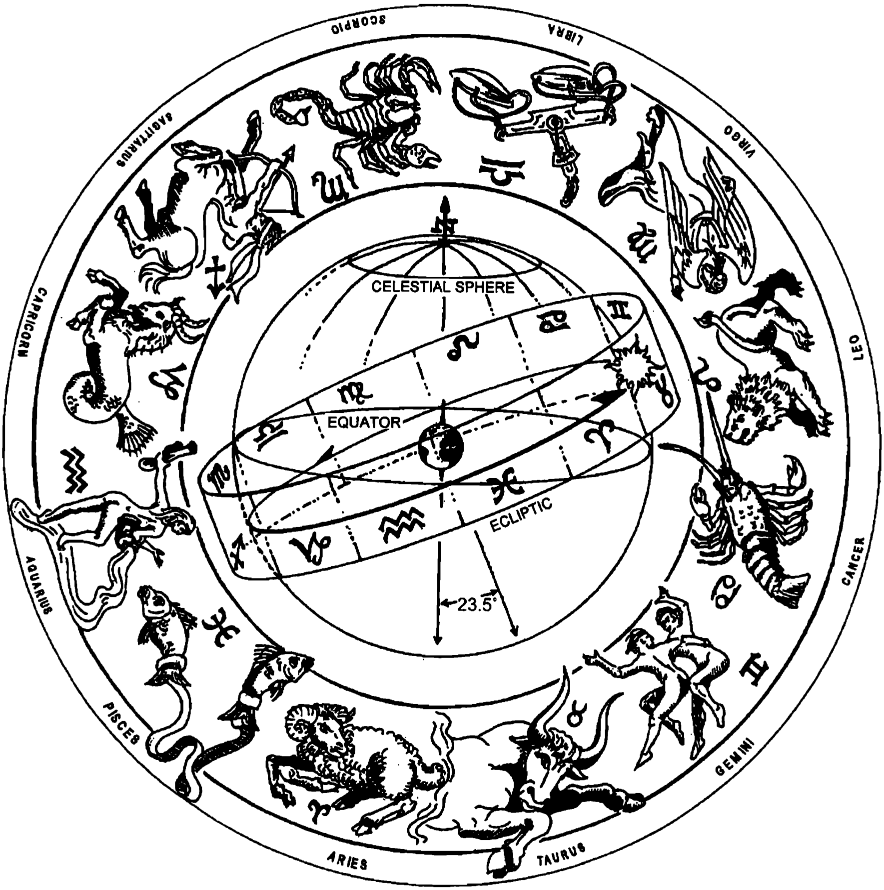
Greek & Roman Calendars

Constructions of Time in the Classical World

ROBERT HANNAH



SCORPIO
LIBRA
VIRGO
LEO
CANCER
GEMINI
TAURUS
ARIES
PISCES
AQUARIUS
CAPRICORN
SAGITTARIUS
CELESTIAL SPHERE
EQUATOR
ECLIPTIC
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Duckworth

First published in 2005 by
Gerald Duckworth & Co. Ltd.
90-93 Cowcross Street, London EC1M 6BF
Tel: 020 7490 7300
Fax: 020 7490 0080
inquiries@duckworth-publishers.co.uk
www.ducknet.co.uk

A catalogue record for this book is available
from the British Library

ISBN 0 7156 3301 5

Typeset by Ray Davies
Printed and bound in Great Britain by
CPI Bath Ltd

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Introduction

The recent turn of the millennium regenerated interest in the history of the calendar on both the academic and the popular levels. Whether the new millennium should be celebrated at the beginning of 2000 or of 2001, or whether it had in fact already passed some years earlier, were questions which engaged people for a while through 1999, and they brought to the fore the underlying question of what constituted the beginning of our present western era.

While this era, in its traditional form of years AD, stems from the early medieval period with its explicit reference to the birth of Christ, it was nevertheless constructed on a strong base of Roman chronology, and because of that genealogy we are drawn inexorably into the ancient world of time-reckoning. On another level, the ancient modes of reckoning time continue to influence modern conceptions and methods. Our own digital wristwatches may not look it, but they are just a very abstracted form of a clock which attempted originally to measure and recreate the movements of the celestial sphere, a process which stems from Greek and Roman antiquity, and indeed beyond that to Egyptian and Mesopotamian antiquity.

The standard works on ancient Greek and Roman calendars in English are Bickerman (1968/1980) and Samuel (1972). Both are successful general surveys, erudite yet accessible. They stand at the end of a long and venerable European tradition in the history of chronology which goes back through Ginzel (1906-14) to Ideler (1825-6) to Scaliger (1629). These latter works remain fundamental, but they are also practically inaccessible for most people. This present book does not pretend to stand in the same company, but in part seeks to make available to a wider readership the results of its predecessors, that is, an understanding of the process by which the classical ancestor of our own western calendar was formed, bringing the narrative up to date with more recent discoveries on Greek and Roman calendars. The book's more novel aim is to set these time-reckoning devices, more often and very readily described just in mathematical or abstract terms, on a stage occupied by real people, by Greeks and Romans who developed these calendars for a variety of purposes and lived with them. So the book examines the calendar both as an astronomically based timepiece and as a social instrument by which people organised their activities.

In Chapter 1 I set the scene by describing the principal units of time which stem from observational astronomy: the day, the month, the seasons, the year (both lunar and solar). These form the basis of the ancient calendars, and hence our own.

The earliest calendars of the Greeks, from the late Bronze Age (*c.* 1400-1200 BC) to the Archaic period (sixth century BC), are the subject of Chapter 2. This is also a good opportunity to examine the early Greek star calendar as it is described by the poet Hesiod. The issue of how a lunar and a solar year can be married together is also discussed, as a number of systems were developed by the Greeks in this period.

Chapter 3 focuses particularly on the calendars of Athens in the fifth century BC: the festival and the political, but also the seasonal, since this is a period of considerable development for the star calendar, or parapegma, in the hands of the astronomers Meton and Euktemon. I examine the degree to which the festival calendar was tampered with by officials, and make some proposals about the role of the star calendar as a regulatory device to maintain alignment between the festivals and the seasons.

In Chapter 4 I use several regional examples as the basis of a study of the modern reconstruction of Greek calendars from the fifth to the second centuries BC. How do we know, for instance, what the months of a particular city's calendar were, and what their order in the calendar was? This provides a useful foundation for a detailed technical discussion of the synchronisation between the various cities' calendars. The contact between the Greek world and the worlds of Egypt and the Persian Empire in the Hellenistic period provides opportunities for further synchronisms, this time between the Macedonian calendar and the Babylonian and Egyptian ones.

The calendars of Rome are the subject of Chapter 5. I examine the structure of the Republican calendar, and discuss how successfully it was kept in alignment with the seasons and the sun. Its political and religious nature is also analysed. This calendar is superseded by a solar calendar, introduced by Julius Caesar at the end of the Republic, and properly embedded by Augustus. I investigate its form and origin, and some of its effects, again both political and religious.

Finally, in Chapter 6 what might be termed the 'afterlife' of the Julian calendar in antiquity is discussed. The process of the adoption of the new calendar through the eastern Roman Empire was not an easy one, and through it we can see how the local Greek calendars examined earlier are changed. A late Roman calendar gives us a chance to see how the Roman world of the fourth century AD maintained its pagan and secular past in the face of the encroachment of the new religion of Christianity. And this area of interface between pagan past and Christian future forms the basis of our last discussion, on the creation of the new era, *anno domini*, or AD, with which we live still.

In providing references throughout the text, I have not intended to be exhaustive but indicative. I have favoured quoting from Greek and Latin primary sources (unless otherwise stated, all translations are my own). When translating Greek names, I have usually sought to preserve the Greek forms rather than the Latin, so that, for instance, the hero of the *Iliad* is Akhilleus, rather than Achilles. But since consistency might on occasion be confusing to some, for familiarity's sake I have kept some Latin forms, such as Thucydides, Plato and Ptolemy. Of modern secondary sources I have focused on providing directions to works which are fundamental in their field, while still trying to keep the reader abreast of the most recent discussions.

A word of caution: while chronology and calendars are functions of time, the nature and philosophy of time are not the subject of this book. They are the focus of another project on which I am engaged.

Acknowledgements

This book started life as an idea which sprang from a book chapter I wrote on ancient calendars (Hannah 2001). This in its turn had grown out of several years' work on the Greek star calendar (parapegma), to which I was drawn after studying Greek and Roman monuments which used the zodiacal signs as a means of representing time.

Over the past 15 years or so, then, I have accumulated more debts than I can hope to remember, and I trust that friends and colleagues whose names I omit here will not feel aggrieved at my lapse of memory: Andrew Barker, John Barsby, Owen Baxter, Roger Beck, Chris Bennett, John Betts, Mary and Peter Blomberg, Alan Bowen, Bridget Buxton, Amanda Claridge, Ivor Davidson, †Chris Ehrhardt, Janis Elliott, Denis Feeney, Peter Fraser, Françoise Gury, Jon Hall, David Hammond-Tooke, David Hannah, Goran Henriksson, †Douglas Kidd, Daryn Lehoux, Doug Little, Stan Lusby, Stephen McCready, John D. Morgan II, Marina Moss, Vivian Nutton, Stefan Pedersen, Chris Prentice, Nicholas Purcell, Paul Roche, Anthony Spalinger, Wesley Stevens, Richard Stoneman, Liba Taub, Edmund Thomas, Agathe Thornton and Greg Waite. I hope this book repays in some small way the enjoyment I have had in discussing its issues with these people. To Roger Beck, Denis Feeney and Liba Taub I am particularly grateful for having read through large parts of this book in draft and offered suggestions for improvement. Of course, any errors that persist are my own responsibility.

I am also indebted to the University of Otago for a period of sabbatical leave in 2002-3, during which much of this book was written, and to the University's library staff for prompt service of my frequent interloan requests. Valerie Scott, Librarian to the British School at Rome, which holds Stefan Weinstock's library on ancient calendars, was ever helpful on my visits there. The Library of the Warburg Institute in London has been a treasure trove for the past ten years.

Deborah Blake at Duckworth has been a marvellous editor, unfazed as this project has grown into something much larger than I originally anticipated. Also at Duckworth Margaret Haynes was a sharp-eyed copy-editor who saved me from inconsistencies. The illustrations have been drawn with wit and attention to detail by Karl Hart, to whom I am extremely grateful. Star charts from the computer planetarium, Voyager (version III), Carina Software, 830 Williams Street, San Leandro, California, have been most useful.

My greatest debt is to my wife, Pat, and children, Ngaire and Mark, who have borne with my absences – more metaphysical than physical, perhaps – while I have worked on this project. This book is dedicated to them in gratitude.

1

Astronomy and Calendars

We are all aware that the sun rises in the east and sets in the west, and so creates daytime, while night-time is simply the product of the sun's absence between these two events. Similarly most of us are aware of the rising and setting of the moon along much the same trajectory as the sun. We know, though, that it does not look the same each night but presents a different phase through a monthly cycle from new, to first quarter, to full, to last quarter and back to new. Finally, some of us know that many of the stars also rise in the east, travel to the west and set there in the course of a night. If we are reasonably keen observers of the night sky, we also know that the stars visible in one season of the year differ from those of another, and so their movements across the sky represent a larger cycle than just the diurnal.

The fundamental distinction between light and dark gives us the day; the phases of the moon provide us with the month; and the changing seasons inure us to the year. Not surprisingly, then, the three categories of celestial phenomena which we listed above – solar, lunar and stellar – lie at the heart of most calendars.

Furthermore, the way in which I have described the motions of the bodies, as if they actually rise and set, captures not only our popular descriptions of the events, but also the normal mode of understanding these motions in the ancient world. These phenomena of rising and setting, we know, are the product not of the sun or moon or stars moving, but of the earth rotating on its axis and so creating the illusion for us, who live on the planet, that it is the celestial bodies which are moving. Despite our knowing the truth of the matter, our language persists in describing these astronomical events in a fashion which reflects much better the perspective of the ancient world with which we are dealing in this book.

The smooth functioning of an ordered society depends in part on the possession by that society of a means of regularising its activities according to a calendar. This is as true of tiny, subsistence-level societies, such as the 400 or so Umeda people of Papua New Guinea (Gell 1992: 37-53), as it is of our own highly urbanised Western societies in London or New York or Sydney. Different interests – political, economic, religious, agricultural

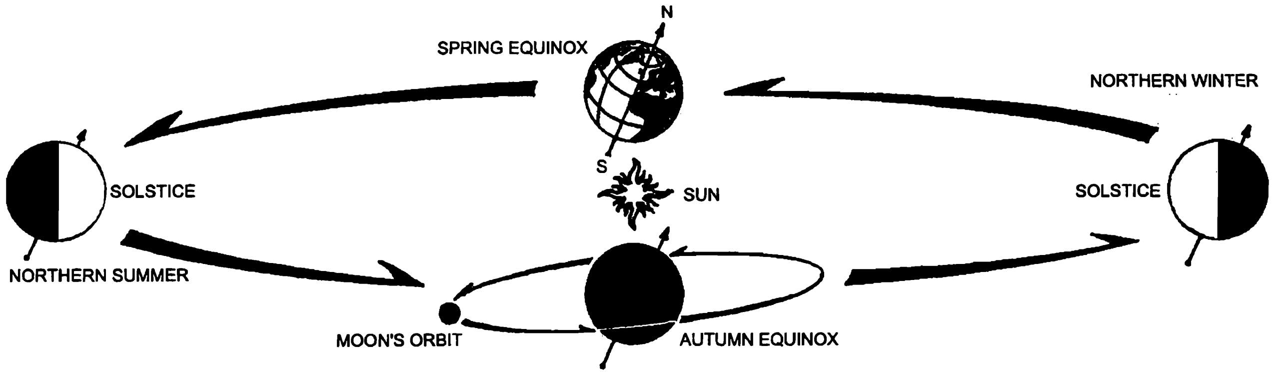

Figure 1. The annual orbit of the earth around the sun, and the monthly orbit of the moon around the earth.

– produce different ways of coordinating human activities and the natural passage of days and seasons.

The seasons, which in a temperate climate like that of Europe we call spring, summer, autumn (or fall), and winter, are a product of the annual orbit of the tilted earth circling around the sun once. The fixed tilt of the earth with respect to the sun means that as the earth orbits the sun, at one point the northern pole of the earth is closer to the sun and the southern is angled further away, while at a point opposite this one, the southern pole is angled closer to the sun and the northern is further away. These two points mark the seasons of summer and winter respectively for northern hemisphere inhabitants, and winter and summer respectively for those in the southern hemisphere. The points midway between in the orbit mark the seasons of spring and autumn (Figure 1).

In the course of this movement of the earth, we notice that day and night change in length. In midsummer the days are at their longest, while nights are shortest, as the earth, through its tilt, is exposed more fully to the sun. The opposite applies in midwinter. Midway between, day and night are practically equal in duration, and we call these points the equinoxes (from the Latin *aequinox*, 'equal night').

The summer and winter points of the orbit are called the solstices, from the Latin for 'sun' (*sol*) and 'to stand' (*sistere*). This term clearly has nothing to do with long days and short nights, or vice versa, and to understand it we need to view the earth's orbit around the sun from a different perspective, in fact, from our point of view here on earth.

Through the course of the seasons we see the sun apparently shifting north or south along the eastern or western horizons. If we are in the northern hemisphere, we observe the sun in midsummer rising and setting at its most northerly points on the horizon. As the season shifts to autumn and winter, the sun's rising or setting point on the horizon shifts also, moving further and further south, until in midwinter it reaches its most southerly point. Thereafter, the sun returns back along the track it has measured out on the horizon, through the midpoint between the two extreme turning points and back to the summer point. The two turning points of summer and winter are called the solstices because at these the sun appears to stand still for a few days before retracing its path back along the horizon in the ensuing days. The midpoint between the solstices does double service as the equinoctial points of spring and autumn.

Our own western calendar, the so-called Gregorian or reformed Julian, is a solar calendar, which uses the sun as the principal means of keeping our activities aligned with the seasons, although those activities are less season-specific the more industrial and the less agricultural our lives have become. Put very simply, the solar year on which this calendar depends measures the passage of time from one spring equinox to the next, and consists of 365.24219 mean solar days, or, to put it more approximately but also more usefully for day-to-day affairs, 365¼ days. To be of any use in the everyday world, a calendar must measure whole days, so the fact that the solar year consists of more than a whole number of days means that we have to find a way of allowing for the gradual addition of a quarter-day every year. So now we add one day every fourth ('leap') year to bring the calendar back into alignment with the sun – a fact which the Romans, the first users of this calendar, misunderstood after its introduction in 45 BC, as we shall see. The fact that the year is not exactly 365¼ days long, but rather 365.24219 days, means that further adjustments have been necessary with and since the Gregorian reform of 1582, to allow for the small differences between the practical and the precise formulations of the year which accumulate over long periods of time.

Because of the earth's daily rotation around its own axis, which creates the sense of sunrise and sunset during the day, we also gain the impression of star-rise and star-set during the night. The spin of the earth around its axis causes us to see the stars move from east to west, as they appear to rise and then set, in parallel semicircles above the horizon. These semicircles are really full circles, continuing under the horizon as the earth spins in full circles. The axis around which the stars seem to wheel is the axis of the earth extended out into space. These circles are smallest at the northern and southern poles of the extended axis, and largest at its midpoint, or equator, which is simply the extension of the earth's equator out into space too.

Stars close to the northern pole will not rise or set for observers closer to the equator, but will appear to circle perpetually around the pole. For these same observers, stars closer to the south celestial pole will not even rise above the horizon, but will always circle the pole invisible to northern viewers. Just which stars will always stay above the horizon, which will rise and set, and which will never be seen are a function of the particular latitude of the observer on earth, and can be readily calculated if that latitude is known. But experienced long distance travellers in antiquity would have gained a 'road sense' of when certain stars would dip permanently out of sight the further north they travelled, or which would appear anew from below the horizon as they travelled further south.

While no star clearly marks the south celestial pole at present, the north celestial pole is usefully indicated by Polaris in the constellation Ursa Minor (the Little Bear). But this will not always be the case in the future, nor has it always been the case in the past. Because of the effects of the sun and moon, the earth in its spin actually wobbles very slowly like a child's spinning-top. As a result, the earth's poles themselves execute a full circle every 25,800 years. This means that what we currently observe as a Pole Star will change over a long period of time: in about 12,000 years' time, or 12,000 years ago, the north celestial pole was close to the star Vega in the constellation Lyra, a star over 50° away across the sky from Polaris.

To the casual observer, the sun too appears to wheel daily in a circle parallel to the circles of the stars. But to anyone observing the sun over an extended period it becomes clear that it moves not only up and down the horizon but also gradually across the stars, tracing its own distinctive circle, which lies aslant to the unchanging paths of the stars. This separate solar track is a result of the earth's orbiting the sun through the year and of its doing so at a tilt to the sun. If the earth were not tilted towards the sun but were 'upright', then the circle traced out by the sun through the course of the year would also be parallel to the circles of the stars. But because the earth is tilted, the sun's apparent path cuts across the stars' circles at an angle.

We can map out this path if we look at the stars which follow the sun in the evening twilight and which precede the sun at dawn. These change over time through the year as the earth moves through its orbit, and they form a broad band which sweeps up, at an angle to the horizon, in a semicircle from east to west. The band continues under the horizon to form a full circle, which represents the apparent path of the sun across the backcloth of the stars through the year. This band is called the ecliptic, and the stars along its course have long been grouped into 12 constellations which are called the zodiac, a name which derives from a Greek word signifying the transformation of these stars into images of 'living creatures' of animal or human form (Figure 2). The names of these zodiacal figures as they have come down to us (Aries, Taurus, Gemini, etc.) are simply Latin translations of earlier Greek names (Krios, Tauros, Didymoi, etc.), which in their turn are translations of the Babylonian names for these groups of stars. The sun's apparent passage across each of these constellations may be used as a measure of the solar year, with each constellation marking out a rough twelfth of the year. The Greeks used this method of marking out the solar year, and the Romans borrowed it from them, recognising in the 12-part division a series of solar or zodiacal 'months'.

As a backdrop to the sun's movement through the year, the zodiacal stars form an artificial band which takes on a life of its own. These stars gain a special value commensurate with whatever value people put on the sun. In antiquity the sun was regarded as one of a special class of stars which were assumed to orbit the earth. These were the 'wandering stars', or planets (the word is derived from a Greek word signifying 'wanderer'). Like the sun, these planets have paths which are not only at variance with those of the other, 'fixed', stars, but which also happen to fall within the area of the zodiac. The Greeks and Romans (and, significantly, the Baby-

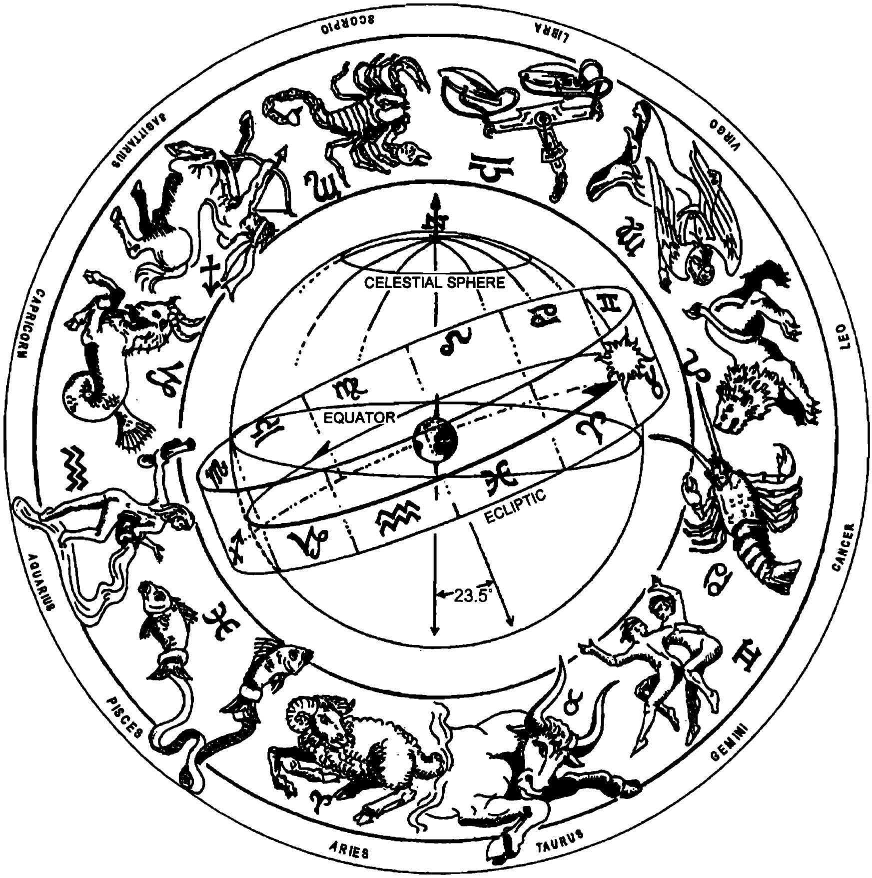

Figure 2. The zodiac. Constellations are represented in Classical fashion, as if seen from outside the celestial sphere.

lonians before them) numbered among the planets Saturn, Jupiter, Mars, the Sun, Venus, Mercury and the Moon (this is to give them their order from the furthest from the earth to the nearest to it, as the ancients saw the situation). The zodiacal constellations therefore gained even more in prestige as the apparent 'home' of the planets. Once the planets were seen as influencing human life on earth through their own special character, astrology was born.

Here it is worth recalling the earth's spinning-top 'wobble', which we briefly examined earlier. This effect is called lunisolar precession, or the precession of the equinoxes. The latter name reminds us that our view of all stars, not just those at the poles, is affected by this 'wobble'. The stars which presently mark the position of the sun at the spring equinox, for instance, have also changed over time. We see the effects of this shift most noticeably in the everyday world of newspaper and magazine astrology.

If we look up our horoscopes in the newspaper today, we look under our 'star sign', which is the zodiacal sign in which the sun was supposed to be placed at the moment of our birth. So a modern chart will tell someone born on 10 March that their sign is Pisces, on the assumption that the sun was in Pisces on that date. But on 10 March at present the sun is a whole sign, or 30°, away in Aquarius. These modern astrological charts are simply fossilised remnants of ancient Greek and Roman astrology, when the stars were seen from a different point in the earth's long 'wobble'. On 10 March in AD 150, for instance, it was true to say that the sun was in Pisces. We shall have cause to examine this world of astrology in more detail when it impinges on the Roman calendar.

Although effectively fixed with respect to their positions relative to each other, the stars which rise and set do so earlier each night by about four minutes as a result of the earth's daily shift along its orbit of the sun. At a certain time of the year (which is dependent upon the star's position in the sky and the observer's latitude on earth) a given star will rise at the same time as the sun and so be invisible because of the sun's light. Over the next few days the star will rise earlier and earlier than the sun until it first becomes visible just before sunrise, at the end of night. For a very bright star like Sirius this event occurs about an hour before sunrise; for fainter stars, it will be longer before sunrise. Over the ensuing weeks the star will rise progressively earlier and earlier back through the night, until eventually it rises at the start of night, just after sunset. How soon after sunset is again a function of the brightness of the star. Then the star will disappear into the sun's light at sunset. Thereafter, the star's rising will take place during daylight, in the evening, then in the afternoon and then during the morning through to sunrise, and so it will be invisible until the star reappears on the eastern horizon just before sunrise again. This sequence provides observers typically with two significant phenomena: a star's first visible morning rising (often termed its heliacal rising), and its last visible evening rising (called its acronychal rising). For instance, for Sirius, the brightest star in the sky, at the latitude of Athens, the heliacal rising currently takes place before dawn about 12 August, and its acronychal rising five months later after sunset on about 19 January.

A similar programme of phases can be gone through with regard to a star's setting with respect to the sun. In this case, a star will set in the west on a given day at sunrise, and so be invisible. Over the next few days the star will set progressively earlier than sunrise until it first becomes visible at the end of night, ahead of sunrise. Over the ensuing weeks the star will set earlier and earlier back through the night, until eventually it sets at the beginning of night, just after sunset. The star will then disappear into the light of the setting sun, and so on through daylight – evening, midday, dawn – and so will be invisible until the star reappears on the western horizon just before the glimmer of dawn. This sequence provides viewers with two further significant phenomena: a star's first visible morning setting (called its cosmical setting), and its last visible evening setting (termed its heliacal setting). Again if we observe Sirius at the latitude of Athens in the present day, the cosmical setting takes place before dawn around 12 December, while the heliacal setting follows five months later in the evening around 19 May.

The difference between a year measured by the stars and one measured by the sun is very small, and is a result of that slow shift of the stars called the precession of the equinoxes. We noted earlier that the solar year consists of 365.24219 mean solar days, which we tend to approximate to $365^1/_4$ days for practical purposes. This year, which is technically called the tropical year, measures the passage of the sun from one spring equinox to the next. A sidereal year, on the other hand, measures the passage of the sun across a point among the stars, and comprises 365.2564 mean solar days. Obviously this is also approximately $365^1/_4$ days, the difference between this year and the tropical year being only 20 minutes 23 seconds. Even over 100 years this difference builds up to barely a day and a half. For our purposes, then, we may treat the sidereal and tropical years as effectively the same, so that within a person's lifetime a calendar run by observations of the stars from one year to the next is equivalent to a solar calendar.

The last major celestial body which affects the ancient calendar is the moon, which we have already seen was regarded as one of the seven planets. In itself, though, it forms the basis of some of the principal units of time. Where the sun gives us the day, the zodiacal month and the solar or seasonal year, the moon gives us the lunar month and the lunar year.

The moon accomplishes its own orbit around the earth on average every 29.53059 days, or about once every $29^1/_2$ days (Figures 1 and 3). In that time it passes between the earth and the sun and becomes lost to sight as the 'new' moon. It reappears a day or two later, following the sun as it sets, and looks like a very fine crescent. Because it orbits the earth approximately once every $29^1/_2$ days, it shifts just over 12° across the sky every 24 hours. After about 14 days or so it has traversed about 180°, and so it then stands opposite the point at which it was formerly between the sun and the earth. Now being opposite both the earth and the sun, the moon is fully lit up by the sun on the face it turns towards the earth, and so it displays itself as a 'full' moon. Midway between these two positions it has presented its 'first quarter' phase, and midway between the full and the next new moon, it displays its 'last quarter' before disappearing again. This whole period constitutes a 'month'.

