IAN PROUDFOOT

In search of lost time

Javanese and Balinese understandings of the Indic calendar

The history of calendars is best approached as a technical subject that has cultural and political dimensions.¹ The functions of calendars – to enumerate days, months and years – can be achieved in a variety of ways. In broad terms Muslims expect their calendars to predict the phases of the moon, Christians expect their calendars to match the seasons of the year, and Hindus and Chinese expect their calendars to do both. These expectations can be met by different technical means, so that even among those who subscribe to a common set of expectations, there are invariably differences in the working calendars. Because the calendar coordinates participation in ritual, political and administrative life, the currency of a shared calendar is a way of delineating the boundaries of sometimes overlapping communities. This is not just a matter of choosing to follow the Hindu, Muslim or Christian calendar for one purpose or another; each of these calendars has a plasticity that raises the possibility of difference. Eighteenth-century Dutch towns chose between Catholic or Protestant calendars ten days apart; nineteenth-century Javanese Muslims in Surakarta often broke the fast a day ahead or a day behind their co-religionists in Yogyakarta; and the Balinese kingdoms ran calendars that often differed by a month, while in some villages brahmans and commoners chose to follow calendars that separated their monthly full-moon rites by a day.² Sometimes differences are present simply because of poor communication and the lack of any need for coordination; at other times they are conscious statements of contested allegiance.

The generic Indic calendar has a long history in Java and Bali. Dates in an Indic calendar appear in Java's oldest historical documents, the dated inscriptions of the eighth century. They continue right through the record of inscriptions in Java and Bali up to the fall of Majapahit in the fifteenth century AD.

¹ My thanks to Chris Eade for introducing me to this topic and for his continuing friendly advice. I am also grateful to the anonymous readers of this paper for their careful comments.

² For Europe, Grotefend 1971; for Southeast Asia, Proudfoot 2006:87; for Bali, see the discussion below, with Widjanegara 1932:39-40; W. 1934:3.

IAN PROUDFOOT is a visiting fellow in the Southeast Asia Centre, Faculty of Asian Studies, Australian National University. His most recent publications are *Old Muslim calendars of Southeast Asia*, Leiden: Brill, 2006, and 'Brushes with modernity on Batavia's horse tram 1869-1871', *RIMA* 39-1, 2005, pp. 129-87. He can be contacted at ian.proudfoot@anu.edu.au.

Subsequent dates in Indic calendars appear in Old Javanese and Balinese literary sources and in administrative instruments issued by the courts of Bali and Lombok into the twentieth century. Indic calendars are still used in Bali for religious purposes.

The older dates in the Javanese and Balinese inscriptions are remarkably consistent and orthodox. While elements of astrology accompanying the dates become increasingly elaborate, the format of the dates themselves and the language used to express them hardly change.³ They are evidence of a long-standing chancery convention, which speaks volumes for the continuity of Javanese court culture over seven centuries. A handful of late dates in inscriptions issued outside the chancery depart from this formality. Dates found in literature from later Java and Bali, and later manuscript charters from Bali and Lombok, are more varied in form, and depart further from the Indic model in superficial ways: for instance, they more frequently use the Javanese method of naming months by number rather than by the Sanskrit names that were invariably found in the old chancery dates. Nevertheless, behind these and other changes, the fundamental shape of the Indic calendar persisted.

This consistency contrasts with conditions in India, where a plethora of regional variants and changes in calendar practice from dynasty to dynasty were the norm. In all important respects the Indic calendar in Southeast Asia followed the scholarly conventions of the Indic astronomical treatises,⁴ and enumerated its years in the Śaka era. The choice of era seemed particularly significant to De Casparis as an indication that the Javanese calendar was learned from Indian theory rather than from Indian practice. In India it was common practice to date inscriptions using dynastic eras and regnal dates, but in Java we find only one early example of a regnal date, and two examples of dates in a dynastic era.⁵ Observing that the Śaka era was 'the era used in all astronomical works', De Casparis (1978:15) concludes that:

The Śaka era is apparently one of a considerable number of aspects of ancient Indian civilisation which were adopted and assimilated by the 'clerks' of South East Asia who became familiar with Indian religion and erudition.⁶

³ This consistency makes the small variations all the more noteworthy: for example the hitherto unremarked shift from introducing Old Javanese dates with the Sanskrit *tatkāla* to the more Javanese *irikā diwasa* around 832-851 Śaka (AD 910-929), an early step in vernacularization.

⁴ That is: it began its months with the new moon (not as some Indian calendars, with the full moon); its years began near the March equinox (not as some Indian calendars, near the September equinox); its year comprised lunar months (not as some Indian calendars, zodiacal solar months); and it consistently enumerated its years in the Śaka era as expired years (and not as in some Indian eras, as current years). For the variety of eras and calendrical forms, see Sewell and Balkrishna Dikshit 1896:39-47.

⁵ Sircar 1965:217-306; De Casparis 1978:12; Damais 1951-58: A90, A92 in the Sañjaya era.

⁶ De Casparis (1978:15), referring here to the well-known formulation of Van den Bosch 1961. See also De Casparis 1978:10, 24. There are, however, some local peculiarities, such as the name Asuji for the month Āświna. It is important to note that Śaka era is the era of the *karaṇa*, not of the *siddhānta*, which use the Kaliyuga.

This is true as far as it goes, but it should not lead us to suppose that the Javanese adopted the fully-fledged Indic calendar laid out in the astronomical treatises. The Indic calendar derives in principle from the astronomical movements of the sun and the moon. In its full form, the calendar combines simulations of the apparent movements of the sun and the moon around the earth in epicyclic orbits. Each of these is a subtle calculation. The calendar is then shaped by the relationships between these two dynamic elements. Indian astronomers generated the calendar by running a solar calendar and a lunar calendar in parallel, and calibrating one against the other. Thus Indic (lunar) months are counted by the solar month current when they end, and Indic (solar) days are counted by the lunar day on which they begin at dawn. In its pure forms, this procedure throws up some intricate results, but in the main it produces the two salient features of most Indic calendars: the addition of a leap month every two to three years, and the suppression of a day in roughly every second month.⁷ The cycles of this calendar are deeply buried, and span impenetrably vast stretches of time. Astronomers calculated current time from a base point in 3102 BC when all the planets were aligned and which is also supposed to be the beginning of the current era, *kaliyuga*, the last stage in the world's downward spiral into depravity.

It is doubtful that the finer points of Indic astronomy were ever known in Java. Certainly this field did not become part of Javanese knowledge. Gomperts (2001:122) analysed Old Javanese sources, concluding that 'The planetary cycles and their related calculations were not clearly understood'. This is no surprise, in light of the way calendar knowledge was organized in India. At its peak stood the definitive treatises of the schools of astronomy, *siddhānta*, too abstruse, complex and mathematically sophisticated for practical calendar-making or astrology (Dershowitz and Reingold 1997:189-90; Van Wijk 1938:13). The most influential of these canons is the *Sūryasiddhānta*. Below these canonical works sprawled a secondary literature designed to provide the tools necessary for fixing dates and casting horoscopes. These texts, called *karaṇa* 'implementations', or *koṣṭhaka* 'depositories', comprised rules of thumb, tables of calculated values, and relatively simple formulae which rendered the abstract spherical geometry and hypercorrect calculations of the *siddhānta* into a more manageable arithmetic adapted to current

⁷ About every three years, most often at a time when the solar month is longer thanks to the earth's elliptical orbit around the sun, two (lunar) months will end in the same solar month, and therefore the lunar month will occur twice – in effect a leap month is added to the year. Conversely, more rarely, when the solar month is shorter, one lunar month will fully encompass a solar month, meaning that the corresponding lunar month will be skipped. For days of the month, the effects are reversed. About every couple of months a lunar day will happen to fall fully within a solar day, so that the next solar day begins two lunar days later. Again conversely, and again more rarely, a lunar day will encompass a whole solar day, so that successive solar days begin while the same lunar day is current, and thus a day is doubled.

eras and localities. They ironed out the self-cancelling fluctuations of the true astronomical system, and produced dates in the Śaka era.⁸ A *karaṇa*-regulated calendar might thus be accessible to specialists lacking mathematical or astronomical sophistication. We can be reasonably sure that a formulation of this kind was the form in which the Indic calendar came to Java. Its use would explain why, despite their seeming lack of astronomical sophistication, 'Indo-Javanese astrologers were mathematical craftsmen skilled in calculating time. They could easily falsify any day from a remote past into a perfectly consistent date in the Indo-Javanese period [...].'⁹ Through his close analysis of inconsistencies in the astrological data found in the inscriptions, Eade also concluded that court astrologers were using a *karaṇa* (Eade and Gislén 2000:70, 221-3).

So, we must think of the Javano-Balinese calendar as localized – in time and place – like all other practical calendars in the Indic world. Looking at the Javanese calendar in this light, it is no longer a puzzle why its dates do not precisely coincide with those predicted by the astronomy of the *Sūryasiddhānta*.¹⁰ Like any other Indic calendar, it will have been formulated on a set of locally adapted rules. But what was the nature of this localization? We cannot deduce this from the empirical evidence alone: Eade's analyses have shown that the possibilities are too numerous, and the evidence too thinly scattered.¹¹ If we knew something of the *karaṇa* that was in use, that could be the key to unlock the workings of the Javanese calendar; but Gomperts is pessimistic that we will ever find this key.

[I]n my view it is impossible to identify the specific Sanskrit *siddhānta* or *karaṇa* texts that found their way to Java. I deem Indo-Javanese mathematical astronomy largely irretrievable if no new texts are discovered in Balinese libraries.¹²

Pink's extensive survey of Balinese divination and calendrical texts, *wariga*, has indeed failed to find any mathematical astronomy.

Balinese *wariga* do discuss the mechanics of the calendar, but from another angle. Their interest is in how the Śaka calendar relates to the day-cycles that

⁸ Pingree 1981:32-40, 1978; Billard 1971. For a working example, see Faraut 1910.

⁹ Gomperts (2001:123), commenting on how later copies of early charters were endowed with the astrological bearings that came to be expected in later times.

¹⁰ To overcome this problem, Damais (1951-58, I:20) localized the *Sūryasiddhānta* for longitude, though not for latitude. See also Gomperts 2001:94-5; Eade and Gislén 2000.

¹¹ It is instructive to compare the success of Eade (1995) with mainland Southeast Asian calendars, with the inconclusive outcome of Eade and Gislén (2000) for Java. The difference springs from Eade's ability, in the former case, to take as his point of departure a full account of the formulae and procedures followed by the royal astrologer at the court of Cambodia in the early years of the last century; for Java he had no such point of departure.

¹² Gomperts 2001:123. Friederich (1850:55) touches on the genres of texts used by Balinese priests to manage the calendar. The focus of these texts was on divination rather than calendar management. See also Pink 1993:26-7.

are the engine of Javanese and Balinese divination. Their approach opens a new perspective on the idea of localization that has not yet been explored.

The history of the day-cycles goes back as far as the history of the Śaka calendar in Java. The oldest dated inscriptions in Java are in Sanskrit. They mention only the date in the Śaka calendar and the weekday, which by this time had become a standard accessory of Indic dates everywhere. As soon as inscriptions begin to appear in Old Javanese, almost a century later, the Śaka dates are accompanied by information about the three key day-cycles: the six-day cycle, the five-day market cycle, and the weekday, always in this order and almost always denoted by single-syllable abbreviations for the names of days in each of the cycles. The same day-cycles appear in Bali when inscriptions begin to be issued in Old Javanese, reflecting the Javanization of Balinese high culture in the eleventh century AD. (Before that time, Old Balinese inscriptions had instead mentioned only the Balinese market cycle of three days.) The three Javanese day-cycles were soon elaborated into the *wuku* cycle of 30 named weeks. At first the *wuku* appears sporadically in a few inscriptions published in East Java, but following the shift of political power from Central to East Java, again in the eleventh century, the *wuku* became a standard element of chancery dates, always included alongside the six-day, five-day, and seven-day cycles. These day-cycles and the *wuku* cycle combine in a 210-day meta-cycle, endlessly repeating with unwavering regularity. This matrix is the wellspring of Javanese and Balinese divination.

Beyond sharing the weekday cycle, the Śaka calendar and the *wuku* cycles appear to have nothing in common, arising from quite different notions of how time should be delineated, and indeed of the nature of time itself. Yet it is hardly possible that the two systems of time-reckoning should have run side-by-side for centuries without some mutual influence, or at least some attempt to understand one in terms of the other.

