A.), this shower has a probable period of 16 years with an expected return during 1951-1955.

Much of the above information is derived from Hoffmeister's "Meteorströme" ("Meteoric Currents") published in 1948. The orbits of the Cometary Currents are closely related to the orbits of the comets indicated, and those of the Ecliptical Currents to the orbits of certain minor planets.

For the moon during the above periods see Phases of the Moon on page 5

THE PLANETS AS SEEN FROM SOUTH AFRICA 1952



LATITUDE 30 SOUTH

LONGITUDE 30 EAST

ASTRONOMICAL DIARY

JANUARY, 1952

Full Moon 12d. 06h. 42m. **New Moon 27d. 00h. 26m.**

Mercury and Venus in the eastern morning sky; Jupiter in the western evening sky; Mars and Saturn rising just before midnight.

	d.	m.	
Jan.	3	22	Jupiter in conjunction with the Moon, Jupiter 5° south.
,,	4		Earth at Perithelion, distance 0.983 astronomical units.
,,	6		Mercury at Greatest Elongation, 23° west.
,,	19	11	Saturn in conjunction with the Moon, Saturn 7° north.
,,	20	14	Mars in conjunction with the Moon, Mars 7° north.
,,	23	04	Occultation of Antares.
,,	24	09	Venus in conjunction with the Moon, Venus 6° north.
,,	25		Saturn at a Stationary Point.
,,	25	18	Mercury in Conjunction with the Moon, Mercury 3° north.
,,	31	14	Jupiter in conjunction with the Moon, Jupiter 5° south.

FEBRUARY, 1952

Full Moon 11d. 02h. 28m. **New Moon 25d. 11h. 16m.**

Venus in the eastern morning sky; Jupiter in the western evening sky; Mars and Saturn rising during the evening.

	d.	h.	
Feb.	11	02	Partial eclipse of the Moon.
,,	15	16	Saturn in conjunction with the Moon, Saturn 7° north.
,,	17	17	Mars in conjunction with the Moon, Mars 7° north.
,,	22		Mercury in Superior Conjunction with the Sun.
,,	23	05	Venus in conjunction with the Moon, Venus 3° north.
,,	25	12	Total eclipse of the Sun.
,,	28	10	Jupiter in conjunction with the Moon, Jupiter 5° south.

MARCH, 1952

Full Moon 11d. 20h. 14m. **New Moon 25d. 22h. 12m.**

Venus in the eastern morning sky; Jupiter in the early evening western sky; Mars and Saturn rising soon after sunset.

	d.	h.	
Mar.	10	02	Occultation of Regulus.
,,	13	19	Saturn in conjunction with the Moon, Saturn 7° north.
,,	16	10	Mars in conjunction with the Moon, Mars 7° north.
,,	18		Mercury at Greatest Elongation, 19° east.
,,	20	18	Equinox.
,,	24	04	Venus in conjunction with the Moon, Venus 2° south.
,,	25		Mars at a Stationary Point.
,,	26		Mercury at a Stationary Point.
,,	27	01	Mercury in conjunction with the Moon, Mercury 0°.7 south.
,,	27	07	Jupiter in conjunction with the Moon, Jupiter 6° south.

APRIL, 1952

Full Moon 10d. 10h. 53m. **New Moon 24d. 09h. 27m.**

Mercury and Venus in the eastern morning sky; Saturn and Mars visible throughout the night.

	d.	h.	
April	1		Saturn in Opposition with the Sun.
,,	5		Mercury in Inferior Conjunction with the Sun.
,,	9	22	Saturn in conjunction with the Moon, Saturn 7° north.
,,	12	13	Mars in conjunction with the Moon, Mars 7° north.
,,	13	23	Occultation of Antares.
,,	16	21	Mercury in conjunction with Venus, Mercury 1°.3 north.
,,	17		Mercury at a Stationary Point.
,,	17		Jupiter in conjunction with the Sun.
,,	22	18	Mercury in conjunction with the Moon, Mercury 6° south.
,,	23	06	Venus in conjunction with the Moon, Venus 6° south.

MAY, 1952

Full Moon 9d. 22h. 16m. **New Moon 23d. 21h. 28m.**

Mercury and Venus in the eastern morning sky; Saturn and Mars visible throughout the night.

	d.	h.	
May	1		Mars in Opposition with the Sun.
,,	3	16	Occultation of Regulus.
,,	3		Mercury at Greatest Elongation, 27° west.
,,	5	16	Venus in conjunction with Jupiter, Venus 0°.3 south.
,,	7	04	Saturn in conjunction with the Moon, Saturn 7° north.
,,	9	05	Mars in conjunction with the Moon, Mars 6° north.
,,	17	04	Mercury in conjunction with Jupiter, Mercury 1°.8 south.
,,	21	23	Jupiter in conjunction with the Moon, Jupiter 6° south.
,,	22	12	Mercury in conjunction with the Moon, Mercury 7° south.