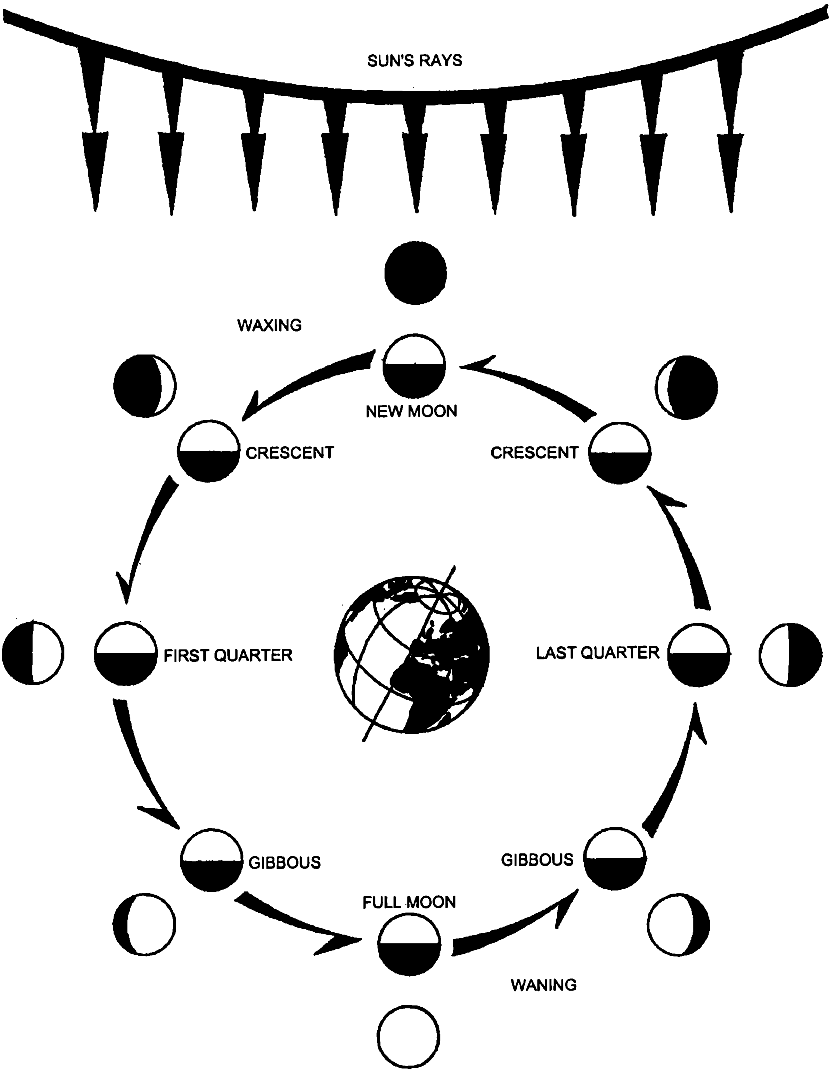

Figure 3. The phases of the moon as it orbits the earth.

The regularity of these phases, and, generally speaking, of the months themselves to casual observers, led to the use of the month as a fundamental unit of time for all ancient societies. Indeed, it is initially far more important than the solar year, which is too long as a single unit of measure for practical, everyday usage.

A lunar year is also established, usually comprising 12 such months, or

354 days on average. The trouble with such a year is that it does not sit at all well with the seasonal year, which is ruled by the sun and which comprises about $365^1/_4$ days. The effect of the difference is well illustrated nowadays by the vagaries of the Islamic religious calendar.

This calendar is a lunar calendar, using the moon as its basis. To allow for the fact that each lunar month is not a whole number of days, but instead about $29^1/_2$ days on average, the months of the Islamic year are usually made alternately of 29 days and 30 days. For some Muslims each month starts when the first sliver of the crescent moon is sighted, that is, a day or two after the actual new moon, which is invisible. If the new moon's crescent is not visible, the current month may be extended to 30 days, to be followed immediately by the next month regardless of the state of visibility. Over a 30-year cycle, an extra day is then added to the last month in years 2, 5, 7, 10, 13, 16, 18, 21, 24, 26 and 29, making these years lunar leap years, in order to bring the first day of the month back into correspondence with the date of the actual new moon.

Since 12 lunar months usually add up to only 354 days, they fall short of a seasonal/solar year by about 11 days. Because the Islamic calendar does not try to realign the two types of year, the effect of this discrepancy between them is that the Islamic religious year drifts through the seasons. The gradual nature of this shift, and its effect on every month, may be illustrated by the following selection:

Islamic months	**Gregorian dates**
Ramadan (30)	7 November – 6 December
Shawwal (29)	7 December – 4 January
Dhu'l-Qa'da (30)	5 January – 3 February
Dhu'l-Hijjah (29)	4 February – 4 March
Muharram (30)	5 March – 3 April
Safar (29)	4 April – 2 May
Rabi' I (30)	3 May – 1 June
Rabi' II (29)	2 June – 30 June
Jumada I (30)	1 July – 30 July
Jumada II (29)	31 July – 28 August
Rajab (30)	29 August – 27 September
Sha'ban (29)	28 September – 26 October
Ramadan (30)	27 October – 25 November
Shawwal (29)	26 November – 24 December
Dhu'l-Qa'da (30)	25 December – 13 January

The holy month of Ramadan, it can be seen, shifts too, and over a period of solar years it will run through each of the seasons, at one time occurring in winter, then progressively in autumn, summer and spring. Such a change is of relatively little consequence in the subtropical region in which Islam was born, but as the religion has moved into areas where summer days are much longer, the arduousness of the daytime fast of Ramadan has increased markedly.

The Islamic New Year, the first day of the month of Muharram, also necessarily drifts back through the solar year, at the rate of about 11 days a year, at one time occurring in winter, at another in summer (the following are the calculated dates published in advance of the actual occurrence):

1988	14 August	1998	28 April
1989	4 August	1999	17 April
1990	24 July	2000	6 April
1991	13 July	2001	26 March
1992	2 July	2002	15 March
1993	21 June	2003	5 March
1994	11 June	2004	22 February
1995	31 May	2005	10 February
1996	20 May	2006	31 January
1997	9 May	2007	20 January

In the western world, we still encounter the misalignment between the lunar and the solar years in the form of the Christian Lenten and Easter period. This period and festival are tied to the occurrence of the spring equinox – a solar event – and the first full moon after that – a lunar event. Easter therefore wanders through a determinable period of weeks over the years, and we naturally talk, for instance, of an 'early' or a 'late' Easter. Because of this, the whole period of Christian Lent, the 40 days preceding Easter Sunday, and a similar period after Easter wander up and down the calendar year. By contrast, other Christian festivals are tied to the solar calendar – most obviously, Christmas. This occupies the date, 25 December, which marked in the ancient Roman calendar the Birthday of the Sun around the winter solstice.

2

Early Greek Calendars

Bronze Age Greece

While writing existed in the Mycenaean Greek world of the late Bronze Age, in the form of a deciphered script called Linear B (to distinguish it from the earlier, still undeciphered Linear A script of Minoan Crete), it tells us little about the calendar systems of that prehistoric world.

The tablets from Knossos (*c.* 1370 BC) and Pylos (*c.* 1200 BC) list, respectively, up to eight and up to six month-names. These are usually attached to the word *me-no*, which is taken to be the Mycenaean Greek form of the later historical Greek word for 'month', *men*, a word which is itself related to *mene*, an early Greek word for 'moon'. This word suggests that the Mycenaean calendar was at least initially lunar or partly so. The month-names themselves appear to derive from gods' names or local place names. The partial lists from Knossos and Pylos suggest that each palace had a different set of names for the months, which is the practice in the later historical period for the city-states.

From Knossos a set of 11 tablets (in the Fp- series) provides us with the majority of the month-names from this palace. These tablets seem to form part of a ritual calendar, in which monthly offerings were recorded as being issued to various places, priests and divinities. Each tablet opens with the name of a month, followed by the offerings, as Tablet Fp1 demonstrates:

In the month of Deukios:	
To the Diktaian Zeus	12 litres of oil.
To Daidaleion:	24 litres of oil.
To *Pa-de-*:	12 litres of oil,
To all the gods:	36 litres of oil,
To the augur: ?	12 litres of oil.
Amnisos, to all the gods: ?	24 litres of oil,
To ?Erinys: ?	6 litres of oil.
To **47-da-*:	2 litres of oil,
To the priestess of the winds:	8 litres of oil.
(total)	136 litres of oil.

Knossos Fp1, trans. Ventris and Chadwick 1973: 306

The month-names preserved from Knossos are: *de-u-ki-jo-jo* (of Deukios); *wo-de-wi-jo* (and *wo-de-wi-jo-jo*, in the genitive); *ka-ra-e-ri-jo* (also in the genitive as *[ka]-ra-e-ri-jo-jo*; perhaps related to the month-name Klareon in historical Ephesos and Kolophon); *di-wi-jo-jo* (of Diwios; comparable to the historical month-name Dios found in Macedonia, Aitolia, Lesbos and elsewhere); *a-ma-ko-to*; *ra-pa-to* (i.e. Lapatos, a month-name which survived in third-century BC Arcadian Orchomenos); and possibly *pa-ja-ni-jo* and *e-me-si-jo-jo*.

At Pylos there are *pa-ki-ja-ni-jo-jo*; *di-pi-si-jo* (reminiscent of Thessalian Dipsios); *me-tu-wo-ne-wo*; *wa-na-se-wi-jo* and possibly *ki-ri-ti-jo-jo* and *po-ro-wi-to-jo*. It is tempting to wonder whether the month *ki-ri-ti-jo-jo* (of Krithios?) has something to do with barley (*krithe* in later Greek), but whether with its sowing or harvesting we cannot tell. The Pylian name *po-ro-wi-to-jo* is not qualified by *me-no* as a month, but it could be read as *plowi(s)toio* and has therefore sometimes been taken to be a month 'of sailing' or 'of navigation' (related to the later Greek *ploisdein*, to sail). If correct, this interpretation would suggest that this month belongs to the sailing season of summer, but obviously this is highly speculative. Otherwise, we do not know the order of the Mycenaean months in the year (Trümpy 1997: 2; Samuel 1972: 64).

The four month-names which may be reflected in later historical names – *di-wi-jo* for Macedonian Dios, *ra-pa-to* for Lapatos in Arcadian Orkhomenos, *di-pi-si-jo* for Thessalian Dipsios, and possibly *ka-ra-e-ri-jo* for Ephesian/Kolophonian Klareon – are all the hard material evidence that we have to suggest any continuity from the Bronze Age calendar to the calendars of Greece in the historical period.

Yet one theory has proposed that the Greek calendar ultimately is derived from Mesopotamia via Minoan Crete, thus bypassing even this material evidence from the intermediate Mycenaean Linear B. The theory is based on the apparent semesterisation of the historical Greek year around the equinoxes in certain facets of religious life, a practice which would seem to be parallel to, and derived from, earlier equinoctial ritual celebrations in the Babylonian months of Nisannu (at New Year) and Tashritu. The particular feature which was thought to connect Mesopotamian ritual with both Bronze Age Crete and historical Greece was the presence of a bull at the various rituals, while the allusion to a snake in some Greek cults was regarded as a further link back to Minoan Crete (Thomson 1972: 111-14).

As it stands, the theory of a Mesopotamian origin for the later Greek calendars remains unprovable. Linear B neither proves it nor disproves it. More recent archaeological work in Greece and Crete has tended to demonstrate an increasingly complex series of interconnections between the various areas of the eastern Mediterranean, particularly between Crete and Egypt, which were not foreseen when a Near Eastern origin for the calendar was promoted, and which may suggest that an Egyptian source of influence is at least as plausible, if outside influence there must be.

That Minoan Cretans may have used a sophisticated astronomy in various aspects of life – for instance, for orienting their palaces and other buildings towards the rising-points of the solstices and apparently even of the equinoxes as well as the moon and certain stars on the horizon – is currently being demonstrated. On this basis a native Minoan lunisolar calendar has recently been proposed, and its preservation into the historical period presumed (Henriksson and Blomberg 1996, 1997-8, Blomberg and Henriksson 2000, 2003).

The processes of continuity and discontinuity from the Bronze Age to the historical period, across the great divide of the so-called Greek Dark Age, are, however, much more complex than used to be thought, and it seems prudent to withhold acceptance of either an eastern origin or a native Cretan origin for the Greek calendar until more hard evidence is excavated.

Homer and Hesiod

The collapse of the Mycenaean Greek world between 1200 and 1100 BC was followed by a lengthy Dark Age, from which the Greek world did not emerge until the mid-eighth century BC. At that stage writing was reintroduced to Greece, but in a very different form from the Bronze Age syllabic script of Linear B. From Phoenicia in the east came the Semitic alphabetic script, which the Greeks adopted and developed into a variety of forms.

Linear B had been the language of accountants, from which an impression of contemporary social living conditions has to be reconstructed by archaeologists. The new alphabetic script may also have started life for the Greeks to express the language of commerce, though more of traders than of accountants as such. From a very early stage (*c.* 725 BC), however, writing was used to record poetry, and it soon became a means of preserving the originally oral epic poetry that had developed through the Dark Ages. This culminated in the works of Homer, the *Iliad* (*c.* 750 BC) and the *Odyssey* (*c.* 725 BC), narrative poems retailing events of the legendary Trojan War and its aftermath. A generation or so later (*c.* 700 BC) Hesiod produced epic poetry for different purposes – Creation myth, and Wisdom literature – which are more closely related to Near Eastern literary forms. Of special interest here is his *Works and Days*, in which the poet ostensibly teaches his brother how to farm. From this poem in particular it is possible to gain an idea of how the Greeks reckoned time.

Not surprisingly, given the themes of the *Iliad* and the *Odyssey*, Homer says very little explicitly regarding any form of calendar. His year incorporates the expected elements of days and months, which were seen as bringing the seasons round in a circle (*Odyssey* 11.294-5, 14.293-4), while the year itself is called 'revolving' (*Iliad* 2.551, 8.404, 8.418, 23.833, *Odyssey* 1.16, 11.248), a notion found also in Hesiod (*Works and Days* 386, and in his Creation poem, the *Theogony* 184). In the following century or so the composers of some of the Homeric Hymns – so called from their supposed derivation from Homer – use the same terminology (*Hymn to Demeter* 265, 445, 463; *Hymn to Apollo* 350).

The waning and waxing of the moon are referred to as a means for timing Odysseus' return to Ithaka (*Odyssey* 19.307), while whole months are used to count the length of a pregnancy (*Iliad* 19.117, compare *Hymn to Hermes* 11), but overall the Homeric year was a seasonal and agricultural one, and therefore solar rather than lunar. This seasonal year is reflected in other parts of the Homeric and Hesiodic poems. It is the canvas on which is painted with broad brush strokes a kind of 'natural' calendar, in so far as it demonstrates an awareness by the Greeks of an annually repeated series of natural and celestial events, which signal the appropriate time for certain activities on the land or sea, from one year to the next. It is not a chronological calendar, in the sense that dates from a given epoch could be assigned to the years, but it is, nonetheless, a calendar, which has a long future ahead of it. The moon's phases presumably provided another form of calendar for various activities, but how they were articulated with the seasonal year at this early stage, we do not know.

The celestial events which form the core of this seasonal calendar are the risings and settings of certain stars. These are observed in the evening after sunset and at dawn just before sunrise, the pivotal periods when people shift from daytime activities to those of night-time, and vice versa. At the simplest level, we find Homer referring to this year when he mentions the dawn rising of the star Sirius in autumn, in a simile for the dire appearance of the vengeful Akhilleus before Troy:

> Old Priam saw him first with his eyes, rushing over the plain, shining like the star which comes in late summer, and its conspicuous light appears among the many stars in the dark of night; and they give it the name the dog of Orion. It is the brightest, but it is made an evil sign, and brings great heat for wretched mortals.
>
> Homer, *Iliad* 22.26-31

The poet not only notes the star's rising, but also makes it the cause of the coincident heat at the height of summer. Hesiod reports in similar vein, colourfully ascribing to Sirius the ability to dry up men's heads and knees (*Works and Days* 587). This association between the stars' appearances and their supposed effects on the weather and on people may be regarded as part of the ominous nature of celestial bodies. It will survive in meteorological lore and in horoscopal astrology.

But the agricultural year's celestial markers may be found in more subtle references. For instance, Homer begins his description of a new shield for the Greek hero, Akhilleus, with this passage:

> He made on it earth and sky and sea, and untiring sun and moon coming full, and all the signs with which heaven is wreathed, Pleiades and Hyades and the strength of Orion and Bear, whom they also name Wagon, which turns round about there and watches Orion closely, and alone is without a share in the baths of Ocean.
>
> Homer, *Iliad* 18.483-9

The shield is a part of a new panoply being made for Akhilleus by the smith-god, Hephaistos, at the request of the hero's mother, the sea-goddess Thetis. On the new shield Homer lavishes a great deal of decorative detail about human life, in the city and the countryside, which arguably has much to do with the larger themes of the poem. This description of human life begins with the lines quoted above, and it is interesting for our purposes to see how these lines foreshadow the seasonal work of the countryside.

To understand this better, we can usefully look ahead to Hesiod's slightly later *Works and Days*, in which almost the same stars are encountered. In his fullest reference to these stars, Hesiod records the dawn setting of the Pleiades, the Hyades, and Orion as a signal for the time for winter ploughing:

> But when Pleiades and Hyades and the strength of Orion set, then be mindful of seasonable ploughing …
>
> Hesiod, *Works and Days* 614-17

The setting of the Pleiades alone is mentioned as an indicator of the time for ploughing in early winter on one other occasion (*Works and Days* 384). Another sign for the same activity of early winter ploughing and sowing is the call of the crane:

> When you hear call the voice of the crane, sounding yearly on high from the clouds, which brings the signal for ploughing and shows the season of rainy winter, but stings the heart of the man without oxen …
>
> Hesiod, *Works and Days* 448-51

Homer knew the call of the migrating crane as a sign of oncoming wintry rains (*Iliad* 3.3-6), and recognition of the coincidence has a long tradition in Greek literature (West 1978: 272). For the fifth-century dramatist

Euripides, if we understand him correctly, the cry of the crane coincided with the morning setting of the Pleiades and Orion (Euripides, *Helen* 1487-90; Wenskus 1990: 79). In modern times, although the numbers of cranes have diminished markedly as breeding areas have been lost, large flocks still migrate from Scandinavia and Russia south through eastern or western Europe to African winter quarters. The birds leave their eastern German halting places in this migration between late September and mid-October, to reach the Mediterranean in mid- to late October, before passing on to Africa (Cramp 1980: 619-20).

This migration period accords well with the Homeric and Hesiodic testimony. The dawn setting of the Pleiades, the Hyades, and Orion occurred in the time of Homer from the very end of October into early November in our terms. If we broaden our observation of the stars so as to include the Bear, which neither rises nor sets, we discover that as these dawn settings occurred, the Bear moved into another significant cardinal position, that of direct north. Indeed, the Bear lay not only directly north, but also at the highest point of its circuit around the pole (Figure 4). As

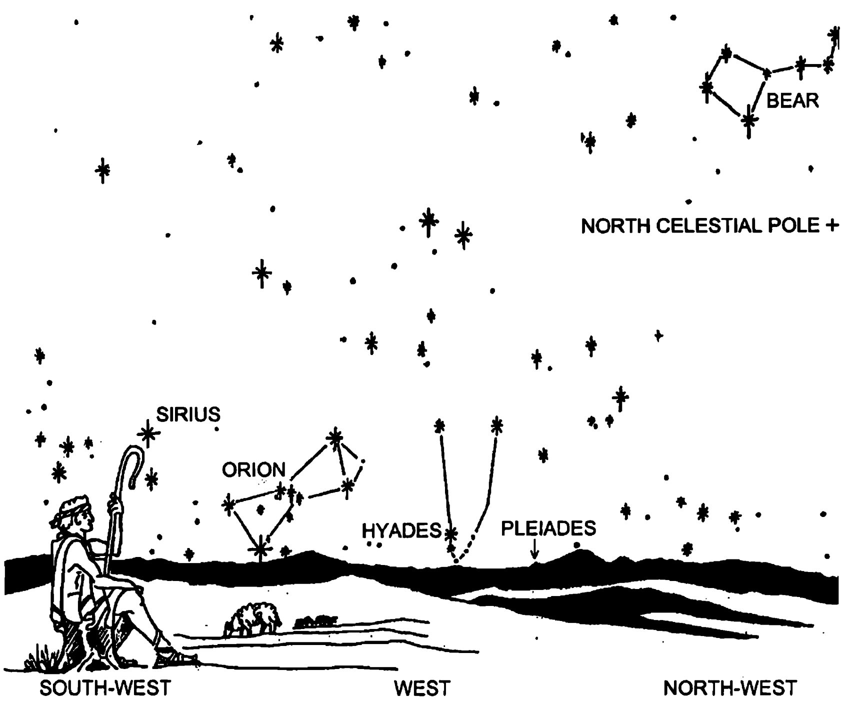

Figure 4. The dawn setting of the Pleiades, the Hyades, and Orion, and the upper culmination of the Bear, late October to early November 700 BC, Thebes in Boiotia.

Hesiod testifies, this is the time for ploughing. It is also, we may note, the sign of the start of the season of winter.

This configuration is repeated at another significant time of the year, when it occurs in the dusk of evening in late March to early April. This period is not so distinctly denoted by Hesiod, at least in terms of coincident star phases, but he does mention the setting of the Pleiades as the start of a period of 40 days' invisibility of this cluster, at the end of which their rising will signal the time for harvesting the grain crop (*Works and Days* 385-7). This setting belongs to about 26 March, a few days after the spring equinox (21 March). To this same time in late March we can reasonably ascribe the following encouraging sign to the farmer who had left the ploughing and sowing of his fields as late as the solstice in mid-winter rather than doing it at the start of winter:

> But if you plough late, this may be a remedy for you: when the cuckoo calls for the first time in the leaves of the oak, and delights mortals over endless earth, then Zeus may rain on the third day and not cease, neither exceeding, nor falling short of, an ox's hoof; thus the late plougher may come out even with the early plougher.
>
> Hesiod, *Works and Days* 485-90

The cuckoo still migrates northward from its African winter quarters to southern Europe from late March, with the main body of birds arriving there, and their call being heard, in April and early May (Cramp 1985: 405; Pollard 1977: 43). Its appearance, therefore, denotes the second half of spring. Aristophanes, in his late fifth-century play *Birds* (lines 505-6), treats the call 'cuckoo!' as a signal among the Egyptians and Phoenicians for work to start on the grain harvest. (This may seem premature, but the relatively early maturation of these crops in Egypt is noted by Theophrastos, *Enquiry into Plants* 8.2.7: the first barley is reaped after six months' growth and wheat after seven, whereas in Greece barley takes seven to eight months to ripen, and wheat even longer.) Later Roman writers also set the bird's first sighting about the time of the spring equinox: for them it served as a signal to farmers to complete in the first two weeks after the equinox those tasks which ought to have been done before it, particularly their vine-pruning (Pliny, *Natural History* 18.249; Horace, *Satires* 1.7.28-31). For Hesiod, the cuckoo's call is a signal for the possibility of oncoming rains which will benefit the tardy farmer who left his ploughing and planting late. It coincides with the evening setting of the Pleiades, and, by association, of the Hyades and Orion around the same time, while the Bear lies to the north. Such may also have been the associations in Homer's mind.

In addition to these two periods of farming activity denoted by the

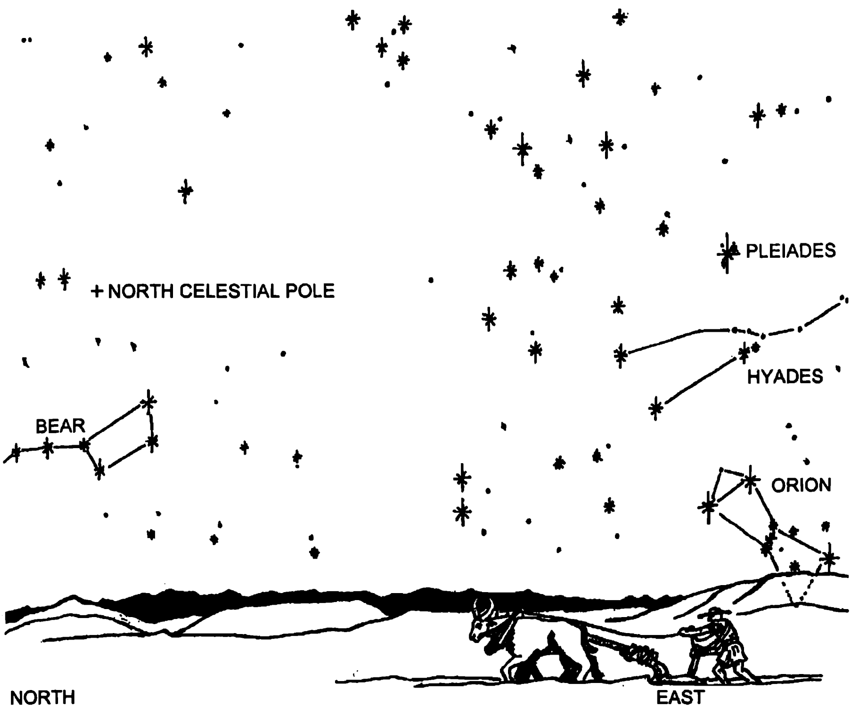

Figure 5. The dawn rising of the Pleiades, the Hyades, and Orion, and the lower culmination of the Bear, mid-May to late-July 700 BC, Thebes in Boiotia.

setting of the Pleiades, the Hyades, and Orion (and the upper culmination of the Bear), we can find other tasks timed by the *rising* of these same stars. As the Pleiades, the Hyades, and Orion rose at dawn, the Bear again lay directly north but this time at the lowest point of its circuit (Figure 5).

Now, Hesiod exhorts his farmer: 'When the Pleiades, the daughters of Atlas, rise, begin the harvest ...' (*Works and Days* 383-4). More picturesquely elsewhere, he warns his farmer to stop digging his vines at this time, when the snail also appears, and instead to prepare his reaping tools:

> But when the house-carrier comes from the earth up the plants, fleeing the Pleiades, it is no longer necessary to dig over the vines, but to sharpen your sickles, and rouse the servants.
>
> Hesiod, *Works and Days* 571-3

This rising of the Pleiades is the one that follows their 40 days of invisibility mentioned above, and it occurred in mid-May. Later agricultural writers would associate this observation with the start of summer (e.g.

Pliny, *Natural History* 18.222), and it is possible that Hesiod was aware of this too, although he is not so explicit.

By the time of Orion's dawn rising, about the time of the summer solstice, the harvest must have been completed, for the farmer now must set to threshing the grain:

> Urge on the servants to thresh the sacred grain of Demeter, when the strength of Orion first appears ...
>
> Hesiod, *Works and Days* 597-8

All hard work must be finished by the time Sirius appears at dawn a month later, and brings with it the worst heat of summer (*Works and Days* 587).

The whole harvesting operation through to winnowing, then, can be assigned to the period between mid-May and late July in our terms. This compares well with dates for harvesting in modern but pre-technological Greece, when barley was harvested and threshed in the third and fourth weeks of June, while wheat was harvested, threshed and winnowed from the first week of July to the end of the first week of August (du Boulay 1974: 275-6). The timing of the whole process was given in Homer's and Hesiod's period by the dawn rising of the Pleiades and Orion. The Hyades are not mentioned, nor is the Bear (as ever in Hesiod), but the former slot in necessarily between the Pleiades and Orion, while the latter's lower culmination may be what Homer implied when he included the Bear among the other three star groups on Akhilleus' shield.

There is a second significant period when the rising of the Pleiades, the Hyades and Orion, and the northing of the Bear occurred. This was in the evening in mid- to late September, but it is not an occasion observed by Hesiod, who instead records the slightly earlier dawn rising of Arcturus and the coincident southing of Orion and Sirius (about 10 September) as a sign to cut wood and to begin the grape harvest (*Works and Days* 414-22, 609-14).

Overall, then, we can see that Homer's selection of stars for Akhilleus' shield probably alludes to a series of significant times for agriculture. There is the dawn setting of the Pleiades, Hyades and Orion, coupled with the upper culmination of the Bear, which signals the time for ploughing at the start of winter in October. Then there is the evening occurrence of the same observation in late March, which serves both to warn the farmer of the need to prepare for the coming harvest season, and to raise the hopes of the tardy ploughman if rain comes soon afterwards. Finally, there is the dawn rising of the Pleiades, Hyades and Orion, with the lower culmination of the Bear, which signals the start of the harvest, and arguably of summer itself. Homer's choice of stars is not arbitrary, nor just an example of synecdoche, of using a part to refer to the whole of the night sky. Rather, his selection displays a sensitivity to particular celestial markers of the agricultural seasons, and foreshadows the fuller description of these further on in the Shield, where ploughing and harvesting are described at length (*Iliad* 18.541-60).

Hesiod provides a more extensive and explicit range of star observations as seasonal markers in his *Works and Days* than does Homer. In all, Hesiod notes ten observations of the risings, settings or culmination of five stars or star groups (if we count the culminations of Orion and Sirius as one). For a calendar, this may seem a very thin haul of observations, and it certainly appears so in comparison with earlier Babylonian forms and later Greek ones.

At least as early as 1000 BC the Babylonians included in their calendar the horizon observations of the dawn and dusk risings of certain stars and the calculated dates for the solstices and equinoxes. The seventh-century BC compilation of earlier star-catalogues called MUL.APIN ('The Plough'), after its opening line, gives an indication of how this type of calendar ran. Here are the entries for the first three months of the year (with modern star names in brackets):

> On the 1st of Nisannu the Hired Man [Aries] becomes visible.
> On the 20th of Nisannu the Crook [Auriga] becomes visible.
> On the 1st of Ayaru the Stars [Pleiades] become visible.
> On the 20th of Ayaru the Jaw of the Bull [α Tauri and Hyades] becomes visible.
> On the 10th of Simanu the True Shepherd of Anu [Orion] and the Great Twins [α and β Geminorum, and the stars north and south of them] become visible.
>
> MUL.APIN 1.ii.36-40, trans. Hunger and Pingree 1989: 40-1

This calendar is based on an ideal 360-day year, made up of 12 months each of 30 days. There is no explanation of how allowance would be made for the extra five or six days that are required to maintain correspondence between this calendar and the seasonal year of 365 or 366 days. Observations of the stars are limited to days 1, 5, 10, 15, 20 and 25 of any month, which adds further to the sense of idealisation in this calendar, since the phenomena will not recur from one year to the next on those same days without allowance being made for the proper length of the seasonal year.