The problem of 'lost' time in Balinese texts

Bali's *wariga* texts treat the Śaka calendar as part of a larger body of Balinese knowledge that deals with the qualities of time.¹³ The core of this knowledge is expounding the effects of the intersecting cycles of days. Each day in each cycle has its own name and particular characteristics, associations, colours, governing deities, and so forth. The full personality of each of the 210 days in the *wuku* cycle is thus a product of the interacting qualities of each of the days in the lesser cycles that are current on that day. A certain number of days are renowned for coincidences that are potent in one way or another and have special names, but all days have their peculiar characteristics. For

¹³ This discussion draws largely on Pink 1993:49-104.

everyday divination the essential tool is the *tika*, a diagrammatic or pictorial mapping of these coincidences across the 210-day cycle or, for more popular use, the *palelintangan*, presenting pictorial mnemonics for the 35 days of the combined five-day and seven-day cycles, a pattern that recurs six times in each *wuku* cycle.

A minor branch of this time-knowledge deals with the Śaka calendar. While this calendar is less densely imbued with divinatory meanings, its months and the days of the month are significant. There was naturally therefore a desire to mesh the workings of the Śaka calendar with the deeper system of *wuku*-based divinatory time. This would mean discovering simple recurrent cycles in the Śaka calendar as well.

This happened at a superficial level when the years of the decade were formed into a *wuku*-style cycle, each year having a name and divinatory gloss (Pink 1993:67-8) – though common practice was to enumerate the years in the decade by number. Dating by years of the decade was current in Majapahit Java, but not in chancery dates.¹⁴ In later Balinese sources the decades themselves are dealt with in the same way. They have no divinatory weight, but constitute the cycle of the century, which in Java was associated with the rise and fall of kingdoms.¹⁵

But more constructive meshing was harder. It meant accommodating the two features of the Śaka calendar which seem to disturb its regular progression, namely the suppression of dates and the adding of months. The cog that allowed the Śaka calendar to engage with *wuku* cycles was the rule for suppressing days. We may assume that in the *karaṇa* at first followed in Java and Bali, a simplified system of suppressing dates must have allowed someone in early Java (we can assume) to realize that the average period between suppressions of dates was very close to 63 days.¹⁶ With only a small loss of accuracy, this simplification greatly aided calendar-making, making it easy to space the suppressions with the aid of an ingenious mnemonic.¹⁷

¹⁴ The 'rustic' inscriptions, Damais A193, A194, A195, refer only to the year in the decade. See further notes 38 and 39. References in this form refer to the catalogue of dates collected by Damais (1951-58).

¹⁵ Ricklefs (1974:11, 15, 116-219) shows in his treatment of Jogjakarta under Mangkubumi that eighteenth-century Javanese thinkers were deeply affected by the notion that kingdoms rose and fell in a regular cycle that repeated every century. This continues an older tradition: note that the Pararaton narrative ends at 1400-1403 Śaka, with the death of the last ruler in the palace in 1400, and the eruption of a volcano in the last week of the Javanese *pawukon* cycle: see Phalgunadi 1996:136-7; Ricklefs 1974:179, 182.

¹⁶ In the full-blown *Sūryasiddhānta* there are both fairly frequent suppressed dates and less frequent double dates. We should expect a *karaṇa* to have averaged these out, making a suppression due about every 62.894 days.

¹⁷ A mnemonic verse in Sanskrit *śloka* form lists the days of the fortnight on which successive suppressions will fall. (The Indic calendars divide the month into two fortnights each of 15 lunar days during which the moon waxes or wanes.) The list begins with the 15th, which is either

But more importantly, it happens that 63 days equals exactly nine weeks. This allows the pattern of suppressions to engage with the *wuku* cycle. It is possible to list the successive named weeks in which suppression occurs, to form a cycle that repeats after ten suppressions, or ninety weeks. This is called *pangalantaka*. It is customary to start the *pangalantaka* cycle with the week Sungsang, following which the suppressions fall in the *wuku* Tambir, Kulawu, Wariga, Pahang, Bala, Kurantil, Langkir, and Wuye, after which we are back to Sungsang for the next cycle. The suppression always falls on the same weekday in the seven-day cycle, while moving twice through days of the five-day cycle, taking two steps back each time. This pattern is quite in harmony with the *wuku* system: it involves the two most prominent divinatory cycles – of five and seven days; it runs through the *tika* cycle of 210 days precisely three times; and it behaves just like a *tika* pattern as it steps back through the days of the five-day cycle – the days of the five-day cycle step back in precisely the same way through the seven-day cycle.

In this scheme, the Śaka calendar not only meshes with the *wuku* cycles but also assimilates. The assimilation is so successful that it seems to raise a vexing question: what has happened to the days lost through suppression? No day is ever lost in any *wuku* cycle. The major cycles repeat with endlessly regular integrity. The four-, eight- and nine-day cycles have to be adjusted to fit into the 210-day *tika*, but the adjustment is always done by repeating days, never by suppressing them. For the *wariga*, this problem of the lost days seems fortuitously to provide a solution to the other irregularity of the Śaka calendar: its added leap months. In the view put forward in the *wariga*, a day that has been cut from a month is not lost, but held in storage. After a *pangalantaka* there are ten days in storage, so that after three *pangalantaka* there are thirty, just the right amount to populate a month of their own. This seems to kill two birds with one stone. A home for the lost days has been found, and the second oddity of the Śaka calendar, its leap months, has also been explained.¹⁸

The virtue of this scheme is that it fully assimilates the Śaka calendar into the cyclical world of the *wuku*. A leap month occurs after every three *pangalantaka*, or 1,890 days. Three *pangalantaka* form a large cycle called *nemu gelang*, ‘the clasped necklace’, a name redolent with completeness. At the clasp of the necklace, there is a leap month (*sasih nampih*). When a leap month

a new moon or a full moon, and then runs through the dates 4, 8, 12, 1, 5, 9, 13, 2, 6, 10, 14, 3, 7, 11 and back to 15. If the beginning 15th is the new moon, then even-numbered dates fall in the waxing fortnight and odd-numbered dates fall in the waning fortnight, until the next 15th arrives, which will be the full moon, and the alignments are reversed. See Pink 1993:74.

¹⁸ An illustration of the force of this idea that ‘lost’ days belong in a leap month can be seen in Widjanegara (1933:98–9), where the author offers a series of quite spurious calculations to show that the plan of his patron Goris to add a leap month every 30 months would provide a way of accommodating the ‘lost’ *ngunalatri*. His conclusion is explicit: ‘we add the ngoena-latri every 2½ years’ and thus bring the length of the year into line with the 366 days of the Christian year. The imperative overrode the conventions of arithmetic.

is due, the current month is repeated, so the leap month bears the same name as the one preceding it, and the pair are taken as forming a single great month (*sasih ulanan ageng*). As 1,890 days nominally amounts to five years plus three months, the month that will be repeated is predictable according to a cycle of its own. In one of the *wariga* formulations, the first repeated month is the 11th, next time around it will be the 2nd, then the 5th, and then the 8th, and then the pattern repeats; or in another formulation, if the first repeated month is the 1st, the next time around it will be the 4th, then the 7th, and then the 10th. This whole pattern, comprising four clasped necklaces, is one revolution (*ideran*), lasting 7,560 days. This is the ultimate meta-cycle recognized by the *wariga* texts; it is thought to accommodate complete rotations of every lesser cycle: all the day-cycles, of 1, 2, 3, 4, 5, 6, 7, 8, 9, and 10 days; the cycles of 35 days (for the *palelintangan*), 210 days (for the *tika*), and 410 days (long *odalan*); and the notional calendrical cycles of 15 days (for the fortnight), 30 days (for the month), and 360 days (for the year), 630 days (for the *pangalantaka*) and 1890 days (for the *nemu gelang*).

This is a gloriously elaborate speculation that has little to do with how the calendar worked. There were of course no lost days. The sense that some days were lost in the Śaka calendar arises from a common confusion between two concepts: *wara*, the natural solar day; and *tithi*, the postulated lunar day of the Śaka calendar that governs the numbering of days in the month.¹⁹ When a 'day' is suppressed, it is merely that two *tithi* fall in a single *wara*, and – as it is the *tithi* that govern the numbering of days in the month – the numbering of days in the month gives the impression that one has been skipped. The confounding of *tithi* and *wara* in Bali is the more understandable as *tithi* had lost the role they had in India for the timing of ritual observances.²⁰

So, the idea of collecting 'lost' days in a leap year is a specious solution to an imaginary problem. In calendrical terms, the suppression of days and the addition of leap months have entirely unrelated functions. (Days are suppressed to adjust the length of the month, to keep it true to the phases of the moon. Leap months are added to adjust the length of the year, to keep it true to the sun's seasons.) The suppression of days and the addition of leap years appear to have been linked in this *wariga* speculation just because they are the two kinds of anomaly that stop the Śaka calendar from running like a *wuku*-like cycle.

¹⁹ To overcome this confusion, Lüem (1988:224) translates *wara* as 'day' ('Tag') and *tithi* as 'date' ('Datum'). However this may be too rigorous, for once the underpinnings of the Śaka calendar had been forgotten, *tithi* was commonly taken simply to mean 'day of the month', thus becoming largely coterminous with *wara*. In the *Sūryasiddhānta* and other Indian systems, each *tithi* is current for the time it takes for the moon to increase its angle from the sun by 13°.

²⁰ Kane 1930-62, V:71-80. Time-dependent rites in Bali, such as post-birth ceremonies, are fixed according to *wara*, and in most cases follow the *wuku* cycle.

This fanciful calculation is old. We can infer this from the fact that the same reasoning about the leap month compensating for missing days and the same pattern for adding leap months were reported to nineteenth-century investigators of the calendar of the Tengger people, followers of the pre-Muslim Buda tradition in the Brama highlands in East Java. The resemblance is too close to be coincidental. The best explanation for it is that both descend from an older Majapahit tradition. Balinese and Tengger both assert that they are custodians of Majapahit traditions, and in this matter we have no reason to doubt them.²¹

In linking the two perceived anomalies of the Śaka calendar – its ‘lost’ days and its extra months – the astrologers have misunderstood or ignored the operative rule for adding leap months. The *wariga* model has to wait for over five years to accumulate enough ‘lost’ days to populate a leap month,²² when one is required every two to three years. The cumulative effect of this delay would be to cause the year to make a full cycle through the seasons in less than a century. This does not fit the historical evidence. The year was always seasonal, so in practice a leap month must have been added almost every three years.

What, then, was the rule for leap months? In the mid-nineteenth century, Friederich (1850:50-1, 57) was unable to learn the principle, as the knowledge was ‘tightly held by certain priests’. In modern Bali this is still largely true, and there is evidently no agreement over several competing alternatives. None of the modern alternatives fits the dates we find in historical sources;²³ rather the historical record indicates that the adding of leap months was handled somewhat arbitrarily. The current month was often different in Bali and Lombok, and from place to place in Bali.²⁴ Such discrepancies are

²¹ The alternative would be to contrive some later transmission of the speculation from Bali to Java or vice versa. There were contacts (see Creese 1991:411), but there is no difficulty with the simpler assumption of descent from a Majapahit or earlier common source.

²² It produces a year of 360.0 days. Pink (1993:78) found some prescriptions in the *wariga* texts calling for additional leap months to be added after every 100 and 800 years, but this still leaves the Balinese year far too short, at about 360.3 days. It is, however, a recognition that the *nemu gelang* rule was deficient.

²³ Eiseman (1999:33-7) sets out the *mala* method and the *nampih* method which temporarily replaced it during part of the last decade, together with the ‘historical method’ (which is the *Sūryasiddhānta*). Table 1 (p. 97) tests the fit of each of these methods with the East Javanese and Balinese dates in the inscriptions. Goris (1931-32:183, 1960:116) describes the addition of a *nampih* month every 30 months, by doubling Karo when the Śaka year-number is evenly divisible by 5, and Kaulu in the alternate cases. This method appears to have been invented by Goris on the basis of a defective understanding of the Indian calendar he got from Friederich (1850:51), who – to his credit – cautions that he found no parallel for the concept in Bali. Widjanegara (1933:98-100), after valiantly justifying Goris’s rule, concludes by implying his own lack of confidence that it is the answer.

²⁴ Explicitly in Damais F249/F250, F261/262, F299/F300, F315/F317. Korn (1933:117) describes a more aberrant local calendar, though its details are unclear.

symptomatic of the fragmentation of political and cultural life among the small kingdoms of Bali and Lombok, no doubt compounded by the lack of an agreed rule for managing the addition of leap months.

