

of human conception, and that in very deed all men are brothers. I have only space for a few :

I. Love of false display.

- (a) There are many rosaries, the beads of which are not told in devotion.
- (b) A turban on his head, and with nothing on the lower parts of the body.

II. Ingratitude.

When in distress a man calls on his god.

III. The mother-in-law.

If the mother-in-law gets a chance, she comes three times a day to her daughter's house.

IV. The contrary wife.

If I ask for chutney, she gives me salt : who can stand a wife who is so contrary ?

and so on.

The compilation is a very creditable one, and a positive contribution to knowledge. I wish that other district officers would follow the example.

R. N. CUST,

June 14, 1896.

Hon. Sec. to R.A.S.

THE INDIAN CALENDAR, with Tables for the conversion of Hindu and Muhammadan into A.D. dates, and *vice versâ*. By R. SEWELL and Ś. B. DĪKSHIT. With Tables of eclipses visible in India, by Dr. R. SCHRAM. (London : Swan Sonnenschein and Co., Limited, 1896.)

Although during the last ten years several excellent essays have been published on the subject,<sup>1</sup> the verification of Hindu dates is often still considered a task of great intricacy, to be approached only by people who possess an intimate knowledge of Indian astronomy. If those who

<sup>1</sup> I allude to Prof. Jacobi's "Methods and Tables for Verifying Hindu Dates," in *Ind. Ant.*, vol. xvii, p. 145 ff., and especially to the same scholar's "Computation of Hindu Dates in Inscriptions," etc., in *Ep. Ind.*, vol. i, p. 403 ff., and vol. ii, p. 487 ff. Very good tables for the approximate conversion of Hindu dates have been published by Dr. Schram in *Ind. Ant.*, vol. xviii, p. 290 ff.

hold such an opinion will devote a few hours' study to the work which we now owe to the painstaking industry of Mr. Sewell and Mr. Dikshit, they will see how greatly they are mistaken, or will, at any rate, admit that the two authors have removed whatever difficulty hitherto has seemed to surround the matter of which the work treats.

This new work naturally divides itself into two parts. The first part gives a clear account of the Hindu and Muhammadan calendars, and of the various eras and cycles which have been, or are still, used in different parts of India, interspersed with some valuable remarks on the astronomical writings of the Hindus. The second, more extensive part contains 136 pages of tables for the conversion of Hindu and Muhammadan dates into the corresponding European dates, and *vice versâ*, and for the calculation of the *nakṣatras*, *yogas*, and other items, sometimes quoted in Indian dates. It also fully explains the construction of the tables, and gives examples to show the working of them. In an appendix the well-known astronomer, Dr. R. Schram, of Vienna, besides, furnishes a list of the solar eclipses likely to have been visible in India during the period to which the work refers (*i.e.* from A.D. 300 to A.D. 1900), with tables by which it is extremely easy to ascertain whether (the greatest phase of) a solar eclipse was visible at a given place in India, and at what time of the day it took place there. The additions and corrections, among other things, contain Mr. Dikshit's rules and tables for calculating Jupiter's apparent (or true) place, the necessity for which has probably been suggested by a number of South Indian dates, lately published.

That this work is the outcome of an immense amount of patient labour, is self-evident; and, judging from the tests which I have applied, it may well be trusted for the accuracy of its statements. To convey to the reader some idea of the great ease with which the object for which it is designed is really attained by it, I shall show the practical working of its rules and tables by using them for the verification of two or three dates of Indian inscriptions.

But to make my calculations generally intelligible, I must premise some trite remarks on the Hindu calendar, and say a few words about the tables of our authors.