Another part of MUL.APIN provides us with a different means of describing these phenomena, by day-intervals divorced from any notion of the month:

> 35 days pass from the rising of the Fish to the rising of the Crook.
> 10 days pass from the rising of the Crook to the rising of the Stars.
> 20 days pass from the rising of the Stars to the rising of the Bull of Heaven.
>
> MUL.APIN 1.iii.43-5, trans. Hunger and Pingree 1989: 55-6

The total number of days in the list from beginning to end of the sequence remains 360. This, together with the consistent use of day-intervals divisible by 5 or 10, leaves the modern reader with a sense of artificiality about the observations. We shall find this method recurring in classical Greece, but with a greater sense of empiricism in the observations.

For an agricultural calendar whose intention is to signal the appropriate times for a few highly significant activities on the farm through the year, Hesiod's calendar may be a little spartan in comparison with its Near Eastern cousins, but it is nonetheless surprisingly sophisticated (Reiche 1989). The advantage to the farmer of a calendar organised according to the periodic observation of the appearance or disappearance of stars on the horizon is that it provided him with a timing mechanism more distinctive and refined than that of the sun alone, and yet tied much more to the sun and its seasons than observations of the wandering moon would be. The moon may still provide signals for certain agricultural activities, such as when to plant in a given month – although after Hesiod we know of this sort of practice more from the Romans than from the Greeks – but the farmer still needed to know at what point in the year to engage in this activity. The moon alone could not tell him, for through its various phases one month's moons look exactly like those of the next.

Other aspects of Hesiod's natural calendar are remarkable. Its seasonal character is explicit, with spring, summer, autumn and winter all recognised, and their start or end all identifiable. Spring begins with the evening rise of Arcturus in the middle of February. Summer may be presumed to start with the dawn rise of the Pleiades in mid-May and the call to harvest, which is pre-eminently summer's task; but even without that presumption, summertime is noted explicitly at the dawn rising of Sirius in late July, and its end is recorded at 50 days after the solstice towards mid-August. This provides an implicit record of the start of autumn, whose rains are clearly noted in September. Finally, winter's start occurs as the Pleiades set in the morning in late October.

Both solstices are mentioned, but neither equinox is, even though the almost coincident setting of the Pleiades in late March is observed. Instead, Hesiod offers us hints of what we would call 'mid-quarter' days as the dominant seasonal markers. For him, as for most of antiquity, the tropical points of the solstices and equinoxes were the indicators not of the start or end of the agricultural seasons, but of the midpoints in them. The actual starting points were about halfway between the tropics. The later Roman writers Varro and Pliny make this absolutely clear. Pliny, for instance, places the starts of his seasons as follows: spring at the blowing of the west wind, Favonius (the Greek Zephyros), on 8 February (unusually, a meteorological phenomenon, rather than an astronomical one); summer at the dawn rising of the Pleiades on 10 May; autumn at the dawn setting of the Lyre (Lyra) on 8 or 11 August; and winter at the dawn setting of the Pleiades on 11 November (Pliny, *Natural History* 18.222).

This seasonal character to Hesiod's calendar also underlies the second major interest evinced in it after the agricultural tasks: the times when one can or cannot sail. The prime sailing season starts at the time of the summer solstice, and runs for 50 days until mid-August. For some of this time, we are told, 'the winds are steady' (*Works and Days* 670), a reference probably to the north-westerly Etesians. Later authorities have these starting at the time of the dawn rising of Sirius, although Hesiod does not mention it at that point. They end, according to some, at the time of the evening setting of Lyra in mid-August, a signal for the start of autumn (cf. West 1978: 323). A secondary sailing season is placed in spring (*Works and Days* 678-82). Outside these periods sailing is best avoided because of the weather. Autumn and early winter are particularly picked out as inauspicious times with storms at sea making sailing difficult.

Archaic Greek calendars

The moon lies at the core of Greek city-state calendars throughout their history, and in this they resemble the type of calendar which we encounter in Mesopotamia and Assyria. The Greeks took the evening sighting of the new moon's crescent as the sign of a new month (Aratos, *Phainomena* 733-5; Samuel 1972: 57; Kidd 1997: 425-6). The invisibility of the waning crescent *in the morning* has also been promoted as the signal to start a new month on the next day (Pritchett 1982; Depuydt 1997b), but this runs counter to Aratos' explicit testimony.

In one regard there is a subtle distinction between the lunar calendars of Greece and the East. The names of the months in the East, from the Sumerian calendars onwards, were derived from agricultural activities and seasonal phenomena. In Greece, on the other hand, the months were named either after gods who were honoured in those months, or after associated religious festivals which took place in them. For instance, the Spartan month Karneios refers to Apollo Karneios and the festival of the Karneia held in his honour in that month. The equivalent month in Athens was called Metageitnion, reflecting another cult title of Apollo, although the presumed associated festival has left no trace in the literary or inscriptional record. Particular months might be associated with particular seasons, as we shall see that Lenaion was with winter for Hesiod, but it seems that out of the hundreds of historical Greek month-names preserved only one, Haliotropios, signified a seasonal phenomenon, and an astronomical one at that: the summer solstice (preserved in inscriptions from the western Greek cities of Epidamnos and Apollonia on the Aous: Samuel 1972: 79, 80, and see his Index of Months 284-97; Robert and

Robert 1973: 69; Nilsson 1920: 364; on the west Greek Poitropios and Enduspoitropios, see Trümpy 1997: 213).

There is, therefore, a distinctly sacral character to Greek calendars from the beginning of the historical period, and this remains the case throughout their history. Only from the second century BC do we find this character countered, as a few states adopt a purely numerical system for the names of the months, i.e. First, Second, Third, ... Twelfth. But this is probably done less out of an explicit desire to secularise the calendar than simply to provide uniformity across otherwise localised calendars. Significantly, all these numerical months occur in federated calendars – those of the leagues of Phokis, Ozolian Lokris, and Akhaia. Indeed, in the case of the Lokrian league, the federal calendar existed alongside local city calendars within the league, which retained named months which differed from one city to another (Samuel 1972: 70-1, 75-6, 97; Nilsson 1920: 364).

At what date the sacral character of the Greek calendars was established is unknown. One theory was that the adoption of month-names associated with particular festivals must post-date Homer (who mentions none) and Hesiod (whose mention of Lenaion was considered a later author's interpolation into the text), but not by much. Furthermore, a special link was noticed between certain days of the month and the god Apollo, notably the day of the new moon and the seventh day, the latter being considered his birthday (cf. Hesiod, *Works and Days* 770-1; Herodotos 6.57; scholion to Aristophanes, *Wealth* 1126; Nilsson 1962: 38-9). Finally, at Delphi some festivals were held every eight years (those of Septerion, Herois, and Charilla: Plutarch, *Greek Questions* 12), a period that coincides with the eight-year cycle (the octaeteris, to be discussed below), which was developed by the Greeks to make lunar and solar time correspond, and which perhaps was the original timeframe for the celebration of the Pythian Games held at Delphi. All these factors suggested that Delphi, a religious centre of panhellenic significance and particularly associated with Apollo, may have been the source for the sacral character of the Greek lunar calendars from the second half of the seventh century BC onwards (Nilsson 1955: 644-7).

A more recent analysis, however, has pointed to the similarity between Athenian months and those of the Ionian Greeks (on the western seaboard of Turkey), whose foundation legends held their cities to be colonies from Athens in prehistoric times. For example, Miletos shares with Athens the month-names Thargelion, Metageitnion, Boedromion, Pyanopsion (also Pyanepsion in Athens), Poseideon, and Anthesterion. This analysis has suggested that these common month-names predate not only the spread of the Delphic oracle's influence but also the Athenian migrations to Ionia several centuries earlier (West 1997: 28, 353; Trümpy 1997: 18-19). In the case of Miletos, this migration seems to have taken place about 1050 BC, to judge from similarities in the ceramic remains from Miletos and Athens. This would place the origins of the Greek calendars back in the early Iron Age at the latest, and probably further back, in the Bronze Age. Unfortunately, as we have seen, little regarding the Mycenaean calendar survives, or can be understood, from the Linear B tablets. None of the surviving month-names bears any resemblance to the Athenian-Ionian month-names (barring perhaps *ka-ra-e-ri-jo* and Ephesian Klareon), nor are they obviously solely religious in character, and therefore they do not help to resolve the question of the origin of the sacral nature of Greek calendars.

None of this tells us much about the astronomical nature of the early Greek calendar. So a report by Diogenes Laertius (1.59, probably third century AD), that the statesman Solon required the Athenians 'to observe their days according to the moon' is intriguing, if it means that the Athenians did not adopt a lunar calendar until the remarkably late date of Solon's time in the early sixth century BC. This is too late in the piece for Athens to have taken such a step, given the consistently lunar character of all Greek calendars. Geminos (*Introduction to Astronomy* 8.26, mid-first century AD) does report that 'the ancients' used to count 30 days to a month, so perhaps Diogenes had hold of a tradition which credited Solon, rightly or wrongly, with instituting in Athens a more rigorous adherence to the true lunar month of 29½ days, rather than the looser, but popular, 30 days. To achieve this tighter correlation with the moon, Solon may have established the system of alternating 30-day ('full') and 29-day ('hollow') months. As Geminos (or a later interpolator) explains (8.33), this gives 59 days every two months, the same value as two proper lunar months (29.5 x 2), while six 'full' and six 'hollow' months make a lunar year of 354 days, rather than a year of 12 30-day months or 360 days.

On the other hand, it may be that Solon was credited with introducing the decade system of counting the days in an Athenian month, as this at least nominally recognises the periods of the moon's waxing, fullness, and waning; or some particular aspect of this decade system, such as the method of counting the last ten days of the month backwards (as Plutarch, *Solon* 25.3 records). We shall look at these facets of the Athenian calendar in the next chapter.

Early intercalary systems

What the religious character of the historical Greek calendars indicates is that they were not only created around the gods and their festivals, but were presumably intended to ensure that the festivals and associated rituals were performed at the right time. Where things get particularly interesting is when the festivals associated with a given month – whether or not they were tied to that month's name – are of an agricultural, and therefore seasonal, character. Obvious candidates in this regard would be those festivals associated with the cult of the agricultural goddesses, Demeter and Persephone, such as the Eleusinia and the Mysteries in Attika, or the Thesmophoria which were celebrated throughout the Greek world. If the agricultural festivals were to maintain alignment with the appropriate seasons, and yet also continue to fall within the correct lunar month, it is clear that some means of coordinating the lunar and solar cycles was necessary. Otherwise, these festivals would soon become divorced from their original agricultural contexts and run throughout the year over a period of time, like the modern Islamic religious months.

At issue for societies which run both lunar and seasonal/solar systems of reckoning time is how to make equal the fundamentally incommensurate periods of the lunar and solar years. To put the problem in modern terms, since a solar year comprises 365.24219 days, while one lunar month averages 29.53059 days, it is impossible to have a whole number of lunar months in a single solar year: a solar year consists of more than 12 but less than 13 lunar months. What societies discovered early on, however, is that it is possible to assign a whole number of lunar months to a certain number of solar years and so to attain an approximate equality between the two periods. In these various lunisolar systems, most years will require only 12 lunar months, but an occasional one will need to have a 13th month added (intercalated). We shall examine this problem in more detail later on.

That some form of regulation of the lunar year existed from an early stage is implicit in the record of Hesiod, even though he refers to only one month by name in his *Works and Days*. This is the month of Lenaion, which is characterised as the worst of winter, 'bad days, real ox-flayers ...' (*Works and Days* 504, taking here the view that this line is not a later interpolation). For the month to be so firmly and vividly associated with wild, wintry weather, some form of brake must have been applied to the lunar calendar to keep this lunar month within the season of winter. How crude or sophisticated that brake was, we cannot tell, but it would have to take the form of the addition of an extra month every now and then to allow the solar year to catch up with the lunar. The month could well have moved up and down the season for all we know, as Easter does with the northern spring, but it seems unlikely that it was allowed to drift completely outside it, if it retained a wintry association.

Several methods had been devised in the ancient Near East to determine whether a given year should be left with 12 lunar months or adjusted to 13 (Rochberg-Halton 1992: 811). One procedure recorded in the MUL.APIN tablets involved observing the relative positions of the moon and the Pleiades:

> [If] the Stars and the Moon are in conjunction [on the 15th of Arahsamnu], this year is normal.
> [If] the Stars and the Moon are in conjunction on the 15th of [Kislimu], this year is a leap year.
>
> MUL.APIN 2.ii.1-2; trans. Hunger and Pingree 1989: 91

Here the difference in time between the two observations of the same phenomenon is a lunar month. What is anticipated is that the lunar year, naturally running ahead of the solar year by 11 days per year, has eventually overrun the solar year by a full month. The first observation presents the ideal circumstance, with a conjunction between the Pleiades and the moon in month 8, Arahsamnu, of the Babylonian year. The second reading tells us that if this conjunction occurs a whole month later in the calendar, in month 9, Kislimu, then an intercalary month will have to be added to bring the lunar and solar calendars back into synchronicity.

The Greeks of Hesiod's time could conceivably have used such star-and-moon mechanisms like their eastern neighbours, but we have no direct evidence of it. Nevertheless, we can imagine some possible methods on the basis of the astronomy that Hesiod was familiar with. The recognition of the solstices, which are used by Hesiod as the starting point for lengthy day-counts, could have provided an approach for foreseeing the need for a leap year in the lunar calendar. This would seem to be a particularly likely method, since Hesiod not only notes the winter solstice, but also names a winter month, Lenaion. As we have seen, for this month to maintain its wintry character, there needs to have been some form of intercalation, however crude that may have been. There are just over 180 days between the two solstices, so when a year begins with the observation of the first new moon after one of them, the other solstice should take place in the sixth or seventh lunar month (six lunar months amount to 177 days). If the second solstice occurs at the start of the eighth month, this gives the observer good warning that the lunar year is running ahead of the solar, and that an extra month must be added to the current lunar year to slow it down, if it is to retain its solar connection (Samuel 1972: 17).

Obviously, this method works best in a system which usually intercalates in the second half of the year, so that the braking effect of the extra month can be applied after the second solstice but before the next year begins. Such a system operated later in pagan Anglo-Saxon England (Meaney 1985: 2-4), so it is a credible option for ancient Greece. But if an intercalation is operating in the first half of the year, then either the second solstice's warning has been picked up too late in the previous year and the correction held over to the following year, or another method is being used. Another possible technique which the Greeks could have used, and which resembles the Babylonian one we have just seen, relies on the observation of a star in a particular lunar month. Let us take our cue again from Hesiod. The call of the migrating crane is a signal for ploughing and the start of winter (*Works and Days* 448-51). The same season's ploughing is also usefully forewarned by the setting first of the Pleiades, and then of the Hyades and Orion (*Works and Days* 384, 614-7). If these phenomena were also tied to a particular lunar month – in the way that Lenaion is tied to winter – then their occurrence, say, a month later than anticipated would indicate the need for an intercalary month to bring the lunar year back into synchronisation with the seasons and the sun.

Even in the Near East, intercalation was a haphazard affair, regulated from the second millennium BC only by a limitation on which months could be doubled (the sixth, Ululu, and the twelfth, Addaru), and by royal decree. For instance, Hammurabi, king of Babylon 1848-1806 BC, decreed:

> Tell Sin-iddinam, Hammurabi sends you the following message, 'This year has an additional month. The coming month should be designated as the second month Ululu, and wherever the annual tax had been ordered to be brought in to Babylon on the 24th of the month Tashritu it should now be brought to Babylon on the 24th of the second month Ululu'.
>
> trans. Britton and Walker 1996: 45

We cannot judge who would have ordered an intercalation, or suppression, in Greece in Hesiod's time; nor is it at all clear whether there was any limitation on which month might be doubled.

The introduction of the earliest intercalary system reported in our sources is undated: Geminos simply ascribes it to 'the ancients', in the same sentence in which he talks of the 30-day month (Geminos, *Introduction to Astronomy* 8.26). It comprised the addition of an extra month every second year. If the Greeks really did originally run their years as 12 months of 30 days each, this primitive intercalary system would give alternating years of 360 and 390 days, or 750 days for the two-year period, which in turn overreach two solar years by $19^1/_2$ days ($365^1/_4$ x 2 = $730^1/_2$ days). So the virtue of having in a 360-day year a period which is not too far short of the solar year is then rapidly wasted by having far too long a biennium. On the other hand, if the biennial intercalary system was applied to two lunar years whose months were alternately 30 and 29 days in length, this would produce a biennium amounting to 738 days, which in turn overreach two solar years by only seven-and-a-half days. In view of the fact that the Greek historian Herodotos (2.4) still talks of the use of the biennial system of intercalation among the Greeks of his own time (the mid-fifth century BC), when alternating 30- and 29-day months were also in use, the biennium of 738 days seems more likely, and we shall assume it for what follows.

Censorinus, writing in the third century AD, also describes the biennial intercalary system, reporting that

> when the old city-states in Greece realised that while the sun in its annual course describes its circle, the new moon rises sometimes 12, sometimes 13 times and that this often happens alternately, they supposed that 12½ months corresponded with the natural year. So they fixed their civil years in such a way that by intercalating they made them alternate years of 12 months and 13 months ...
>
> Censorinus, *On the Birthday* 18.2

This system was called a trieteris ('three-year' system), because of the inclusive means of reckoning the Greeks employed, although Censorinus prefers to think of it as a dieteris ('two-year' system). He adds, rather cryptically,

> After the error was recognised, they doubled this period of time and made the tetraeteris. Because it returned in the fifth year, they called this a pentaeteris, by which means a more suitable 'great year' was resolved on from a quadriennium, since it was understood that the year of the sun corresponds to 365 days and about a quarter of a day, which makes a single day in four years. ... This period of time, which was deemed to correspond only to the course of the sun and not of the moon, was also doubled and the octaeteris was made ... .
>
> Censorinus, *On the Birthday* 18.3-4

This passage does not make much sense. Censorinus does not explain what the 'error' was which drove the Greeks to double the dieteris into a tetraeteris, but he implies that it has something to do with a realisation that over a four-year period the odd quarter-day of the solar year can be accommodated through the quadriennial leap day. He certainly states that the end result matched the solar year and not the lunar, so it does not look as though the tetraeteris was intended to be a lunisolar calendar as such. After all, simply doubling the dieteris in itself only doubles its error, if no subtraction is made for the extra days that the system produces; and Censorinus makes no mention of such an adjustment. The error over four years is of the order of 15 days between the lunar calendar and the solar, with the former running ahead of the latter, and as that is only half a month and not a whole one, it is difficult to see how it could be catered for in practical terms. It has been thought that Censorinus was just inventing the tetraeteris to allow a smoother transition from non-astronomical to astronomical calendars, like the octaeteris, which we shall soon discuss (Samuel 1972: 34). Perhaps not surprisingly, we have no evidence from the various Greek cities that such a quadriennial system was ever put to use.

We have seen that with the dieteris the difference between the lunar and solar years would simply increase further as time went on, if nothing was done about it, adding up to a whole 30-day month after eight years, or two months after 16 years, and so on. Links between particular months and seasons, like Hesiod's Lenaion and winter, would become first stretched and then broken completely within less than a lifetime. Similarly, any bond between agricultural activities, which are necessarily tied to the sun, and religious festivals which could be tied to the lunar calendar, would diminish over time. A month's difference could lead, for instance, to people celebrating a first-fruits festival too soon before the first fruits have been harvested. It would take almost a century (96 years) for the original synchronisation to recur. So this particular system rapidly defeats its own purpose unless the accumulated extra month is subtracted. Since no such subtraction is reported in our sources, the dieteris is usually considered nowadays to have been both impractical and unpractised in Greece.

Herodotos (2.4) disparaged the biennial intercalary system, in favour of the more refined Egyptian solar year, which, he believed, kept pace better with the seasons. What is intriguing is that Herodotos implies that this relatively crude intercalary system operated in his own time, despite a number of significant advances in accuracy by then, and despite our total lack of surviving evidence for its public use. In fact he himself adopts such a system in a calculation of the length of a human lifespan in the course of a reported conversation between Solon the Athenian and Kroisos, king of Lydia (Herodotos 1.32). Solon equates the 70 years of a lifespan initially with 25,200 days, but he then adds to this sum the missing intercalary months, at the rate of one month every two years. There would be 35 of these intercalary months, producing a further 1,050 days, which in turn raise the total for the 70 years to 26,250 days.

Throughout these calculations, it is also interesting to note that all the months are assumed to be of 30 days' length, and the ordinary, unintercalated year to be of 360 days' duration, while the intercalary year has 390 days. As we have already seen, such a system might suit the time of Solon, if he was also responsible later for introducing the more accurate lunar year of 354 days.

But the 30-day month had a long lifespan. In the late fifth century BC, the medical writer Hippokrates has 'four tens of seven-day periods' (i.e. 280 days) equalling nine months and ten days, which implies 30-day months (Hippokrates, *On Flesh* 19.27-8). Such talk of regular 30-day months, as opposed to the alternating 30-day ('full') and 29-day ('hollow') months, may be thought to be nothing more than loose, popular usage retained beyond its 'use-by date'. Yet it is worth noting that in the public sphere for a considerable period of time wages were based on the notional 30-day month, e.g. pay of two drachmae per day over 13 months would come to 780 drachmae (i.e. 2 x 30 x 13) (*CIA* ii.2, no. 834c, line 60). An anecdote about the mid-fourth-century BC general Memnon of Rhodes, however fictional it may be, confirms the popular expectation that pay would be made on the basis of months of 30 days' duration: as a cost-cutting measure, Memnon ruled that his troops would not be given their rations nor given any pay on the six fictional days added to the year through the addition of a day to each of the 'hollow' months, on the grounds that his men kept no watches, made no marches, and incurred no expenses on those days ('Aristotle', *Economics* 1351b11-15). Of course, disjunctures between accounting methods and calendars are not the preserve of the ancient world, and it may be that it proved easier to have an artificially equal number of days to the month throughout a fiscal period than to adhere slavishly to the civil lunisolar calendar and worry how many 'full' and how many 'hollow' months should be included in the reckoning.

Under the dieteris, over a period of eight solar years four lunar months have been added, of which one must be subtracted to realign the lunar and solar years. This formula perhaps gives a clue to how another system was developed by the end of the sixth century or early fifth century BC, if not earlier (although Herodotos' testimony mentioned above suggests that this new system had not banished the older biennial system later in the fifth century). This is the so-called octaeteris, or eight-year cycle, whose invention is ascribed to Kleostratos by Censorinus (*On the Birthday* 18.5, though he credits other astronomers with such a cycle too). The octaeteris provided for the regular addition of three, not four, 30-day lunar months in three of the eight lunar years, usually in years 3, 5 and 8 of the cycle (Table 1).

If we calculate this out, we find that eight solar years amount to 2,922 days ($365^1/_4$ x 8), while eight lunar years, each of 12 months alternating with 29 and 30 days, together with three extra 30-day months, also add up to 2,922 days (354 x 8 + 90). We may note here, for future reference, that the sum of months in an octaeteris is 99.

Geminos (*Introduction to Astronomy* 8.27-31) makes a similar calculation, and gives the following explanation about the origin of the octaeteris: each lunar year is $11^1/_4$ days behind the solar year; multiplying this difference by eight produces 90, a round number of days, which may be divided into three whole months, which in turn must be added to the eight years of the cycle to bring the lunar calendar back into line with the solar. This looks more like a later justification than the actual origin of the octaeteris.

To comprehend the effects of a wandering lunar calendar, let us take a look at some Greek festivals. The Pythian Games at Delphi were one of the top four panhellenic games festivals – the Olympic Games, the Isthmian Games, and the Nemean Games being the others. In the historical period, the Pythian festival was celebrated every four years on the seventh day of

Month	Y1	Y2	Y3	Y4	Y5	Y6	Y7	Y8
i	30	30	30	30	30	30	30	30
ii	29	29	29	29	29	29	29	29
iii	30	30	30	30	30	30	30	30
iv	29	29	29	29	29	29	29	29
v	30	30	30	30	30	30	30	30
vi	29	29	29	29	29	29	29	29
vii	30	30	30	30	30	30	30	30
viii	29	29	29	29	29	29	29	29
ix	30	30	30	30	30	30	30	30
x	29	29	29	29	29	29	29	29
xi	30	30	30	30	30	30	30	30
xii	29	29	29	29	29	29	29	29
Intercalary			30		30			30

Table 1: The octaeteris. Columns Y1-Y8 are years in the cycle, each comprising months i-xii, alternately of 30 and 29 days, plus an intercalary month of 30 days to be set somewhere in years 3, 5 and 8.

the month Boukatios, the second month in the lunar calendar of Delphi. Originally, however, it may have been an eight-year festival organised according to an octaeteris, to judge from a comment by Censorinus. After mentioning the various figures credited with inventing the octaeteris, Censorinus (*On the Birthday* 18.6) notes that many Greek cults celebrated their festivals at this interval of time, and expressly mentions the Pythian Games as an example of a festival which was once celebrated every eight years. The association of the Pythian Games with the octaeteris in this passage suggests also that the local Delphic calendar was organised according to an eight-year cycle.

If this was so, then the Games would have been celebrated at unequal intervals alternately of 49 and 50 months. The reason for this is that in order to keep the festival in the same lunar month for every celebration, while still keeping the lunar calendar as a whole closely tied to the sun, it would be necessary to intercalate one month in the first four years, and two months in the second four-year period. Therefore, in the first four-year period (a quadriennium), instead of having an interval between festivals of just 48 lunar months (4 x 12), the octaeteris would require the intercalation of one month, bringing the interval to 49. In the second quadriennium, the octaeteris requires the intercalation of two further months, to be added to the intervening 48. If we check Table 1, the Games would be held first in month ii of year 1 of the cycle. Maintaining attachment to month ii, the next celebration would be in year 5, by which time an intercalary month has been added (in year 3). Then the next Games would occur in year 9, by which time two further intercalary months have been added (to years 5 and 8).

The alternating system of celebration after first 49 months and then 50 months, which we have assumed for the Pythian Games, is expressly ascribed by one ancient commentator to the Olympic Games, the most famous of the panhellenic festivals, celebrated at Olympia in Elis. Unfortunately, the evidence we have for the date of the celebration of this major festival is both so scanty and apparently confused that the current consensus among scholars is that all we can state with any degree of certainty is only that the Games were held in 'midsummer' and culminated with a full moon (Samuel 1972: 194). As we shall see, however, some better sense can perhaps be made of the material that survives.

In the third century AD writers make it plain that the Olympic Games took place in the direst heat of summer: Censorinus talks of the Olympic Games being celebrated during 'the days of summer' (*On the Birthday* 21.6), and Aelian (*Varia Historia* 14.18) has a story about the heat endured by spectators at the Games being a worse punishment than being sent to work in the mill. The association with midsummer appears to have been the case long before their time, with a series of celebrations between the early fifth century and the mid-first century BC plausibly dated to the months of July or August, the height of the Greek summer (cf. Samuel 1972: 191).

An ancient marginal comment (a scholion) to Pindar's *Olympian Ode* 3.35 further tells us that the Olympic Games were celebrated at full moon alternately after 49 and 50 months, and that this alternation placed the Games 'now in the month of Apollonios and now in the month of Parthenios, according to the Egyptians in Mesori or Thoth'. The workings of the Egyptian calendar will be explained in detail in Chapter 4, but for the moment let us try to run with the scholiast's thought as best we can. Since the Egyptian months belong to a solar calendar which was fixed to the Roman calendar in 30 BC, so that New Year's Day (1 Thoth) occurred from then on usually on 29 August, we can easily assign the months Mesori and Thoth after 30 BC to the dates 25 July – 23 August and 29 August – 27 September, respectively, presumably also including the intervening five extra ('epagomenal') days of 24-28 August, which brought the total of days in the Egyptian calendar up to 365. Before 30 BC the situation was not only fluid but also such that the dates of Mesori and Thoth would hardly count as the days of even late summer. In 300 BC, for example, the period from the beginning of Mesori to the end of Thoth encompassed 30 September to 3 December, well beyond the summer season. So the ancient commentator's statement about the correspondence of the Olympic Games to these Egyptian months cannot reflect the pre-Roman situation before 30 BC if the Games were associated with summertime.

The problem that has been seen with this apparently neat correspondence between the Elean months of Apollonios and Parthenios, on the one hand, and the Egyptian months of Mesori and Thoth, on the other, is that normally we could not equate a lunar month precisely with a solar one over any length of time, since the lunar month would be more or less mobile in relation to the sun (depending on any system of intercalation). It may be, however, that precise correlation was not what was meant, but rather a broad association with some overlap, maintained through intercalation, as happened during the medieval period, when lunar months were broadly associated with solar months in the various mechanisms for calculating the date of Easter (Wallis 1999: xliii).

Another scholion to an earlier line in the same poem by Pindar (*Olympian Ode* 3.33) is what confuses the subject apparently hopelessly. The Greek is too corrupted now to allow any straightforward translation, but what appears to be intended is that Komarkhos – an historian writing possibly somewhere between about 450 and 250 BC – related that the Olympic period (and therefore also presumably the year) began with the new moon of the local Elean month of 'Thosythias' about the time of the winter solstice; that the first Olympic Games were held in month 8 of the year; and that thereafter the Games were celebrated alternately in the season called *opora* (i.e. late summer), or at the dawn rising of Arcturus. Eight lunar months after the winter solstice in late December would place the Games in the equivalent of mid-August, while the dawn rising of Arcturus occurred in antiquity around mid-September.