The Balinese could have got along quite nicely without any rule at all, by making ad hoc adjustments according to observation of the seasons. The *wariga* literature is well acquainted with measurements of the year that rely on simple astronomical observations. For this purpose the constellations Orion (*wuluku*) and the Pleiades (*kartika*) were tracked through the heavens, and it was understood that the first month of this star-based year, Kasa, began with the appearance of the constellation Orion above the horizon, with the Pleiades 'at the height of a coconut tree'. This happens at the time of the northern solstice. Friederich (1850:49) reported this also as a method of adjusting the calendar, with the last month of the year being doubled if the Pleiades assumed their proper place on the horizon at sunset.²⁵

However, a peculiar development in the modern Balinese calendar indicates that there was indeed some rule for managing leap years that did not rely upon the stars. We see this with a change in the calendar in northern Bali in the mid-nineteenth century. By this time, the Balinese year was regularly a month ahead of the seasons. The first month of the year, Cetra/Kasanga, now regularly began in February rather than in March, as it had in early Java or India. To restore the seasonality of the Śaka year, the beginning of the year was moved to the following month, Wesaka/Kasada.²⁶ The effect was that the end-of-year observance, Nyepi, returned to March (and the end of the eighth month of the star year) in the north, while in the south it continued to be observed a month earlier, in February.²⁷ The change is striking, because the adjustment of the beginning of the year could have been made more simply by adding a leap month. The fact that this was not done implies that, while the beginning of the year was anchored by the seasons or the stars, there was another principle governing the addition of leap months. As to what that principle may have been, all we can say for now is that it was not the rule prescribed in the *wariga* tradition.

²⁵ For Java, compare Maass 1924:117-25.

²⁶ The first instance found by Damais is F252 (1856 AD).

²⁷ The Wesaka beginning became standard across Bali after the Second World War, according to Damais (1951-58, V:226-7), because the administrative centre was Singaraja in the north. The sale of the first printed calendars, also from Singaraja, in 1933 must also have had an impact: see W. 1934:3; see also Goris 1960:116.

Revisiting the calendar of early East Java and Bali

It is, however, possible to imagine what the rule might have been if we suppose that it was conceived in the same spirit as the rule for suppressing days. The rule for suppressing days sprang from the insight that there was an uncomplicated cycle of time close to the frequency at which the operation was required. The same could be said of leap months, which have to be added after approximately every 33 months. A rule formulated in these simple terms would keep the calendar fully in line with the seasons for about two centuries, after which an additional leap month would be required. If this rule were to be stated in the same manner as the rule for leap months found in the *wariga*, it would run as follows: if the first month to be doubled was the 11th, the next time round it would be the 8th, then the 5th, then the 2nd, and then the pattern repeats. This cyclical rule does indeed look very much like the rule in the *wariga*: it is its mirror-image.

We can test this hypothesized rule against the early evidence – not against the Balinese record of recent centuries, which is too fragmented and internally contradictory, but against the older Javanese and Balinese inscriptions, which offer a more consistent record.²⁸

A difficulty in mapping the rule onto the empirical evidence is that we do not know when the cycle of leap months began, and therefore cannot know that, say, the 11th month was the first month to be doubled. As there are 33 months between successive intercalations of a leap month, there are 33 possible starting points which will all give different outcomes. Our method of testing is simply to try all 33 alternatives, and to assume that the one that gives the best result is the one that was current.²⁹ The result is mapped out in Appendix 2. For comparison, the same test is applied to the alternative patterns of intercalation current in modern Bali. These both run through a 19-year pattern, the difference between them being that one clusters the leap months at the northern solstice while the other distributes them across the northern span from equinox to equinox.³⁰ For these cases it was a matter of finding the best fit of the 19 alternative starting points. The results can be summarized as follows:

²⁸ See Appendix 1 (p. 110). In the older corpus there is only one instance of (possibly) competing calendars: Damais A142, A143, briefly discussed in note 66 to Appendix 2 (p. 113).

²⁹ It is merely a coincidence that the version of the cyclical rule that produces the best fit happens to place the leap months in the familiar series of 11th, 8th, 5th and 2nd months. This pattern, differently shifted, holds for 11 of the 33 alternative beginnings of the cycle.

³⁰ Eisemann 1999:36-7. When only Desta (Jyestha) and Sada (Āṣāḍha) are doubled, the added months are called *mala*; when months from Wesaka to Asuji are doubled, *nampih*. See note 23.

Table 1. Matches with discriminating dates produced by leap-month methods 829-1408 Śaka

method	all discriminating dates		divergent dates	
		%		%
total	117	100	22	100
cyclical	104	89	19	86
clustered (that is mala)	102	87	14	64
distributed (that is nampih)	103	88	15	68
before 1040 Śaka	63	100	5	100
cyclical	51	81	2	40
clustered	56	89	3	60
distributed	57	90	3	60
after 1040 Śaka	54	100	17	100
cyclical	53	98	17	100
clustered	46	85	11	64
distributed	46	85	12	71

In this table, divergent dates are those discriminating dates in which the current month differs from that predicted by the *Sūryasiddhānta* canon.

Before 1040, our proposed short cycle is no better than the alternatives; all are poor matches for the empirical evidence. After 1040 this changes. The proportion of empirical dates that diverge from the *Sūryasiddhānta* model increases, until during the last hundred years of the epigraphic data, four of the seven dates are divergent. After 1040, the clustered and distributed patterns match less well; but the cyclical rule begins to produce spectacular results. For the whole period after 1040 it fails to match only one date, which happens to be a dubious item.³¹ This certainly surpasses the probative threshold of ‘an entire success rate over a concentrated period’ (Eade and Gislén 2000:64). We observe further that the good fit of the cyclical rule coincides with the increasing divergence of the empirical record from the *Sūryasiddhānta* model.

On the other hand, in order to achieve this excellent fit, we have posited the addition of an extra leap month on two occasions. Here we face a logical problem. The need to assume these adjustments smacks of special pleading; but on the other hand, the model of the calendar we are applying foresaw that such an adjustment would be required about every two centuries, or

³¹ Damais A171, briefly discussed in Appendix 2, note 66 (pp. 115-6).

better every 220 years. This is not a defect in the rule; on the contrary, it is yet another way in which it resembles the rule for suppression of days. The suppression of days needs adjustment about every 120 years. The mechanism of the adjustment was to shift the start of the cycle by one day, but the *wariga* are unclear on when the adjustment should be made. According to Eiseman, one text indicated that it should occur every 100 years, but recent Balinese practice points rather to ad hoc adjustment as the need was seen to arise.³² Applying this model to the proposed leap-month cycle, we must confess to not knowing the precise mechanism of the adjustment (though there is nothing complex about the addition of an extra leap month), but take comfort in the precedent of unsystematic adjustment. If the timing of the supererogatory month was similarly ad hoc, the opportunistic timing of the adjustments implied in our model may reflect reality; their unruliness nevertheless detracts from the cogency of the proposal.

The Majapahit calendrical environment

On all the evidence, there was a change in the way the calendar was managed in the eleventh century Śāka (early twelfth century AD). We can be certain that the short cycle for leap months was not current at court in earlier Java. It does not seem to fit the empirical data; and moreover two Javanese inscriptions mention leap months which cannot fit any modulation of the rule.³³ We can be almost as confident that the short cycle did operate from the eleventh century Śāka onwards. By 1072 Śāka, the dates in Balinese inscriptions too have evidently fallen in line with the Javanese. For the rest of the period of the inscriptions, Javanese and Balinese dates are indistinguishable.

This chronology places the adoption of this creative Javanization of the Indic calendar in the reign of Bāmeśwara (Kāmeśwara), or perhaps his

³² As with the addition of leap months, there was no uniformity in practice in Bali in historical times. In the 1930s, two systems were current, producing a divergence (in almost all cases) of one day. The differences were both local and social: so versions of the calendar were known as *purnama-tilem geria* (followed by brahmans), *purnama-tilem desa* or *jaba* (followed by commoner villagers), and so on. The social divisions are significant, because the monthly rituals of the full moon were fixed by these dating systems. The issue was addressed by the island-wide meeting of administrators in 1932 (Widjanegara 1932; W. 1934:3). In more recent times, one system has prevailed, but without consensus on when adjustments were to be made. A ruling by Parisada Hindu Dharma in favour of a change in the run-up to the new Śāka century in 1978 was ineffectual (Eiseman 1989:188, 1999:60-7). Before 1959 there was no Parisada, and not only diverse implementations of the rule, but apparently divergent rules as well. Analogous local adjustments were also characteristic of the form of the Muslim calendar adopted in Southeast Asia, causing no difficulty in practical use.

³³ In Central Java, Damais A66/67 in 822 Śāka doubling Poṣya followed by A80 in 828 doubling Śrāwaṇa are irreconcilable on the cyclical rule. The Balinese 977 doubling Cetra would fit with A66/67 but not A80. In later inscriptions, no doublings are mentioned.

successor Jayabhaya. This was an environment of great cultural invention. Kāmeśwara and his queen, ruling in Daha, probably provided the inspiration for the Javanese culture hero Pañji, whose romantic exploits became a staple of Javanese and Balinese literature. It was at Jayabhaya's court that the great Indian epic was given its most famous Javanese form, with the composition of the great Bhāratayuddha kakawin.³⁴ This was the period in which vernacularization of Java's Indic high culture gained pace, and the distinctive East Javanese variant of Java's Indic culture began to precipitate.³⁵

This new understanding of the history of the Indic calendar in Java changes our view of the calendrical landscape. Hitherto it has been assumed that Old Javanese time-reckoning was characterized by two separate systems – the cycles and the Śaka calendars – which ran in parallel but in mechanical isolation from each other. It has also been assumed that the Javanese Śaka calendar and the Indic astrology found in inscriptions belong to the same system of formulations, that they stem from the same *karaṇa*. We can now see that both of these assumptions are unjustified. This leads us to a richer understanding of the dynamics of old Java's calendrical culture.

From Daha to Majapahit, the information about time conveyed in the inscriptions became increasingly complex and included more elements of Indic astrology (De Casparis 1978:18, 55-6). As the fruits of this science became more salient in the inscriptions, we gain the impression that Indic astrology was wielded as a weapon in the symbolic and technical armoury of the East Javanese court (Gomperts 2001:100). The 'Majapahit sun' may also be a zodiacal symbol, linked to the cult of the zodiac. In India this cult was celebrated with libations marking the times when the sun progressed from one sign to the next. Ritual beakers dating from Majapahit times, and ornamented with the twelve signs of the zodiac, are evidence for this cult in Java.³⁶ These zodiac beakers are still part of the accoutrements of a Tengger priest and recognized as emblems of their Majapahit heritage, though the meaning of their zodiac symbols has long since been lost. Indeed, the impetus for this astrology probably perished with the dissipation of political power following the demise of Majapahit. Once we no longer have court-issued inscriptions, we also no longer have evidence for this astrology.

We can now see that during the same period in which this Indic astrology was being elaborated by court astrologers armed with some *karaṇa*, the ordi-

³⁴ Rassers 1922:136-40, 300-3; Supomo 1995. The later fame of Joyoboyo as the Nostradamus of Java rests, apparently, on his patronage of this great *kakawin*, and thus not on any role as a calendar culture hero (Krom 1926:289; Drewes 1925:130-7).

³⁵ Emblematically, Airlanga, the last major ruler before Daha, was also the last Javanese ruler to issue an inscription in Sanskrit for domestic consumption. On Indic vernacularization, see Pollock 1996.

³⁶ Bullough 1995:42, 46, 91, 109, 114; De Casparis 1978:32-3. On the *saṃkrānti* cults, see Kane 1958, V:211-25.

nary Śaka calendar had been naturalized into a form that was more consonant with cyclical *wuku*-minded notions of time. The coordination of the calendar was important to the courts of East Java because it regulated the timing of the two annual festivals, the royal obsequies, and the new year festival.³⁷ The performance of royal obsequies was prescribed for the full moon (namely the 15th day) of the month Bhadra, at which time they were to be celebrated across the realm. The new year festival began in the last week of the old year, when delegations from all parts of the realm, including Bali (during Majapahit times), assembled in the capital with tribute. A grand ceremonial procession took place on the penultimate day of the old year. All present, including the king, took their places in this procession according to rank. On the first day of the new year, the king appeared in the main courtyard, receiving holy water from the priests and tokens of homage from his officials. This was followed by a public reading of the constitution, again an assertion of the order of precedence. The exercise was wrapped up with a tournament and roisterous public banquet before the assembled dignitaries dispersed, returning to their apanages. This pinnacle of the ceremonial year was intricately timed according to the Śaka calendar. Its timing required the coordination of the calendar across the full reach of the realm. Unless a common rule for adding months was observed, delegations might arrive a month too early or a month too late, spoiling the purpose of this assembly. If the realm was to enact its order, the calendar had to be in order too. The need to maintain synchronicity of the calendar across the realm may have provided an incentive for Javanizing it.