The first month of the ordinary Hindu solar year theoretically commences at the instant of the sun's entrance into the sign Aries, *i.e.* at the Meṣa-saṁkrānti, and each succeeding saṁkrānti (or entrance of the sun into a sign of the zodiac) marks the theoretical beginning of a new solar month. The civil beginning of a solar month, *i.e.* whether in every-day life the month commences on the day of the saṁkrānti or on the following (or third) day, depends on the exact time of the day when the saṁkrānti takes place, and is regulated by rules which differ in different parts of India. The first month of the luni-solar year, on the other hand, commonly commences at the new moon which immediately precedes the commencement of the solar year, and each succeeding new moon forms the commencement of a new lunar month. The year ordinarily contains 12 such months, but to keep the luni-solar year in accord with the solar year another lunar month (homonymous with one of the 12 ordinary months) is added every third or, more rarely, every second year; and sometimes we have two homonymous lunar months in a year, while at the same time the name of another month is expunged. Each lunar month has two halves (*pakṣa*)—the bright half from new moon to full moon, and the dark half from full moon to new moon. Either *pakṣa*, again, contains 15 *tithis* which (since a *tithi* is the variable time occupied by the moon in increasing her distance from the sun by 12 degrees) are of variable length, and the calculation of the exact length of which is of the utmost importance, because a civil day receives the number of the *tithi* which ends in it or is wholly occupied by it. Thus, "the 1st of the bright half of Caitra" (*Caitra-sudi* 1) would ordinarily denote that civil day on which ends the first *tithi* of the bright half of Caitra (the first lunar month of the luni-solar year); and "the 11th of the dark half of Phālguna," that civil day on which ends the 11th *tithi* of the dark half (*i.e.*, counting from new moon, the 26th *tithi*)

of Phālguna. In general, 60 *tithis* (the collective number of *tithis* of two lunar months) are approximately equivalent to 59 civil days. Subject to the modification that a civil day is reckoned from sunrise to sunrise, the weekdays of the Hindus agree with our own; and the most ordinary (though not always sufficient) way of testing the correctness of the date of an Indian inscription, is to ascertain whether the *tithi* of the date did really end on the weekday which is joined with it in the original record, or whether a given solar day really fell on the given weekday.

Now our authors have furnished us with tables for both the approximate and the accurate conversion of Hindu solar and luni-solar dates. To the tables for the approximate conversion of dates—they are two “eye-tables,” constructed on methods invented by two native scholars of Madras—they themselves apparently do not attach any very great importance, and in my opinion these tables should never be used for the verification of dates.<sup>1</sup> The tables for the accurate conversion of Hindu dates are to a considerable extent based on, and some of them are identical or nearly identical with, the tables published by Prof. Jacobi in the *Indian Antiquary*. But the principal Table I, which comprises no less than one hundred pages, contains a great amount of independent work, inasmuch as it furnishes ready to hand, for each of the 1601 years from Kaliyuga 3402 current<sup>2</sup> to Kaliyuga 5002 current (*i.e.* A.D. 300 to

<sup>1</sup> Regarding the approximate method, the authors, on p. 65, say: “Results found by this method *may* be inaccurate by as much as two days, but not more. If the era and bases of calculation of the given Hindu date are clearly known, and if the given date mentions a weekday, the day found by the tables may be altered to suit it.” But “the bases of calculation” of a given date can never be known until a date has been *accurately* verified; and that one should alter the day found by the tables so as to suit a given weekday, I consider rather dangerous advice.

<sup>2</sup> Although the dates which employ the principal Hindu eras commonly give expired years—dates of the Vikrama era do so nearly always, and for every Śaka date with a current year we have about four Śaka dates with expired years—the authors in their tables throughout have given current years. How, from a practical point of view, they may justify this, I do not know; but I am the more surprised at their procedure because, judging from the notes on pp. 40 and 42, they are inclined to look on the Vikrama years of the dates and on the “so-called expired Śaka years” as current years (*not* the current years of their tables).

1900), a number of important data which a person engaged in the examination of Hindu dates formerly in many cases had to calculate for himself, often at no small expense of time and labour. Thus, Table I gives us for each year not merely the concurrent Jovian year according to both the northern and southern systems, but also the added lunar month (both mean<sup>1</sup> and true) and the suppressed month when there is one, the moment of the Meṣa-saṁkrānti according to the Ārya- and Sūrya-siddhāntas, and the European equivalent of the first civil day of the luni-solar year, with certain sets of figures from which the end of the first *tithi* (*Caitra-sudi* 1) on that day may be ascertained, etc. These data in Table I form the basis of all calculations; and the conversion or verification of a date, as I shall now show, consists in the simple addition to them of the interval in time between the commencement of the year and the given date, which is found by the help of one of the minor tables.