While the August–September equivalences provided by this second commentary sit within the July–September period provided by the first scholion, scholars have seen difficulties in trying to match the two sets of information any further. If the first month of the year began at the time of the winter solstice, and if the Games were celebrated at intervals of 49 and then 50 months, the calendar ought to be a lunisolar one regulated by an octaeteris cycle, the sum of whose months, we have seen, is 99. Therefore, it is usually argued, as we saw with the Pythian Games, the Olympic festival should have occurred in the same lunar month carrying the same name, and not alternately in Apollonios and Parthenios (Table 2).

But perhaps there are other explanations. Table 3 follows the Olympic Games through a cycle of two octaeterides, but this time allowing the festival to alternate between the eighth and ninth months in the year, as the scholion suggests. If the scholiast is taken literally, Apollonios, the first Olympian month in which the Games would be celebrated, ought to equate with the earlier of the two Egyptian months, Mesori, while the second Olympian month, Parthenios, should equate with Thoth. Let us allow for this in Table 3, so that month viii is Apollonios and month ix is Parthenios.

Two questions arise. It will be seen that from year 1 to year 17 celebrations of the Games alternate between Apollonios and Parthenios (as the scholiast reports), but not at intervals of 49 and 50 months, rather of the reverse, 50 and 49 months. Did the scholiast simply confuse his numbers and report a 49/50-month alternation, when he should have indicated a 50/49-month alternation?

On the other hand, it would be possible to start an octaeterid cycle at Table 3's year 5, and then to say, quite correctly, that the Games were held alternately every 49 and 50 months. But in this scenario, Parthenios is the first month of celebration, followed by Apollonios. So did the scholiast simply confuse his months?

To achieve the literal 49/50-month alternation, the octaeteris must run differently from that illustrated above for the Pythian Games with intercalations not in years 3, 5 and 8 of the cycle, but in years 1, 4 and 7. This is not necessarily a problem, since different types of octaeterides existed according to Censorinus (*On the Birthday* 18.6). But it is a messy solution, since this second version of the cycle has the disadvantage of starting in such a way that the lunar year leaps ahead of the solar in the very first year, something which Geminos advises should be avoided (*Introduction to Astronomy* 8.32).

In itself, though, the alternation of the months is not necessarily such a problem as it has been made out to be, since it is a result either of a different form of the octaeteris, or of simple confusion over the sum or the names of the alternating months. We can therefore accept the ancient evidence that the Olympic Games were held not only at a full moon in midsummer, but also in an octaeterid system, either in the months Apollonios and Parthenios at alternating intervals of 50 and 49 months, or in the months Parthenios and Apollonios at alternating intervals of 49 and 50 months.

While not perfect – as indeed no system could be, with the incommensurate lunar and solar periods – the octaeteris provided a useful and easily managed means of correlating the lunar festival calendar with the solar one. The variables with which it had to deal were few in number, and it could cope reasonably well with these. The mathematical mechanisms underlying the eight-year cycle have already been demonstrated, but two further points are worth noting about this and other lunisolar cycles in the present context.

Firstly, expressing the calculations above in modern terms has helped to make the time lags between unregulated and regulated calendars meaningful to present-day readers. However, it also obscures the fact that somehow the Greeks had to have become aware of increasingly small fractional differences between their adjusted lunisolar years and the solar year. We do not know how they measured these differences so accurately in the early periods.

Secondly, for all the apparent utility of these cycles for coordinating the year and its mix of seasonal and lunar festivals, there is no incontrovertible evidence that the Greek cities made use of the eight-year or the later cycles to keep their lunar calendars in alignment with the solar year. It is an implication by Censorinus about the Delphic calendar, when he reports on the Pythian Games, but that is all it is. Instead, it looks as though the lunar calendars themselves were, at the basic level of the month, a mixture of empirical observation and schematic calculation, with a variation from one city to another in the timing of the start of the month which modern scholars find uncomfortably large. In addition, these calendars were open to irregular intercalation, and consequent subtraction, especially when the city was under pressure (as in wartime).

We shall examine these issues further in the following chapter.

Month	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**
i	30	30	30	30	30	30	30	30	30
ii	29	29	29	29	29	29	29	29	29
iii	30	30	30	30	30	30	30	30	30
iv	29	29	29	29	29	29	29	29	29
v	30	30	30	30	30	30	30	30	30
vi	29	29	29	29	29	29	29	29	29
vii	30	30	30	30	30	30	30	30	30
viii	**29**	29	29	29	**29**	29	29	29	**29**
ix	30	30	30	30	30	30	30	30	30
x	29	29	29	29	29	29	29	29	29
xi	30	30	30	30	30	30	30	30	30
xii	29	29	29	29	29	29	29	29	29
Intercalary			30		30			30	
Sum of months:					49				50

Table 2: The Olympic Games (version 1). In years 5 and 9 of the cycle, the Games are celebrated in month viii, after intervals of 49 and 50 months.

Month	**Y1**	**Y2**	**Y3**	**Y4**	**Y5**	**Y6**	**Y7**	**Y8**	**Y9**
i	30	30	30	30	30	30	30	30	30
ii	29	29	29	29	29	29	29	29	29
iii	30	30	30	30	30	30	30	30	30
iv	29	29	29	29	29	29	29	29	29
v	30	30	30	30	30	30	30	30	30
vi	29	29	29	29	29	29	29	29	29
vii	30	30	30	30	30	30	30	30	30
viii	**29**	29	29	29	29	29	29	29	**29**
ix	30	30	30	30	**30**	30	30	30	30
x	29	29	29	29	29	29	29	29	29
xi	30	30	30	30	30	30	30	30	30
xii	29	29	29	29	29	29	29	29	29
Intercalary			30		30			30	
Sum of months:					50				49

Month	**Y10**	**Y11**	**Y12**	**Y13**	**Y14**	**Y15**	**Y16**	**Y17**
i	30	30	30	30	30	30	30	30
ii	29	29	29	29	29	29	29	29
iii	30	30	30	30	30	30	30	30
iv	29	29	29	29	29	29	29	29
v	30	30	30	30	30	30	30	30
vi	29	29	29	29	29	29	29	29
vii	30	30	30	30	30	30	30	30
viii	29	29	29	29	29	29	29	**29**
ix	30	30	30	**30**	30	30	30	30
x	29	29	29	29	29	29	29	29
xi	30	30	30	30	30	30	30	30
xii	29	29	29	29	29	29	29	29
Intercalary		30		30			30	
Sum of months:				50				49

Table 3: The Olympic Games (version 2). Month viii is read as Apollonios, ix as Parthenios.

3

Classical Greek Calendars

The calendars of Athens

As with much of our evidence from ancient Greece, what survives from the city-state of Athens is so much greater in quantity than from elsewhere that it tends to dominate our perception of classical Greek culture. In the case of calendars and time-reckoning, we do know that there were differences between the various city-states. The names of the months, for instance, differed markedly from one city to another, and the new year did not necessarily start on the same day in each city. We shall have occasion to discuss these issues in Chapter 4. But the situation in Athens for the classical period does provide something of a benchmark for our understanding of the Greek calendar and allows an insight at the local level into the complexity of the problem of time-reckoning in classical Greece. It is also in classical Athens that we find the further development of a seasonal, and therefore solar, calendar in a world otherwise dominated by lunar and lunisolar calendars.

In fifth-century Athens there were two principal means of time-reckoning in use: the festival calendar and the political calendar. To this a third system may be added, in the form of a seasonal calendar. Let us examine each of these in turn.

The festival calendar

This calendar served to regulate the celebration of religious festivals in Athens. It indicated the specific days of specific months on which the festivals were to be held and sacrifices to be made. In effect, it also provided a framework for the political calendar in the city, since there was a tendency to avoid holding political meetings on religious festival days.

The festival calendar was a lunar calendar. All other Greek states used a lunar calendar as well, but with regional differences in the month-names and in the means of numbering the days. Even though all these calendars were probably based on observation of the first crescent of the new moon to mark the start of each month, this does not necessarily mean that all these calendars must have recognised the same day as the start of a lunar month: observational calendars can lead to a significant degree of variability.

The 12 lunar months in Athens were:

1. Hekatombaion, 2. Metageitnion, 3. Boedromion, 4. Pyanepsion, 5. Maimakterion, 6. Poseideon, 7. Gamelion, 8. Anthesterion, 9. Elaphebolion, 10. Mounichion, 11. Thargelion, 12. Skirophorion.

The names and order are secured by a variety of forms of evidence, epigraphic and literary, as we shall see in the next chapter, when we deal with the issue of reconstructing Greek calendars. The year started on Hekatombaion 1, which occurred on the evening of the first sighting of the new moon's crescent following the summer solstice. Another way of expressing this practice is that the last month of the year included the summer solstice. This perhaps captures practice better, as we shall find when discussing the work of the Athenian Meton, who observed the solstice in mid-Skirophorion. In this regard New Year's Day in Athens parallels the Christian Easter in being a movable feast tied to both lunar and solar phenomena. As we have already seen, the solstices are recognised as early as Hesiod in Greek literature (*Works and Days* 479-80, 564-7, 663-5). They were probably identified then in a rough-and-ready manner from noting the extreme positions of the sun on the horizon through the year.

To maintain alignment with the seasons, a lunar calendar eventually requires the intercalation of a 13th month. In Athens it is usually thought that this was achieved by repeating the sixth month, Poseideon, but the evidence is not so emphatic on this point, and indeed indicates that months 1, 2, 6, 7 and 8 could be repeated for intercalation. For the fifth century BC, the only inscriptional evidence of intercalation in Athens is for month 1, Hekatombaion, to be repeated if necessary (Pritchett 2001: 8). This is allowed for in the so-called First-Fruits Decree of the 430s, which we shall have occasion to investigate further.

Day 1 of the month was called 'new month [day]'. Days 2 to 10 were numbered 'the second [day] of the rising month', 'the third [day] ...' and so on. Days 11 to 20 were simply numbered 'the eleventh [day]' and so on, and marked the period of the full moon. But from day 21 to the end of the month, the days were counted backwards: day 21 was called 'the tenth [day] of the dying [month]', day 22 was called 'the ninth ...', and day 29 was called 'the second ...'. The last day of the month, day 30, was called 'the old and new' to signify the transition from one month to the next. In a month of 29 days rather than 30, it was day 29 which was omitted.

The term 'the old and new' (*hene kai nea*) for the last day of the month reflects the notion that the previous evening's moon was partly the old month's moon coming to its end, and partly the new month's moon coming into existence. Hesiod, though, after calling the last day of the month 'the thirtieth', names the first of the following month 'the old' (*Works and Days* 766, 771), so that the old month has invaded the beginning of the new. The explanation may lie in a popular derivation of the word for 'old' (*hene*) from the word for 'one' (*heis*), which then left the phrase 'and new' (*kai nea*) appearing redundant (West 1978: 351). Solon was reckoned the inventor of the name 'the old and new' for the end of the month (Plutarch, *Solon* 25.3; Diogenes Laertius 1.58). As Plutarch points out, the name captures the intent of Homer's earlier characterisation of the day as the one 'when one month is dying and the next is rising' (*Odyssey* 14.162; 19.307). The attribution to Solon is of some antiquity by Plutarch's time, since Aristophanes alluded to it earlier while having fun with the term in his play *Clouds* (1131-1258). Plato also plays on the name of the day in a spurious etymology for a word for the moon, in his dialogue *Cratylus* (409a-c), which is dramatically set in the same general period as Aristophanes' comedy.

The political calendar

A fundamental component of the Athenian democracy was a Council of 500 (the Boule), comprising 50 citizens drawn by lot annually from each of the city-state's ten tribes. The representatives of each tribe acted as a Standing Committee (prytany) of the Council for a tenth of the year. The year was thus divided into ten 'months' (prytanies). In the political calendar of Athens, dates were counted according to these ten prytanies of each year's Council. One prytany year was distinguished from another by giving each year the name of the official who was secretary of the first prytany, but since there was no sense of an epoch or era from which all political years began, we are reliant on later, more or less continuous, lists of magistrates (archons) to relate any Athenian political year to one in our present system.

This calendar is the one encountered in the prescripts of Athenian inscriptions of the fifth century BC:

> It was resolved by the Boule and the People, Aigeis held the prytany, Neokleides was secretary, Hagnodemos presided, Kallias moved: ...
>
> *IG* I^3.36 (424/3 BC)

In the 420s BC, there is evidence that this political, or bouleutic, year was 365 or 366 days in length (Pritchett 2001: 166, but cf. Meritt 1961: 60-71). As a whole, then, the year appears to be solar in character, since the sum of days matches the solar year fairly well. The ten prytanies may have been divided up as a set of six with 37 days each followed by another four of 36 days each, although other combinations are possible. This assumption is based on some testimony from Athenian financial records, but more particularly on the evidence for the fourth century, by which time the political year had been brought into line with the festival calendar. The Aristotelian *Constitution of Athens* explains the later system:

> Each of the tribes holds the prytany in turn, according to what they obtain by lot, the first four for 36 days each, the last six for 35, for they observe the year according to the moon.
>
> 'Aristotle', *Constitution of Athens* 43.2

This division of the year into four prytanies of 36 days each and six of 35 days each gives a total of 354 days, or 12 lunar months. The author does not say so, but an intercalary year of 384 days, with the additional month/prytany, was probably divided into four months of 39 days followed by six of 38. Nor does he say anything of the process of deciding when an intercalary year would be needed, but in the interests of equality in government the decision would have to be made in the previous year on the basis of some such method as we proposed in the previous chapter.

At 365/6 days in length in the late fifth century, the prytany year was therefore completely independent of the lunar festival calendar of about 354 or 384 days, neither starting nor finishing at the same point as the latter, as various pieces of evidence illustrate. Antiphon's speech, *On the Chorus Boy* (44-5), provides the equation for 419/18 BC Prytany I.36 = Metageitnion 21, and assumes 30 days for Hekatombaion (therefore a 'full' month), all of which leads to the conclusion that Prytany I.1 occurred on Hekatombaion 16, i.e. 15 days after the start of the festival calendar (Meritt 1961: 209). The Aristotelian *Constitution of Athens* (32.1) indicates that the political year 411/10 BC would have started on Skirophorion 14 had not the revolution intervened, and so half a month earlier than the festival year.

How long the two calendars were independent of each other we do not know. Estimates for the date of introduction for the 'solar' bouleutic year range from the late sixth century BC (in the time of Kleisthenes' reforms), through the middle of the fifth century (the time of Ephialtes' reforms), to 432 BC (the time of Meton's invention of the lunisolar cycle) (Rhodes 1972: 224-5, who opts for the mid-fifth century). It was dropped in favour of running both the bouleutic and the festival years as lunar ones, beginning and ending at the same time, from 407 BC (Rhodes 1981: 406-7; Pritchett 2001: 181).

A seasonal calendar

This calendar is of quite a different character from the other two. In fact it represents more a continuation of the farmer's calendar of Hesiod which we studied in the previous chapter than a politically recognised system. It had a broad structure formed initially by the length of the seasonal year, and was subdivided by the solstices and equinoxes, and by the appearance or disappearance on the horizon of a number of fixed stars, which marked the beginning, middle or end of a season. It was therefore a rudimentary solar calendar.

It is a seasonal calendar which Thucydides used occasionally in his history of the Peloponnesian War late in the fifth century BC, as may be illustrated in this famous description of the dating of the Peace of Nikias:

> This treaty was made as winter was ending, in the spring, immediately after the city Dionysia, just ten years and a few days over having elapsed from when the invasion of Attika and the beginning of this war first took place. This must be considered according to the periods of time, and not by trusting the counting of the names everywhere of those who either from holding office or from some other honour act as markers for past events. For accuracy is not possible, where something may have occurred while they were at the beginning of office, or in the middle, or however it happened to be. But by counting according to summers and winters, as this is written, it will be found that, each having the force of a half of a year, there were ten summers and as many winters in this first war. Thucydides 5.20.1-2

Here Thucydides explicitly contrasts the immutable accuracy of the seasonal calendar with the vagaries of political calendars. At other points in his narrative, he uses the first visible dawn rising of the star Arcturus and the winter solstice to signal the time of events (Thucydides 2.78.2; 7.16.2).

In much the same period, Greek medical writers similarly used the equinoxes and the risings and settings of stars to refer to different seasons of the year. For example, one writer tells us:

> Anyone who reflects on and considers these things may foresee most of what will result from the changes. One should especially beware of the greatest changes of the seasons, and neither give medicine willingly, nor cauterise the belly, nor cut until ten or more days have past. These are the greatest and most dangerous, the two solstices, and especially the summer; and the two equinoxes are also so considered, but especially the autumnal. One should also beware of the rising of the stars, especially of the Dog, then of Arcturus, and then the setting of the Pleiades; for illnesses reach their crises especially in those days, and some are fatal, some cease, while all others change to another form and another state. So it is with regard to these matters.
> 'Hippokrates', *On Airs, Waters, and Places* 11

In another medical text, winter is given as lasting from the setting of the Pleiades to the spring equinox, spring from the equinox to the rising of the Pleiades, summer from then until the rising of Arcturus, and autumn from the rising of Arcturus to the setting of the Pleiades ('Hippokrates', *On Regimen* 3.68.2). These divisions create very uneven seasons in themselves, but especially in contrast with the earlier Hesiodic seasons, and the later, Roman versions which we saw briefly in the previous chapter: winter for this doctor lasts about 144 days (about 30 October – 23 March), spring 54 (23 March – 16 May), summer 122 (16 May – 15 September), and autumn 45 days (15 September – 30 October). But such elongated seasons of winter and summer, and correspondingly abbreviated seasons of spring and autumn, are matched by the seasonal chronology adopted by Thucydides for his history. For him, spring and autumn may be subsumed into 'summer', which thus ran from early March probably to early November (Gomme 1956: 705-6).

What creates this imbalance is the unusual use of the equinoctial periods as termini for the changes from one season to the next – the vernal equinox explicitly between spring and summer, and the autumnal implicitly through the almost coincident rising of Arcturus. In this regard the 'Hippokratic' seasons seem to be a mixture of the agricultural seasons which we have encountered since Hesiod, and the astronomical seasons which we shall encounter in more detail with the parapegmas.

Such seasonal subdivisions, in whatever version, were to have a very long history, and become part of the cultural 'baggage' which is taken for granted by both the Greeks and later the Romans and is assumed to need no explanation.

Tampering with the calendar

While the Athenian festival calendar was basically a lunar calendar, it still had to tie in with the solar, seasonal year, at least at the start of the new year. Intercalation made this festival calendar a lunisolar one, akin to the Babylonian type but lacking regularity, it seems, either for the specific month for intercalation, or with regard to a systematic cycle over a number of years.

There is a well-entrenched belief in current scholarship that the Athenian festival calendar suffered in practice from tampering by the city's chief annual officials, the archons, with days haphazardly intercalated or subtracted, and that it was therefore often seriously out of phase with the moon itself. Thucydides' reports on the calendar dates for the one-year armistice between Athens and Sparta in 423 BC, and for the Peace of Nikias in 422/1 BC, are taken to illustrate this presumed lack of synchronicity with the moon. For the one-year armistice, Thucydides relates:

> They agreed in the popular assembly that the armistice be for one year, to begin on that day, the 14th of the month of Elaphebolion. ... The Spartans and their allies concluded a truce on these terms with the Athenians and their allies on the 12th day of the Spartan month Geraistios...
>
> Thucydides 4.118.12-119.1

In this first case, there is a difference of two days between the two dates, with the Athenian month running two days ahead of the Spartan. Two years later, however, the Peace of Nikias is signed, and Thucydides reports:

> In Sparta Pleistolas the ephor begins the treaty, on the 4th day of the waning month of Artemisios [i.e. the 27th], and in Athens the archon Alkaios, on the 6th day of the waning month of Elaphebolion [i.e. the 25th].
>
> Thucydides 5.19

In this case, there is still a difference of two days between the two dates, but this time the Athenian month is running two days behind the Spartan.

Since both states used lunar calendars, these instances would seem to suggest that one calendar, if not both, must have slipped out of alignment with the observed moon. The lack of agreement between the two calendars looks even worse at first, because within two years the Athenian month of Elaphebolion has shifted from being more or less in line with the Spartan Geraistios, to being more or less contemporaneous with the Spartan Artemisios. It is usually assumed, however, that one state or the other had taken the opportunity to intercalate an extra month in this period. Thus, the Athenian Elaphebolion could in fact equate with the Spartan Geraistios in one year, but with Artemisios two years later.

Even allowing for this, we also need to acknowledge that observational calendars introduce a larger degree of variability than has been allowed for in the traditional hypothesis of haphazard intercalation. In Greek calendars the beginning of a lunar month did not occur with the actual astronomical conjunction of sun and moon. That is a moment based upon calculation, since the true new moon is invisible. Instead, it came with the first sighting of the new moon's crescent, in the evening of the day before what we would call day 1 of the new month. This observation could be affected by a variety of factors, including the latitude (important for any comparisons between cities, although within Greece the differences are small), the nature of the observer's horizon (since this event occurs close to sunset), and weather (a seasonal variable). Modern calculation suggests that the new moon's crescent may not have become visible at the latitude of Athens until anywhere between about 18 and 65 hours following conjunction. In comparison, nineteenth-century observations in Athens indicated that the time lag could be between 29 and 63 hours. In other words, first observation of the crescent could take place between one and three days after the true new moon. Since this observation was in the evening, the next day would be the one called day 1 of the new month. Taking this into account and further difficulties in visibility caused by the weather or the horizon, we may need to allow for the new month starting between two and as many as seven days after conjunction. On this basis, the 'slippage' of four days in the two years reported by Thucydides could be due to the variabilities inherent in an observational lunar calendar, rather than to haphazard tampering on the part of the city officials (Dunn 1999).

Given the possibility that systematised intercalation was followed by the Greek cities, such as through an octaeteris as we posited for Delphi and Olympia in Chapter 2, then the observed moon may have been limited to the one at the start of a given year or cycle. Thereafter, the cycle would control the identification of each successive month's first day.

The original observation of the new moon's crescent forms the basis for the counting of days up to day 20 of a month. But how are we to account for the backward count of days 21 to 29? The procedure itself suggests that some form of calculation took place to gauge the end of a month, in addition to any observation. But if a systematic cycle was not used, it remains unknown precisely how any advance calculations of the new moon and the appearance of its crescent would have been made. And, if observation mattered, it is almost inevitable that days in the new month would have to be adjusted by addition or subtraction to realign the month with the moon. It may be that observation of the waning crescent could have been used on day 28 to predict when the new crescent would next be visible. This would allow time for calculating whether day 29 would be needed or not. According to this argument, the timing of the end of the month, like that of its start, would still be based on observation. Yet the difficulty we have noted in observing the new crescent would also lead us to suspect that predicting its appearance from the preceding old crescent would be a chancy affair, especially if weather conditions prevented observation by day 28. Use of a more rigid system, such as an octaeterid cycle, would overcome these perceived difficulties and account for the ability to 'foresee' the next 'new moon'.

All the above would appear to be the case for classical Athens. It has been proposed, however, that alongside the festival calendar there lay another lunar calendar which acted as a regulator for the festival calendar as the latter got seriously out of step with the moon's phases through tampering by the archons (Neugebauer and Pritchett 1947). Certainly this situation applied later in the second century BC, in the Hellenistic period, as inscriptions with multiple dates indicate. Dates in the festival calendar are referred to as being 'according to the archon', while those in the regulatory calendar are termed 'according to the god', meaning, it is assumed, the moon rather than the sun. But there is no similar hard evidence that a regulatory calendar did exist in the fifth and fourth centuries, nor is there a need to assume its existence (Dunn 1999: 229). The closest we get to such, it is worth repeating, is the possible use of a multi-year cycle which regulates the months and years systematically.

Thucydides was not the only person concerned about the variability of calendars in the fifth century. In his play *Clouds*, first produced in 423 BC, Aristophanes has his chorus of Clouds convey a series of complaints from the Moon about the way the Athenians ignore her pivotal role in time-keeping:

> She says that she does other good turns, but that you do not observe the days correctly at all, but make them run up and down, so that she says the gods threaten her each time, whenever they are cheated of a meal and go home not having had the feast according to the reckoning of the days. And then whenever you should be sacrificing, you are torturing and judging, and often when we gods are observing a fast, when we mourn for Memnon or Sarpedon, you are pouring libations and laughing. For this reason Hyperbolos, having been chosen by lot this year to be the sacred remembrancer, then was deprived of his garland by us gods. For this way he will know better that one must observe the days of one's life according to the moon.
>
> Aristophanes, *Clouds* 615-26

The usual interpretation of this complaint about missed fasts and mistimed festivals is that it stems from the lunar festival calendar slipping out of alignment with the moon's true phases, because of haphazard human interference in the calendar. The archons, it is supposed, unsystematically added or subtracted days to the point that festival days were now out of time with the moon. An odd feature of this interpretation, however, is the fact that it ignores the reference earlier in *Clouds* (16-18) to the expectation that when the moon has reached its 'twenties', the month is nearing its end and with it the due date for the interest on loans. So if there was a difference between the phase of the moon and the date of the lunar month, it cannot have been great.

What is more, explicit evidence for tampering with the festival calendar in the fifth century is very limited. There is more later, from the Hellenistic period, which is usually, but probably anachronistically, taken to represent similar practices in earlier times.

One instance of such tampering in the classical period comes not from Athens itself but from another Greek city, Argos. Thucydides mentions a retaliatory raid made by Argos on Epidauros in 419/18 BC. This took place four days before the holy month of Karneios, and 'for the whole time that their expedition lasted they called each day the fourth from the end of the month' (Thucydides 5.54). The expedition must have lasted into the month of Karneios, since Thucydides adds that some of Argos's allies refused to go along and fight with her specifically because it was the holy month. So, unlike the Argives, they apparently were not prepared to cut their religious cloth by adjusting their own calendars to suit a political or military need. This type of tampering was rare, to judge from surviving evidence, and this may be precisely why Thucydides mentions it. When the calendar was adjusted, the evidence indicates that it was due usually to the extreme needs of war, as this case illustrates (Dunn 1999). Or it may have been due to a desire to coordinate activities better with a related religious requirement, which then had to be postponed. We shall meet an instance of this with the First-Fruits Decree.

The Moon's complaint in Aristophanes' play may be interpreted in other ways. The misalignment may be between the festival calendar, which was moon-based, and the political calendar, which had become partially or entirely sun-based. Aristophanes could then be presenting a contemporary reaction to the inability of one calendar to align with the other, for instance with the prytanies of one year running over from one lunar year into the next. Admittedly, at the level of the 'month', alignment between these two calendars had never been an expectation: the prytanies were 10 in number, not 12 or 13; with an ordinary lunar year of 354 days, the prytanies were 35 or 36 days long, rather than 29 or 30, while in the 420s they were probably of 36 or 37 days' length in an ordinary year. Nevertheless, the fact that the political calendar had become, or reverted to being, a lunar one of 354/384 days from 407 BC does suggest that correspondence over the year-length, if not the 'month'-length, was desired in Athens. But it is hard to see how Athens' brief dalliance with a solar-type year for the political calendar could have affected people's expectations for the timing of festivals. If anything, it would affect their expectations of the timing of the prytanies, but Aristophanes does not convey a complaint about that.

Another possibility, more likely, is that the complaint in *Clouds* is illustrative of a shift from the use of the moon as the fundamental overseer of the year, to the sun in some guise. The use of a lunisolar or a seasonal calendar could have had the effect of upsetting people's expectations of the timing of certain festivals, however good the new calendar may have been for improving the associations between festivals, the moon and agricultural milestones. The social effects of such a change could have been similar to the disturbances caused by the introduction of the Gregorian calendar reform in England in 1752. At that time 11 days were summarily cut from the year to bring the English calendar back into line with the sun, and into line with the calendar on much of the European Continent, where the Gregorian reform had been adopted gradually from its first introduction in 1582. While the stories of riots and deaths in England over the introduction of the new calendar are a myth fabricated in the nineteenth century, nevertheless the reform did cause confusion. This was particularly strongly felt in the religious sphere, as major and minor festival days, which were used to signal agricultural activities, were shifted, or not, from the 'Old Style' to the 'New Style' calendar (Poole 1998).

It is reasonable to imagine, therefore, that something similar could have occurred in Athens in the late fifth century BC, if a new lunisolar or even purely solar/seasonal calendar was tried, in place of an irregular lunar or looser lunisolar calendar. The fact that in the 420s BC the political calendar's year was 365 or 366 days in length makes it tempting to think that an official effort had been made to adjust the city's calendars to the solar year. Unfortunately the evidence is too scanty to prove that this was so with the political calendar, but developments in lunisolar cycles and in the seasonal calendar around the same time make it highly suggestive. A move towards using the sun as the gauge of time would also have political overtones, given the association in the Greek mind between the sun and the Persians, their long-standing enemies.

That some link was made between festivals and seasonal calendars is evident from a later remark by Columella, the Roman agricultural writer of the mid-first century AD, who refers explicitly to the star calendars of the Greeks being adapted to public festivals:

> Indeed, in this rural instruction I am now following the calendars of Eudoxos and Meton and the old astronomers, which are adapted to the public sacrifices, because that old view, understood by farmers, is better known, and, on the other hand, the subtlety of Hipparkhos is not necessary, as they say, for the duller learning of rustics.
>
> Columella, *On Agriculture* 9.14.12

We shall encounter an example of just such an adaptation from around 300 BC. But what was possible in classical Athens?

Meton and Euktemon

Columella mentions Meton, an astronomer who worked in Athens exactly at the time we are examining. He appears as a figure of fun in another Aristophanic comedy, *Birds* (992-1019), specifically as a 'geometer', or town planner, but he is better known from other sources for a variety of activities concerning the calendar.

