3.3   INDIAN CALENDARS

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VEDĀṄGA JYAUTIṢA CALENDAR
The first treatise on calendric astronomy was compiled
C 1300 B.C.and is known as "The *Vedāṅga Jyautiṣa*. It gives rules for
framing calendar covering a five-year period, called a *'Yuga'* . In
this *yuga*-period calendar, there were 1830 civil days, 60 solar
months, 62 synodic lunar months, and 67 sidereal lunar months. The calen-
dar was luni-solar, and the year started from the first day of the
bright fortnight when the Sun returned to the Delphini star group.
Corrections were made, as required, to maintain this stipulation to the
extent possible. The *Vedāṅga* calendar was framed on the mean motions
of the luminaries, the Sun and the Moon, and was based on approximate
values of their periods. *Vedāṅga Jyautiṣa* calendar remained in use for
a very long time from C 1300 B.C. to C 400 A.D. when *Siddhānta
Jyautiṣa* calendar based on true positions of the Sun and the Moon came
into use and gradually replaced totally the *Vedāṅga* calendar.

THE SŪRYA SIDDHĀNTA
On the dwindling of *Vedāṅga Jyautiṣa* system, many books on
Siddhānta Jyautiṣa appeared, but the best treatise on the subject and
also one that is followed now is named as *Sūrya Siddhānta*. It is not
known who was the author of this famous book, and when it first came
into use. It completely replaced the Vedāṅga Jyautiṣa calendar which
ruled the calendric system of this sub-continent for more than 1500
years.

The *Sūrya Siddhānta* astronomers devised rules for framing the calendar
on the basis of true positions of the Sun and the Moon as against their
mean positions used earlier. They calculated the year on the basis of
sidereal or *nirayana* system as opposed to tropical or *sāyana* system
followed by the Gregorian calendar. The word *'nirayana'* means 'with no
motion' and the word *'sāyana'* means 'with motion', and this refers to
the vernal equinox which is constantly retrograding, the present rate
being 50".3 per year. The fixed point from which all *nirayana* calcula-
tions are made is that which is opposite the Star Spica (α-Virginis),
called Citrā in the Indian language. In other words, from this point,
the longitude of Citrā or spica is 180^0. For assigning a precise posi-
tion of this point, the Indian Astronomical Ephemeris has adopted its
tropical longitude as $23^0 15'00"$ on 21 March 1956. The angular distance
in longitude of this fixed point from the vernal equinoctial point on
1 November 1985 was $23^0 39'.3$

The Zodiac belt, which is called *rāsi cakra* of this calendric system, is divided as usual into 12 equal parts starting from the aforementioned fixed initial point, and each part or zodiac sign spanning 30^0 along the ecliptic is known as *rāsi* , and the names of the twelve *rāsis* counted from the beginning are (1) Meṣa (2) Vṛṣa (3) Mithuna (4) Karkaṭa (5) Siṃha (6) Kanyā (7) Tulā (8) Vṛścika (9) Dhanuṣ (10) Makara (11) Kumbha and (12) Mīna, corresponding English names for the above *rāsis* or zodiac signs are: (1) Aries (2) Taurus (3) Gemini (4) Cancer (5) Leo (6) Virgo (7) Libra (8) Scorpio (9) Sagittarius (10) Capricon (11) Aquarius and (12) Pisces. But the difference is that in the English or Western system, these zodiac signs are reckoned from the moving vernal equinoctial point and not from a fixed point in the sky, and hence in the two systems the zodiac signs of same name do not coincide, and the Western zodiac signs are $23^0 39'$ on the west of those of the same name in the Indian system.

CALENDARS FOLLOWED UNDER SŪRYA SIDDHĀNTIC SYSTEM
In India, apart from the Gregorian calendar which is used by the government and commercial houses, mainly three different calendars based on *Sūrya Siddhānta* system, are in use today. One is a solar calendar, and the two others are luni-solar ones. The main difference between the two luni-solar calendars is that in one the lunar months are new-Moon ending, and in the other these are full-Moon endings. These three different calendars are described below.