(1) In *Ind. Ant.*, vol. xix, p. 25, No. 12, I have shown that the date "*Tuesday*, the 3rd of the bright half of Pauṣa of Vikrama 1280 expired, at the Uttarāyaṇa-saṁkrānti," correctly corresponds to *Tuesday*, the 26th December, A.D. 1223 (when, by Prof. Jacobi's tables, the 3rd *tithi* of the bright half ended approximately 14h. 6m. after mean sunrise), and that the Uttarāyaṇa-saṁkrānti did take place on that day. By the work under notice the calculation would be made thus:—

From Table I we see that Vikrama (1280 expired=) 1281 current corresponds to A.D. 1223-4, and that Bhādrapada (the 6th month of the year) was repeated in that year. Pauṣa, ordinarily the 10th month of the luni-solar year (Table III), therefore, was here the 11th month, and the number of *tithis* from (but exclusive of) the first *tithi* of the year (the equivalent of which is given in

<sup>1</sup> Our authors on p. 27 say that the change from the mean to the true system of intercalation took place about A.D. 1040. But my examination of dates has shown to me that in practice the change had taken place already in the beginning of the 10th century A.D.

Table I) to the 3rd *tithi* of the bright half of Pausa was  $30 \times 10 = 300 + 3 = 303 - 1$  (for the first *tithi* of the year) = 302, approximately equivalent, according to what has been said above, to 297 civil days. All we have to do now is to take from columns 19, 20, and 23–25 of Table I (p. lix) the figures given for the commencement of the luni-solar year Vikrama 1281 current, and to add from Table IV (p. cx) the increase for 297 civil days, thus:—

	<i>d.</i> <sup>1</sup>	<i>w.</i>	<i>a.</i>	<i>b.</i>	<i>c.</i>
T. I.	(63)	0	9916	549	221
+ T. IV.	(297)	3	574	779	813
	(360)	3	490	328	34
Equation for 328 by T. VI.			264		
„ „ 34 by T. VII.			47		
			<u><i>t</i>=801</u>		

Now, one complete *tithi* (*t*) being equal to 333, the result, *t*=801 (which is between 667 and 1000), shows (Table VIII) that on the 360th day of A.D. 1223–4, which by Table IX was the 26th December, A.D. 1223, and which was 3=Tuesday, the 3rd *tithi* of the bright half was current at mean sunrise; and the difference between 801 and 1000 (the end of the 3rd *tithi*)=199 by Table X shows further that that 3rd *tithi* ended approximately 14h. 6m. after mean sunrise, exactly as found by Prof. Jacobi's tables.

Similarly, to find the exact moment of the Uttarāyaṇa- (or Makara-) saṁkrānti, we only have to take from columns 13–17*a* of Table I (p. lix) the time of the Meṣa-saṁkrānti for the year of the date, and to add from columns 6–9 of Table III (p. cvii) the increase for the Makara-saṁkrānti. Proceeding thus, according to the Sūrya-siddhānta, we find—

<sup>1</sup> The number 63 under *d* denotes the 63rd day of A.D. 1223; the 0 under *w* denotes the weekday Saturday (Sunday being counted as 1, Monday as 2, etc., and Saturday as 7 or 0). The figures under *a*, *b*, and *c* give certain quantities from which the condition of the *tithi* at sunrise is ascertained, *a* being corrected by the equations for *b* and *c*, taken from Tables VI and VII. In adding up the numbers under *b* and *c*, thousands are omitted; in adding up those under *a*, ten-thousands.

$$\begin{array}{rcl}
 \text{T. I.} & (84) & 0 \quad 10 \text{ h. } 37 \text{ m.} \\
 + \text{ T. III, col. 9.} & (275) & 2 \quad 15 \text{ h. } 17 \text{ m.} \\
 & & \hline
 & (359) & 2 \quad 25 \text{ h. } 54 \text{ m.} \\
 & = (360) & 3 \quad 1 \text{ h. } 54 \text{ m.}
 \end{array}$$

which means that the Uttarāyaṇa-samkrānti took place on the same day which above we have found for the *tithi* of the date, by the Sūrya-siddhānta 1 h. 54 m. after mean sunrise. The original date is therefore shown to be correct in every particular.