Theophrastos (*On Weather Signs* 4) reports that Phaeinos, a resident foreigner in Athens, observed the solstices there from Mount Lykabettos (a hill 277 m high on the outskirts of ancient Athens), and that under his tutelage Meton devised a cycle of 19 years. Aelian (*Varia Historia* 10.7) tells us that Meton set up pillars (*stelai*) and recorded the solstices, as well as discovering the 19-year cycle. A scholiast on Aratos, *Phainomena* 752, records Meton's discovery of his cycle, and that his followers set up tablets (*pinakes*) in cities dealing with the 19-year cycle, and noting the changes of season 'and many other things suitable to what men need in life'. A number of sources, including Geminos and Ptolemy, quote observations from parapegmas, or star calendars, of Meton and his contemporary, Euktemon. Philochoros (according to a scholion on Aristophanes, *Birds* 997) says that in the archonship of Apseudes, who preceded Pythodoros, Meton erected an instrument called a *heliotropion* in the political assembly area on the Pnyx hill in Athens. Diodoros (12.36.2) tells us that in the archonship of Apseudes Meton made public his 19-year cycle, the beginning of which he fixed on the 13th day of the month Skirophorion. Finally, Ptolemy (*Almagest* 3.1 H205) discusses the observation of the solstice made by Meton and Euktemon – treating the two as collaborators – in the context of the relative accuracy of such observations. He places it in the archonship of Apseudes in Athens, on a date equivalent to the Egyptian 21 Phamenoth, an equation already made much earlier in one of two fragmentary stone parapegmas from Miletos (MI, late second century BC). (Incidentally, Geminos, *Introduction to Astronomy* 8.50, ascribes the 19-year cycle to 'those around Euktemon, Philippos and Kallippos', omitting to mention Meton specifically.)

All of the above activities may be seen as linked together not so much as purely astronomical ventures, but as calendrical enterprises, which depend more or less on knowing the date of the summer solstice, and which, incidentally, may have depended on Babylonian sources. Of particular interest to us in this context is what is said, or may be inferred about, the 19-year cycle and the parapegmas of Meton and Euktemon.

Meton's teacher, Phaeinos, is identified as a resident alien, or metic, of Athens. We do not know where he or his family originally came from, but it has been suggested that he may have been an Asiatic Greek, who helped transmit Babylonian astronomical knowledge to Athens. The type of instrument that Meton set up on the Pnyx – a *heliotropion* – by its very name suggests that it had something to do with the solar tropics (i.e. 'turning points') of the solstices and possibly the equinoxes. Since Greek astronomical observations are regularly horizon-oriented at this time, it is likely to have been a device aligned to an horizon rising point, rather than a sundial casting the shadow of a noon sun.

The archonship of Apseudes occurred in 433/2 BC, and the placement of Meton's and Euktemon's observation of the solstice in the month of Skirophorion, i.e. the last month of the Athenian lunisolar year, situates their activity in mid-432 BC. The date recorded is Skirophorion 13. The Milesian parapegma and Ptolemy equate this with the Egyptian date 21 Phamenoth. This would indicate 22 June in modern terms, which is a day too early for the actual solstice on 23 June. But this is not the only problem in correlation. The Athenian months were supposed to start with the first sighting of the new moon's crescent. If Skirophorion 13 is the same as 22 June, then Skirophorion 1 started after sunset on 9 June, and ran through the daytime of 10 June. This, however, would be more than a day before the true new moon (the morning of 11 June), and three days before its first possible sighting (the evening of 12 June), according to modern calculation. This discrepancy displays an odd disregard for the movement of the moon at the time, in so far as a date in the local lunar calendar is given for the solstice which was at variance with the moon's actual phase. Such variance would not be new in our understanding of the Athenian lunisolar calendar in the fifth century, but it does look odd in a story about precise observational astronomy.

The best solution offered so far appears to lie in undoing the correlation between the Athenian Skirophorion 13 and the Egyptian 21 Phamenoth and hence with 22 June (a correlation that may be the result of faulty calculations in the second century BC), and in accepting the possibility that what Meton and Euktemon did was not to observe the solstice, but to find its position on the horizon on a date which they had already gained from elsewhere. Since only one solstitial observation by Meton and Euktemon is ever mentioned in the sources, it seems unlikely that they actually observed the solstice – something which ought to occupy several observations – so much as marked its position on the horizon for a given date. The date could have been derived (indirectly, presumably) from Babylonia, where mathematical schemes already existed to provide matrices of dates for phenomena such as the solstices, equinoxes, and risings and settings of the star Sirius. According to these, a date equivalent to 23 June is a strong possibility for the date of the summer solstice in 432 BC (Bowen and Goldstein 1988; cf. Jones 2000a: 150-1).

This is not a perfect solution, since the same schemes provide quite different dates for the other three tropical points in the solar year in comparison with what we can recover of Euktemon's dates for these phenomena. Nonetheless, while on this model the Athenian lunar month would still be ahead of the true lunar phase, it would not be by so much, and arguably within the bounds of the margin of error for the type of mixed observational-schematic lunar calendar that the Athenian civil calendar seems to have been: Skirophorion 1 would start with the evening of 10 June and run through 11 June, while the true new moon occurred on the morning of 11 June and would not be visible until the evening of 12 June at the earliest. Furthermore, the date provided for the solstice could then be fed into the more highly developed form of the star calendar – the parapegma – for which Meton and his colleague Euktemon were responsible. As far as we can tell from what survives, Euktemon's parapegma was constructed so as to begin with the occurrence of the summer solstice.

What was publicised in Athens and other Greek cities was apparently much more than just a notice about the solstice. Rather, it looks very much like a combination of what we find in full-blown parapegmas – which not only record the solar phenomena of the solstices and equinoxes, but also provide indications of the weather, which are allied to star phenomena – and of the 19-year cycle which we call 'Metonic'. Let us examine each of these.

The Metonic cycle

When we examined the octaeteris, the correspondence of 2,922 days between eight solar years and the eight-year lunar cycle looked excellent. In fact it ultimately fails, because we have used approximations of both the solar year and the lunar month to arrive at the total. In reality, a solar year consists of 365.24219 days (using modern notation), while one lunar month amounts to an average of 29.53059 days. This means that our calculation for the octaeteris should read 2921.93752 days for eight solar years, and 2923.52841 days for the equivalent 99 lunar months. The difference of just over a day and a half per octaeteris may sound insignificant, but it would mount up over time. After just nine octaeterides, i.e. 72 years, the difference would amount to 14 days. So within a good lifetime, the calendar has slipped the distance between a new moon and a full one, and this could clearly affect the celebration of a festival attached to a particular phase of the moon.

It is this apparently minute difference of a little more than a day and a half per octaeteris that later lunisolar cycles attempted to whittle down. Whether such whittling was done in the service of pure science, as we would understand the term, and specifically of astronomy, or whether it was undertaken in the interests of the religious cults and the state, and therefore had a utilitarian purpose, remains an open question.

The mathematical aim of these lunisolar cycles is always to find as nearly as possible a whole number of lunar months which corresponds to a whole number of solar years. One possible mechanism, which Geminos mentions (*Introduction to Astronomy* 8.36-41) and which naturally follows from the octaeteris, is the 16-year cycle, and its correlate, the 160-year cycle. Obviously, the basic cycle is a simple doubling of the octaeteris, which produces an excess in the lunar calendar of about three days over the solar. If these three days are maintained, they gradually add up, so that over a period of ten such 16-year cycles, i.e. 160 years, the excess has amounted to a whole 30-day month. This month then has to be omitted every 160 years.

There is no evidence that either the 16-year cycle or the 160-year cycle was used publicly. A system intermediate between the 8- and 16-year cycles is an 11-year cycle, with four intercalary months. This may be what Censorinus (*On the Birthday* 18.6-7) has in mind when he talks of a 'dodekaeteris' (literally, a '12-year cycle', but perhaps really an 11-year cycle counting inclusively). It is nicknamed 'the Chaldaean' from its use by the eastern astrologers for horoscopes. If the cycle did no more than add four months over the period, then it does no better than the octaeteris, producing a difference of just over two days between the requisite 136 lunar months and the 11 solar years. Again, and perhaps not surprisingly because of this lack of improvement, we do not find it used.

The next major cycle devised by the Greeks was the 19-year cycle, which is usually attributed to Meton, although his colleague Euktemon and others are credited with it by Geminos. The Babylonians also devised a 19-year lunisolar cycle at some time in the fifth century BC, but we cannot tell whether the Greeks developed it independently of their eastern neighbours, or borrowed it from them.

Geminos (*Introduction to Astronomy* 8.50-8; Heath 1913: 293-4) provides the most useful information about the Greek version of the cycle, although it is unlikely to be an accurate account of the means by which the initial cycle was devised. He tells us that the astronomers of the time of Euktemon, Philippos and Kallippos (thus covering the century from the late fifth century BC) observed that over a period of 19 years there were 6,940 days or 235 months, including seven intercalary months. Of the 235 months, they made 110 'hollow' (i.e. of 29 days each), and the remaining 125 'full' (i.e. of 30 days each). The imbalance between 'full' and 'hollow' months means that they cannot alternate throughout the cycle, but sometimes there would be two 'full' months in succession. Geminos then explains how the devisers of the cycle arrived at 110 'hollow' months: all 235 months are initially assigned 30 days each, which gives a total of 7,050 days to the 19-year period. This overshoots the sum of 6,940 days of 235 lunar months by 110 days, so 110 months must each have one day omitted through the cycle, and they become 29-day months. To ensure as even a distribution of this omission as possible, we are informed that the Greeks divided the 6,940 days by 110 to get a quotient of 63, so that the 110 days were removed at intervals of 63 days.

If the 19-year cycle is left to run unchanged, in four cycles (76 years) it gains a day against a solar calendar of $365^1/_4$ days: 6,940 x 4 = 27,760 days, whereas $365^1/_4$ x 76 = 27,759 days. Geminos (8.59-60) tells us that Kallippos therefore refined the 19-year cycle by running it over four periods and removing the extra day that had accumulated over that period (presumably by making a 'full' month 'hollow'). The first Metonic cycle began in 432 BC, while the first Kallippic cycle began in 330 BC.

Scholars are divided as to whether to take Geminos seriously about the awkward omission of days in Meton's cycle, and even about his account of the cycle as a whole (e.g. Neugebauer 1975: 617-18 did not believe in the application of the omission procedure; Toomer 1984: 12-13 thinks Geminos' description is 'fiction', and is pessimistic about all attempts to reconstruct the cycle). Those who do accept the testimony are agreed that the omitted days should be every 64th one, rather than every 63rd (the latter does not achieve the correct sums) (Evans 1998: 186). They have also interpreted Diodoros' account (12.36.2) of the cycle's invention as meaning that the epoch for the start of the cycle was the summer solstice in 432 BC. Thus, the cycle starts on that very day, which was dated to Skirophorion 13 according to a lunar month which, it is further believed, was calculated rather than observed by Meton, and yet which utilised the Athenian calendar's month-names (to the potential confusion of anyone outside Meton's circle who heard of the cycle). Each successive year of the cycle is assumed to be a solar year, on the grounds that Meton (and Euktemon) published in concert with the cycle a parapegma, which is solar-based. Each year in the cycle begins with the next summer solstice.

From eclipse dates for the years 383-382 BC supplied by Ptolemy (*Almagest* 4.11, H340-3; Toomer 1984: 211-13), it has been deduced that four years in the first 11 of the 19-year cycle were intercalary, while year 12 was not, and year 13 was. The view – among those who have believed that this exercise is worth undertaking at all – is that the intercalary months belong to years 2 (or 3), 5, 8, 10 (or 11), 13, 16 and 18 (or 19) (Fotheringham 1924; van der Waerden 1960). From the same evidence in Ptolemy, the month Poseideon has been identified as the month to be doubled for intercalation in year 13; while Skirophorion is intercalated in year 16 on the basis of astronomical observations made by Timocharis between 295 and 283 BC and recorded by Ptolemy (*Almagest* 7.3, H25-32, Toomer 1984: 334-7).

All of this needs to be treated with a great deal of caution, since none of it comes directly from the fifth century BC, and the evidence for the workings and application of the cycle is so thin. To suggest anything more than the above will seem foolhardy, but we may find some extra assistance in understanding and interpreting the evidence from another time when the cycle was used to help fix a particular date, that of the pivotal Christian festival of Easter. Medieval computists based their Easter Tables for this calculation on a combination of lunar and solar phenomena, some of which were provided by a lunisolar cycle. There were several cycles in use at different times and places, including the octaeteris; its relative, the 112-year cycle; the 19-year Metonic cycle; the 84-year cycle, which combines four 19-year cycles and an octaeteris at its end; and the 95-year cycle, which represents five Metonic cycles. Each cycle began with the age of the moon on a given date in the solar calendar. The solar date varied according to tradition, e.g. 1 January in Rome but 22 March in Alexandria. In the first year of the cycle, the moon should preferably be new on this epochal date, and in each succeeding year it would be 11 days older on that same solar date, thus representing the difference between the lunar and solar years. This essential datum was called the lunar epact. In itself it did not indicate the date of Easter Sunday, which was to fall after the first full moon after the spring equinox (to put it crudely), but rather the epact was a crucial step towards fixing that date.

If we regard the original Metonic cycle in a similar light, then we find that it begins with a solar phenomenon (the summer solstice) which is dated according to a lunar calendar (Skirophorion 13). This lunar date provides us with an age for the moon – nominally 13 days old – at the time of the epochal solstice in 432 BC. New Year's Day, Hekatombaion 1, should then follow Skirophorion 30, 18 days later (assuming the month is 'full'). Whether Skirophorion 13 is an official civil date or just Meton's own calculation, we do not know, but simplicity would seem to suggest, contrary to current belief, that we initially allow it to correspond to the local civil date – still a calculated or schematic date, rather than an observed one, since Skirophorion 1 would occur just ahead of the new moon (true and observed). We then treat the epochal summer solstice on Skirophorion 13 in 432 BC as the date from which the lunisolar New Year's Day (like the lunisolar Easter) must be reckoned. What the cycle must then do is tell the user that by the time of the next solstice the moon will be 11 days older, and therefore that the lunar date will 11 days more advanced, i.e. Skirophorion 24. New Year's Day, Hekatombaion 1, will therefore be seven days later.

How the cycle could do this is not clear from the description by Geminos, but the fact that Meton and Euktemon established parapegmas, and the story that Meton's followers set up tablets (*pinakes*) in cities dealing with the 19-year cycle and noting the changes of season 'and many other things suitable to what men need in life', together suggest that the 19-year cycle was attached somehow to a parapegma (cf. Jones 2000a: 156-7). To judge from the fragmentary remains of later parapegmas alone, the resultant 'tablets' set up by Meton's followers around the Greek world must have been physically very imposing and therefore very influential on the populace. They do not sound like the kind of object made just to assist specialist astronomers, but more like instruments to be used in the public sphere.

A parapegma keeps track of the solar year via various star phases, and so it presumably provided the means to enable users of Meton's cycle to keep track of the date of the solstice. Let us examine what we know of Meton's and Euktemon's parapegmas.

The parapegma

As it has survived archaeologically, the parapegma consists of inscribed stone tablets (painted wood also may have been used, but has not survived), with data arranged in a number of columns. A peg would be moved manually from one day to the next through the year, through a series of holes, alongside some of which are chiselled the star observations or weather predictions for the day. Days lacking observations are marked simply by empty peg-holes, set one after another in a line if necessary.

The following excerpt from the earlier of the two parapegmas from Miletos (MI, late second century BC) provides a useful guide to the type. The mark **O** here indicates peg-holes in the original; words in angled brackets have been restored; modern constellation equivalents are in square brackets; see Hannah 2001: 76-9 for star charts illustrating each entry:

O The Sun in the Water-Pourer [Aquarius]
O <The Lion> [Leo] begins setting in the morning and the Lyre [Lyra] sets
OO
O The Bird [Cygnus] begins setting at nightfall
OOOOOOOOO
O Andromeda [Andromeda] begins to rise at dawn
OO
O The Water-Pourer [Aquarius] is in the middle of its rising
O The Horse [Pegasus] begins to rise in the morning
O
O The whole Centaur [Centaurus] sets in the morning
O The whole Hydra [Hydra] sets in the morning
O The Great Fish [Pisces] begins to set in the evening
O The Arrow [Sagitta] sets, a season of continuous west winds
OOOO
O The whole Bird [Cygnus] sets in the evening
O <Arktouros [Arcturus] rises> in the evening

After Diels and Rehm 1904: 104

Meton's parapegma is the next stage of development after Hesiod's relatively rudimentary, but seemingly effective, calendar for farmers and sailors. Nothing survives of it archaeologically, and evidence for it in later literature is limited to a handful of observations, mainly predictions of weather changes. But for the parapegma of his contemporary, Euktemon, there is a good deal of evidence from later literature and inscriptions, for it was one of the most popular star calendars used in later periods. It survives organised certainly in two distinct ways, with the star observations arranged under the 12 signs of the zodiac or attached to a civil calendar, and probably in a third form, with the observations organised according to the number of days between observations. Euktemon arguably used only this last method, of day-counts between his sightings, then at some later stage – in the fourth century or even later – this parapegma was organised according to the zodiacal months (Hannah 2002).

The most extensive quotation from Euktemon's calendar appears in the collection of parapegmas attached to the *Introduction to Astronomy* of Geminos. He structures the observations from Euktemon's parapegma according to the artificial signs of the zodiac (i.e. under 'solar' months, as Censorinus defines them: *On the Birthday* 22.1-2), recording that on the *n*th day of the sun's passage through a given zodiacal sign, certain stars rose or set at dawn or dusk, and foreshadowed certain weather conditions. We can extract from this compilation the observations associated only with Euktemon, and so gain a 'text'.

For instance, this 'text' reads as follows for the zodiacal month of Leo:

> The sun passes through Leo in 31 days.
> On the 1st day, the Dog [Sirius] is visible, and the stifling heat begins; signs of weather.
> On the 14th, the heat is at its greatest.
> On the 17th, the Lyre [Lyra] sets; and it also rains; and the Etesian winds stop; and the Horse [Pegasus] rises.
>
> After Aujac 1975: 99

The whole sequence of observations in Geminos starts with the first day of the sun's entry into Cancer, a day which also marked the summer solstice. Because of this, we can assign nominal modern (Gregorian) calendar dates for Geminos' compiled observations and therefore to Euktemon's own. Thus, the 'month' of Leo just quoted could be assigned the following dates:

23 July	On the 1st day, the Dog [Sirius] is visible, and the stifling heat begins; signs of weather.
5 August	On the 14th, the heat is at its greatest.
8 August	On the 17th, the Lyre [Lyra] sets; and it also rains; and the Etesian winds stop; and the Horse [Pegasus] rises.

Whenever it was that Euktemon's observations were eventually structured into zodiacal months, this later version of his parapegma would represent a significant transition from the older day-count star calendar to a new type of calendar whose focus was more the sun's visible annual path through the zodiac. Even the day-count version, which was probably the original form of Euktemon's parapegma, displays an increased attention to the sun over the earlier Hesiodic type, in its notice of not only the solstices but also the equinoxes. Calendars so tied to the apparent movement of the sun would be better able to keep pace with the seasons through the years and would represent a major step forward in the regulation of those human affairs which were tied to the seasons.

Yet whereas Hesiod's calendar tied stellar phenomena explicitly to agricultural activities, Euktemon's tied them, if to anything, apparently only to weather forecasts. Agricultural and maritime activities could be run by it, but they are not explicitly stated. Indeed, a parapegma set up in a city like Athens seems of little immediate use either to farmers out in the countryside or to sailors out at sea. On the surface, Euktemon's star calendar seems as ignorant of farming as Iskhomakhos, the contemporary fictional farmer in Xenophon's *On Household Management*, is unaware of the stars.

The absence of an overtly stated practical purpose gives Euktemon's calendar the appearance of a disinterested, 'scientific' construct, created for its own intrinsic interest. But was it? The very choice of stars in the calendar argues against this interpretation. The traditional core of observed stars within and outside the zodiacal belt from Hesiod's time was extended by Euktemon by far more from outside the zodiac than from within it. If anything, the Milky Way, rather than the ecliptic, appears to be the reference line used by Euktemon for his additional observations. It was not his intention to create a calendar with the sole scientific purpose of keeping track of the sun's apparent movement in the sky, since otherwise we would expect a list of stars which were more closely connected with the sun, as indeed occurs a century later in the parapegma of the Greek astronomer Kallippos, who records the rising and setting only of zodiacal stars.

One characteristic of the classical parapegma, just mentioned, is its devotion to signalling changes in the weather, a feature which it has in common with the Near Eastern parallels (or prototypes) for this form of calendar. This is as close as it gets to the type of star calendar which we saw Hesiod using, where weather and other natural phenomena are explicitly linked to directions on the appropriate agricultural activities through the year.

Another characteristic of the parapegma is its inclusion of the four fixed solar time points: not only the solstices, which Hesiod had provided, but also the equinoxes. These, allied with an increased number of star observations, invest the parapegma with the facility to measure time in the broad terms that suit agricultural activities, as opposed to simply marking its passage through the year.

The fact that later stone parapegmas have been found within Greek cities, such as Athens and Miletos, has led to the suggestion that the local civil calendar or the religious festival calendar could be aligned with the stellar and solar phenomena of the parapegma (Pritchett and van der

Waerden 1961: 40). In his *Republic*, set dramatically in the 420s, Plato promotes the notion that the ideal political leader should know as much about the seasonal calendar as the farmer and sailor: '... being well versed in the seasons and months and years belongs not only to farming and sailing, but also no less to generalship', says Glaukon (*Republic* VII.527d.2-4). This may be idealised fiction, but as far as the festival calendar is concerned we have already seen that the Roman agricultural writer Columella refers explicitly to the star calendars of Meton and Eudoxos being adapted to public festivals (*On Agriculture* 9.14.12).

An example of such a festival-cum-star calendar has actually survived in a papyrus from Hibeh in Egypt, dating to about 300 BC. This is a festival calendar for the temple of Neith at Sais, incorporating 'state' and local festivals alongside astronomical and meteorological observations. The astronomical observations appear to be derived from the fourth-century Greek parapegma of Eudoxos, who was a pupil of Plato and worked a generation after Euktemon. These have then been structured within a scheme of 12 zodiacal months, a scheme which itself has been further worked into the native Egyptian solar calendar. To give a brief example, here is the Egyptian month of Tybi (approximately our March):

Tybi [5]	[The sun is] in Aries.
20	Spring equinox, the night is 12 hours and the day is 12 hours, and the feast of Phitorois.
27	Pleiades set in the evening, the night is $11^{38}/_{45}$ hours, the day $12^{7}/_{45}$.

P. Hibeh 27.62-6; cf. Grenfell and Hunt 1906: 152

In the surviving Greek parapegmas farmers are not explicitly addressed through reference to agricultural activity. Nevertheless, Columella's notice suggests that farmers were familiar with such a calendar. But he also implies that another group was interested in such calendars, a group further up the agricultural chain, who still relied on the seasonal cycle but less directly as a basis for their own activities. As the Hibeh papyrus also hints, these 'others' were the religious authorities, whose purpose would have been to keep the festivals of the gods in time with the agricultural seasons to which the cults were attached. For these officials, knowledge of the length of the solar year would have been important, so that religious festivals centring on agricultural events, such as sowing and harvesting, could be held at the appropriate, seasonal time.

A harvest festival

So, to take this line of argument further, what advantage would the Metonic cycle and the parapegma of Euktemon offer to farmers and priestly officials of late fifth-century Athens?

Let us take a look at what the star calendars provide for the time of the annual grain harvest. Hesiod does not describe events in strict succession, but nevertheless we can reconstruct his timetable without too much trouble. He exhorts his farmer to start the harvest at the rising of the Pleiades, after their 40-day period of invisibility (*Works and Days* 383-7, 571-3). This is a reference to the morning rise of these stars, which took place around 13 May in Hesiod's time. Harvesting presumably continues until the time for threshing the grain, an activity signalled by the dawn appearance of Orion (*Works and Days* 597-600), which can be placed at about the time of the summer solstice, from 23 June onwards. All hard work must be finished by the time Sirius appears and brings with it the worst heat of summer (*Works and Days* 587). The dawn appearance of Sirius can be put at 22 July, so threshing should be completed by the third week of July.

In Euktemon's parapegma, this is a particularly busy time with frequent, closely spaced observations. These reiterate Hesiod's observations, but also add substantially to them. If we translate the zodiacal dates given by Geminos into modern (Gregorian) dates, and do not concern ourselves about the actual dates of occurrence for the phenomena (there can be several days' difference between the parapegma's ideal and reality), then Euktemon has:

29 April	Goat [Capella] rises at dawn; fair weather; it rains with southern water.
4 May	Pleiades rise; beginning of summer, and there is sign of weather.
22 May	Eagle [Aquila] rises in the evening.
23 May	Arcturus sets at dawn; there is sign of weather; ... Hyades rise at dawn; there is sign of weather.
15 June	Shoulder of Orion rises.
5 July	All of Orion rises.
19 July	Dog [Sirius] rises.
20 July	Eagle [Aquila] sets at dawn; storm at sea comes on.
23 July	Dog [Sirius] is visible, and stifling heat comes on; there are signs of weather.
5 August	Stifling heat is greatest.
8 August	Lyre [Lyra] sets; and it still rains; and Etesian winds stop; and Horse [Pegasus] rises.

For Hesiod the time for harvesting is signalled only by the dawn rising of the Pleiades (13 May), the first star observation since the evening setting of these same stars '40 nights and days' earlier (in late March). This is a considerable gap between observations, and Euktemon overcomes it by adding considerably to the list. He has been watching the evening setting not only of the Pleiades, but also of the Hyades and Sirius in succession through the month preceding the reappearance of the Pleiades.

More than this, he has also managed the shift from evening to dawn observations just ahead of the rising of the Pleiades, by watching for the rising of Capella at dawn (in late April).

Hesiod signals the time for threshing the grain harvest with a single dawn rising of Orion. Euktemon, on the other hand, now provides two dawn observations before the rise of Orion – the setting of Arcturus and the rise of the Hyades (23 May), the latter by its position forewarning the observer of the coming rising of Orion. Orion itself provides two readings, rather then Hesiod's one: the shoulder (Betelgeuse, α Orionis, 15 June), and then the whole of the constellation 20 days later (Rigel, β Orionis, or Saiph, κ Orionis, 5 July). This last observation may do double duty, providing both a final signal that threshing should be underway and also a warning of the forthcoming rising of the baleful Dog-star, Sirius, which indicates the height of summer heat and the time when vigorous physical activity like threshing and winnowing should come to a halt. Euktemon therefore offers a close-set sequence of observations which acts as a very generous safety net of over 50 days for the period of threshing.

This activity continues for Hesiod until the dawn rising of Sirius, when it is too hot to work. For Euktemon the period of greatest heat extends for two weeks, from the appearance of Sirius (23 July) until 5 August. (For comparison, in modern Greece the winnowing period could last into the first week of August, when, coincidentally, the rising of Sirius also now occurred (8 August).) Hesiod advises that the winnowing should be done 'in a place where there is a good strong wind' (*Works and Days* 599), while, closer to the time of Euktemon, Xenophon (*On Household Management* 18) describes with some humour the practicalities of reaping, threshing and winnowing grain in, and against, the wind. Euktemon advises that the Etesian winds will cease blowing at the time of the dawn setting of the Lyre and evening rising of the Horse. This would occur on 8 August, just a few days after the period of greatest heat in summer. So if the heat does not stop the farmers winnowing, the cessation of the necessary winds soon will.

The Etesian winds cease at the midway point between the summer solstice and the autumn equinox. In other cultures such a midpoint between two seasonal tropics is recognised as one of the four 'mid-quarter' days. These can serve as markers for agricultural activity – such is still the case, for instance, in Scotland (Trevarthen 2000: 301) – and hence for the agricultural seasons themselves. If we earlier found a hint of such 'mid-quarter' days in Hesiod, it grows firmer with Euktemon's parapegma, not least because of the explicit notice of the equinoxes in addition to the solstices (assuming Euktemon meant to indicate the summer solstice, which is oddly missing in Geminos' version). In the case of the cessation of the Etesian winds, the observation signals the end of the period of activity to do with the cereal harvest, and the need to turn one's attention to autumnal matters such as the grape harvest.

So we can see how Euktemon's parapegma could have provided a greatly enhanced calendar to farmers than the balder almanac of Hesiod. It would probably be foolish, however, to grant the parapegma any more authority among the farming fraternity than that of a 'handy table' of useful dates, and wiser to take our lead from Xenophon's fictional farmer, Iskhomakhos, who would take each year as it comes, now planting early, now late, or now in mid-season, depending on circumstances (*On Household Management* 17.4-6). But let us now look at any related religious festival activity at this time in Athenian territory.

Over the period equivalent to our May-to-August, one particular festival of agricultural significance calls for attention: the Eleusinia. It is connected with the cult of the goddesses Demeter and Persephone (Kore), best known as the foci of the Eleusinian Mysteries which took place later in the autumn in the month of Boedromion. (Of another festival in honour of Demeter and Kore, the Skira, celebrated on Skirophorion 12, so near the middle of the last month in the Athenian calendar, and near the time of the summer solstice, too little is known or can be gleaned from the scanty sources about its nature to be useful for the present discussion.)

The Eleusinia took up four successive days within the middle of the second month of the year, Metageitnion, somewhere between days 13 and 20 (Mikalson 1975: 46). This would place the festival in the first half of August at the earliest. It was held annually, but every second year it became a games festival, with greater celebration every fourth, the prize consisting of grain from the Rarian Field, which, according to myth, was the field where grain was first cultivated (Clinton 1979: 9-12). The Eleusinia have been seen as the most likely destination of the offerings of first fruits of the cereal crop from Attika and elsewhere in the Greek world (Meiggs and Lewis 1969: 221; Dunn 1999: 221, 230). These offerings were made partly to fulfil ancestral custom, and partly to respond to the so-called First-Fruits Decree, which was passed in Athens probably in the 430s BC.