Although almost all our information about the calendar comes from court sources, we do get a few glimpses of time reckoning beyond the court. A dozen or so Majapahit-era inscriptions from Java and Bali express their dates differently. These inscriptions seem to have been issued by rural grandees rather than by the court chancery.³⁸ They give the dates in a very simple form, with some interesting characteristics. First, the name of the month is an ordinal number, instead of the Sanskritic name that is always used by the chancery.³⁹ In the literary texts, as also in later Bali, we find the ordinal names for months used along with the Sanskritic names. These ordinal names of

³⁷ Pigeaud 1960; Robson 1995: Cantos 69, 83-91.

³⁸ Damais A190, A193-A203, D64, D66. De Casparis (1978:20) mentions them as examples of short dates where it was 'apparently felt that a detailed or lengthy date would be out of proportion in a very short edict'. This is obviously true, but their nature is better caught by Pigeaud (1960, II:143), who characterizes them as 'rustic' dates.

³⁹ Damais A194 and A200 appear to be exceptions: both use the month name Jyeṣṭha. However, in Balinese *wariga* we find the ordinal sequence with the names Desta (Jyeṣṭha) and Sada (Āṣāḍha) for the 11th and 12th months. In Brandes's reconstruction (1899), the solar agricultural calendar ran for ten numbered months followed by a double month of fallow with months named Hapit kayu and Hapit lemah. This is confirmed in Balinese *wariga* (Pink 1993:61). The use of names, rather than ordinal numbers, at this point in the cycle seems to have opened the door to substitution from the named months of the Indic calendar.

months derive from a Javanese solar calendar. Their sequence begins at the northern solstice, not at the northern spring equinox in the Indian manner. Accounts of this *mangsa* calendar in Balinese *wariga* and nineteenth-century Javanese sources give its months unequal lengths, as is appropriate if they were delimited by the lengths of a shadow cast by a gnomon.⁴⁰ Should we then take it that when Old Javanese use the ordinal name of the month they refer to this agricultural calendar? When a literary work describes the beauty of the fourth month, does this merely add a bucolic colouring to Kartika in the court calendar, or does it signify the synchronous month in the agricultural calendar? We cannot be sure. In Balinese *wariga*, the ordinal names of months refer indiscriminately to lunar months in the Śaka year, to months of the solar calendar, and to months in the star calendar (which also follows the solar cycle). Second, most of these rustic inscriptions give only the unit (*sirah*) of the year, indicating that they have made the decade into a *wuku*-like cycle in the manner mentioned above. Yet, on the other hand, none of these simple dates includes explicit information about *wuku* cycles. Third, they use the term *tithi* in an unorthodox sense. In only one of these inscriptions does *tithi* indicate a numbered day.⁴¹ In the other cases, it acts as an indicator that dating information follows, or takes on the meaning of 'month'.⁴²

These peculiarities imply that there were other calendar traditions alongside the courtly Śaka calendar, or at least that there were popular understandings of the Śaka calendar that assimilated it with indigenous Javanese methods of time-reckoning. From such sources must have come the impetus for the Daha renovation of the Śaka calendar. This context also helps us understand why, when we no longer have inscriptions issued by the court chancery, we also no longer hear of the complex astrology they had propagated.

In the foregrounding of cycles and the reinterpretation of *tithi* we have conditions congenial to the kind of speculation about leap months that are preserved in both Balinese *wariga* and Tengger tradition. As we argued earlier, there is no reason to doubt that both Balinese and Tengger speculations stem from a popular tradition of Majapahit times, or earlier. This brings us close to the conclusion reached by Smith-Hefner following her comparison of a ritual text in its Tengger and Balinese versions, when she views it as a 'more popular, less courtly variant of Hinduism' belonging to a liturgical community that stretched from East Java to Bali.⁴³

⁴⁰ This conforms to the information given by Tjondro Negoro 1882. See also Pink 1993:80; Van den Bosch 1980.

⁴¹ Damais D64 (Bali), yet the day is not classed as *tanggal* (in the waxing fortnight) or *panglong* (in the waning fortnight), as expected for Śaka calendar dates.

⁴² The same usage is found in Kuñjarakarna 19.2 (Zoetmulder 1982; Pigeaud 1960, V:266).

⁴³ Smith-Hefner 1990:327. She judges that 'Tengger manuscripts [...] have more to tell us about Old Javanese religion than scholars have long thought' (Smith-Hefner 1990:288). Her emphasis on the popular nature of the tradition stems, in part, from the fact that in Bali the text she studied was in the custody of the commoner *sengguhu* priest. See also Hefner 1985:271-6.

The Muslim Śaka calendar

Following the decline and disintegration of Majapahit, a new political centre arose at Mataram. This new inland power began to synthesize a new pan-Java cultural identity, drawing on the culture of the Javanese north coast Pasisir, which it strove to dominate. The new identity involved the adoption of Islam and with it a folkish form of the Muslim calendar.⁴⁴

The new calendar described time in ways unlike any earlier Indic or Javanese calendar. It was simpler than any of its predecessors. Like all orthodox Muslim calendars, it was strictly lunar, without leap months, and therefore not seasonal. Its year comprised twelve months of alternately 30 and 29 days. The years ran in eight-year cycles, to which the name *windu*, the Old Javanese term for 'decade', was applied. The *windu* fixes a recurring pattern in which leap days are added to three years in the eight, as is necessary to keep the months in phase with the moon. And by a very happy accident, the days in a *windu* coincide with full rounds of both the seven-day and five-day cycles, thus making the *windu* a perpetual calendar that effortlessly meshes dates with these two key *wuku* elements.

Within the month, dates were numbered differently. In the Indic calendars, including those of old Java and Bali, they run through two fortnights: one for the waxing moon (*tanggal*, for the first 15 *tithi*, culminating with the full-moon day, *purnama*) and one for the waning moon (*panglong*, for the last 15 *tithi*, culminating in the new moon day, *tilem*). The Muslim calendar simply numbered the days sequentially, up to the 30th in long months or the 29th in short months.

The only element of the court calendar that was not changed was the era. Mataram continued to number the years of its Muslim calendar in the Śaka era. This gesture was immaterial for the working of the calendar, but preserved a symbolic continuity with the past, and perpetuated the ideology that synchronizes the rise and fall of kingdoms with the beginning and end of the Śaka century.

The adoption of this new form of calendar at the Javanese exemplary centre changed the calendrical environment throughout the Mataram realm. The two annual festivals were given Muslim garb, and the celebration of the birth of the Prophet (Garebeg Mulud) became the national festival in the spirit of the former new year festival. It was on this occasion each year that office-holders from across the realm assembled at the court to participate in a grand national *slamatan* hosted by the ruler in honour of his ancestors, including the Prophet Muhammad (Tirtakoesoema 2003). As we have seen, in pre-Muslim times the royal festivals had had a role in calibrating the calendar. This was

⁴⁴ Carey 1992; Ricklefs 1978:232-3, 1998:37, 39; Proudfoot 2006:55-8.

no longer necessary with the highly predictable Muslim calendar,⁴⁵ but the obligations of fealty accompanying the Garebeg Mulud impressed the new non-seasonal calendar across the realm (Proudfoot 2006:59).

The Tengger calendar

As this Muslim-shaped calendar radiated from Central Java's court centres, those who continued with the old Indic style were inevitably affected. The only documented survival of an Indic calendar in Java,⁴⁶ the Tengger calendar, resembles its Balinese counterparts in some ways, and the calendar of lowland Muslim Java in other ways.

The Tengger calendar is an example of the fragmentary locally-managed calendars that persisted after the dissolution of central power under Majapahit. In the relative isolation of the upper slopes of Mount Brama, the Tengger maintained the Buda tradition while the surrounding lowland Javanese increasingly identified themselves as Muslims. The Tengger community was bound together by common participation in an annual ceremony of offerings held on the 14th and 15th of the month Kasada.⁴⁷ On these days thousands of representatives of households from right across the Tengger area would congregate at the Sea of Sand high on Mount Brama to witness an all-night ceremony. In some years, new priests were inducted at midnight and in the early hours of the morning. The following dawn, all cast offerings to the Supreme God into the crater of Mount Brama. For the calendar, this shared observance is important because it requires the calendar to be coordinated across the participating domain. On a small local scale, the Kasada ceremony has the same calendrical function as the new year festival once had at the court of Majapahit.

The workings of the Tengger calendar are particularly difficult to grasp, not only because the sources of our information are so thin and poor, but because the calendar itself was a fluid mix of (Majapahit) heritage and (Muslim) accommodation.

The heritage is clear in the Tengger version of the problem of the 'lost' days, which shows a close kinship with the Balinese *wariga* speculation. As in the Balinese case, it proceeds from the conviction that the leap month is a repository for days lost from short months. This is a recognizably Indic perspective, deriving from the way the length of the month was regulated

⁴⁵ Disputes regarding the Muslim calendar are about a day here or there for the beginning and end of the fasting month. While they have political and ideological resonances, these differences are clearly smaller in scope than the differences of a day or a month likely with variant Indic calendars.

⁴⁶ The Baduy of West Java also have a luni-solar calendar, but it is better considered a variant of the star calendar. See further note 56.

⁴⁷ Hefner 1985:46-51; *Upacara kasada* 1978-79; Team Peneliti Institut Hindu Dharma 1982:25.

through suppressing dates, common in Indic calendars and current in Bali. The Tengger agree that the leap month is a means of compensating for the days 'lost' from months that have 30 days in principle but may in fact run for only 29 days. Similarly, every year was seen as having 12 months in principle, though every five years the year was 13 months long. This conception of leap months is another Indic trait, and has to do with the way leap months were added, by repeating one of the months in the course of the year.⁴⁸ The series of months in which doubling takes place is also familiar. The reported Tengger sequence begins with the 5th month, then the 10th month, then the 2nd month, and returns to the 5th month. We recognize here an incomplete version of the sequence found in the Balinese *wariga*.

However, the Tengger formulation of the problem of 'lost' days has changed in subtle but far-reaching ways under the influence of the Javanese Muslim calendar. Most remarkably, it has moved from being a speculation about the relationship between the two salient anomalies of the Indic calendar (as we see it in Bali) to being a working rule that operated the calendar. The theory linking the 'lost' days and leap months remained an intellectual conceit so long as the calendar kept pace with the seasons; but when seasonality was no longer thought to be inherent in the calendar, the scene was set for the speculation to become a working rule. As the Javanese Muslim calendar ignores seasonality, so the Tengger calendar, sympathetically, has renounced it also. In accordance with the 'lost' days rule, a leap month was added only once in five years, and the Tengger harvest festival, in Kasada, began to revolve through the seasonal year.

The Tengger calendar thus gained its distinctive five-year cycle. This pattern was also congenial to the Javanese Muslim model with its eight-year cycle. Like its Muslim counterpart, the Tengger cycle was also called *windu*. The similarity goes further, too. The years in the Javanese Muslim *windu* were labelled with letters of the Arabic alphabet that convey numerical values, and indirectly indicate the day of the seven-day week on which the year begins. The Tengger years are labelled, too, though simply with the sequential names of days in the *pasaran* five-day cycle. This makes the Tengger *windu* look a little more like its Javanese Muslim counterpart; it is also symptomatic of an intense interest in *wuku* cycles. The Tengger were steeped in this science, using *tika* boards identical to those found in Bali, together with a Javanese variant, the *papan sadrolas*.⁴⁹

⁴⁸ The Tengger have a curious way of expressing this, saying when the 5th month is repeated, that the 5th month is made the 4th (*kalima kinapatake*), etcetera mutatis mutandis. The implication is that the month which was the 5th, having now become the 4th, will again be followed by the 5th (De Jongh 1879:133).

⁴⁹ Jasper 1928:37-8, facing 36; Hageman 1871:6; Meinsma 1879:142-4. For Van Hien (1912-13, III:1-144), however, they specialized in lot-casting.

The rise of the five-year *windu* runs parallel with assimilations of the Tengger calendar to the Javanese Muslim model at the level of the month. The first affected the way days were counted within the month. The Tengger knew both the Indic and the Muslim methods, and so we find records of days counted in waxing and waning fortnights and also of days counted sequentially through the month. A factor favouring the Muslim-style sequential count was that it suited another method of denoting the days of the month with the names of the 30 *wuku* weeks (Domis 1836:144, 146; Van Hien 1912-13, I:277) – another example of *wuku* thinking infiltrating the Tengger calendar.

The second assimilation concerns the way days were dropped from some months. The idea of suppressing dates in the interior of the month gave way to the idea that alternate months were inherently shorter. The old manner of suppressing dates – every nine weeks in the Balinese practice – produced something close to this pattern, with an alternation of long and short months interrupted only about once a year by two successive long months. The simpler notion of continuously alternating months of 29 and 30 days again brought the Tengger calendar closer to the Javanese Muslim model. In this scheme, months that run for only 29 days might simply end with the 14th day of the waning fortnight (*panglong patbelas*) (De Jongh 1879:134) – in a nice combination of Indic façade and Muslim frame.