(2) In *Ind. Ant.*, vol. xxiii, p. 129, No. 99, I have stated that the date "*Thursday*, the 11th of the dark half of Phālguna of Śaka 1042 current, the year Vikārin," regularly corresponds to *Thursday*, the 26th February, A.D. 1120.

From Table I (p. lii) we see that Śaka 1042 current = A.D. 1119–20 by the southern luni-solar cycle was the year Vikārin, and that there was no added month in that year. Phālguna, therefore (by Table III), was the 12th lunar month, and the 11th *tithi* of the dark half being the 15 + 11 = 26th *tithi* of the month, we have  $30 \times 11 = 330 + 26 = 356 - 1 = 355$  *tithis*, approximately = 349 civil days. Accordingly we have—

$$\begin{array}{rcl}
 \text{T. I (p. lii).} & (73) & 6 \quad 30 \quad 340 \quad 251 \\
 + \text{ T. III (p. cx).} & (349) & 6 \quad 8183 \quad 666 \quad 955 \\
 & & \hline
 & (422) & 5 \quad 8213 \quad 6 \quad 206^1 \\
 \text{Equation for 6 by T. VI.} & & 145 \\
 \text{,, ,, 206 by T. VII.} & & 2 \\
 & & \hline
 & & t = 8360.
 \end{array}$$

$T = 8360$ , being between 8333 and 8667 (Table VIII), the result is that the 11th *tithi* of the dark half was current at mean sunrise<sup>2</sup> of 5 = *Thursday*, the day 422 of

<sup>1</sup> These figures for *a*, *b*, and *c*, again, are exactly the same as those found by Prof. Jacobi's tables for the 26th February, A.D. 1120.

<sup>2</sup> The exact time of the end of the *tithi*, calculated according to the new tables, was 19 h. 56 m. after mean sunrise, but for ordinary purposes it is unnecessary to calculate this, because  $t = 8360$  sufficiently shows that the 26th February, A.D. 1120, under any circumstances was the 11th of the dark half.

A.D. 1119–20, which by Table IX (p. cxvii) was the 26th February, A.D. 1120.

(3) In *Ind. Ant.*, vol. xxiii, p. 132, No. 113, we have a date which gives us “*Wednesday*, the 3rd of the month of Paṅguṇi of Śaka 1347 expired, the year Viśvāvasu.”

From Table II, Part II (p. cv), we see that Paṅguṇi is the solar month of Mīna, the commencement of which is marked by the Mīna-saṁkrānti. We therefore must find the time of that saṁkrānti for Śaka 1347 expired=1348 current, which by Table I (p. lxxii), according to the southern luni-solar cycle, *was* the Jovian year Viśvāvasu, and which corresponds to A.D. 1425–6. Using the figures for the Ārya-siddhānta, we find from columns 13, 14, and 17 of

T. I (p. lxxiii).	(85)	2	15 h. 22 m.
+ T. III (p. cvii).	(334)	5	22 h. 5 m.
	(419)	7=0	37 h. 27 m.
	=(420)	1	13 h. 27 m.

Accordingly, the Mīna-saṁkrānti of the given year took place 13 h. 27 m. after mean sunrise of 1=Sunday of the day 420 of A.D. 1425–6, which by Table IX (p. cxvii) was the 24th February, A.D. 1426. And since the saṁkrānti took place here more than 12 hours after mean sunrise, the month of Mīna or Paṅguṇi commenced (p. 12) on the following day, Monday the 25th February, and the 3rd of Paṅguṇi was the 27th February, A.D. 1426, which *was* a *Wednesday*.