This decree called for the collection, in the names of the two goddesses of Eleusis (Demeter and Kore), of first fruits of barley and wheat from Athens and her allies, their storage at Eleusis, and the use of the proceeds from the sale of the grain for sacrifice and dedications (*IG* I^3 78; Cavanaugh 1996). The decree does not specify the time nor occasion for the delivery of these first fruits, nor the form they are to be in. But the fact that another form of tribute – in money or ships – was expected to be paid to Athens by her allies at the time of a state festival, the City Dionysia in mid-Elaphebolion (Isokrates, *On the Peace* 82), suggests that a formal occasion for receipt of the first fruits is worth considering. The Eleusinia would be the festival nearest in time to the grain harvest.

The only problem with the festival in this regard is that its timing within the year may seem rather late for first fruits. By way of comparison, in the Near East the Jews were required to offer first fruits of the barley harvest, in the form of a sheaf, at the feast of Passover (so in late March to mid-April), and then of the more slowly maturing wheat harvest at the Feast of Weeks, i.e. Pentecost, seven weeks later (in May to June) (*Leviticus* 23:10-20; Rigsby 1992). It may be recalled also that Aristophanes (*Birds* 505-6) recorded the call of the cuckoo as a signal among the Egyptians and Phoenicians to set to harvesting barley and wheat, and this would belong to the time from late March onwards. As we have seen, the harvest period in Greece runs somewhat later, from mid-May to July. The star calendars do not tell us so, but we are probably dealing here with the period in which both barley and wheat would be reaped. In modern, pre-technological Greece, barley was harvested and threshed in the third and fourth weeks of June, while wheat was harvested and threshed from the first week of July to the end of the first week of August (du Boulay 1974: 275-6). This matches what we can reconstruct for classical Greece. We have from Theophrastos (*Enquiry into Plants* 8.2.6-7) the information that barley takes seven to eight months to ripen, and wheat even longer, with both crops maturing about 40 days after flowering. We can combine this with the evidence for the timing of religious festivals celebrating the cycle of ploughing/sowing (Proerosia), green shoots (Chloia) and flowering (Antheia) of the grain crop. A sacrificial calendar from Thorikos records the Proerosia in Boedromion, the Chloia six months later in Elaphebolion, and the Antheia in the following month, Mounichion (Parker 1987). This leaves us expecting the harvest to begin in Skirophorion, the month of the summer solstice in June.

Whichever way we look at it, though, mid-Metageitnion and the Eleusinia would appear to lie too late in the harvesting cycle for plain sheaves from the first reaping to be what was wanted at Eleusis. Instead, it would be threshed grain that would suit the timing better, particularly if we consider the issue of the time of delivery.

The First-Fruits Decree allows for the month of Hekatombaion to be repeated as an intercalary month in the following year (nothing is said for subsequent years). Interestingly, this decree is the only surviving inscriptional evidence of an intercalary month in fifth-century Athens, which suggests that some importance is attached to what is going on. The usual interpretation for this uncommon regulation is that the additional month was to give longer notice of the date at which first fruits must be delivered at Eleusis for the Eleusinia (Dunn 1999: 221, 230). But in addition what the intercalation may signal is that the month of Hekatombaion itself –

the first month, after all, of the Athenian year – was considered the appropriate month in which *first* fruits should start to be delivered to Eleusis. This is the time not only of the solstice but also of the period for threshing grain, signalled by the dawn rising of Orion. The festival of the Eleusinia, in the middle of the second month of the year, would then provide a suitably timed and relevant opportunity to celebrate the offerings of first fruits from the Greek world. In somewhat similar fashion, the Jewish festival of Passover is celebrated in the first month of the year, Nissan, and this is the month in which first fruits of the barley harvest are to be offered; while first fruits of wheat are to be offered at Pentecost, in the third month. And, according to the Talmud, one of the three criteria for intercalation in the Jewish lunar calendar was the ripening of crops, so that a 13th month would be added if the barley was not ripe enough in time for Passover, or the first fruits in time for Pentecost (Herr 1976: 853).

Two further reasons for repeating Hekatombaion then look likely. One would be climatic: if the growing season for the grain crops had been unusually cold, then the harvest could be delayed beyond what the calendar in its normal running might permit, so an extra month could be useful for farmers.

The other reason is calendaric: the lawmakers may have wanted to provide leeway to allow for the significant variability in the timing of the start of the year in the Athenian calendar, which could see the demand for the first fruits coming too early in the harvesting process. Let us recall that the date of Hekatombaion 1 falls on the evening of the first sighting of the new moon's crescent after the summer solstice. Like present-day Easter, this Athenian New Year's Day necessarily wandered up and down the calendar within a range of dates from the solstice to a month or so later in late July. Too early a start to the year following the decree could mean too tight a period for the reception of first fruits, particularly from overseas. So the availability of an intercalary month right at the start of the Athenian year would be a helpful cushion.

Clearly, being able to know when the next Hekatombaion would fall, and hence when the Eleusinia would next be celebrated, would be of great benefit to the officials (*hieropoioi*) charged with administering the collection of the first fruits. An unregulated lunar calendar or a dieteris would not help at all, while a relatively loose lunisolar calendar, such as an octaeteris, would offer some hope of maintaining the association with a particular lunar month, but would be incapable of ensuring that that month always kept its link with the stars or the solstice. To achieve this last connection as well as the association with the lunar month and even the phase of the moon (if the Eleusinia's occupation of mid-month, the period of the full moon, was considered necessary, as it was with the Eleusinian Mysteries), the 19-year cycle offered the best opportunity antiquity could offer to ensure the proper timing on a regular basis. Of course, something looser than a rigid mathematical formula might be possible, so long as the authorities could foresee a forthcoming lack of synchronicity with the solstice or the moon and adjust the calendar more or less haphazardly to suit. But some more refined regulatory algorithm would be necessary if the associations with both the sun and the moon were always to be kept.

Complicated though any system may seem to be in order to resolve these lunar and solar requirements, it would still be far less complex than those which impinged later on the calculation (*computus*) of the crucial Christian festival of Easter. Calculating the date of the Pythian Games is child's play in comparison, since the variables are so few in number – association with one particular lunar month – and the octaeteris was sufficient for this calculation. The Olympic Games added a solar requirement to a lunar, with the celebration taking place not only at a full moon but in midsummer too. Again, an octaeteris could cope, it seems, so long as alternate lunar months were permitted, and midsummer was generously interpreted. But agricultural festivals, like the Eleusinia in the middle of the month of Metageitnion, upped the ante considerably by fixing the celebration near to or at a full moon of a particular lunar month at a particular time of the seasonal/solar year. This is moving close to the complexity of the later Easter *computus*. A more refined tool than the octaeteris is needed, if random, year-by-year intercalations are to be avoided. The 19-year Metonic cycle, with a regulatory parapegma to ensure the link to the epochal summer solstice, is such a tool.

In this way, the Athenian situation resembles facets of another society with a strong agricultural and religious focus: that of medieval Europe. The annual fairs brought traders together from far and wide on fixed dates, which were sometimes associated with the feast day of the patron saint of the religious establishment which oversaw the festival and took its tolls. This coordination of a widespread and disparate congregation of people could take place only if there was an ability to compute the solar year accurately (Goody 1968: 35). The Easter *computus*, although much more complex, also relied on astronomical indicators of the appropriate time of the year for the forthcoming celebration of the festival of Easter, which was meant to be held on the same day across Christendom. Advance notice of its date was required as early as the winter solstice, so that it could be announced at the feast of the Epiphany, and so that preparations for the 40-day period of Lent leading up to Easter could be made (McCluskey 1998: 77-96).

The period of Meton certainly witnessed dissatisfaction with traditional methods of time-reckoning, as we have seen from Thucydides and Aristophanes. It is presently thought unlikely that the 19-year Metonic cycle was introduced in the late fifth century to regulate the Athenian civil years, though a few have thought so. Rather, it is regarded as a tool developed by astronomers for astronomers, primarily to date their observations by more accurately. Yet this belief rests on an assumption of the notion of science for science's sake existing in late fifth-century Athens. Such is barely the case even in the more individualistic Hellenistic period, when advances in astronomy were as likely to be brought to the aid of the burgeoning practice of astrology as to any intrinsically scientific endeavour. Back in classical Athens, both Aristophanes and Plato display a close familiarity with a utilitarian basis for scientific advance that should warn us to beware of 'pure', unmediated intentions in the cause of science. It is worth recalling that Meton and Euktemon conducted their solstitial research not in the quiet grove of Akademe, but in the public assembly area of the Pnyx hill.

The advances in calendar construction made by Meton and Euktemon might have had even broader, more political significance. The calendar's ability to offer a more regular progression within the year and from one year to the next could have been extremely attractive to the political leaders of Athens in the later fifth century as a means of coordinating and even centralising political and religious activities across the Athenian world. In this period the city tried to increase its control over its allies not only through standardised coinage, weights and measures (Fornara 1977: 102-4 no. 97), but also through centralised cults and festivals (Fehr 1980). The First-Fruits Decree appears to be part of this process, and we have seen how the Metonic cycle and the parapegma might have supported such ventures.

It is true that there is no evidence for the allies adopting the names of the Athenian months, nor even the same New Year's Day (as we shall soon see, Athens' ally Delos is a striking example of nonconformity). But in this respect the situation is not very different from what pertains later in the Greek East, when the Roman Julian solar calendar is introduced and imposed over Greek lunar or lunisolar calendars. Then, the Roman month-names are not adopted, nor is 1 January necessarily adopted as New Year's Day. In both the earlier Athenian and the later Roman situations, what is provided by the Metonic cycle or the Julian calendar is a framework, by which other local calendars could be coordinated more closely with the seasonal and solar cycle, and with the parent community's religious or political year.

Given this scenario, it is possible also to see not only why a refined lunisolar, or even purely solar, calendar might have been introduced in Athens, but also why it did not last. This calendar was a tool of the Athenian state, and one aim of introducing it may have been to centralise control over the political and religious affairs of the allied states under Athenian hegemony. Once that hegemony was weakened and then broken at the end of the fifth century, the calendar it had generated would have died too. The yoking of both the bouleutic and the festival calendars to the moon from 407 BC predates Athens' final defeat in the Peloponnesian War by just a couple of years. The time would no longer have been propitious for a calendar which followed the sun.

4

Synchronisms

Reconstructing Greek calendars

The fourth century BC was a time for the rise and fall of city-states and leagues on the Greek mainland – from Athens to Sparta to Thebes – until the royal power of Macedon, in the person first of Philip II and then of his son, Alexander III (the Great), finally inserted itself permanently on the Greek political landscape and brought the city-states under its sway. No sooner was this done than Philip directed his war machine, now a combined force of Macedonians, Greeks and foreign allies, against the Persian Empire. With Philip's assassination in 336 BC it was left to his young son to take war to the east, and to gain such extraordinary victories and so expand Macedonian-Greek territory, that subsequent generals and kings for centuries would seek (usually uselessly) to emulate his campaigns.

It is from this period onwards that much of our evidence for the great variety among Greek calendars comes. To establish a baseline for the following discussion, let us recall the Athenian calendar:

1. Hekatombaion, 2. Metageitnion, 3. Boedromion, 4. Pyanepsion, 5. Maimakterion, 6. Poseideon, 7. Gamelion, 8. Anthesterion, 9. Elaphebolion, 10. Mounichion, 11. Thargelion, 12. Skirophorion.

The evidence which secures these names and order is varied. For instance, in a manner similar to the Linear B ritual calendar mentioned in Chapter 2, we have a number of more or less complete calendars of sacrifices from the districts (demes) of Attika. The most straightforward one, in terms of its reference to the months, is also the earliest surviving example. It comes from the deme of Thorikos and dates probably to the 430s BC (*IG* I^3.256 bis, p.958; Price 1999: 172-3). The requisite sacrifices to various gods in each month of the year are listed in succession, from Hekatombaion to Skirophonion (only the name of Metageitnion has had to be restored). Other such calendars are known from the demes of Eleusis, Erkhia and Teithras, and from the Marathonian tetrapolis, and date to the fourth century BC (Dow 1968). These 'month by month' calendars defined the public ritual year and in Attika may stem from a sixth-century codification, which has, rightly or not, been associated with Solon (Plutarch, *Solon* 25.1-2; Parker 1996: 43-7). This earlier law was revised at the end of the fifth century amid some controversy regarding which old sacrifices were to be retained and which new ones introduced, as the Athenian law court orator Lysias demonstrates (*Speech* 30). But our knowledge of the revised law is very fragmentary, and hence our understanding of the relationship between what may be called the central state calendar and district calendars like that from Thorikos remains hazy (Lambert 2002).

The same ordering of the months found in the sacrificial calendars underlies statements by another orator, Antiphon, also in the late fifth century BC, when he talks of Thargelion and Skirophorion as the last two months of the year, and of Hekatombaion and Metageitnion as the first two (Antiphon, *On the Chorus Boy* 42, 44). Demosthenes, in the fourth century, does much the same in enumerating Hekatombaion, Metageitnion and Boedromion in succession for the start of a new year (Demosthenes, *Olynthiac* 3.5). In his ideal state Plato sets the start of the civic year with the month following the summer solstice (*Laws* 767c.4-7), presumably on the basis of his own experience of the Athenian system. More curiously but also usefully, Aristotle also in the fourth century refers to the sequence of the months of Mounichion, Thargelion and Skirophorion as the breeding period of most fish, associates Hekatombaion with the time of the summer solstice when the tunny breeds, and gives the months Skirophorion, Hekatombaion and Metageitnion as the period over which the crayfish retains its eggs after conception (*Enquiry into Animals* 543b6-13, 549a14-16). And his colleague Theophrastos tells us that reeds for playing the pipe in the natural style used to be cut in the month of Boedromion when Arcturus was rising (i.e. about mid-September), but that a change to a more affected style of playing led to the cutting taking place 'in Skirophorion and Hekatombaion just a little before the solstice or just after' (*Enquiry into Plants* 4.11.4-5).

This placement of the first Athenian month of the year stands in contrast to that in some other Greek calendars. We saw in Chapter 2 that the Elean calendar began at the winter solstice; so too did the Boiotian calendar. In the course of a description of events in the year after the crucial Theban defeat of Sparta at Leuktra in 371 BC (events which led, through the weakening of Spartan hegemony in the Peloponnese, to the formation of the Arkadian League), Plutarch lets drop the information that the Boiotian year began and ended at the winter solstice:

> When, however, both men [Pelopidas and Epaminondas] were Boiotarchs, they invaded and won over most of the peoples, causing Elis, Argos, the whole of Arkadia and most of Lakonia to revolt from the Lakedaimonians. But with the middle of winter around the solstice approaching, and a few

> days remaining of the end of the last month, it was required that others assume the command just as the first month was starting, or for those who did not relinquish it to die.
>
> Plutarch, *Pelopidas* 24.1-2

So Boiotia was running its civil year from the winter solstice, six months askew from that of Athens.

Curiously – since it was a dependency of Athens for so long – Delos also started its year after the winter solstice, and with a set of month-names of which only three correspond with the Athenian ones. Accounts rendered by the board of religious officials (*hieropoioi*) in Delos for the years 270-268 BC (*IG* XI.2.203) list under income the full sequence of the months as:

1. Lenaion, 2. Hieros, 3. Galaxion, 4. Artemision, 5. Targelion (elsewhere Thargelion), 6. Panemos, 7. Hekatombaion, 8. Metageitnion, 9. Bouphonion, 10. Apatourion, 11. Aresion, 12. Posideon.

Under expenditure per month the record repeats this sequence in the same order, suggesting that the sequence represents the order of months from the year's beginning. Thus, Lenaion, the winter month-name we encountered in Hesiod, was the first month on Delos. That it is also a winter month on Delos is confirmed by synchronisms between the Delian calendar and that of Athens, which occur in inscriptions recording the activities of the officials called the Amphiktyons of Athens. This was a council of four or five, set up by Athens at some stage after 479 BC, when the island became the meeting place for the council of the Athenian-led Delian League, which had been set up to avenge the Persian attacks on Greece. The council was charged with the task of administering the temples of Apollo and Artemis on Delos. Its presence and role signify Athenian domination of the island's sanctuaries, which lasted (barring some brief periods) through the fifth and fourth centuries down to 314 BC, when the island gained its independence.

An early Amphictionic account, datable to 434/3 BC through the archons' names in the prescript, includes, among other relationships, the correspondence Metageitnion in Athens = Bouphonion on Delos (*IG* I^2.377.14-15). A later set of accounts from 377/3 BC starts:

> Gods!
>
> The Amphiktyons of Athens enacted the following, from the archonship of Kalleas to the month Thargelion in the archonship of Hippodamas in Athens, and on Delos from the archonship of Epigenes to the month Thargelion in the archonship of Hippias ...
>
> *ID* 98.1-5

Further on the same record states (with some restoration):

> The Amphiktyons of Athens enacted the following, from the month Skirophorion in the archonship of Hippodamas to the archonship of Sokratides in Athens, and on Delos from the month Panemos to the archonship of Pyrrhaithos ...
>
> *ID* 98.57-9

Knitting these synchronisms together produces the following initial correspondence between the Athenian and Delian calendars:

Athens	**Delos**
6. Poseideon	1. Lenaion
7. Gamelion	2. Hieros
8. Anthesterion	3. Galaxion
9. Elaphebolion	4. Artemision
10. Mounichion	
11. Thargelion	5. Thargelion
12. Skirophorion	6. Panemos
1. Hekatombaion	7. Hekatombaion
	8. Metageitnion
2. Metageitnion	9. Bouphonion
3. Boedromion	10. Apatourion
4. Pyanepsion	11. Aresion
5. Maimakterion	12. Posideon

Clearly, with Athenian Mounichion lacking a Delian counterpart, and Delian Metageitnion lacking an Athenian, something is amiss here. An early solution proposed resolving this asynchrony by running the Athenian Hekatombaion across the second half of the Delian Hekatombaion and the first half of the Delian Metageitnion, and then splitting the other Athenian months in the same fashion, so that the discrepancies in the initial list of correspondences disappear (Homolle 1881):

Athens	**Delos**
7. Poseideon-Gamelion	1. Lenaion
8. Gamelion-Anthesterion	2. Hieros
9. Anthesterion-Elaphebolion	3. Galaxion
10. Elaphebolion-Mounichion	4. Artemision
11. Mounichion-Thargelion	5. Thargelion
12. Thargelion-Skirophorion	6. Panemos
1. Skirophorion-Hekatombaion	7. Hekatombaion
2. Hekatombaion-Metageitnion	8. Metageitnion
3. Metageitnion-Boedromion	9. Bouphonion
4. Boedromion-Pyanepsion	10. Apatourion
5. Pyanepsion-Maimakterion	11. Aresion
6. Maimakterion-Poseideon	12. Posideon

Although this realignment fits the records noted above – with part of Athenian Metageitnion still corresponding to Delian Bouphonion, Delian and Athenian Thargelion partially aligning, and Athenian Skirophonion partly running alongside Delian Panemos – nevertheless it breaks a cardinal rule of Greek calendrics: the months should start with a new moon. This table has the Delian months necessarily starting about the time of the full moon, a situation for which there is no known parallel in the Greek world.

A later solution resolved the discrepancies between the two calendars by preserving a new-moon start to each month and assuming that intercalation of a month had split the two calendars apart from a normal synchronism that ran as in the 377/3 BC accounts (West 1934):

Athens	**Delos**
7. Gamelion	1. Lenaion
8. Anthesterion	2. Hieros
9. Elaphebolion	3. Galaxion
10. Mounichion	4. Artemision
11. Thargelion	5. Thargelion
12. Skirophorion	6. Panemos
1. Hekatombaion	7. Hekatombaion
2. Metageitnion	8. Metageitnion
3. Boedromion	9. Bouphonion
4. Pyanepsion	10. Apatourion
5. Maimakterion	11. Aresion
6. Poseideon	12. Posideon

Whichever reconstruction we take, there is no doubt that the beginning of the Delian year coincided more or less with Athenian Gamelion and therefore occurred around the time of the winter solstice. In other words, the Delian year ran more closely to ours, as our January begins soon after the (northern) winter solstice. We shall need to keep in mind this distinction between the Delian and Athenian years in what follows.

The road to the second, and still current, reconstruction is complicated, and not without its own hazards. The journey starts with the same early Amphictionic account of 434/3 BC (*IG* I^2.377+) with which we began the first reconstruction. The correspondence between Athenian Metageitnion and Delian Bouphonion belongs to the record of a loan of a large sum of money, the period for which 'begins with the month Metageitnion in Athen[s in the archonship of *X*, in] Delos with the month Bouphonion in the archonship of Eupteres' (lines 14-15, with restored words in square brackets). There then follows an account for the lease of temple property, the period for which 'begin]s in the month Poseideon in Athens in the archonship of Krates; i[n Delos in the month of *A*] in the archonship of Eupteres' (lines 16-18). Finally, a further lease, this time for sacred land in neighbouring Rheneia, has a period which begins 'in month [*B*] in the archonship of Apseudes, in Delos in [month] Hieros [in the archonship of *Y*]' (lines 21-2). Put in tabular form, these entries run thus:

	Athens	**Delos**
Loan	Metageitnion (archon *X*)	Bouphonion (Eupteres)
Lease I	Poseideon (Krates)	month *A* (Eupteres)
Lease II	month *B* (Apseudes)	Hieros (archon *Y*)

with the unknown archons at Athens and Delos labelled *X* and *Y* respectively, and the unknown months at Delos and Athens marked *A* and *B* respectively. Expanding this table gives us:

Athens	**Delos**
Metageitnion (Krates)	Bouphonion (Eupteres)
Boedromion	Apatourion
Pyanepsion	Aresion
Maimakterion	Posideon
Poseideon (Krates)	Lenaion (new Delian archon)
Gamelion	Hieros

The Delian archon Eupteres would hold office from Lenaion to Posideon, and be replaced at the start of the next Lenaion by the new archon. This next Lenaion, however, ought to coincide with Athenian Poseideon (barring any intercalations), when Krates was still archon in Athens, and yet Lease I had Eupteres still archon in Delos then. If Athens intercalated a month in this sequence, and Delos did not, then Eupteres still would not be the archon in Athenian Poseideon, because Athenian Poseideon would coincide with Delian Hieros. If Delos did intercalate also, then the sequence still holds as above, and Eupteres will have been replaced. But if Delos intercalated a month in its sequence, and if Athens did not, then Eupteres could be the archon in Athenian Poseideon, because Athenian Poseideon would coincide with Delian Posideon; the argument against this is that Delos normally intercalated month 6, Panemos (e.g. *ID* 290.4), so intercalation by Delos in this case is unlikely anyway.

So whichever way we look at the accounts, they cannot be in chronological sequence in the inscription. The likeliest order is:

	Athens	**Delos**
Lease I	Poseideon (Krates)	month *A* (Eupteres)
Loan	Metageitnion (archon *X*)	Bouphonion (Eupteres)
Lease II	month *B* (Apseudes)	Hieros (archon *Y*)

If we assume ordinary, non-intercalated years, this fills out as:

	Athens	Delos
Lease I	Poseideon (Krates)	Lenaion (Eupteres)
	Gamelion	Hieros
	Anthesterion	Galaxion
	Elaphebolion	Artemision
	Mounichion	Thargelion
	Thargelion	Panemos
	Skirophorion	Hekatombaion
	Hekatombaion (Apseudes)	Metageitnion
Loan	Metageitnion	Bouphonion
	Boedromion	Apatourion
	Pyanepsion	Aresion
	Maimakterion	Posideon
	Poseideon	Lenaion (archon *Y*)
Lease II	Gamelion	Hieros

The Delian month *A* is thus Lenaion, the Athenian month *B* is Gamelion, and the Athenian archon *X* is Apseudes. Only the Delian archon *Y*, who succeeds Eupteres, cannot be identified from internal evidence in this inscription.

Several scenarios can be run through this reconstruction, to see what happens if months are intercalated by either the Athenians or the Delians, or by both. On the whole, if the Athenians intercalated a month, then the Delians must have done so also for this synchronism to hold (West 1934). Whether the Athenians intercalated a month or not remains uncertain, which is a pity, as this impinges on the debate surrounding the discovery of the 19-year lunisolar cycle by Meton in the archonship of the same Apseudes as turns up in these accounts (see chapter 3). At some stage, however, according to this theory an intercalation of a month brought the two calendars into synchrony in the form we encounter in the fourth-century accounts. When this occurred we do not know.

As we have seen, Delos began its year with the winter solstice, six months away from Athens. Delphi, on the other hand, observed the same starting point as Athens. The route to realising this fact is equally roundabout, but worth following as it introduces us to another type of evidence with calendric data.

Excavations in Delphi have unearthed inscriptions belonging to the period between 201 BC and AD 100 and recording the public manumission at the sanctuary of over 1200 slaves in that period, initially from the outlying towns and then (from the mid-second century BC) mostly from Delphi itself. Because we know relatively little about the practice of slaves buying their own freedom from elsewhere in the Greek world, this body of material from Delphi has formed the foundation of sociological studies not only of the process of manumission but also of the changing state of slavery in Greece at that time (Hopkins 1978). But our interest is in what these inscriptions can tell us of Greek calendars.

The beginning of an example of a manumission from 167 BC illustrates the type of calendric information that these inscriptions provide:

> When Panaitolos of Phytaion was general of the Aitolians, in the month of Homoloios, and at Delphi Xeneas was archon in the month Bysios, Kritodamos son of Damokles, of Physke, sold to Pythian Apollo a male slave [literally, 'body'] whose name is Maiphatas, of Galatian race, and a female slave whose name is Ammia, of Illyrian race, for the price of seven minas of silver.
>
> *SGDI* 1854.1-9; cf. Austin 1981: 221-2, no. 127(b)

Here a synchronism is given between the Delphian month Bysios and the Aitolian month Homoloios. Through other such inscriptions we can build a list of all the Delphian and Aitolian months, which are here arranged simply according to the anglicised alphabetical order for the Delphian months:

Delphi	**Aitolia**
Amalios	Euthaios
Apellaios	Laphraios
Boathoos	Prokyklios
Boukatios	Panamos
Bysios	Homoloios
Daidaphorios	Boukatios
Endyspoitropios	Dionysios
Heraios	Athanaios
Herakleios	Agyeios
Ilaios	Hippodromios
Poitropios	Dios
Theoxenios	Hermaios

We shall return to the Aitolian months at the end of this discussion, but let us for the moment concentrate on establishing the order of the Delphian months in the year. Another manumission document from Delphi for the same year provides a synchronism between Delphian Heraïos and the first month in the calendar of Phokis:

> When Aristoteles son of Aristarchos was general of the Phokians in the First month, and at Delphi Xeneas son of Babylos was archon in the month Heraios, Aristeas son of Aristodamos of Stiris sold to Pythian Apollo a male slave whose name is Protos son of Protos of Sidonian race, for the price of eight minas of silver ...
>
> *SGDI* 1727.1-2

The Phokian calendar was a federal calendar, serving the various cities of the federal state of Phokis (which had existed since the sixth century BC), and its months are referred to either by names as usual, or – more usefully for our purposes – by ordinal numeral adjectives: First, Second, Third, ... Twelfth. So the synchronism in the manumission case just quoted is between Heraios and the Phokian 'First'. Other inscriptions for the manumission of Phokian slaves allow us to draw up a table not only of correspondences between Delphian and Phokian months, but also, because of the numerical form of the Phokian months, of their relative order. After Heraios, the rest of the months at Delphi were, in chronological order: Daidaphorios, Poitropios (which was also the intercalary month), Amalios, Bysios, Theoxenios, Endyspoitropios, Herakleios, Ilaios, Apellaios, Boukatios, and Boathoos (Samuel 1972: 71).

Now we need to find which was the first month of the year. From another means of dating used in Delphian inscriptions we can deduce that the year there started not with Heraios, the equivalent of the Phokian First month, but in fact with Apellaios, which corresponded to the Phokian Tenth. This other system of dating organises the year, and often the months explicitly, into either a first or a second semester (i.e. six-month periods). For example, a manumission involving Elateia in Phokis in the period about 150-100 BC records:

> When at Delphi Kleodamos was archon in the month Apellaios, and in the first semester the councillors were Sostratos son of Sotylos, Hagionos son of Dromokleides, Damosthenes son of Archonos, and in Elateia Eukleides son of Pytheas was archon in the Tenth month, Aphthonetos son of Praxias of Elateia sold to Pythian Apollo a female slave whose name is Dionysia, for the price of four minas of silver ...
>
> *SGDI* 2214.1-7

From inscriptions utilising this semester system we can place the six Delphian months Apellaios to Poitropios (including the intercalary month) in the first semester, and Amalios to Ilaios in the second.

With the order of months at Delphi thus secured, can we ascertain in what season the year started? For this, we turn to other inscriptional evidence which provides equivalences between Delphi's months and those of Athens. Thus, for instance, another manumission from between about 150 and 140 BC starts:

> When at Delphi Eukleos was archon in the month Poitropios, and in the first semester the councillors were Eudoxos son of Praxias, Hagesilaos son of Tarantinos, and the secretary was Politas son of Asandros, and in Athens Xenokles was general in the month Poseideon, Xenon son of Philistos the

> Athenian sold to Pythian Apollo a female slave whose name is Arsinoa of homebred origin, for the price of ten minas of silver ...
>
> *SGDI* 2089.1-6

That is, the sixth month, Poitropios, in Delphi is equivalent to the sixth month in Athens, Poseideon. A considerably later inscription (*FD* III.2.66), dated to AD 98 and recording the sending of Athenian ambassadors to offer a sacrifice at Delphi, provides a correlation between Boathoos (spelt Bathoos), the third month at Delphi, and Athens' third month, Boedromion, which confirms the earlier correspondence between the two states' calendars and illustrates its longevity into the Imperial Roman period. This alignment also indicates that Delphi began its year as Athens did, after the summer solstice.