This simpler notion of alternating months has an interesting side-effect. It means that 'lost' days are accumulated at a slightly faster rate, so that 30 days have gone missing precisely every five years. This means that the calendar is ready for a leap month once in every five-year *windu*. In the Balinese model, it took 63 months to accumulate the 30 'lost' days, so that the leap month arrived after 5¼ years: that is, usually in every fifth year (though in a later month) but then in the sixth year. In the new Tengger conception, the leap month simply appeared in every fifth year,⁵⁰ making the Tengger *windu* ideally as regular as its Javanese Muslim counterpart.

It is an irony that as the rationalization of the 'lost' days gained traction in governing the operation of the calendar, it also became more tenuous. It was already a fiction in its Balinese form, and now the Tengger have kicked away its hypothetical supports. Without the suppression of dates, it is harder to conceive of days being 'lost'. And, when a leap month is due precisely every five years, its placement in the odd series of 5th month, 10th month, then 2nd month has become merely ornamental – and it does not matter if the series has been imperfectly remembered.

This Tengger solution to the problem of 'lost' days supplied the rules on which the Tengger calendar ran, but it is not the whole story of how the calendar was actually managed. The empirical evidence of Tengger dates and descriptions of the full-moon Kasada ceremony agree that the Tengger

⁵⁰ Balinese 1,890 days, Tengger 1,800 days (Pink 1993:77; De Jongh 1879:133).

kept their months in line with the phases of the moon, though tending to run slightly slow. A simple alternation of short and long months will cause the calendar to run slightly faster than the moon, so there must have been some means of keeping it in phase that we do not know about. Possibilities are an occasional adjustment based on observation of the moon, or occasional realignment of Tengger months against the months of the Javanese Muslim calendar (which keep good time with the moon).⁵¹ The older, more accurate method of suppressing dates may also not have been forgotten altogether: it is found in the modern Tengger calendar, having been either reintroduced, or more likely revived, under Balinese influence.⁵²

The addition of leap months must have been coordinated across the Tengger domain, but it is not clear that leap months were in fact added regularly on the turning of the five-year *windu*. There was no consistency in the labelling of years of the five-year cycle,⁵³ so the timing of leap months cannot be directly linked to a particular year in the cycle. Perhaps to add to this confusion, or as an explanation for some of it, the leap month appears to have been linked to the celebration of *unan-unan*, a solemn cleansing rite for the village.⁵⁴ However, Kohlbrugge (1901:139) reports that in the 1930s the observance of *unan-unan* could be delayed if funds were short, when it would be celebrated after eight years, picking up the Javanese Muslim version of the *windu* in place of the Tengger five-year version.⁵⁵ A delay of this kind might also explain the seven-year *windu* reported by Jasper (1928:35, 54) for Lumajang. When *unan-unan* was delayed, was the leap month also delayed? This does not seem out of the question, for in the Tengger calendar the leap month no longer ensures the seasonality of the year. If the timing was variable, we can nevertheless be sure that the adding of leap months was coordinated across the Tengger lands, for otherwise the shared Kasada ceremony would fall into disarray. All in all, it is very likely that the Tengger

⁵¹ The Javanese Muslim calendar achieves this by adding a day to three years in each eight-year *windu*.

⁵² Lüem (1988:224) describes the suppression of dates, a day so affected being called *mecak*. Unfortunately she was unable to discover the pattern behind *mecak* occurrences. The term *hari tumbuk* is reported by Widyaprakosa (1994:41); however, his description is not clearly specific to Tengger.

⁵³ See List 3 in Proudfoot, 'Reconstructing the Tengger calendar' in this journal.

⁵⁴ Widyaprakosa (1994:58) reports a folk-etymology of *unan-unan*, relating it to the making up of deficiency. His account of the placing of intercalation in the month Dhesta may show Balinese influence. However, it fits with the (admittedly ambiguous) statement by Kohlbrugge (1901:132, 139) that *unan-unan* is celebrated at the end of the *windu*.

⁵⁵ Widyaprakosa (1994:90) reports rationalization of the Tengger five-year *windu* in terms of the predominant Javanese Muslim eight-year *windu*, in which the Tengger *windu* is taken to be a *windu* of *wuku* years, referring to the divinational cycle of 210 days. Although the usual sense of a year in such contexts is 420 days, it must be 210 in this case, giving a span of 1,680 days, that is between four and five Tengger years, and thus vaguely approximating the five-year *windu*.

calendar entailed quite a degree of pragmatic adjustment.⁵⁶

Perhaps the ultimate assimilation of the Tengger calendar to its Muslim environment is the common practice of locating Tengger dates in the current Muslim Javanese year.⁵⁷ This is what might be expected of a folk calendar. We have already noticed that some 'rustic' dates from Majapahit did not count years through more than a decade (or *windu*). The *pasaran* labels of the Tengger years provided a way of counting within the *windu*, now of five years. When a year number was required, it was easy to borrow from the Javanese Muslim calendar. There may have been a separate Tengger era, but if so it was not much used. Calendar eras and centuries of time are the business of dynasties: small-scale societies have little use for them.

In sum, the Tengger calendar preserves traces of its origins as an Indic calendar, while being substantially reshaped in a milieu in which the dominant descriptions of time derive from *wuku*-based divination and the Javanese Muslim calendar.

By the nineteenth century this kind of calendar was found only among the Tengger in their highland outpost, but analogous calendars must have been more widely current in Javanese backwaters in the seventeenth and eighteenth centuries. Indeed, Van der Molen has discovered evidence for this among the manuscripts, written in the Old Javanese *gunung* script, from a Buda hermitage at Merbabu on the slopes of Mount Merapi in Central Java.⁵⁸ Two texts from this collection are particularly interesting: one dated in the Indic month Wesaka; the other giving the year a *pasaran* label. The presence of a *pasaran* label suggests that either the Tengger calendar or something similarly conceived was also current in Central Java. Both the Merbabu dates

⁵⁶ For insight into how a rustic calendar could be managed through continuous pragmatic adjustment, rather than with the overheads of calendrical rules, the better attested operation of the Baduy calendar is worth noting (Van Tricht 1929:92-5; Geise 1952:32-46; Jacobs 1891:78; Iskandar 1992:65-7). Each year the headman decides when the agricultural cycle is to start, possibly delaying it by a day or so to ensure that the divination board gives a favourable reading. The day then fixed for the beginning of field-clearing is called 18th Sapar, and all the rituals for the ensuing agricultural season then follow sequentially. This delay provides an unacknowledged technique for keeping the months broadly in phase with the moon. That the calendar may be a day or two different in different villages is of no practical account. The Baduy track the seasons by observing the positions of the constellations Orion (*kidang*, *guru desa*) and the Pleiades (*kartika*), and the flowering of certain plants. The year is adjusted, when necessary to keep it seasonal, through the timing of the harvest festival. When it was necessary to take the sacred first fruits from a late-planted plot, the month Kasa was extended by 30 days, so that the ceremony could still take place on 17th Kasa, thus effectively adding a leap month to the year. According to Van Tricht, the extension of Kasa following crop failure was a very rare event. This can hardly be so, for on Van Tricht's own account the Baduy calendar remained seasonal from 1822 to 1928.

⁵⁷ See List 2 in Proudfoot, 'Reconstructing the Tengger calendar' in this journal.

⁵⁸ Wiryamartana and Van der Molen 2001. The two relevant texts are discussed in Van der Molen 1983:76-87.

include exceptionally copious information on *wuku* cycles as well, matching another feature of Tengger time-reckoning.

The survival of this style of calendar in outposts in both Central and East Java is evidence that it had been more widespread in earlier times. As the Merbabu *pasaran* label dates to about AD 1765, the hybridization of the old Indic calendar might have begun quite soon after the adoption of a Muslim calendar at the Mataram court in AD 1633, and become prevalent in the non-Muslim parts of Javanese society that were nevertheless under Mataram's sway.

The career of the Śaka calendar

This analysis has given us a more rounded understanding of some portions of Java's calendar history. The story has more to it than the adoption of an Indic calendar in the eighth century and a modified Muslim calendar in the seventeenth century. Java's calendars have proved to be pliable and responsive to changing political and cultural configurations, and there has been more cross-pollination between the *wuku* system and the calendars than has hitherto been allowed. The history of the *wuku* system has yet to be written, and – alas – lies beyond the scope of this study of the Śaka calendar.⁵⁹

For our present purposes, it will be convenient to recapitulate the developments in the Indic calendar suggested by this study. The following narrative is a mix of fact and likely speculation.

Over half a century after the break-up of Airlangga's kingdom in AD 1045, the reestablishment of royal authority in Daha provided the occasion for adopting a form of the Indic calendar more attuned to the widely-held *wuku* notions of time. In its new form the Middle Javanese calendar was managed by successive court chanceries for three and a half centuries. Then the dissolution of Majapahit made the environment more fluid. The effect on the Śaka calendar was to behead it. The zodiac astrology that had become a preoccupation of the royal astrologers disappeared along with their offices. Without the guiding hand of the court chancery and the imperative for coordination across an extensive realm, the calendar came to be managed in a more relaxed and ad hoc manner. The rules for adding months largely fell into abeyance, in part replaced with adjustments according to rudimentary observations of the constellations Orion and Pleiades as an alternative method of maintaining the seasonality of the year, bringing the Indic calendar closer to

⁵⁹ One part of this history will no doubt show how the influence of the Śaka calendar with its seven-day week led to the displacement of the old 6 x 5 month by a 5 x 7 'month', and perhaps also the rise of named *wuku*. The seven-day week gained further salience with the advent of the Muslim calendar, with its Friday prayers.

the star-based folk calendar.

Pragmatic calendars of this ilk may have run in Java for two or three centuries. In Bali they continued until relatively modern times. In the nineteenth century, the local calendars in northern Bali neglected to add a timely extra month (perhaps through application of a faulty rule) but continued to reckon the beginning of the year according to the star signs, with the result that the year came to begin with the tenth month, *Wesaka*, instead of the ninth month, *Cetra*. More recently, a process of reformulation in light of Indian models has begun,⁶⁰ and in the latter part of the twentieth century variant local calendars were marginalized by the printing of popular calendars based on the aberrant northern Balinese year.⁶¹

In Java, things took a different turn. First, along the north coast, a form of the Muslim calendar gained currency along with the new religion. In the late sixteenth century a new power centre was rising in Central Java, styling itself *Mataram* in memory of the ninth-century Central Javanese Indic kingdom, and drawing its ideological and cultural resources from the Muslim north-coast periphery. The adoption of Islam by the *Mataram* court entailed a radical reformulation of the *Śaka* calendar. The new *Mataram* calendar assumed the structure of the lunar Islamic calendar, but maintained the *Śaka* era. The twice-yearly court festivals were given Muslim meanings, and – with the Muslim calendar – lost their seasonality.

In districts not challenged by the new calendar of *Mataram* and in *Buda* (Hindu-Javanese) religious circles the old calendar persisted. In the *Mataram* domains it was under the sway of the new courtly Muslim calendar. In these circles, there was also an intense and intricate concern with *wuku* cycles. The *Buda* calendar used among the *Tengger* is an example of the type of calendar produced by this confluence of influences. It assumed some of the characteristics of the Javanese Muslim calendar: abandoning seasonality, taking up the idea of *windu* with named years, and using the current year of the Muslim era to number its years. Yet it also retained Indic features: continuing to add leap months and usually enumerating days through fortnights rather than through months. Like *Tengger* identity generally, the *Buda* calendar was a dynamic mix of accommodation and resistance to the lowland Muslim culture.

⁶⁰ Eiseman 1999:36-7. For the more general context, Geertz 1973.

⁶¹ The first printed calendar was published by Gedung Kirta for AD 1935.

Appendix 1. Devolution of the Javanese-Balinese Indic calendar

Commentary

The chart shows the seasonal timing of the beginning of the Śaka year by mapping it onto the Gregorian calendar. The grey zigzag line represents the beginning according to the Sūryasiddhānta system.⁶² The white line is the trend underlying its oscillations. The black dots indicate the beginning of the year implied by dates given in Javanese and Balinese sources. The black line represents the trend underlying these scattered points. Note that nothing plotted on the chart represents an attested date. All year-beginnings are derived by calculation: the Sūryasiddhānta from the formularies, the Javanese and Balinese extrapolated from attested dates.

The chart illustrates two characteristic patterns associated with the Indic calendar. 1. The trend line for the beginning of the Śaka year gradually moves later in the seasonal year, thanks to the precession of equinoxes.⁶³ The beginning of the year, supposedly falling close to the equinox, but historically tied to Aries (Meṣa), gradually moves later into the seasonal year. In the space of 1,300 years the Sūryasiddhānta calendar has drifted later by about 21 days. 2. The sawtooth pattern derives from the method used to keep the lunar months in line with the solar houses. Broadly, the beginning of a year of twelve lunar months steps earlier in the seasonal year until a leap month is added, pushing the next beginning back to a later time, whence the process begins again.