JUNE, 1952

Full Moon 8d. 07h. 07m. **New Moon 22d. 10h. 45m.**

Mars and Saturn visible most of the night; Jupiter in the early morning eastern sky.

	d.	h.	
June	3	11	Saturn in conjunction with the Moon, Saturn 7° north.
,,	5	03	Mars in conjunction with the Moon, Mars 4° north.
,,	9		Mercury in Superior Conjunction with the Sun.
,,	11		Mars at a Stationary Point.
,,	11		Saturn at a Stationary Point.
,,	18	16	Jupiter in conjunction with the Moon, Jupiter 6° south.
,,	21	13	Solstice.
,,	23	22	Mercury in conjunction with the Moon, Mercury 0°.9 south.
,,	24		Venus in Superior Conjunction with the Sun.
,,	30	20	Saturn in conjunction with the Moon, Saturn 7° north.

JULY, 1952

Full Moon 7d. 14h. 33m. **New Moon 22d. 01h. 30m.**

Mercury visible in the early evening sky; Mars and Saturn most of the evening; Jupiter in the early morning eastern sky.

	d.	h.	
July	2	18	Mars in conjunction with the Moon, Mars 4° north.
,,	3		Earth at Aphelion, distance 1.017 astronomical units.
,,	15		Mercury at Greatest Elongation, 27° east.
,,	16	06	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	24	06	Mercury in conjunction with the Moon, Mercury 2° south.
,,	28		Mercury at a Stationary Point.
,,	28	06	Saturn in conjunction with the Moon, Saturn 7° north.
,,	30	21	Mars in conjunction with the Moon, Mars 4° north.

AUGUST, 1952

Full Moon 5d. 21h. 40m. **New Moon 20d. 17h. 20m.**

Venus visible low in the western evening sky; Mars and Saturn in the evening sky; Jupiter rises soon after midnight.

	d.	h.	
Aug.	4	20	Mercury in conjunction with Venus, Mercury 6°.4 south.
,,	5	22	Partial eclipse of the Moon.
,,	12		Mercury in Inferior Conjunction with the Sun.
,,	12	19	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	19	14	Mercury in conjunction with the Moon, Mercury 4° south.
,,	20	18	Annular eclipse of the Sun.
,,	21		Mercury at a Stationary Point.
,,	22	08	Venus in conjunction with the Moon, Venus 4° north.
,,	24	17	Saturn in conjunction with the Moon, Saturn 7° north.
,,	28	07	Mars in conjunction with the Moon, Mars 3° north.
,,	30		Mercury at Greatest Elongation, 18° west.

SEPTEMBER, 1952

Full Moon 4d. 05h. 19m. **New Moon 19d. 09h. 22m.**

Venus and Mars in the evening sky; Jupiter rises before midnight.

	d.	h.	
Sept.	6	22	Mercury in conjunction with Regulus, Mercury 0°.9 north.
,,	9	05	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	10		Jupiter at a Stationary Point.
,,	16	01	Venus in conjunction with Saturn, Venus 1°.6 south.
,,	21	04	Saturn in conjunction with the Moon, Saturn 7° north.
,,	21	16	Venus in conjunction with the Moon, Venus 6° north.
,,	23	04	Equinox.
,,	24		Mercury in Superior Conjunction with the Sun.
,,	25	20	Mars in conjunction with the Moon, Mars 3° north.

OCTOBER, 1952

Full Moon 3d. 14h. 15m. **New Moon 19d. 00h. 42m.**

Mercury may be visible in western evening sky at the end of the month; Venus and Mars visible in the evening western sky; Jupiter rises in the early evening.

	d.	h.	
Oct.	6	12	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	11		Saturn in conjunction with the Sun.
,,	20	12	Mercury in conjunction with the Moon, Mercury 4° north.
,,	21	17	Venus in conjunction with the Moon, Venus 4° north.
,,	24	13	Mars in conjunction with the Moon, Mars 1° north.