By the same token, however, since the First month at Phokis corresponds to the fourth Delphian month, Heraios, the year in that federal league did not begin around either of the solstices. We can define this epoch more sharply thanks to more records from Delphi. Let us first tabulate the different calendars, as we have built them up so far, to display their correlations:

Athens	**Delphi**	**Phokis**	**Aitolia**
Hekatombaion	Apellaios	Tenth	Laphraios
Metageitnion	Boukatios	Eleventh	Panamos
Boedromion	Boathoos	Twelfth	Prokyklios
Pyanepsion	Heraios	First	Athanaios
Maimakterion	Daidaphorios	Second	Boukatios
Poseideon	Poitropios	Third	Dios
Gamelion	Amalios	Fourth	Euthaios
Anthesterion	Bysios	Fifth	Homoloios
Elaphebolion	Theoxenios	Sixth	Hermaios
Mounichion	Endyspoitropios	Seventh	Dionysios
Thargelion	Herakleios	Eighth	Agyeios
Skirophorion	Ilaios	Ninth	Hippodromios

The First month in Phokis corresponds to Delphian Heraios, and so to Athenian Pyanepsion. The start of Pyanepsion lies three months and some days beyond the summer solstice in Skirophorion. Three months on from the solstice brings us to the autumn equinox, which therefore lies within Boedromion. This is the equivalent, more or less, of the Twelfth Phokian month, so the First starts presumably with the first new moon following the equinox.

This tabulation presents the Aitolian months in their correct order in comparison with those of Delphi. The manumission records at Delphi, which provide synchronisms between that city and Aitolia in the early second century BC, also demonstrate that the period of the office of general (*strategos*) in Aitolia must have begun about the time of the Delphian month of Boathoos, and ended in Boukatios (Mommsen 1878: 120; although the most telling document, *SGDI* 1988, is heavily restored at this point). These months correspond to Aitolian Prokyklios and Panamos respectively, which indicates that the Aitolian year also began, presumably with Prokyklios, close to the autumn equinox. This is confirmed by the historian Polybios, in a passage concerning military activities in springtime 219 BC:

> ... the Aitolians held elections of magistrates immediately after the autumn equinox, while the Akhaians did this about the rising of the Pleiades.
>
> Polybios 4.37.2-3

Finally, the fourth solar tropical point, the spring equinox, was also used as the starting point of the calendar of Miletos, perhaps after its New Year's Day was shifted from the original autumn equinox date to the vernal at some stage between perhaps 313 and 288 BC (Samuel 1972: 114).

How well these calendars could adhere to the solar starting points, whether it be a solstice or an equinox, would be a measure of how well they could stay synchronised with each other. In Chapter 2, in the course of our investigation of the timing of the Pythian and Olympic Games, we saw that both local calendars, the Delphian and the Elean, were probably run according to an octaeteris. Such a scheme was designed to maintain alignment between the lunar months and the solar year over the eight-year cycle. But we also saw in Chapter 3, while discussing the 19-year Metonic cycle, that over a period of eight years the octaeteris ran ahead of the solar year by just over a day and a half. The Metonic and the later Kallippic cycles sought to address this drift between a lunisolar cycle and the solar year, but there appears to be no hard evidence that the Greek states ever instituted the use of these more refined cycles to run their civil or festival calendars by (however attractive the proposition has been to some scholars). The Athenian-Delian synchronisms suggest that differences existed between states in applying intercalary months, which in turn implies the use of different mechanisms for calculating when an intercalation should be made. So it would be a pointless exercise, in the present state of our knowledge, to try to apply a single particular lunisolar cycle, be it octaeterid or Metonic or whatever, to the calendars of several states, to discover how they might correlate over a long period of time.

A further note of caution is worth sounding with regard to the issue of synchronisms. There is the case of a double correspondence for one month in the Thessalian calendar, Thyos, with two non-contiguous months in the Delphian calendar, Endyspoitropios (*SGDI* 1720: 161/0? BC) and then Bysios, two months earlier (*FD* III.2.213: about 124 BC). Months which have changed their allegiance to this degree over a relatively short period of time probably belong to calendars which did not even nominally run step for step with each other, in the way the Athenian, Delian, Delphian, Aitolian and Phokian calendars appear to have done (Samuel 1972: 84).

The Macedonian calendar in the East

The conquest of the Persian Empire by Alexander the Great forcibly brought together not only Greeks and Macedonians, on the one hand, and the huge diversity of people who inhabited the Empire, on the other, but also their calendars. In particular, the Macedonian calendar gained widespread currency both geographically and temporally. Not only did it fuse with local calendars across Alexander's new empire in Egypt and Asia, but it also became the calendar 'of the Greeks', as the eastern peoples termed it, and as such entered the Judaeo-Christian tradition. Thus the Macedonian calendar is the most widely attested Greek calendar.

The Macedonian month-names are:

1. Dios, 2. Apellaios, 3. Audnaios (or Audynaios), 4. Peritios, 5. Dystros, 6. Xanthikos (in literature, or Xandikos in inscriptions), 7. Artemisios, 8. Daisios, 9. Panemos, 10. Loios, 11. Gorpiaios, 12. Hyperberetaios.

The names and order are secured by a large variety of forms of evidence – Greek, Roman and Christian literature and inscriptions, as well as numerous papyri from Egypt. To give a few examples: John Lydus, the sixth-century AD Byzantine official who wrote a book on the Roman calendar, at one point lists all the months of the calendars of the Athenians, Greeks (i.e. the Macedonians, starting with Gorpiaios), Hebrews, Egyptians and Romans (i.e. from the Julian calendar) (*On the Months* 3.22). More intriguingly, John Chrysostom, the late fourth-century AD bishop of Constantinople, gives us in effect the full complement of Macedonian months when he names the seven months (counting inclusively) between the conception of John the Baptist and that of Jesus, and then names the nine months of Mary's pregnancy with Jesus (*On the Birthday*, *PG* 49.358).

Finally, the great Byzantine lexicon of the tenth century AD, the *Suda*, lists separately under their appropriate alphabetic letters eight of the Macedonian month-names with their Roman Julian equivalents, and adds beside Hyperberetaios:

> 'Hyperberetaios' according to the Macedonians: name of a month; October; and a proverb: 'Hyperberetaios' is said of the very old, for among the Macedonians the last month of the year is recorded as Hyperberetaios.
>
> *Suda*, ed. Adler 1971: 4.651 no.239

This implies that Dios is the first month. The entry in the *Suda* may go back to a collection of proverbs (*paroimiai*) made by Zenobios in the second century AD, since the very same definition is quoted by him. Zenobios in turn summarised material from writers like Didymos from the first century BC. How far back into the period of the pre-Hellenistic Macedonian kingdom this placement of Dios holds we do not know, because the bulk of our knowledge of the Macedonian calendar belongs to the period following Alexander's conquests. Here it is filtered to us through its fusion with local calendars. Two particular contacts are of great interest: those with Babylonia and Egypt, where extremely old calendar traditions already held sway, into which the Macedonian calendar fitted with different degrees of success.

The Babylonian calendar

In Babylonia the Macedonian Greeks came into contact with a lunisolar calendar of considerable age and sophistication. The Babylonians had created a calendar of 12 29- or 30-day lunar months, each of which began on the evening when the new moon's crescent was first visible. Thus the day started in the evening at sunset, a practice which survives to the present day, through a common heritage, in the time-reckoning of Judaism and Islam.

Originally, the names of the Mesopotamian months varied, depending on the region, and usually reflected a given month's distinguishing ritual observance or agricultural activity (e.g. with month-names meaning 'Sheep' and 'Ploughing'). Gradually a standardisation came about, based on the month-names from Nippur, the centre of a Sumerian league situated to the south-east of modern Baghdad. Around 2000 BC these names were adopted for use throughout southern Mesopotamia, perhaps in a political move by the incoming monarch of the new Isin dynasty. The resulting calendar aided in the unification of the Isin Empire, and appears to have migrated along the trade routes to Babylon. About 1730 BC the Nippur month-names were taken over as logograms to denote months in the Standard Mesopotamian calendar, itself constructed under Samsuiluna of Babylon (*c.* 1749-1712 BC) perhaps as a means of further unifying his empire. The new calendar was a hybrid, with months taken from various calendars rather than just one city's. Through this mechanism the Babylonian administration may have sought to please everyone by privileging no one, and through the use of the old Southern-Mesopotamian Sumerian month-names from Nippur as logograms for the months, the authorities may have given the calendar a patina of tradition that satisfied the scribes and legitimised the end product (Cohen 1993: 8-13).

The year began at the spring equinox and ran: Nisannu, Aiaru, Simanu, Du'uzu, Abu, Ululu, Tashritu (about the time of the autumn equinox), Arahsamna, Kislimu, Tebetu, Shabatu, Addaru (Rochberg-Halton 1992: 812). These month-names have been reflected in the months of the Jewish calendar ever since the last centuries BC, because of the Babylonian annexation of Jerusalem in 586 BC and the Jews' contact with the Babylonians (and later the Persians) during and after the exile: Nisan, Iyyar, Sivan, Tammuz, Av, Elul, Tishri, Marheshvan, Kislev, Teveth, Shevat, Adar. While individual Jewish month-names occur in literature from the Hellenistic and Roman periods (1-2 *Maccabees*, Josephos, rabbinic texts), the earliest document listing all these Jewish months in succession is the *Megillath Ta'anith* of the first or early second century AD. The Jews also used an ordinal system for naming the months, i.e. 'first', 'second', etc., either on its own or in conjunction with the Babylonian names (Schürer 1973-87: i.587-8; Herr 1976: 836-8).

As we have seen already in the Greek world, to maintain alignment between the lunar and solar cycles there is a need to intercalate a 13th lunar month at some stage. Synchrony between the lunar months and the seasonal year was perhaps of more obvious importance to the Mesopotamian peoples than to the Greeks because the names of the Mesopotamian months had traditionally been associated with agricultural activities to be undertaken during them. Evidence for such intercalation is certainly very early. For a long time an extra month was intercalated only at irregular intervals. From the second millennium BC onwards documents show that usually either the sixth or twelfth month (Ululu or Addaru) was doubled, although still on the basis of an *ad hoc* royal decree, as we saw in Chapter 2. The king was still the one who issued such instructions in the time of Nabunaid (556-539 BC), the last of the kings of Babylon before the Persian Achaemenid dynasty gained power. Under the latter the instructions for intercalation emanated from priestly officials in Babylon (Parker and Dubberstein 1956: 1-2).

Such intercalation at the end of either semester in the year might be a reflection of a third cycle beyond the lunar and solar ones: the equinoctial cycle. The two seasons of the Babylonian year, summer/hot and winter/cold, began in the month of an equinox. But beyond this fundamental ecological division of the seasonal year, the equinoxes also played a significant role in the calendars of the region, as major festivals were paralleled in the first and seventh months of the year. Rather than seeing one of these as marking the beginning of the year and the other the midpoint, it appears that the Babylonians regarded these festivals as each signifying the beginning of a six-month equinox 'year' (Cohen 1993: 6-7).

One letter instructing on intercalation, dating to some time under Kyros (539-530 BC) or Kambyses (530-522 BC), seems to have been issued with very short notice only a month ahead of the intercalary month (Parker and

Dubberstein 1956: 1-2). Such apparent lack of system was overcome in the Persian Empire by standardisation of a 19-year intercalary cycle of seven months certainly by 367 BC, and possibly by 383 BC, although it is thought likely that the cycle may have been invented at some stage earlier still in the fifth century BC. Such a 19-year cycle is usually named 'Metonic', after its presumed discoverer, the late fifth-century BC Greek astronomer Meton, whom we encountered in the previous chapter, but the cycle was probably known in Babylonia independently of him. The extra seven months were to be inserted as a second Addaru in years 3, 6, 8, 11, 14 and 19, and a second Ululu in year 17 (Parker and Dubberstein 1956: 6).

This is the calendar which Alexander and his successors encountered. How well the Macedonian calendar survived its contact with the Babylonian can be demonstrated through a set of synchronisms provided by the second-century AD astronomer, Ptolemy. But before analysing these, let us examine the situation in Egypt, since some knowledge of its calendar is also necessary to understand Ptolemy's synchronisms.

The Egyptian calendar

There was a lunar calendar in Egypt, with months of 29 and 30 days. It is attested from the Twelfth Dynasty (about 1900 BC) through to the Roman period, and was used for festival and cultic purposes. A Roman papyrus (P. Carlsberg 9), covering the years AD 19-144 from the reign of the emperor Tiberius to that of Antoninus Pius, provides evidence of a 25-year cycle which would have allowed the Egyptians to correlate this lunar calendar with the Egyptian 365-day civil year (Neugebauer 1975: 563-5; Grzybek 1990: 53-60, 135-42). The principle is similar to that of the Greek lunisolar cycles: 309 lunar months, at an average of 29.53059 days each, amount to 9124.95231 days, while 25 years each of 365 days comprise 9125 days. The difference is a little more than an hour per 25-year cycle, so it is remarkably accurate. Some recent studies, however, have doubted that this cycle was actually put to use (Jones 1997, Depuydt 1997a: 198-202). It is also worth emphasising that the cycle stands in contrast with the Greek cycles, in so far as it brings the lunar months into synchrony not with the seasonal or solar year but with the civil year of 365 days, which is $^1/_4$ of a day per year smaller than the solar year.

Alongside this religious calendar, an administrative calendar appeared which avoided the difficulties which arise from a purely lunar calendar. Each administrative year had exactly 365 days. There were 12 months, each of 30 days and named after a divinity or a religious festival associated with it. We know these names now by their Greek forms:

1. Thoth, 2. Phaophi, 3. Hathyr, 4. Choiach, 5. Tybi, 6. Mecheir, 7. Phamenoth, 8. Pharmouthi, 9. Pachons, 10. Payni, 11. Epeiph, 12. Mesore.

The month-name Hathyr, for example, reflects an association with the goddess Hathor.

Five extra days were added to bring the total up to 365. These were what the Greeks called the 'epagomenal', or additional, days, and they were added at the end of the year after the month of Mesore.

Why 365 days were taken as the total for a year remains uncertain. Two natural phenomena in Egypt look likely causes: the annual flood of the Nile, and the almost coincident dawn rising of the star Sirius. The high point of the annual Nile flood could be measured by simple means – as it has been down to modern times by various Nilometers – to establish a gauge by day-counts of the average length of the seasonal year. The Egyptian names of the three seasonal divisions of the year are reflective of the great river's influence on the pattern of Egyptian life: 'inundation', 'emergence' (of the fields from the flood waters), and 'dryness' (of the river before the next flood). In the first century BC the Greek historian Diodoros (1.11, 12, 16) refers to these three divisions as summer, winter and spring. The summer flood of the Nile was agriculturally and calendrically the first season in Egyptian eyes, as it brought with it the necessary silt, into which grain seed could be sown in winter, to be harvested in spring. Each season comprised four months: Thoth, Phaophi, Hathyr and Choiach in 'inundation'; Tybi, Mecheir, Phamenoth and Pharmouthi in 'emergence'; and Pachons, Payni, Epeiph and Mesore in 'dryness'.

The other natural event which might point to a 365-day cycle was the morning rising of the prominent star Sirius, called Sothis or the star of Isis by the Egyptians. At some stage the Egyptians noticed that the first observed morning rising of this star, after a period of 70 days' invisibility since its last visible evening setting, more or less coincided with the start of the Nile flood. The earliest evidence for this association is from the First Dynasty, in which Sothis is described as 'Bringer of the New Year and of the Inundation' (Griffiths 1970: 444). The trilingual Canopus Decree of 238 BC reflects the same idea when it decrees that:

> a public assembly be celebrated every year in the temples and throughout the whole country for King Ptolemy and Queen Berenike, the Benefactor Gods, on the day on which the star of Isis rises, which is considered in the holy books to be the New Year, and which is celebrated now in the ninth year on the first day of the month Payni, on which the Little Boubastia and the Great Boubastia are celebrated, the gathering in of the crops occurs and the rising of the river …
>
> *OGIS* 56.35-8

Even quite late in the record, in the early second century AD, this association between the rising of Sirius and the rise of the Nile is recalled by Plutarch (*On Isis and Osiris* 38): 'Of the stars, they consider Sirius belongs to Isis because it brings water ...'. Over a long period of time, it could be seen that the average time between the heliacal risings of Sirius was $365^1/_4$ days, the length of the seasonal year.

The age of the Egyptian civil calendar is unknown. Since the eighteenth century of our era guesses have been hazarded, suggesting that it was invented around 1322 BC, or 2782 BC, or even 4241 BC (Bickerman 1980: 41-2). All these dates are based on an awareness of the importance of the rising of Sirius to the calendar, and the assumption that it coincided with the Egyptian New Year's Day, 1 Thoth, when the calendar was first introduced. But the assumption may be unwarranted: new calendars need not begin on their New Year's Day, as the introduction of the Gregorian calendar in England in 1752 demonstrates.

The origin of a second major calendrical phenomenon which we still owe to ancient Egypt – the notion of the 24-hour day – is just as difficult to trace. Again, two possible causes are considered likely: the ratio of lunar months to one solar year, and the practice of counting hours through the night on the basis of the rising of certain stars. Neither on its own explains the creation of 12 hours, but in combination they present a plausible background.

The traditional view is that the division of the day into 24 hours was derived from the Egyptian method of telling the time at night. From around 2400 BC the Egyptians began to tell the time by hours at night via the rising of the stars. By about 2150 BC these hours certainly numbered 12 (Parker 1974: 53). Evidence comes from surviving 'star clocks', which are diagonal diagrams of stars on the inside of coffin lids from the 9th to the 12th Dynasties (2160-1773 BC) (Rochberg-Halton 1992: 813). The division into 12 hours may also derive from the basic ratio of 12 lunar cycles to the one cycle of the sun, which may have been transferred by analogy from the year to the period of daylight and then of night, to create 12 day-sections and 12 night-sections (Quirk 2001: 42).

The hours became associated with certain stars or star groups which rose heliacally at ten-day intervals through the year. Sirius was one of these, and it was joined by 35 other stars, whose identification is still a matter for conjecture (Belmonte 2003). Collectively they are now known as the 'decans', after the Greek name for the interval between their risings (*deka* is Greek for ten). The number ten lay also at the base of another division of Egyptian time. This was the ten-day 'week', which split each month into equal thirds, and gave the year (excepting the five epagomenal days) a total of 36 weeks. Seven such weeks constituted the archetypal period of ideally 70 days' absence in the Underworld (Duat) not only for Sirius between its heliacal setting in May and its heliacal rising in July, but hence also for all the decanal stars, before they were reborn at the time of their heliacal rising (Parker 1974: 54-6). We might note also that from this behaviour of Sirius and its fellow decanal stars was derived the period of 70 days for the embalming and entombment of the body of the deceased Pharaoh, before he joined the Sun God.

The first day of a decade, or week, provided a star sighting just ahead of dawn. Ten days later this same star would be rising about 40 minutes (in our terms) before the end of the night, and so would have lost its role as a harbinger of dawn to the next decanal star as it rose heliacally. But each of these stars, and several of their decanal brethren, would rise in succession through the course of any given night. The interval between the rising of one such star and the next constituted an Egyptian 'hour'. With 36 decanal stars covering the full circle of the sky, and therefore the whole day and night, over the course of a single night half of the 36 decanal stars would rise one after another. Yet the number of hours that the night was divided into was always 12, not 18. This means that the 'hour' was not of a single fixed length, but varied over the course of the night and across the seasons as the night grew longer or shorter.

Herodotos, we saw earlier, wrote in high praise of the Egyptian calendar as contrasted with the contemporary Greek calendars:

> The Egyptians, they said, were the first men who reckoned by years and made the year to consist of 12 divisions of the seasons. They discovered this from the stars (so they said). And their reckoning is, to my mind, a juster one than that of the Greeks; for the Greeks add an intercalary month every third year, so that the seasons may agree; but the Egyptians, reckoning 30 days to each of the 12 months, add five days in every year over and above the number, and so the completed circle of seasons is made to agree with the calendar.
>
> Herodotos 2.4

We have already examined the biennial intercalary system in Greece and found it wanting. But others beyond Herodotos were aware that even the Egyptian system had its failings too.

The historian's definition of the Egyptian civil or administrative year is accurate, in that it comprised 12 months each of 30 days, plus five additional days tacked on at the end of the year, to bring the total up to 365 days. Certainly a year of such length is sufficiently close to the true solar year as to make the Egyptian calendar an extraordinary achievement in the context of the vagrant lunar or awkward lunisolar calendars of her neighbours. Yet in the long run even 365 days is not long enough to avoid a displacement between the civil calendar and the seasonal year, and hence between religious festivals and the relevant seasons, as the astronomer Geminos points out:

The Egyptians have distinguished and calculated in a manner which is the opposite of the Greeks'. For they do not observe that the years run according to the sun, nor the months and days according to the moon, but they have used a principle which is peculiar to them. They want the sacrifices to the gods to occur not at the same moment of the year but to pass through all seasons of the year, and the summer festival to occur in winter and autumn and spring as well.

For they have the year of 365 days: they observe 12 30-day months and five epagomenals. They do not add the extra quarter for the reason above, so that for them the festivals retrogress. For in four years they fall a day behind with respect to the sun, and in 40 years they will fall ten days behind with respect to the solar year, so that the festivals will also retrogress the same number of days, until they occur in the same seasons of the year. In 120 years the difference will be one month, both with respect to the solar year and with respect to the seasons of the year.

Geminos, *Introduction to Astronomy* 8.16-19

Censorinus, *On the Birthday* 18.10, makes a similar point about the loss of approximately a day every four Egyptian years against a 'natural quadriennium'. The shift of the administrative calendar against the seasonal year can be charted for any given year. The following table shows the equivalent dates according to the Roman calendar instituted by Julius Caesar from 45 BC for the Egyptian dates in the years 30 BC (the year in which Octavian became the first Roman king of Egypt), 238 BC (the year of an attempted reform of the calendar under the Ptolemies), and 332 BC (when Egypt became part of Alexander's empire).

Month	**30 BC**	**238 BC**	**332 BC**
1 Thoth	31 Aug	22 Oct	14 Nov
1 Phaophi	30 Sep	21 Nov	14 Dec
1 Hathyr	30 Oct	21 Dec	13 Jan
1 Choiach	29 Nov	20 Jan	12 Feb
1 Tybi	29 Dec	19 Feb	14 Mar
1 Mecheir	28 Jan	21 Mar	13 Apr
1 Phamenoth	27 Feb	20 Apr	13 May
1 Pharmouthi	29 Mar	20 May	12 Jun
1 Pachons	28 Apr	19 Jun	12 Jul
1 Payni	28 May	19 Jul	11 Aug
1 Epeiph	27 Jun	18 Aug	10 Sep
1 Mesore	27 Jul	17 Sep	10 Oct
epagomenal 1	26 Aug	17 Oct	9 Nov
epagomenal 2	27 Aug	18 Oct	10 Nov
epagomenal 3	28 Aug	19 Oct	11 Nov
epagomenal 4	29 Aug	20 Oct	12 Nov
epagomenal 5	30 Aug	21 Oct	13 Nov

Table 4. Julian dates for Egyptian dates in 30 BC, 238 BC and 332 BC.

Although the last of the Ptolemies, Cleopatra VII, died on 8 Mesore in 30 BC, the start of Octavian's reign is counted from the next Egyptian New Year, 1 Thoth. In reality, in 30 BC 1 Thoth fell on 29 August, not 31 August as our Table has it. This discrepancy of two days is due to the fact that the new Julian calendar was run incorrectly at the start, having more leap days inserted than should have been the case (see Chapter 5). For chronological purposes we ignore this flawed reality in calculating the dates of events in antiquity, and instead use the ideal Julian calendar, in which 1 Thoth would have fallen on 31 August in 30 BC, as if the Julian leap year rule had been correctly applied from the outset. But it is 29 August as 1 Thoth which underlies the Alexandrian calendar from the time of the Roman occupation, and we encounter it in later 'hemerologia', the synchronised almanacs of the calendars of various provinces and cities, which survive from the ninth century AD onwards, but which reflect much older Roman practices (Kubitschek 1915).

The Egyptians themselves were aware of the drift of their calendar against the seasons, but they did nothing to account for the extra quarter-day every year. The closest they came to correcting it was in 238 BC under the Macedonian Ptolemies. Ptolemy III decreed that an extra day should be added every fourth year to correct the wandering year, thereby creating a leap-year system. The Canopus Decree records this intention:

> In the reign of Ptolemy [III] son of Ptolemy [II] and Arsinoe, the Brother-Sister Gods, in the ninth year, in the time of Apollonides son of Moschion, priest of Alexander and of the Brother-Sister Gods and of the Benefactor Gods, and of Menekrateia daughter of Philammonos, the basket-bearer of Arsinoe Philadelphos, on the 7th of the month Apellaios and the 17th of Tybi of the Egyptians; a decree: ...
>
> so that the seasons also may run properly forever in accordance with the present state of the cosmos, and lest it happen that some of the public festivals, which are celebrated in winter, are ever celebrated in summer, since the star shifts one day every four years, while others, which are celebrated now in summer, are celebrated in winter, at the appropriate times hereafter, just as it has happened to be before, and would have been so now if the organisation of the year, from the 360 days and the five days which were deemed later to be intercalated, held good, *from the present time one day at the festival of the Benefactor Gods to be intercalated every four years after the five which are intercalated before the new year*, so that everyone may see that the correction and restoration of the previous deficiency in the organisation of the seasons and of the year and of the customs to do with the whole regulation of the heavenly sphere has happened through the Benefactor Gods.
>
> *OGIS* 56.1-3, 40-6

As we have seen, at an early stage the day of Sirius' heliacal rising marked the start of the Egyptian year, which was 1 Thoth. Nevertheless, once the administrative calendar was established at 365 days, the actual day of the rising ceased to act as a marker for the start of the civil year, because the calendar omitted the necessary quarter-day which would keep it synchronised with the star. Hence 1 Thoth moved through every season of the year over a period of 1461 Egyptian years (1460 Julian years), by which time it would coincide again with the heliacal rising of Sirius (this is the Sothic cycle, so called after the Egyptian name for Sirius). The Canopus decree indicates that the rising of Sirius then took place on 1 Payni; this means that 1 Thoth fell on 22 October. All the same, rather paradoxically 1 Payni was still regarded as the time of the New Year (despite its not being 1 Thoth), as it coincided with the rising of the Nile and the beginning of the all-important agricultural cycle.

Despite the intention of the Canopus decree, as far as we can tell from subsequent Egyptian documents, the leap-year rule was never put into effect in Ptolemaic times, and the year continued to wander against the seasons. The fact that 1 Thoth lay in late August in 30 BC, when Egypt came under Roman rule, illustrates the continued use of the 'wandering year' in Egypt. Theon, the fourth-century AD astronomer, informs us that a leap-year system was eventually imposed on Egypt 'in the fifth year of the reign of Augustus' (*Commentary on the Almagest*, ed. Rome, p. 908.7-8). This means 26 BC, counting inclusively from 30 BC. Thus a sixth epagomenal day was added to the Egyptian calendar. Theon's date, however, has sometimes been regarded as just a theoretical back-projection, and scholars still debate the true date of the leap-year system's introduction into Egypt, usually opting for 30 BC or 26 BC, with the latter lately gaining in popularity (cf. Snyder 1943, Hagedorn 1994, Jones 2000b, Bennett 2003). What sort of leap-year system Egypt adopted at that time we shall touch on later.

It seems, therefore, that until then the fixed length of the Egyptian year had a strong, symbolic significance which would brook no alteration. But others beyond the circle of religious officials appreciated the Egyptian year for its utilitarian simplicity. Because no allowance had to be made for leap years in calculations, the Egyptian calendar was adopted for dating observations by the astronomers in the Greek city of Alexandria, and was so used by astronomers down to the time of Copernicus (Bickerman 1980: 43).

Ptolemy's synchronisms

In the second century AD, Ptolemy provides three sets of synchronisms which allow us to see how closely the Macedonian calendar was linked to the Babylonian and Egyptian calendars:

In the 75th year according to the Chaldaeans, Dios 14 at dawn, [Mercury] was half a cubit above the southern scale [of Libra]; so that it occupied then according to our coordinates $14^1/_2$° of Claws [i.e. Libra]. The time is during the 512th year from Nabonassar, according to the Egyptians Thoth 9 towards 10 at dawn, during which the mean sun occupied $5^1/_6$° of Scorpius. Therefore the greatest morning elongation was 21°.

Ptolemy, *Almagest* 9.7.9 (H267)

In the 67th year according to the Chaldaeans, Apellaios 5 at dawn, [Mercury] was half a cubit above the northern forehead of Scorpius; so that it occupied then according to our coordinates 213° of Scorpius. The time is during the 504th year from Nabonassar, according to the Egyptians Thoth 27 towards 28 at dawn, during which the mean sun occupied $24^5/_6$° of Scorpius. Therefore this elongation was $22^1/_2$°.