For the mapping of Javanese and Balinese data, the beginning of the year is extrapolated backwards from the attested date, attributing to each apparently intervening month a length that allows for the average possibility of a leap month intervening. The result is fair for plotting a trend, but not accurate for any particular point in the chart.⁶⁴

The trend line for the Javanese and Balinese dates shows that until AD 1350, Javano-Balinese years tend to begin later than the ideal Sūryasiddhānta year. However, from AD 1350 onwards, they begin to run fast. By AD 1700, the underlying Balinese dates are running on average a full month ahead of the Sūryasiddhānta. By AD 1850, they are about two months ahead. The

⁶² For this purpose, the Sūryasiddhānta has been calibrated on the latitude and longitude of Majapahit, though there is no evidence for this practice in Java. The conventional default values for Ujjayinī or Laikā would occasionally produce results differing by a day. For the sake of propriety, the dates before AD 1000 (992 Śaka) have no *bīja* adjustment applied, whereas those after AD 1000 are calculated with *bīja*. The calculations have been made with Yano and Fushimi's *Pancanga* software (2002).

⁶³ The effect of precession is that the signs of the zodiac appear to recede gradually into the seasonal year. Up to AD 600 it was Aries (Meṣa) that harboured the equinox, but by AD 700 Aries had moved further into the seasonal year, and the previous sign, Pisces (Mīna), came to harbour the equinox.

⁶⁴ So, for instance, some of the outlying early beginnings could derive from dates falling in a late month where a leap month has not intervened.

modern Balinese Śaka calendar runs between one and two months ahead of the Sūryasiddhānta. The early slowness of the Javanese calendar seems to arise from some systemic difference from the Sūryasiddhānta. The degree of slowness is not marked, but the trend seems to be fairly consistent for the period up to about AD 1300. Eade has remarked on this phenomenon (Eade and Gislén 2000:98, 125). The Javanese have been consistently precipitate in intercalating leap months, but until we are able to deduce the methods used to run the calendar before 1040 Śaka, we will not understand why.

For the period up to about AD 1600, the mild scattering is what might be expected from a practical implementation of the Indic calendar. However, after 1600 the calendar veers out of control. Most dates are now fast, signalling that timely intercalations have been missed. In some cases three or more intercalations have been missed or delayed. The wide scattering of dates indicates a multiplicity of concurrent calendars. This impression is corroborated by more detailed analysis of the dates.⁶⁵ These are symptoms of a decline in calendrical competence and fragmentation of the cultural domain.

⁶⁵ See Damais F249/F250, F261/F262, F252, F299/F300, F315-F316/F317, generally contradictions between Lombok dates and those found in manuscripts. The calendar was unified only after Independence (Damais 1951-58, V:227).

Appendix 2. Mapping the Middle Javanese calendar

Table 2. The Middle Javanese calendar mapped across East Javanese and Balinese inscriptions

	AD	904	915	926	937	948	959	970	981	992	1003	1014	1025	1036	1047	1058	1069	1080	1091	1102	1113	1124	1135	1146	1157	1168	1179	1190
intercalation																												
1	Phalgunā Kaulu (8)	826	837	848	859	870	881	892	903	914	925	936	947	958	969	980	991	1002	1013	1024	1035	1046	1057	1068	1079	1090	1101	1112
2		827	838	849	860	871	882	893	904	915	926	937	948	959	970	981	992	1003	1014	1025	1036	1047	1058	1069	1080	1091	1102	1113
3		828	839	850	861	872	883	894	905	916	927	938	949	960	971	982	993	1004	1015	1026	1037	1048	1059	1070	1081	1092	1103	1114
4	Margaśira Kalima (5)	829	840	851 (7)	862	873	884	895	906	917	928	939	950	961	972	983	994	1005	1016	1027	1038	1049	1060	1071	1082	1093	1104	1115
5		830	841	852	863	874	885	896	907	918	929	940	951	962	973	984	995	1006	1017	1028	1039	1050	1061	1072	1083	1094	1105	1116
6		831	842	853	864	875	886	897	908	919	930	941	952	963	974	985	996	1007	1018	1029	1040	1051	1062	1073	1084	1095	1106	1117
7	Bhādra Koro (2)	832	843	854	865	876	887	898	909	920	931	942	953	964	975	986	997	1008	1019	1030	1041	1052	1063	1074	1085	1096	1107	1118
8		833	844	855 (3)	866	877	888	899	910	921	932	943	954	965	976	987	998	1009	1020	1031	1042	1053	1064	1075	1086	1097	1108	1119
9	Jyēṣṭha Desta (11)	834	845	856 (3)	867	878	889	900	911	922	933	944	955	966	977	988	999	1010	1021	1032	1043	1054	1065	1076	1087	1098	1109	1120
10		835	846	857	868	879	890	901	912	923	934	945	956	967	978	989	1000	1011	1022	1033	1044	1055	1066	1077	1088	1099	1110	1121
11		836	847	858	869	880	891	902	913	924	935	946	957	968	979	990	1001	1012	1023	1034	1045	1056	1067	1078	1089	1100	1111	1122
																												1122
																												1122

Table 2. (continued). The Middle Javanese calendar mapped across East Javanese and Balinese inscriptions, continued

	AD	1201	1212	1223	1234	1245	1256	1267	1278	1289	1300	1311	1322	1333	1344	1355	1366	1377	1388	1399	1410	1421	1432	1443	1454	1465	1476	1487
	intercalation																											
1	Phaiguna Kaulu (8)	1123	1134	1145	1156	1167	1178	1189	1200	1211	1222	1233	1244	1255	1266	1277	1288	1299	1310	1321	1332	1343	1354	1365	1376	1387	1398	1409
2		1124	1135	1146	1157	1168	1179	1190	1201	1212	1223	1234	1245	1256	1267	1278	1289	1300	1311	1322	1333	1344	1355	1366	1377	1388	1399	1410
3		1125	1136	1147	1158	1169	1180	1191	1202	1213	1224	1235	1246	1257	1268	1279	1290	1301	1312	1323	1334	1345	1356	1367	1378	1389	1400	1411
4	Margasira Kalima (5)	1126 1126	1137	1148	1159	1170	1181	1192	1203	1214	1225	1236	1247	1258	1269	1280	1291	1302	1313	1324	1335	1346	1357	1368	1379	1390	1401	1412
5		1127	1138	1149	1160	1171	1182	1193	1204	1215	1226	1237	1248	1259	1270	1281	1292	1303	1314	1325	1336	1347	1358	1369	1380	1391	1402	1413
6		1128	1139	1150	1161	1172	1183	1194	1205	1216	1227	1238	1249	1260	1271	1282	1293	1304	1315	1326	1337	1348	1359	1370	1381	1392	1403	1414
7	Bhādra Kato (2)	1129	1140	1151	1162	1173	1184	1195	1206	1217	1228	1239	1250	1261	1272	1283	1294	1305	1316	1327	1338	1349	1360	1371	1382	1393	1404	1415
8		1130	1141	1152	1163	1174	1185	1196	1207	1218 1218	1229	1240	1251	1262	1273	1284	1295	1306	1317	1328	1339	1350	1361	1372	1383	1394	1405	1416
9	Jyestha Desta (11)	1131	1142	1153	1164	1175	1186	1197	1208	1219	1230	1241	1252	1263	1274	1285	1296	1307	1318	1329	1340	1351	1362	1373	1384	1395	1406	1417
10		1132	1143	1154	1165	1176	1187	1198	1209	1220	1231	1242	1253	1264	1275	1286	1297	1308	1319	1330	1341	1352	1363	1374	1385	1396	1407	1418
11		1133	1144	1155	1166	1177	1188	1199	1210	1221	1232	1243	1254	1265	1276	1287	1298	1309	1320	1331	1342	1353	1364	1375	1386	1397	1408	1419

Commentary

This table maps all the discriminating dates in Damais's catalogue of dates in the Javanese and Balinese inscriptions, from the beginning of the East Javanese period onwards.⁶⁶ A discriminating date is one in which the Śaka

⁶⁶ Damais (1951-58). Provenance is indicated by Damais' prefixes: A = Java, B = Sunda (1 case), C = Madura (1 case), D = Bali, E = Sumatra (1 case), F = Javano-Balinese literary sources. The dates used here are: 829, A87, IV:48. 831, A88, IV:49. 832, A89, IV:169-70, error in year. 837, A95, IV:50-1. 843, A99, IV:52. 848, A102, IV:138-40. 849, Phālguna, SS: Cetra, A105, IV:53-4. 850, A106, I:28-9, IV:102-3. 851, A107, IV:104-5. A108, IV:54-5 (late copy). A109, IV:55. A110, IV:55. A111, IV:56. A112/3, IV:105-06. 56. A114, IV:57. 852, A115, IV:180. 853, A116, IV:181 (error in year; late copy). 855, A117, IV:57-8. A118, IV:58-9 (late copy). A119, IV:121. 856, A120, IV:182. A121, IV:106. A122, IV:59-60. 859, A123, IV:156-8. 861, A124, IV:60. 865, A126, IV:84. 866, A127, IV:61. 869, A128, IV:170-2. 888, A129, IV:183. 913, A131, IV:62. F1, 5:54. 916, D20, IV:88. 918, A132, IV:62. F2, 5:54. 932, D22, IV:124-5. 933, Cetra, SS: Weśākha, D23, IV:185. 940, A134, IV:233-4. 943, A135, IV:63-4. 944, A136, IV:64. D26, IV:89. 945, D27, IV:162-3. A137, IV:64-5. 947, D29, A138, IV:122-3. 952, A138, IV:122-3. B1, IV:86-7. 954, A139, IV:65-6. 959, A140, IV:161. 963, Kārtika, SS: Mārgaśira, A141, IV:66-7. 964, Gandhakuṭi, A142, IV:67. Pamotan, A143, IV:183-84; Mārgaśira, SS: Poṣya. Eade & Gislén 2000:76-7. The Pamotan inscription appears to fall 5 days before Gandhakuṭi in the month Margasira, however the pawukon and astrology place its date 25 days later. Either two calendars were operating in parallel, or the month in one of the dates has been mistaken. Damais and Eade suppose that the Pamotan month is wrong. In our tests, the alternative that best fits each calendar is used. 971, D32, IV:90. 972, D34, IV:186-7. 977, D35, IV:164: Cetra punaṇ, SS: Weśākha. 980, D36, IV:90-1. 981, A144, IV:141-3. 987, D37, IV:91. 991, D38, IV:164-5. 992, D39, D40, IV:125, 125-6. 993, D41, IV:165. 994, D42, D43, IV:91-2. 995, D45, IV:92. 999, D47, IV:93. 1020, D49, IV:165-6. 1037, D50, IV:93-4. 1038, A145, IV:67-8. The Middle Javanese calendar fits well from this point. 1041, D51, IV:80-1. 1042, A146, IV:68-9: Śrāwaṇa, SS: Bhādrapada. 1050, A147, IV:143-4: Śrāwaṇa, SS: Bhādrapada. 1051, A148, IV:69. 1052, A149, IV:69-70. 1057, A151, IV:70-1. 1058, A152, IV:71. 1068, D52, IV:166-7. 1072, D53, IV:126-7: Cetra, SS: Weśākha. 1081, A155, IV:72-3: Asuji, SS: adhika Asuji, or Asuji. 1082, A156, IV:73: Māgha, SS: Phālguna. 1093, A158, IV:74. 1099, D54, IV:94-5. 1103, A159, IV:74-5. D55, IV:95. 1104, A160, IV:75. 1107, A161, IV:75-6. 1116, A163, IV:76. D56, IV:95. 1120, A165, IV:77. 1122, A166, IV:77. D57, IV:96. We posit the first supererogatory intercalation at this point. 1126, D58, IV:96-7: Weśākha, SS: Jyēṣṭha. A168, IV:148-9: Jyēṣṭha, SS: Āṣādhā. A169, IV:123-4, 1171, A171, IV:197-9. Eade and Gislén 200:97-9. On palaeographical grounds, Damais identifies the Maribong copper-plate charter as 15th century AD copy. The date is inconsistent with the divinatory cycles and the astrological information. Damais suggests emending the year to 1186. Eade prefers emending both the day and the year to get a fair fit with the astrology. But if we have to change the year and the day of the month, is the month safe? 1188, A172, IV:78: Māgha, SS: Phālguna. 1191, A173, IV:78-9. 1208, E10, IV:99-101. Old Malay Javanese script. Inscribed on the pedestal of a statue of Amoghapaśa sent from Java. 1211, A174, IV:79. 1214, A175, IV:151-3. 1216, A177, IV:236. 1218, D59, IV:98: Srawaṇa, SS: Bhādrapada. A178, IV:80-1: Kārtika, SS: Mārgaśira. 1227, A179, IV:108-9. A180, IV:81: Mārgaśira, SS: Poṣya. 1245, A180, IV:81: Mārgaśira, SS: Poṣya. 1246, D60, IV:98. A181, IV:109-10. D61, IV:167. 1250, D62, IV:167-8: Poṣya, SS: Māgha. 1251, A182, IV:81. 1252, A183, IV:82. 1259, D63, IV:99. 1272, A186, IV:82-3: Mārgaśira, SS: Poṣya. 1273, A187, IV:83. At this point the Javanese calendar becomes fast. 1280, A188, IV:83-4: Śrāwaṇa, SS: Āṣādhā. 1289, A191, IV:200-3. 1320, C1, IV:87. 1327, A204, IV:84: Āṣādhā, SS: adhika Āṣādhā. 1340, A206, IV:84: Poṣya, SS: Mārgaśira. 1352, D67, IV:128-30: Cetra, SS: Phālguna. 1369, A207, IV:85. The Javanese calendar becomes slow again. We posit the second supererogatory intercalation at this point. 1395, A209, IV:85-6: Weśākha, SS: Jyēṣṭha. 1408, A210, IV:86: Jyēṣṭha, SS: Āṣādhā.