NOVEMBER, 1952

Full Moon 2d. 01h. 10m. **New Moon 17d. 14h. 56m.**

Mercury may be visible in the evening sky at the beginning of the month; Venus and Mars visible in the western evening sky; Jupiter visible all night.

	d.	h.	
Nov.	2	17	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	8		Jupiter in opposition with the Sun.
,,	10		Mercury at Greatest Elongation, 23° east.
,,	15	08	Saturn in conjunction with the Moon, Saturn 7° north.
,,	18	16	Occultation of Antares.
,,	19	05	Mercury in conjunction with the Moon, Mercury 2° north.
,,	20		Mercury at a Stationary Point.
,,	20	13	Venus in conjunction with the Moon, Venus 1° north.
,,	22	07	Mars in conjunction with the Moon, Mars 0°.2 south.
,,	29	19	Jupiter in conjunction with the Moon, Jupiter 7° south.
,,	30		Mercury in Inferior Conjunction with the Sun.

DECEMBER, 1952

Full Moon 1d. 14h. 41m. **New Moon 17d. 04h. 02m.**

Venus and Mars visible in the western evening sky; Jupiter visible most of the night; Saturn visible in the early morning eastern sky.

	d.	h.	
Dec.	10		Mercury at a Stationary Point.
,,	12	22	Saturn in conjunction with the Moon, Saturn 8° north.
,,	15	16	Mercury in conjunction with the Moon, Mercury 7° north.
,,	18		Mercury at Greatest Elongation, 22° west.
,,	20	10	Venus in conjunction with the Moon, Venus 2° south.
,,	21	04	Mars in conjunction with the Moon, Mars 2° south.
,,	22	00	Solstice.
,,	26	22	Jupiter in conjunction with the Moon, Jupiter 7° south.

THE CALENDAR

To the average person there seems little necessity for design in the construction of a calendar. "Thirty days hath September . . ." seems to be a law of the Medes and Persians, and just about as ancient; and even so, the choice of the numbers of days in the months, and their names, seems more a matter of caprice than set purpose.

Our modern calendar is, in fact, a fairly good compromise between a variety of almost irreconcilable astronomical periodicities, religious, social and historical traditions. Clearly the first periodicity to be recognised is that of the days; to us, this means the exactly constant interval between successive midnights and successive noons. In ancient times, and even to-day in Jewish and Moslem religious usage, the word is used far less precisely, and refers to the cycle starting at dusk and ending at dusk. The simplest calendar of all would consist of no more than an enumeration of the days starting from some arbitrary point, and this system is, in fact, followed by astronomers who give each day a number. This number, the Julian date, reckons the days from Monday, January 1st, 4713 B.C., the day being counted as starting from noon. Thus, Julian Day 2434014 starts at noon on 1952 January 1.

Settled human civilisation began on the shores of the Mediterranean and in the Near East. The establishment of any agrarian life must have immediately brought into prominence a number of other astronomical periodicities. Shepherds who habitually spent nights in the open must rapidly have become aware of the cycle of the lunar phases, and, for convenience, have tended to aggregate the succession of individual days into periods approximating to the length of a lunation. Because the geographical regions involved are ones where the seasonal contrast of weather is rather slight, the lunar cycle, at any rate at first, must have been far more striking than any solar or meteorological cycle. The lunar month has an average length of 29.5306 days, which is sufficiently close to 29.5 to permit an easy grouping of the days into alternate months of 29 and 30 days. A purely lunar calendar with 12 months in the "year" thus gives a period of 354 days, a lunar year.

The moon is an important symbol in Islam: the crescent is included in the national emblems of all the Moslem states: fasts and feasts start and end when two reliable observers first glimpse the lunar crescent in the evening sky. The Moon is the sole basis of the Moslem calendar, and the year, of 12 lunar months, has 354 or 355 days. Years are aggregated into 30-year cycles, of which 19 are common and contain 354 days, and 11 abundant, containing 355 days. The years are counted from the date of the Hegira, Mohammed's flight from Mecca, on July 16, 622 A.D. The difference of 10 or 11 days between the length of the lunar year and that of the solar year, means that dates in the Moslem calendar rotate fairly rapidly through the seasons of the western calendar, taking about 33 solar years to com-

plete the cycle. For example, in 1951, the Moslem New Year, Muharram 1, fell on October 2, while in 1952 it will be on September 21. In 1951 the fast month, Ramadan, began on June 6 and in 1952 it will begin on May 26, or, more precisely, on the evening close to that date when the crescent of the new moon is first glimpsed by two reliable observers.