The great advantage of the addition of Dr. Schram's tables for solar eclipses I would exemplify by the date of an inscription at Saundatti (*Ind. Ant.*, vol. xxiii, p. 130, No. 103), which mentions *a total eclipse of the sun* on Monday, the new-moon *tithi* of Āṣāḍha of Śaka 1151 current, the year Sarvadhārin. By the tables of Mr. Sewell and Mr. Dikshit the date is found to correspond regularly to Monday, the 3rd July, A.D. 1228, and we know that on that



day there was a solar eclipse. The question is whether the eclipse was visible at Saundatti, and if so, whether for that place it was a total eclipse.

The latitude,  $\phi$ , of Saundatti is  $15^{\circ} 46' \text{ N.} = 16^{\circ}$ , and its longitude,  $\lambda$ , is  $75^{\circ} 10' \text{ E.} = 75^{\circ}$ .

Dr. Schram's Table A for A.D. 1228, VII, 3, gives—

$$\begin{array}{rcl} L=508 & \mu=269^{\circ} & s'=54.85 \\ \text{Saundatti has} & \lambda=75^{\circ} & \\ & \hline & \lambda+\mu=344^{\circ} \end{array}$$

With  $\phi=16^{\circ}$  and  $\lambda+\mu=344^{\circ}$ —

$$\begin{array}{rcl} \text{Table B, } L=500 & \text{gives } s''=1.15 \\ \text{and Table B, } L=510 & \text{gives } s''=1.17 \\ \text{therefore } L=508 & . . . . . & s''=1.17 \\ & & \hline & & s'+s''=56.02 \end{array}$$

Now Table C, with  $s'+s''=56.00$  gives *total*, and with  $s'+s''=56.04$  *eleven digits*; with  $s'+s''=56.02$ ; therefore, the eclipse at Saundatti was one of 11.5 digits or an *almost total* eclipse.

Proceeding in the same simple manner by Table D, we further find that the moment of the greatest phase of the eclipse at Saundatti was 11.7 ghaṭikās or 4 h. 41 m. after true sunrise.

As I merely wish to indicate the way in which the new tables are used, I have given here only dates which at once work out quite satisfactorily. The cases we meet with are not always so simple, and in practice we have to consider various possibilities. A *tithi* sometimes may or must be joined with the civil day on which it *commences*. A lunar month, instead of commencing with the new moon, often commences with the full moon. A luni-solar year, instead of beginning with the month Caitra, may commence with Kārttika or other months, and a solar year, *e.g.*, with the Simha- instead of the Meṣa-saṁkrānti. Besides, we rarely know beforehand whether the year of a date is current

or expired, and sometimes only regnal or Jovian years are given to us. But the manner of calculation is the same everywhere, and the work before us contains ample information as to how most of these difficulties should be dealt with.

In a note on p. 109 Mr. Sewell informs us that in a second edition he proposes to add a list of the lunar eclipses visible in India. A list of lunar eclipses is indeed necessary, but in my opinion the lists of both solar and lunar eclipses should give *all* eclipses for the period of which the work treats, because in the verification of dates we also meet with eclipses that were not visible in India. In a new edition a few paragraphs might also be added about the calculation of the *lagna*, sometimes quoted in dates, and of the *ahargana* for a given day; and lists should be given of the deities of the *tithis*, *nakṣatras*, etc., so as to explain such expressions as "the *tithi* of Madana" and "the Maitra *nakṣatra*." I would also suggest the addition of a list of the words used to express numbers, and an explanation of the so-called *kaṭapayādi* method of denoting numbers.

Our authors have acknowledged their indebtedness to Prof. Jacobi, and, for the solution of some problems, have referred us to that scholar's Special Tables, published in *Ep. Ind.*, vol. i, p. 450 ff. Highly as I appreciate the new work of Mr. Sewell and Mr. Dīkshit, I should be wanting in gratitude if, on my part, I did not acknowledge here the great benefit which I myself have derived from Prof. Jacobi's unpretending General Tables, *ibid.*, pp. 443-445, the design of which has always appeared to me a marvel of ingenuity.

Göttingen.

F. KIELHORN.

#### THE BABYLONIAN EXPEDITION OF THE UNIVERSITY OF PENNSYLVANIA.

Professor Hilprecht, of Pennsylvania, has just given to the world the second part of vol. i of the work he is