1 SOLAR CALENDAR
The solar calendar used in India is on *Sūrya Siddhānta* system, and the length of the year is sidereal (*nirayana*) as opposed to tropical (*sāyana*), which is used in framing the Gregorian calendar. The length of the sidereal and tropical years in mean solar days are respectively 365.25635 and 365.24218, and hence the former is longer than the latter by 0.01417 day or by $24^m 20^s$. There are the usual twelve months in a year, and these are named serially as follows: (1) Vaiśākha, (2) Jyaistha (3) Āsāḍha, (4) Śrāvaṇa (5) Bhādra, (6) Āśvina, (7) Kārtika, (8) Agrahāyaṇa, (9) Pauṣa, (10) Māgha, (11) Phālguna, and (12) Caitra. These 12 months are linked respectively with the 12 *rāsis* or zodiacal signs, starting from Meṣa, mentioned earlier, that is, Vaiśākha is linked with Meṣa, Jyaistha with Vṛṣa and so on. The meaning is that the length of months is determined by the time taken by the Sun to traverse the concerned *rāsi* with which the month is linked. For this reason, in some regions months are named as *rāsis*.

The actual time taken by the Sun to traverse the *rāsis* varies from 29.45 to 31.45 days as per Kepler's law applied to the elliptical orbit of the earth where the Sun is located in one of its foci. Again the ingress of the Sun from a *rāsi* to the next (*saṃkrānti*) may take place at any time of day or night but the calendar day of the month, as followed under the traditional system, starts with sunrise. Therefore, a rule or convention is required to be followed for dertermining the day

when the month will start. There are, however, four conventions followed
in four different regions,namely, Bengal, Orissa, Tamil Nadu and Kerala,
and this has given rise to the position that the month may commence on
the day of *saṃkrānti* (ingress of the Sun to the next *rāśi*), or on
the day following,or sometime on the day after. The effect of all this
is that the months of the solar calendar used in *pañcaṅga* (Indian
almanac) may vary from 29 to 32 days. Further, in the same year the same
months may not have the same length in all regions, and again in the
same region the length of the same month may vary from year to year
because months have no fixed number of days.

The solar calendar for counting the days of the months and consequently
the year is followed in the states of Tripura, Assam, Bengal, Orissa,
Tamil Nadu, Kerala and partly in Punjab and Haryana. In all other
states, the luni-solar calendar is followed for calendrical purposes.
Generally, however, the northern states follow the full-Moon ending
pattern while the southern states follow the new-Moon ending one. The
details of these two types of luni-solar calendar are described below:

2   NEW-MOON ENDING OR AMĀNTA LUNAR CALENDAR

The months of this calendar are counted on the time period
of one new Moon to the next, and are named after the solar months in
which the initial new Moon from which the lunar month starts, occurs. In
both new-Moon and full- Moon ending lunar calendars, the year starts
from Caitra while in the solar calendar it starts from Vaiśākha, the
month following Caitra when the Sun enters Mesa *rāśi*, that is,
sidereal sign of Aries.

The lunar month being synodic, the Moon moves through 360^0 from one
new Moon to the next in relation to the Sun. The period of time the Moon
takes to gain successively 12^0 over the Sun is known as *tithi*, and
there being thus 30 *tithis*, in a lunar month, 15 in the waxing or
bright period (*Sukla pakṣa*) and 15 in the waning or dark period
(*Kṛṣṇa pakṣa*) of the Moon. The day number of the month of the lunar
calendar is reckoned on the basis of the ordinal number of the *tithi*
current on the day at sunrise. Now the motions of the Sun and the Moon
not being steady, the duration of a *tithi* varies from 26.78 to 19.98
hours and this results in a *tithi* covering sometimes two sunrises or
falling between them. When this happens, there is a break in the
seriality in the day-number of the days of the month because then the
tithi-day number will be repeated or omitted.

The mean duration of a lunar month is about 29.53 days and the lunar
year thus falls short of the solar year by about 10.9 days. In the luni-
solar calendar this discrepancy is made up by inserting an additional or
intercalary lunar month called *adhika* month to keep the lunar calendar
adjusted with the solar and consequently the lunar months with the
seasons. The procedure followed for this adjustment in the lunisolar
Jewish calendar is that 7 intercalary lunar months are added at laid-
down intervals in 19 lunar years making the total number of days very
nearly equal to 19 solar years. The Indian lunar calendar, however, has

not adopted the above procedure of adding intercalary months in a
mechanical manner. The early Indian astronomers had devised an ingenious
astronomical method for determining the intercalary months which is just
as accurate. The method followed is that when two new Moons occur in one
solar month which is calculated on the basis of exact time taken by the
Sun to traverse the concerned *raśi* then first lunar month commencing
with the first new Moon is treated as an intercalary or *adhika* month,
and the second one as a normal or *śuddha* month. Both lunar months,
however, have the same name as they commence from the same solar month,
but the first month has the prefix *adhika* and the second one *śuddha*
added to them.