As the civilisations of the ancient world developed, the solar rhythm of the seasons became steadily more important in ordinary life. In ancient times it had been realised that the Nile flood reached lower Egypt on approximately the same date each year, about July 19 in modern terms, and that this date could be recognised by its approximate coincidence with the date on which the bright star Sirius rose at sunrise. The peculiar importance of an exact calendar to agriculture in Egypt can readily be appreciated. The land is normally rainless; the land must be prepared in advance for irrigation so as to be ready when the flood arrives. An exact calendar based on solar reckoning was thus a vital element in the livelihood of the whole country.

The principal problem of the modern calendar maker has been to devise a system based exclusively on the sun which enables accurate predictions of future seasonal variations to be made. A purely lunar calendar allows the seasons to circulate round the year, a defect which becomes more and more significant in civilisations in higher latitudes where these variations are pronounced and are of great importanec to agriculture. There has thus been a steady breaking away from the lunar calendar, and a tendency towards a calendar having an exclusively solar basis.

Compromise calendars have been devised, of which the Hebrew calendar now used for religious purposes is an example. The normal year contained 12 lunar months and might have 353, 354 or 355 days. Years were aggregated into 19-year cycles, presumably for quite sound astronomical reasons which cannot be discussed here, and 12 of these were normal. The remaining seven were known as embolismic where, in order to keep the calendar in step with the true solar year, an extra month was inserted. These embolismic years were of lengths 383, 384 or 385 days. This complicated system keeps the Hebrew calendar in step with the solar calendar judged broadly, but in any given year it may be a considerable number of days out. The Jewish New Year in 1951 was on October 1; in 1952 the year 5713 will begin of September 20.

Our modern calendar is the Gregorian, in which the division into months is retained, but there is no longer any real attempt to represent the lunar phases. This calendar in turn is a reformed version of the Julian calendar introduced in Rome as a reformation of the previous lunar calendar. In earlier days the Roman lunar calendar had acquired a modified form and it had been one of the duties of the pontiffs to decide when extra (intercalary) months, should be inserted so as to bring it into step with the sun. Such a responsibility had endowed those who discharged it with great temporal power, and one of the

reasons why the Moslem calendar turned its back on any attempt to keep in step with the sun, was that decisions on intercalation had been misused for ends of personal power.

The reform of Julius Caesar was based on the astronomical advice of Sosigenes, the Alexandrian. The solar year of 365 days and 6 hours was adopted as exact, the year was to begin on January 1st, an approximation to the date of the winter solstice, and the fractional days were to be taken into account by inserting an extra day every fourth year. After Julius Caesar's death, his intercalary rule was misinterpreted and Augustus omitted a number of leap years up to A.D. 8 which is the first of the modern series of leap years occurring in years whose numbers are divisible by four. Previous reforms of the date of beginning of the year had made the months Sextilis, September, to December, the 8th to the 12th months, in contradiction of their names. Sextilis was renamed after Augustus and given an extra day (knocked off February) so that it now had a lucky (odd) number of days.

Dionysius Exiguus, Abbot of Rome, in the early 6th century A.D. fixed the date of the beginning of the year as March 25, the date of the Feast of the Annunciation. This completed the development of the Old Style Calendar, based on a value for the solar year of 365.25 days with New Year in March. In this system March 1st 1000 A.D. and April 1st, 1001 A.D. were days separated by only a month.

The mean value of the tropical year is 365.2422 days, so that the Julian value is too large by 0.0078 days. An error of 8 days is built up in a thousand years, and by the 16th century representations were being made for a reform of the calendar to eliminate this error. In 1582 Pope Gregory XIII decreed that the day following Thursday, October 4th, 1582 would be called Friday, October 15th. This brought the date of the Vernal Equinox back to March 21st. The beginning of the year was also changed back to January 1st. In order to eliminate the error in the adopted length of the year, it was also decreed that century years would not be leap years unless the first two figures themselves divided by four, i.e., 1600 would be a leap year, but 1700 would not. This gives an average year length of 365.2425 days, which still has a slight error, amounting to one day in 3.323 years. Herschel suggested that this should be corrected by omitting a leap year every 4,000 years.

The Gregorian reform was not immediately adopted throughout the civilised world. In Britain the change was made in 1752, September 2nd, 1752 (Old Style) being followed by September 14th, 1752 (New Style). It is said that this change was greeted by riots on the part of those who thought they were being cheated out of 11 days. The principal modern relic of the change is the fact that the British financial year begins on April 5th, which is Old New Year's Day (March 25th) displaced by the 11 day change of 1752. For religious reasons the reform was delayed in Russia until 1918 when the adoption of the Gregorian calendar became universal throughout the world.

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