Dates which are not discriminating and therefore not included are Javanese dates that record

date can be confirmed and fully resolved using *pawukon* elements.

The table is laid out on the framework of the Middle Javanese Calendar. The calendar works on cycles of eleven years in which there is a fixed pattern of leap months, indicated in the leftmost column. Thus, in the third year of the cycle, the leap month occurs when Jyeṣṭha is doubled. Two years later Phālguna is doubled – and so on, until after the doubling of Bhādrapada in the eleventh year, the cycle is ready to start over again. The doubled months are given both the Sanskrit names used in the inscriptions and the ordinal names more common in later sources.

In the following columns years of the Śaka era are shown. On this grid, every occurrence of a discriminating date is shown in bold. Those from Bali are italicized. Dates that diverge from the Sūryasiddhānta are underlined. Those that do not conform to the Middle Javanese calendar are struck through. In all divergent dates the Javanese calendar is slow, except for 1280, 1340 and 1352, which are fast. This period is shaded in light grey. Periods within which we have supposed the supererogatory leap month must fall are shaded darker grey.

The first of the supererogatory leap months, proposed for 1123-1125, seems unwarranted if we take the calendar to have begun about 1040. On the other hand, the second supererogatory leap month, proposed for 1369-1395, is slightly overdue. By this time the calendar has been running unadjusted for over 220 years, and the months have been gradually falling earlier in the seasonal year. This stretch of early dates is an aberration in the Old Javanese calendar. After the adjustment, the dates in 1395 and 1408 are again comfortably slow.

Not shown in this table is a further date from the fifteenth-century Śaka, in the colophon of a manuscript of the Śuddhamala. It fits both the Sūryasiddhānta and the Middle Javanese Calendar proposed here. For the sixteenth-century Śaka, we have a further five dates from the colophons of literary works. Of these, four agree with Sūryasiddhānta and the Middle Javanese Calendar. The remaining date, a colophon of Pararaton, fits neither the Sūryasiddhānta nor the Middle Javanese Calendar.⁶⁷

only one day or wuku cycle or none (26 dates), Sanskrit dates that include only the weekday (1 from Bali and 4 from Sumatra), and Old Balinese dates that record only the three-day market cycle (23 in this period). A few dates cannot be resolved with certainty because elements of the Javanese divinatory cycles are inconsistent, diverge too far from the calendrical elements, have been lost, or become illegible. These dates have been included if a credible reconstruction seems possible, though they are less credible evidence than the clean and consistent records of the great majority of the listed dates. A borderline case of this nature is 1171, discussed briefly above.

⁶⁷ Damais (1951-58) **1481**, Śuddhamala, F8, V:58-59. **1535**, Pararaton, Karwa/Bhādra, SS: Kasa/Śrāwaṇa, F10, I:37-38, V:59. **1546**, Bhāratayuddha MS K, F22, V:66. **1557**, Tantu Paṅgëlaran, F11, V:60. **1567**, Ātmaprasaṅsa, F13, V:60-61. **1600**, Bhāratayuddha MS L; Supomo 1993:259.

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NOTES

IAN PROUDFOOT

Reconstructing the Tengger calendar

The survival of an Indic calendar among the Tengger people of the Brama highlands in east Java opens a window on Java's calendar history. Its hybrid form reflects accommodations between this non-Muslim Javanese group and the increasingly dominant Muslim Javanese culture. Reconstruction is challenging because of this hybridity, because of inconsistencies in practice, and because the historical evidence is sketchy and often difficult to interpret.

The need to rely on nineteenth-century sources

Recent accounts of Tengger ritual and belief incorporate the changes of the 1970s and 1980s that saw massive renovations of Tengger tradition under Balinese tutelage. Hefner's researches (1985:14-5, 206) in the 1970s showed that the last knowledgeable Tengger custodians of the old Buda tradition were then two generations in the past. The knowledge had been tightly held in priestly families, restricted to those born in the lineage and practiced only by those ordained into the priesthood. During the nineteenth century the tradition suffered a disjunction with the abandonment of the old-style script and writing on palm leaves in favour of writing modern Javanese script in paper books. This coincided with a reduction of the relative isolation of the Tengger as the Dutch became interested in the possibilities of growing coffee on the lower slopes of the mountains and built roads to Tosari and other foothill areas during the nineteenth century. Threads of the tradition have been cut short by the conversion of Tengger villages to Islam, a process that gained traction in the second half of the nineteenth century when distinctions between Muslim and non-Muslim began to be more clearly formulated. This attenuated Tengger tradition then had to deal with the modern state. Since the religious policies of the New Order government required the Tengger to regularize and modernize their religion, there has been a strong government-supported push to align the Tengger Buda religion with Balinese Hinduism, already recognized as an official and civilized religion. Under the tutelage of the Parisada Hindu Bali, the Tengger have adopted modern Balinese ritual

terms and manners of prayer, and a Balinese-style temple has been constructed on the Sea of Sand on Mount Brama, the geographical centre-point of Tengger identity (Waluyo 1997:18-9; Hefner 1985:250-60). The renovation of religious practice that the Parisada promoted also apparently involved the calendar (Lüem 1988:224). This means that we cannot rely on modern descriptions of the Tengger calendar, for example by Lüem or Widyaprakosa,¹ unless we can find corroboration for its features in evidence of older Tengger practice.

In the absence of a manuscript or priestly text dealing with the management of the calendar, we have therefore to make what we can of the nineteenth-century Dutch reports of Domis and De Jongh advised by Hageman. These sources and a few others also provide a handful of Tengger dates against which we can test the accounts. Van Hien (1912-13:277-8) gives a sketch of the Tengger calendar in his compendious modern *primbón*, which includes some curiously interesting detail, but is no help for a reconstruction.

The Meinsma papers

De Jongh's report on the Tengger calendar was published in Meinsma (1879). Because of its apparent completeness, it has been influential in all later Dutch discussions of the Tengger calendar. Rouffaer (1921a, 1921b) distilled it into the simple description of the calendar he presented in the *Encyclopaedie van Nederlandsch-Indië*. By projecting this model of the calendar back through time, he developed a rather complex historical argument about the relationship of the Tengger to Majapahit and later Mataram. Jasper (1928:34-9) incorporated the Meinsma-Rouffaer model into his monograph on the Tengger people, while adding incidental information from other sources. Most recently Van der Molen (1983:297-300) worked through the implications of the Meinsma-Rouffaer model by developing two projections of this calendar back through time. Only recently has the German ethnologist, Lüem (1988:24), dismissed key elements of the description as contradicting the findings of her own fieldwork.²

Meinsma's publication comprises his introduction and notes to a pair of papers describing aspects of Tengger time-reckoning. The paper published as 'Part I' seems to have been compiled in 1867 and 1868 by Colonel De Jongh. It contains some data from previously published sources, but is mainly a compilation of information provided by two correspondents with

¹ Lüem 1988:224-7; Widyaprakosa 1994:59. Lüem (1988) does not deal with the contemporary method of intercalating months, which would have been a useful diagnostic for Balinization. Widyaprakosa's short account (1994) appears to synthesize local investigations and Balinese sources.

² Lüem (1988) reports the reverse counting *pasaran* years, and implicitly dismisses intercalation.

access to Tengger informants, one on the northern (Pasuruhan) side, the other on the western (Malang) side. The correspondent on the north was almost certainly Hageman.³

The correspondents sent notes to De Jongh, and in the process of drafting his synthesis of the material, he noticed some points of divergence. He sent a brief list of points for clarification to Hageman, who was back in the field in early January 1868. Hageman's response now constitutes the second of the Meinsma papers. Rather than incorporating this new material into his survey, the compiler made it an appendix to his earlier draft, inserting only a reference to it in his main report when dealing with the 9-day week-cycle. Understanding the history of the two documents, we can certainly go beyond Meinsma's assessment that 'both pieces were almost of the same tenor',⁴ but in so doing we have reduced the independent evidential value of the reports.

The main report is, then, a pastiche of secondary information. Although De Jongh was not insensitive to contradictions in his sources, as the questions he posed to Hageman indicate, he was also willing to report contradictory information without comment. The list of years and *pasaran* labels given near the end of his report throws some light on the process of compilation. The list begins with a year corresponding to 1827 AD. This must be taken from the date reported by Domis in *De Residentie Passoeroeang*, but it has been corrected from the 'Malang' era to the supposed 'Pasuruhan' era, which was considered more authentic. It is questionable whether the year number can be changed while holding the years' *pasaran* name constant, but the recalibration has gone wrong in any case. It is the Tengger year in the second part of 1827 that was a Pon year, not that in the first part, as the revision has it. This revision is not likely to have been made by De Jongh, who went on to include, without comment, an incompatible later year (Pon 1783) in his list of *pasaran* equivalents. Nor is it likely to be Hageman's, for he was not convinced of the superiority of either of the eras, as his comment in 'Part II' reveals. So perhaps the amendment to Domis's date was made by De Jongh's Malang informant. He might also be the source of the comment made by De Jongh that the dates in the list are products of 'the best calculations'.⁵

This inconclusive example shows the multiple layers of reworking that the published information has undergone. The distance between the published data and the original Tengger informants is a problem that affects all our sources in varying degrees. Within Tengger society, specialized ritual and cultural knowledge – of which operating the calendar is a part – was restricted to the *dukun* and to some extent the headman of the village, and passed

³ We deduce this from the fact that the date reported in the second of the Meinsma papers is more fully detailed in Hageman's own publication (1871:17).

⁴ Meinsma (1879:131): beide stukken bijna gelijkkluidend waren.

⁵ De Jongh (1879:137): Naar alle mogelijke berekeningen ...

down in hereditary succession. It took the Hefners a long time to win the confidence of the *dukun* sufficiently for them to be allowed to witness and record ceremonies. They were never given access to written sources. Dutch officials working through lowland Javanese regents seem to have found things little easier, as Van Herwerden (1844:67) commented. These conditions are fertile ground for miscommunication, half-understandings and even obfuscation. Dutch observers were not loath to rationalize what they thought they heard, and Hageman was notably prone to engage in fanciful calculations.⁶ There is nothing we can do about this, except to recognize that the reports we have at second, third or fourth hand are not infallible. We have to grope our way gingerly through this fog, mindful always of Hefner's warning (1985:9) of the 'speculative errors that have plagued many analyses of Tengger tradition'.

Summary of the empirical evidence

Below is a distillation of the empirical information found in published sources for specific Tengger dates plus the two Tengger-like dates found in the Merapi-Merbabu manuscripts of central Java. The sources are indicated in the notes following. The *Sūryasiddhānta* date is given as a good proxy for gauging the phase of the moon, a little more precisely than the Javanese Muslim date. For seasonality the Gregorian Christian calendar is the best guide.

⁶ Witness the farrago of figuring in Hageman (1852, II:368-77). Hageman (1871:5-6) thought that the Tengger were ethnically distinct from the Javanese and had their own calendar dating back to 26 July 99 AD.