It sometimes happens, though at long intervals of time, which may be as
early as 19 years or as late as 141 years, average interval being about
63 years, no new Moon may occur in a certain short solar month like
Agrahāyaṇa, Pauṣa, or Māgha, and in that case there will be no lunar
month after the name of that solar month and thus forming a void in the
seriality of lunar months. This void month is known as *kṣaya* month.
When a *kṣaya* month comes about, there always occur two intercalary or
adhika lunar months in two solar months, one before and one after the
solar month in which no new Moon has occurred. One of the intercalary
months, normally the first one, is treated as an intercalary or *adhika*
month and the second one is treated as normal or *śuddha* month, filling
the void of *kṣaya* month and making the lunar year comprise of normal
12 months.

Amānta luni-solar calendar is followed in the states of Maharashtra,
Gujarat, Andhra Pradesh and Karnataka. In all states, however, *amānta*
luni-solar calendar is used for fixing the dates of religious festivals
which depend on lunar calendar.

3   FULL-MOON ENDING OR PŪRṆIMĀNTA LUNAR CALENDAR
The months of this calendar are reckoned on the basis of
time period from one full Moon to the next, but is named after the
amānta (new-Moon ending) calendar commencing a fortnight later. In
other words, *pūrṇimānta* lunar month begins a fortnight earlier and
ends in the middle of the *amānta* month of the same name. The other
features of this calendar are the same as those mentioned for *amānta*
calendar.

ERAS
Apart from different types of calendar followed, use of
different eras are also in vogue. States following *pūrṇimānta* lunar
calendar and the state of Gujarat following *amānta* lunar calendar, use
Vikrama era which commence from 58 B.C. All states following *amānta*
lunar calendar except Gujarat, use Śālivahana Śaka era commencing from
78 A.D. Śaka Solar era is used by all states following solar calendar,
and in addition Bengali San is used in Tripura, Assam, and Bengal, and
Kollan era in Kerala. The Kali era commencing from 3102 B.C., used by
the pioneer early astronomer Āryabhaṭa, is used throughout in addition.

EVOLVING A STANDARD INDIAN CALENDAR BASED ON NATIONAL TRADITION

The three calendars described above are the principal ones that are in use at present. There exist a number of other different calendars but their use is restricted either to certain areas or to some groups of persons.

The existence of so many different calendars is a legacy of the past political division of the country when several independent kingdoms flourished. Now, attempt is being made to have a standard calendar for the entire country to be used for all purposes. Such a calendar to become acceptable has to keep in mind the traditional system which has been in vogue for many centuries, and at the same time it has to be scientific.
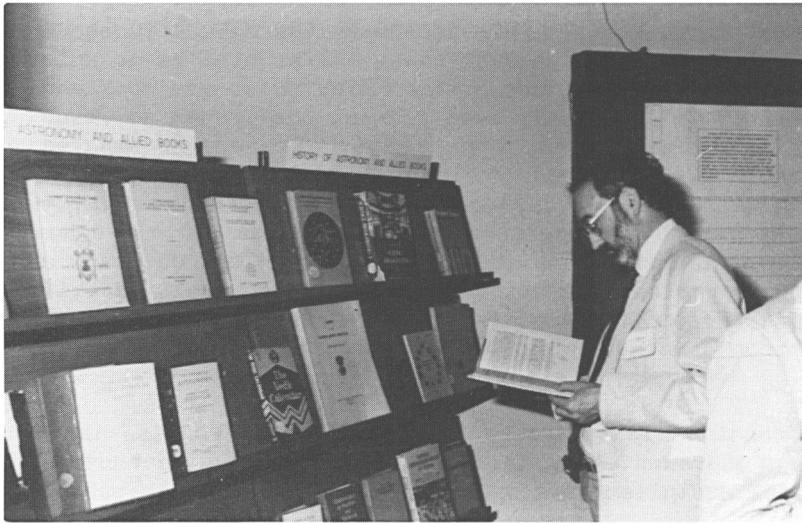
R.Mercier examining books at the
Oriental Astronomy exhibition