List 1. Tengger and Tengger-like dates

#	source	date	Sūryasiddhānta	Javanese Muslim	AD
<i>Merbabu</i>					
1	vd Molen	– Wesaka 1635	11 Weśākha 1633	10 Mulud 1635	29 Apr 1711
2	vd Molen	Kliwon 1667 / 1687			? 1742 / 1762
<i>Tengger</i>					
3	Domis	22 Kanem Pon 1755	24 Kārtika 1749	23 Bakda Mulud 1755	13 Nov 1827
	(a) De Jongh	Pon 1751			1827
	(b) De Jongh	Wage 1752			1827
4	Herwerden	14 Kasada –	14 Māgha [1763]	14 Sura [1770]	24 Feb 1842
5	Hageman 1852	1 [Kasa] 1778	5 Māgha 1771	5 Mulud 1778	18 Jan 1850
6	De Jongh	Pon 1783	1779-80	1786-87	1858
7	De Jongh	14-15 Karo 1786	20 Mārgaśira 1782	18 Jumadilakir 1789	1 Jan 1861
8	De Jongh	Wage 1792	1788-89	1795-96	[1866]-1867
9	Hageman 1879	[1 Kasa] Kliwon 1793	5 Asuji 1789	3 Jumadilakir 1796	2 Oct 1867
	Hageman 1879	[1 Kasa] Kliwon 1796	5 Asuji 1789	3 Jumadilakir 1796	2 Oct 1867
10	Hageman 1871	[1 Kasa] Kliwon 1795	5 Asuji 1789	3 Jumadilakir 1796	2 Oct 1867
11	Hageman 1871	13 Kapat Wage 1793	16 Poṣya 1789	15 Pasa 1796	10 Jan 1868
12	Hageman 1871	14/15 Kasada	16 Bhādrapada 1790	15 Jumadilawal 1797	3 Sep 1868
13	Hageman 1871	14/15 Kasada	17 Bhādrapada 1791	15 Jumadilakir 1798	22 Sep 1869
14	Hageman 1871	14/15 Kasada	18 Bhādrapada 1792	16 Jumadilakir 1799	12 Sep 1870
15	Hageman 1871	[1 Kasa] Pon 1797	4 Asuji 1792	3 Rejeb 1799	28 Sep 1870
16	Lüem	1 Kasa [1915]	2 Phālguna 1904	2 Jumadilawal 1915	15 Feb 1983

Sources

1. Van der Molen 1983:76-83. MS H of Kunjarakarna, which Van der Molen shows is from Merbabu = MS 187 (Setyawati 2002). Van der Molen credibly reconstructs this date as 29 April 1711. On this day the *pawukon* matches in all items except the 4-day cycle (which is inexplicably half a cycle awry) and conforms with a date in Wesaka (so long as we take this to be the Indic month falling in April-May). Van der Molen considers placing the date in either the Śaka era or a Tengger era that he reconstructs using De Jongh's deficient description of the Tengger calendar. These proposals require emendation of the year to 1633 or 1634 respectively although the year is very clearly expressed in the manuscript as 1635. The alternative possibility that this is a year in the Javanese Muslim era fits the evidence more cleanly.
2. Van der Molen 1983:83-87. MS K of Kunjarakarna, from Pamrihan, that is Merbabu = MS 53 (Setyawati 2002). The *pasaran* label of the year is clear, but all else is dubious. The year number is given as a chronogram, and there are

internal inconsistencies in the *pawukon* values.

3. Domis 1836:144, 146. The date is from the Pasuruhan side (Domis 1836:150). Domis reports this date as '22 Kanam' and not, as panglong 7 Kanam, as one would expect if the dates of the month were counted in waxing and waning fortnights in the Indic manner. It is Domis also who mentions that the 30 days were counted with the names of the 30 *wuku*, a practice not consonant with the use of fortnights.
(a), (b) De Jongh 1879:137. These dates appear to be recalculations of the date Domis gives. I do not regard them as empirical evidence.
4. Van Herwerden 1844:73.
5. Hageman 1852, II:374. Like all Hageman's data, this date has to be treated with caution. Hageman is prone to present his calculations as if they were fieldwork data. He loves playing with figures, but is often inaccurate even on his own terms.
6. De Jongh 1879:138. De Jongh's source for this date is unclear. It may have been corrected from the 'Malang' era to that of 'Pasuruhan' as it is presented in the same context as 3 (a), (b) above. If it has been adjusted, its year coincides with #7.
7. De Jongh 1879:138. This date is given as the beginning of the Tengger civil (*burgelijk*) year, but the opening comment in Hageman (1879:139) and an earlier remark in De Jongh (1879:133) indicates that De Jongh had received conflicting advice on the beginning of the Tengger year. There seems to have been a notion that the Karo commemoration was a Tengger New Year celebration. This is analogous to the idea that Lebaran is the Muslim New Year, and is not relevant to the calendar.
8. De Jongh 1879:137.
9. Hageman 1879:139.
10. Hageman (1871:6) expresses this as 1794 elapsed years. It is possibly not an empirical date.
11. Hageman 1871:17. Note the different *pasaran* label of no. 9.
- 12-14. Hageman 1871:8. The context in which Hageman presents these dates suggests that they are, for once, empirical data and not his own calculations. The series indicates that the 1869 AD date has been preceded by a leap month.
15. Hageman (1871:8) gives this date as 1797, but it seems to be an erroneously calculated date. Subsequent dates in the same list are calculated beyond the date of publication of the paper.
16. Lüem (1988:225) does not give the Tengger year at this point, but it can be deduced from the equivalence of 1919 Tengger and 1987 AD mentioned at the beginning of her appendix on the calendar (Lüem 1988:224).

With this empirical evidence we are able to throw some light on the mechanics of the Tengger calendar.

Length of months and suppression of dates

Domis, in 1827, states that every month has 30 days. This notion is compatible with the suppression of dates. This is also what we find in the modern Tengger calendar described by Lüem (1988:224), where the days within the month on which a date is suppressed are called *mecak*. On the other hand, the De Jongh report, in 1867, lists the months of the year with alternately 29 and 30 days, and specifies that a leap month has 30 days. We might take this as merely a simple way of explaining the effect of suppressing days,⁷ but two further pieces of information show that it has to be taken at face value. First, it is carried through to the calculation of the number of days missing in the five-year *windu*. According to De Jongh's account, the Tengger informant explained that each *windu* should have 1800 days, and that by the end of the *windu* 30 days had gone missing. This fits with the alternating months of 29 and 30 days, not a Balinese-style suppression of days. Second, the explicit information that short months finish on *panglong patblas* (the 29th) rather than *tilem* (the 30th) is incompatible with the suppression of dates: rather it points to truncation of the short months.⁸

It is possible that both methods were current. If the month is to keep in phase with the moon, the simple alternation of short and long months requires the lengthening of a short month a little less than every three years.⁹ An occasional adjustment of this kind would keep the two systems broadly in step. The empirical evidence has Tengger dates inconsistently slightly slower than the phases of the moon. This seems to sit more comfortably with the idea that some suppressions had been forgotten, rather than – in the alternative – that there had been too much enthusiasm for lengthening short months. Whatever the case, the variability of the slowness indicates that ad hoc adjustments were being made.

⁷ De Jongh 1879:132-3. Note Friederich's description (1850:50) of the Balinese months as 'divided into 29 to 30 days'.

⁸ It is probably coincidental that another remnant group, the Baduy of West Java also have months of alternately 29 and 30 days, although Van Tricht (1929:92) unaccountably calls this 'an old Javanese institution'. Jacobs (1891:78), says every month had 30 days.

⁹ The Javanese Muslim 8-year *windu* contains three such lengthened months, and requires still further adjustment about every 120 or 126 years.

Tengger era

Of all the elements of a date, the numbering of years tends to be the least stable and most subject to error. If the Palembang chancery could issue charters with dates one year different from all its neighbours (Proudfoot 2006:73), and if Mas Rahmat could keep a diary with dates regularly one or two years wrong as he travelled about Java (Kumar 1985), then it comes as no surprise that the Tengger, keeping track of time in more isolated conditions, might have deviations. De Jongh's report mentions a disagreement in the numbering of years: the year numbered 1793 in the north was numbered 1796 in the west. De Jongh speculated that the Northerners held to an authentic Tengger era while their more acculturated brethren in the west had adopted the Javanese Muslim era.

A glance at the empirical record shows that in a spread of cases gleaned from independent sources, the number of the Tengger year corresponds with the number of the Javanese Muslim year. These are indicated in bold in the following list.

List 2. Evidence of the Tengger era

	Tengger		Javanese Muslim	provenance if known
3 Domis	22 Kanem 1755	24 Kartika 1749	23 Bakda Mulud 1755	Tosari (N)
5 Hageman 1852	1 [Kasa] 1778	5 Magha 1771	5 Mulud 1778	
6 De Jongh	1783(*)	1779-80	1786-87	
7 De Jongh	14-15 Karo 1786*	20 Margasira 1782	18 Jumadilakir 1789	
9 Hageman 1879	[1 Kasa] 1793*	5 Asuji 1789	3 Jumadilakir 1796	'Pasuruhan' (N)
Hageman 1879	[1 Kasa] 1796	5 Asuji 1789	3 Jumadilakir 1796	'Malang' (W)
10 Hageman 1871	[1 Kasa] 1795	5 Asuji 1789	3 Jumadilakir 1796	

11 Hageman 1871	13 Kapat 1793*	16 Pausa 1789	15 Pasa 1796	Tosari (N)
15 Hageman 1871	[1 Kasa] 1797	4 Asuji 1792	3 Rejeb 1799	Tosari (N)
16 Lüem	1 Kasa [1915]	2 Phalguna 1904	2 Jumadilawal 1915	Ngadisari (NE)

The hypothesis that there was an authentic Tengger era surviving on the Pasuruhan side of the highlands has only slim support. Dates that might belong to this era are marked with asterisks in the list. Whether or not we think that #6 has been recalculated, we see that support for the 'Pasuruhan' calendar comes only from dates reported in De Jongh and Hageman over a ten-year period, with the strong likelihood that all these dates come from Hageman. Rather than postulate an era on this basis, it may be safer to think of a localized confusion over the year count. Hageman indeed reports other dates that are incompatible with both the Javanese Muslim era and the 'Pasuruhan' era. But if we still think that there might have been a specifically Tengger era, the difference of three years in 1868 AD (#9) would fit with the notion that the peculiar Tengger calendar began its independent existence either in the conditions of cultural autarchy that preceded the reestablishment of a focal power in Java under Mataram, or at the time of the adoption of the Muslim calendar by that state (in 1663 AD).¹⁰ Whether we prefer to credit that there was a largely forgotten Tengger era or merely local inconsistencies, the fact remains that a majority of the dates attested over a long period use Javanese Muslim year numbers.

Whether the Tengger year was given the number of the Javanese Muslim year current when it began or whether the current Muslim year was directly appropriated for Tengger dates we cannot tell. The nineteenth-century sources all assume that the Tengger year began with the Kasa, the 'first' month, but in Bali and earlier Java, the year began with the ninth month, Kasanga or Caitra. For the Baduy, too, another non-Muslim remnant group, the beginning of the year falls near this season, in Sapar, the fourth month (Van Tricht 1929:93; Jacobs 1891:78). If the nineteenth-century accounts are correct, it may be that the loss of seasonality in the Tengger year also changed the idea of the year's beginning.

Tengger windu

Do the *pasaran* labels of years in the Tengger *windu* match with year numbers,

¹⁰ This is slightly earlier than what Rouffaer (1921) deduced with his deficient model of the calendar.

or are they a separate method of counting? The evidence is too internally contradictory to begin answering this question. Consider the *windus* implied by the dates for which we have *pasaran* labels.

List 3. *Pasaran* labels of Tengger years

Years ending	#3 Domis	#6 De Jongh	#8 #9 De Jongh/ Hage- man 1879	#11 #15 Hageman 1871
	1755	1783	1792, 1793	1793, 1797
...0, ...5	Pon	Kliwon	Pahing	Manis
...1, ...6	Wage	Manis	Pon	Pahing
...2, ...7	Kliwon	Pahing	Wage	Pon
...3, ...8	Manis	Pon	Kliwon	Wage
...4, ...9	Pahing	Wage	Manis	Kliwon

The dates reported around 1867-1870 AD by De Jongh and Hageman have internally consistent pairings (#8, 9 : : 11, 15), but these differ from each other and from the earlier dates (#3, 6). This remains true whether or not we allow for the possibility of a divergence between years numbered in the Javanese Muslim era and in a possible Tengger era, and whether or not the *pasaran* sequence was counted backwards, as Lüem (1988:224) avers.

There is no ready explanation for this randomness. Leap months must have been implemented consistently across the Tengger lands or else the timing of the Tengger-wide Kasada ceremony would fall into disarray. If the conflicting information on *pasaran* labels reported by Hageman for the same year (#9, 11) reflects conditions on the ground, the implication is that the addition of a leap month did not always take place in Manis, as stated in De Jongh's report. Manis for those who followed #8, 9 would be Kliwon for those who followed #11, 15. Alternatively, the difference may be a confusion of Hageman's making.

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