Ptolemy, *Almagest* 9.7.10 (H268)

For this purpose we again took one of the accurately recorded ancient observations, according to which it is declared that, in the 82nd year according to the Chaldaeans, Xanthikos 5 in the evening, the planet Saturn was 2 digits below the southern shoulder of Virgo. Now the time is during the 519th year from Nabonassar, according to the Egyptians Tybi 14 in the evening, at which time we find the mean sun occupying $6^1/_6$° of Pisces.

Ptolemy, *Almagest* 11.7.7 (H419)

The 'Chaldaean' chronology cited by Ptolemy ('the 75th year according to the Chaldaeans' etc.) is the Babylonian calendar in its Hellenistic Greek guise, with Macedonian month-names and a new epoch. It belongs to what we now call the Seleucid Era, but we have to distinguish two epochs for this era, a native Babylonian one and a Macedonian one. The epoch implied by Ptolemy is 1 Nisannu 311 BC, i.e. following the spring equinox of that year. This is the native Babylonian epoch, as suits the use by Ptolemy of Babylonian astronomical observations in his synchronisms. It reflects the fictitious date to which Seleukos I, Alexander's successor in Asia, backdated his accession to the kingship of Babylon. Strictly speaking this year was still year 7 of Alexander IV, Alexander the Great's son, who lost his throne and his life when he was assassinated in the following year, 310/9 BC. Despite this, documents still name the next two years after Alexander IV's death as his years 10 (308/7 BC) and 11 (307/6 BC). It is to 307 or 306 BC that Seleukos' actual accession to the kingship of Babylon belongs, although his use of the title King (*basileus*) is first recorded apparently in 305/4 BC. Why Seleukos chose year 7 of Alexander IV as his first year is a mystery (Bickerman 1944: 73-6).

The second, Macedonian epoch for the Seleucid Era, by way of contrast, was at some time in autumn 312 BC, up to six months earlier than the native Babylonian epoch. The best we can say is that it lay between 1 Loios and 1 Dios. This is partly on the basis of a royal letter of 254 BC, which provides dates for the payment by instalment for land purchased by Laodike, divorced first wife of king Antiochos II. The payments are set down as 'the first in the month Audnaios in the 60th year, the second in Xandikos, and the third in the following trimester' (Welles 1934: no. 18.21-3). This means that the months Audnaios, Peritios, Dystros, Xanthikos, Artemisios, Daisios and Panemos in succession all belong to the same, 60th, year. A papyrus (P. Dura 21), written much later in AD 87, in the month of Panemos, refers to business conducted in the month of Dios 'of the same year' (Bickerman 1944: 74 n.8). So we can add Dios and Apellaios ahead of Audnaios to stand as successive months in any given year. This suggests that New Year's Day lay at the beginning of one of the months following Panemos, somewhere between 1 Loios and 1 Dios inclusive, and therefore about halfway through the Babylonian year.

Incidentally, since this era happened to start a year before the beginning of a proper 19-year Babylonian intercalary cycle, years 1, 4, 7, 9, 12 and 15 of the era had a second Addaru/Xanthikos, while year 18 had a second Ululu/Hyperberetaios – corresponding to years 19, 3, 6, 8, 11, 14 and 17 across two standard cycles (Samuel 1972: 142; Neugebauer 1975: 356).

If we work our way forwards from the Babylonian epoch of 1 Nisannu 311 BC, Ptolemy's '75th year according to the Chaldaeans' corresponds to 237/6 BC. The astronomer provides not Babylonian month-names according to this era but Macedonian ones – Dios 14, Apellaios 5 and Xanthikos 5 – which indicates some degree of assimilation between the two calendars. How great a degree will become clear as we analyse Ptolemy's synchronisms further.

Ptolemy then gives the date in terms of its situation in the much older Era of Nabonassar ('the 512th year from Nabonassar' etc.). This era was used by the Babylonian astronomers and then adopted by the Greek astronomers to indicate the years of observations. Ptolemy uses this era and some others to compute large periods of time, as the following example illustrates:

> But from the reign of Nabonassar to the death of Alexander is a total of 424 years according to the Egyptians, and from the death of Alexander to the reign of Augustus 294 years, and from the first year of Augustus, according to the Egyptians, Thoth 1 at noon – since we establish the epochs from noon – to the 17th year of Hadrian, Athyr 7, 2 equinoctial hours after noon, is 161 years 66 days 2 equinoctial hours. And therefore from the first year of Nabonassar, according to the Egyptians, Thoth 1 at noon, until the time of the above autumnal equinox [on Athyr 7, Hadrian 17], the total is 879 Egyptian years 66 days and 2 equinoctial hours.
>
> Ptolemy, *Almagest* 3.7 (H256); cf. Toomer 1984: 168

From such calculations as these and the associated celestial phenomena, the epoch for the Era of Nabonassar can be set at 26 February 747 BC (Samuel 1972: 51-2). The era allows Ptolemy to calculate the age of the Babylonian observations he has access to. The 512th year from Nabonassar, like the 75th year in the Seleucid Era, corresponds to 237/6 BC (Mommsen 1898/1961: 369). (By the way, the date of the first year of the first Kallippic cycle, 330 BC, is derivable from Ptolemy's use of the Era of Nabonassar at *Almagest* 7.3 (H25-32). And Censorinus, *On the Birthday* 21.9, also refers to this era, letting us know that he was writing in the 986th year since the start of Nabonassar's reign, which computes to AD 238.)

Finally, we need to situate the Egyptian dates in the given years, e.g. 'Thoth 9 towards 10' in the year 237/6 BC. This is an example of a 'double date' in Ptolemy. He uses these for night-time observations only, and he seems to mean 9 Thoth for those using a dawn epoch (i.e. the Egyptians), but 10 Thoth for those using a sunset epoch (i.e. the Babylonians and the Greeks). For our purposes, then, we take the date as 10 Thoth (Toomer 1984: 12). In 237/6 BC, 1 Thoth fell on 21 October (Bickerman 1980: 118), and 10 Thoth is therefore 30 October.

So Ptolemy's synchronisms may be translated as follows: Dios 14, 75 'Chaldaean' (i.e. Seleucid) = 30 October 237 BC; Apellaios 5, 67 Seleucid = 18 November 245 BC; Xanthikos 5, 82 Seleucid = 1 March 229 BC. From these dates we can then compute the first day of the Macedonian months named by Ptolemy: Dios 1, 75 Seleucid = 16 October 237 BC; Apellaios 1, 67 Seleucid = 14 November 245 BC; Xanthikos 1, 82 Seleucid = 26 February 229 BC (a Julian leap year).

If we find the dates for the true new moon around these dates, we gain the following: 15 October 237 BC, 8:32pm; 12 November 245 BC, 11:27pm, and 24 February 229 BC, 9:21am. A day or so after these dates will lie the first visibility of the lunar crescent, and therefore the start of each month at Babylon: 16 or 17 October 237 BC; 14 November 245 BC; 25 February 229 BC.

In Babylon, the month Tashritu began, by modern calculation, in the evening of 17 October in 237 BC; Arahsamnu began on 14 November in 245 BC; and Addaru began on 25 February in 229 BC (Parker and Dubberstein 1956: 38-9; compare Samuel 1962: 45). A quick check back to the dates for the starts of the Macedonian months shows that they lie on these same dates or within a day of them. We are probably dealing, therefore, with a perfect mesh between the Macedonian and the Babylonian months: Dios for Tashritu, Apellaios for Arahsamnu, and Xanthikos for Addaru. This being so, then the equivalences between the complete set of Macedonian and Babylonian months are:

Macedonian	**Babylonian**
Artemisios	Nisannu
Daisios	Aiaru
Panemos	Simanu
Loios	Du'uzu
Gorpiaios	Abu
Hyperberetaios	Ululu
Dios	Tashritu
Apellaios	Arahsamna
Audnaios	Kislimu
Peritios	Tebetu
Dystros	Shabatu
Xanthikos	Addaru

Following the Babylonian 19-year intercalary cycle, six years gained an intercalary second Xanthikos (= Addaru), and one year a second Hyperberetaios (= Ululu). These intercalations occurred in years 3, 6, 8, 11, 14 and 19 of the cycle for the second Xanthikos, which seems to follow the Babylonian sequence, but because the Seleucid calendar began in Dios, halfway through the Babylonian year, the intercalations occur at the end of the first semester, rather than of the second. Therefore, by the time it was necessary to intercalate a second Hyperberetaios at the end of the first half of Babylonian year 17, this occurred at the end of the second half of Seleucid year 16 (compare the table in Parker and Dubberstein 1956: 37, starting the Babylonian 19-year cycle at Nisannu in Year 2, 310/9 BC, but the Seleucid cycle at Tashritu of the same year).

Just when the overall assimilation of the Macedonian months to the Babylonian calendar took place is unknown. It has been argued that it could have been as early as 245 BC, on the basis of the date of Ptolemy's first observation, or even earlier, in Alexander the Great's own lifetime, on the basis of the apparent synchronism between the Macedonian date for Alexander's death, on Daisios 29, and the Babylonian, on month 2 (i.e. Aiaru), day 29 (Samuel 1972: 141; Grzybek 1990: 29-35, 53-6; Depuydt 1997b). Against this it has been argued that the assimilation may have been as much as a century after that first observation, since it is the date of the translation of the Babylonian observations into Greek, rather than the date of the observations themselves, that is significant (Toomer 1984: 13). The distinction between synchronism and assimilation that appears to be drawn here may, however, be too fine a one. A late date for assimilation (second century BC?) does leave one wondering not only about the parallel dating of Alexander's death in the two calendars, but also about what the Byzantine scholar, John Malalas, meant when he reported that Seleukos I, Alexander's successor in Asia, 'ordered that the months of Syria [i.e. Babylonia] should be named after the Macedonian' (*Chronographia*, ed. Dindorf, 202).

The Macedonian-Babylonian synchronism also shows that by the time of its establishment the start of the Macedonian year fell halfway through the Babylonian year, and therefore about the time of the autumn equinox. The use of the Babylonian beginning of the year, at the month of Nisannu, continued under the Seleucids at least in the east of the kingdom and as late as AD 15/16, to judge from coinage minted in Seleuceia on the Tigris. It may be, in fact, that the recognition of the *Macedonian* New Year, in the month of Dios, applied only to the western half of the kingdom and then only to the Greek-speaking elements (Samuel 1972: 142).

Assimilation between the Macedonian calendar and its Babylonian counterpart in the Hellenistic period is a matter of one lunar calendar being drawn into another, more sophisticated version of the same kind. But when assimilation between the Macedonian calendar and its Egyptian counterpart occurs, as it eventually does in two stages, it represents a major paradigm shift from a lunar to an almost solar basis. It is not surprising, then, that the result of the shift is the complete demise of one of the two, namely of the Macedonian lunar calendar in Egypt. From the fourth year of the reign of Ptolemy V Epiphanes (202/1 BC) various documents use double dates which demonstrate the following synchronisation:

Macedonian	**Egyptian**
Dystros	Thoth
Xanthikos	Phaophi
Artemisios	Hathyr
Daisios	Choiach
Panemos	Tybi
Loios	Mecheir
Gorpiaios	Phamenoth
Hyperberetaios	Pharmouthi
Dios	Pachons
Apellaios	Payni
Audnaios	Epeiph
Peritios	Mesore

This system lasted until some time between the 40th and 53rd year of Ptolemy VIII Euergetes II (131/0-118/7 BC). By the end of that period a second system had been introduced, replacing the first with the following synchronisms:

Macedonian	**Egyptian**
Dios	Thoth
Apellaios	Phaophi
Audnaios	Hathyr
Peritios	Choiach
Dystros	Tybi

Xanthikos	Mecheir
Artemisios	Phamenoth
Daisios	Pharmouthi
Panemos	Pachons
Loios	Payni
Gorpiaios	Epeiph
Hyperberetaios	Mesore

This system lasts beyond the Roman takeover in 30 BC (Samuel 1962: 129-38).

5

The Calendars of Rome

The Republican calendar

The Roman calendar still forms the core of our own western calendar, in terms of the month-names, the lengths of those months and – give or take a tweak or two since antiquity – the length of the year. But the route to the present-day version of the Roman calendar is, as ever, not straightforward.

The sequence of the Roman months was the same as it still is in the western calendar: January, February, March, April, May, June, July, August, September, October, November, December. All but July and August derive directly from the calendar of the Roman Republic – those from September to December are in fact the Latin forms of the names, while the rest are anglicised versions of the originals. July and August, on the other hand, stem from two changes in the late Republic/early Empire, when the original names of Quintilis and Sextilis were altered to reflect the names of the two leading political figures of the time, Julius Caesar and Augustus (the former Octavian). In 44 BC, before Julius Caesar's assassination, the Roman Senate decreed that the month Quintilis should be called Iulius after him, because he was born in that month (Cassius Dio 44.5.2). The month Sextilis was named Augustus, in the lifetime of the emperor of that name, because it was the month in which he gained his first consulship and most important victories (Suetonius, *Augustus* 31.2). Later emperors tried to change the names of the months – most notoriously Commodus, who wanted to change the name of every month after some aspect of himself (Cassius Dio 72.15.3) – but these alterations did not take hold.

The awkward variations in the lengths of these months, which have given rise to mnemonic rhymes to help us remember them, we owe to the Romans, who arrived at them through the course of the Republican period. And the imposition of a year-length of 365 days, with a 'leap year' of 366 days every fourth year, is a system for which we can thank Julius Caesar. The refinement of avoiding a leap year in those century years of which the first two digits are not evenly divisible by four, such as 1800, 1900 and 2100, was not made until the sixteenth century, when the original Julian calendar had finally overshot the seasonal year by too many days to be tolerable, particularly to the Catholic Church.

Some scholars believe that there are signs in the names of the Roman months that the calendar was originally a ten-month calendar, which began on the first day of the month of March and then ran through the months of April, May, June, Quintilis, Sextilis, September, October, November, December. All the month-names in Latin are adjectival in form, agreeing implicitly with 'month' (*mensis*). But more than this, the names from Quintilis to December also represent literally the fifth, sixth, seventh, eighth, ninth and tenth months in a sequence which must begin with March. Certainly Macrobius (*Saturnalia* 1.12.3) and Censorinus (*On the Birthday* 20.2-3) talk of a Roman year which was originally of ten months' duration. We encountered a ten-month administrative year among the Athenians, who made it coincident with either the solar year or the lunar (see Chapter 3). But the Roman ten-month year is extraordinary in that tradition held that it was only 304 days long, and therefore considerably shorter than even the 12-month lunar year. The months were of either 31 days' length (March, May, Quintilis, October) or 30 (April, June, Sextilis, September, November, December).

If such a year really existed in practice, it would, of course, have run very quickly out of kilter with the solar, seasonal year. Macrobius in fact informs us:

> it sometimes happened that the cold weather appeared in the summer months and, conversely, the hot weather in the winter months; when this happened, as many days were allowed to be spent without the name of a month as would bring that time of the year to where the appearance of the sky would be found suitable to the present month.
>
> Macrobius, *Saturnalia* 1.12.39

Plutarch says much the same thing when he notes that before Caesar's reform of the calendar 'sacrifices and festivals shifted little by little to the seasons opposite to their dates' (*Caesar* 59.1). Despite the Romans' undoubted capacity to absorb what we would regard as huge discrepancies of up to three or four months between the calendar and the seasons down to the second and first centuries BC, Macrobius' statement that up to six months' difference would be tolerated before the necessary intercalation or suppression of days to realign the two is hard to swallow. Although ethnologists have asserted the existence of ten-month or similar calendars from Africa to New Zealand (Frazer 1929: ii.8-29), an alternative view of the Roman calendar is that it was never of ten months' duration, but probably of 12 and lunisolar from the start. By this argument six months of the year, from January to June, are theophoric in form, i.e. bearing the names of gods, and are balanced equally by another six which are numerical (Brind'Amour 1983: 266). Why this should be so remains unknown.

The Romans ascribed the creation of their own calendar to the shadowy figures of Romulus and Numa, respectively the founder and the second king of Rome (ostensibly in the eighth-seventh centuries BC). According to Macrobius (*Saturnalia* 1.13.1-7), Numa made the calendar lunar, by increasing the Roman year first to 354 days and then to 355, and divided the year into 12 months. The length of the year was increased to 354 days to accord with the time 'in which 12 circuits of the moon are completed', but then Numa afterwards added an extra day 'in honour of the odd number'. To the pre-existing ten months were added January, which was made the first of the year, and February to follow it ahead of March. The rule of the odd number extended also to the lengths of the months. Numa so organised these that each, except February, contained an odd number of days – 29 for January, April, June, Sextilis, September, November, December, and 31 for March, May, Quintilis and October; February had 28 days.

Since the intention, we are told, was to make the year align with the moon, it is curious that the Romans are presented as opting not for a pattern of alternating months of 29 and 30 days, which copes reasonably well with the vagaries of the moon's cycle, but, because of a superstitious regard for odd numbers, for a mixture of 29- and 31-day months, excepting one month of 28 days. Months of 31 days do not suit a lunar calendar, so it may seem easier to accept the story as one of accidental alignment with the moon, rather than of a conscious effort in that direction. But it may be fairer to see in it a telescoped version of two separate stages in the development of the Roman calendar, first to a lunar one, then to a lunisolar one in which the months are more or less divorced from their lunar origins (Michels 1967: 125).

Nonetheless, there are undoubtedly lunar elements to the subdivisions of the pre-Julian Roman months. Each month was divided into three parts: at the Kalends (*kalendae*) on day 1; then the Nones (*nonae*) at day 5 (in the shorter months) or 7 (in the 31-day months); and the Ides (*idus*) on day 13 (in the shorter months) or 15 (in the longer). Varro, writing just about the time of the Julian reform of the calendar in the mid-first century BC, explains the term *kalendae* as deriving from the fact that the Nones of a month are called (*calantur*) on the Kalends. He provides us with the formula spoken by the priest who did the calling: '*kalo Iuno Covella*' ('I call, o Juno Covella'), which was repeated five times if the Nones were to fall on the fifth day of the month, and seven times for Nones on the seventh (*On the Latin Language* 6.27). Macrobius (*Saturnalia* 1.15.9-11) explicitly derives the word *kalendae* from the Greek verb *kalo* (I call), on the basis of the same story as Varro's. He describes the event in more detail, which demonstrates the lunar aspect: originally a minor priestly official was delegated the task of watching for the first sign of the new moon and then reporting its appearance to the high priest. A sacrifice would then be offered, and another priest would summon the people and announce the number of days that remained between the Kalends and the Nones, 'and in fact he would proclaim the fifth day with the word *kalo* spoken five times, and the seventh day with the word repeated seven times'. The first of the days thus 'called' was named *kalendae* after *kalo*. It is also important to note here that the people invested with the authority to deal with the calendar were the *pontifices*, a college of priests. Religion, as we shall have further cause to see, was a fundamental part of the calendar's *raison d'être*.

All three divisions of the month would seem to represent notional lunar phases: from new moon (*kalendae*), to first quarter (the name *nonae* simply signifies eight days – nine by Roman inclusive reckoning – before the next division), to full moon (the name *idus* may stem from a Greek word for the full moon, as Macrobius reports among other derivations (*Saturnalia* 1.15.14-17)). The fixing of the Nones at 'nine' days before the Ides suggests that, while the division of the month at this point may well reflect a lunar basis (at first quarter), the Romans must already have moved away from a strictly observational calendar, since the time between the first quarter and the full moon is not so fixed in reality, but varies from six-and-a-half to just over eight days (Michels 1967: 131-2).

The remaining days of the month were numbered according to their relationship to one of these three divisions, using inclusive and prospective reckoning. Days before the Nones and Ides gain a day by this system: thus, 2 January was designated *ante diem IV nonas Ianuarias* – the fourth day before the Nones of January (where the Nones fall on 5 January). Days between the Ides and the end of the month, on the other hand, gain two days in the reckoning, because of the Roman habit of including the next month's Kalends in the count and the name of the date: so 21 December was called *ante diem X kalendas Ianuarias* – the tenth day before the Kalends of January (where December at this stage had 29 days, and one must add 21 December as well as 1 January).

The months were further divided by Numa, according to Macrobius (*Saturnalia* 1.16.2-5), into days of specific character for sacred and secular business. Each day was designated a 'festival day' (*dies festus*), dedicated to the gods; or a 'non-holiday' (*dies profestus*), i.e. a working day, available for public and private business; or a 'divided day' (*dies intercisus*), split between sacred and secular business. There were further divisions of these days, so that festival days included sacrifices, banquets, games and holidays (*feriae*); while working days included 'lawcourt days' (*fasti*), 'assembly days' (*comitiales*), 'adjournment days' (*comperendini*), 'appointed days' (*stati*), and 'battle days' (*proeliares*).

Public holidays (*feriae*) were still further subdivided into four kinds: 'fixed' (*statiuae*), 'movable' (*conceptiuae*), 'extraordinary' (*imperatiuae*), and 'market days' (*nundinae*) (Macrobius, *Saturnalia* 1.16.5). Lawcourt days (*fasti*) were technically those days on which the magistrate, the praetor, could utter the words 'I grant, I pronounce, I award' (*do, dico, addico*), which are associated with formulae for judgement in court cases (Varro, *On the Latin Language* 6.30, Macrobius, *Saturnalia* 1.16.14). Opposed to the *fasti* were the days called *nefasti* ('non-court days'), on which legal action requiring these formulae could not take place. 'Assembly days' were those on which a motion could be brought before the people; while 'adjournment days' were those on which bail could be set for appearance in court; and 'appointed days' were those fixed for cases involving a foreigner. Finally, 'battle days' were those on which property could be reclaimed or an enemy attacked (Macrobius, *Saturnalia* 1.16.14-15).

The calendar from Antium

Some of these literary definitions help us to understand the abbreviations on painted or inscribed calendars which survive from the Republic and Empire. These present a large amount of information in a highly compressed form, rather like old British coins with their Latin abbreviations. The sole surviving Republican calendar predating the reforms of Julius Caesar is that from Antium, south of Rome, the *Fasti Antiates Maiores*. This dates to 84-55 BC, and its preserved fragments cover just over half the year. Originally it measured 1.16 by 2.5 m, so it was an imposing calendrical monument in its own right. The month of June runs as shown opposite, in the original Latin and with restorations.

The whole calendar starts on 1 January with a column on the far left which presents a continuously repeated sequence of the eight letters from A to H from 1 January to 29 December, by which day it has reached C. When it has got to 1 June, the sequence is at the letter E, and it runs through the month until it reaches 29 June and the letter A; 1 July then follows with B.

These letters are called the nundinal letters. No Roman author explains their presence in these public calendars, but it is assumed that the Augustan poet Ovid must be referring to them near the beginning of his poem on the Roman calendar, the *Fasti*. After giving his definitions of the festival, working and divided days, and then the assembly days, he mentions the type of day 'which always returns from a cycle of nine' (*Fasti* 1.47-54). This 'cycle of nine' is presumably the *nundinae*, which is this eight-day week in the calendar, marked by the first eight letters of the alphabet, but counting as nine days because of the Roman habit of inclusive reckoning from the last day of the previous week. The name *nundinae* came to mean 'market day', because the Romans held their markets on the last day of the cycle. In the public calendars, like the one from Antium, the letters A-H appear to be meant to help people keep track of this nine-day, nundinal cycle. In any given year it would be possible to know which were the market days that year because they would carry the same letter of the alphabet through the year.

E	K • IVN • N	
		— MARTI • IN • CL IVNON • IN
F	F	
G	C	
H	C	
A	NON • N	
		— DI • FIDI
B	N	
C	N	
D	N	
E	VESTAL • N	
		— VESTAE
F	N	
G	MATR • NP	
		— MATRI • MATV FORTVNAE
H	N	
A	EIDVS • NP	
B	N	
C	Q • ST • D • F	
D	C	
E	C	
F	C	
G	C	
		— MINERVAE
H	C	
A	C	
B	C	
C	C	
D	C	
E	C	
F	C	
G	C	
		— LARV
H	C	
A	C	
X	X I X	

After Degrassi 1963: 12-13; Michels 1967: fig. 4

The second column for June begins with the letter K, followed by the abbreviation IVN. This stands for *Kalendae Iuniae*, the Kalends of June. Further down in this column will be found NON, indicating *nonae*, the Nones, on the fifth day; and EIDVS, signifying *idus*, the Ides, on the 13th day.

Elsewhere in the same column are the letters F, C and N. These stand respectively for *fastus*, a 'lawcourt day'; *comitialis*, an 'assembly day'; and *nefastus*, a 'non-court day'. To judge from the entry for November, which alone in the year has no days of uncertain character, there was an underlying pattern to the days marked F and C. The Kalends of November, the Nones, the day following each of these, and the day after the Ides are all F days. All other days in November are C days. In the remaining months of the year, this pattern holds except on days whose character is other than F or C. In other words, there are no certain instances of a day which is F in November being a C in another month, or vice versa (Michels 1967: 33).

One other 'letter' occurs in this column in June. 11 June and the Ides of June on the 13th are characterised as NP days. We do not know precisely what this means. On the calendar itself it looks like an N whose top right corner turns over in a loop, and it therefore is suggestive of the letters N and P run together. No ancient source defines this symbol, and several attempts have been made to unlock its mysteries. It is usually taken as a ligature combining the letters N and P. A common view is that these stand for *nefastus publicus*, which indicates that the day so designated is like a *nefastus* day, on which lawcourts cannot do business, but is also a day on which the great public festivals, *feriae publicae*, can be held (Michels 1967: 76; Beard-North-Price 1998: 62). But an alternative reading of the letters as meaning *nefastus purus* still has its adherents, and it too retains the notion of a day whose character changes partway through (Brind'Amour 1983: 227). On the Ides of June the celebrations included flute-players, who were to meet at the temple of Minerva, being allowed to wear masks and roam through the streets drunk (Varro, *On the Latin Language* 6.17; Censorinus, *On the Birthday* 12.2). The characterisation of 11 June as an NP day has been questioned, as later calendars record it as an N day; either the nature of the day changed over time, or one of the calendar writers made a mistake (Michels 1967: 184).

15 June has a special characterisation beyond those designated F, C, N or NP days. It is labelled Q. ST. D. F., which stands for *Quando Stercus* (or *Stercum*) *Delatum Fas*, i.e. 'when it is lawful for *stercus* to be taken out'. This is the day 'on which *stercus* is swept from the temple of Vesta and taken through the Capitoline hill to a particular place' (Varro, *On the Latin Language* 6.32). *Stercus* should mean 'dung', but some have found it hard to believe that the temple of Vesta was full of this, and so have suggested just 'trash' as a translation (Holland 1961: 319-21). Anyway, regardless of the precise content of the mess, rather appropriately this day was *nefastus* up to the point of the cleansing, but *fastus* thereafter.

Six other entries for June require comment. These are days on which certain major festivals were held: on the 1st, 5th, 9th, 11th, 19th and 27th. MARTI IN CL, on 1 June, stands for *Marti in cliuo* ('for Mars on the hill'), and refers to a festival which was associated with the temple of Mars on the via Appia, two kilometres from the porta Capena in the south-east of Rome (Ovid, *Fasti* 6.191-2). The *cliuus Martis* was originally a rise in the road leading to the temple (Platner and Ashby 1926: 123-4, 327-8; Haselberger et al. 2002: 165, 256-7), and the festival may have celebrated the dedication of the temple. The military character of the site is illustrated by the fact that this was where troops assembled on their way to war (cf. Livy 7.23.3).

We know less for certain about the other festival on 1 June, simply because the inscription on the calendar is incomplete, but we can make educated guesses. The festival and temple of Juno Moneta are mentioned by Ovid (*Fasti* 6.183-4) in his entry for the Kalends of June, while Macrobius (*Saturnalia* 1.12.30) records that the temple of Juno Moneta was dedicated on that day. On this basis, the calendar entry may be restored as IVNON IN ARCE, which is slightly shorthand for *Iunoni in arce*, 'for Juno on the Arx', a reference to the festival celebrating the dedication of the temple of Juno Moneta on the northern part of the Capitoline hill called the Arx (Degrassi 1957: 31; Invernizzi 1994: 64-5; Haselberger et al. 2002: 153).

The festival on the Nones of June, DI FIDI, is *Dio Fidio* ('to Dius Fidius'), which is part of the name of the old Sabine god Semo Sancus Dius Fidius. Ovid's entry for this day has the god claim for himself three of the names:

> I asked if I should refer the Nones to Sancus or to Fidius
> or to you, father Semo; then Sancus said to me:
> 'To whomever of these you give it, I shall have the gift:
> I bear three names: thus did Cures wish it.'
> Therefore the Sabines of old presented him with the temple
> and established it on the Quirinal ridge.
>
> Ovid, *Fasti* 6. 213-18

As VESTAE in the calendar signifies, the festival on 9 June was that in honour of Vesta, the Vestalia. The principal object kept in her temple, at the east end of the Roman Forum, was not an image of the goddess (there was none), but a perpetual fire, a clear symbol of this goddess of the hearth (Steinby 1993-2000: 5.125-8; Haselberger et al. 2002: 256). Ovid (*Fasti* 6.249-348) expatiates at great length on this festival.

11 June marks two festivals: that of the Matralia, and that for Fortuna. The Matralia were held in honour of Mater Matuta (MATRI MATV in the calendar stands for *Matri Matutae*), a goddess devoted to mothers. Her temple stood in the Forum Boarium, and again we are witnessing the celebration of the dedication of the temple at this festival (Steinby 1993-2000: 3.281-5; Haselberger et al. 2002: 127). Similarly the dedication of the temple of Fortuna, also in the Forum Boarium, was celebrated on this day. Both had been burned in 213 BC, but restored together in the following year by magistrates appointed specifically for the purpose (Livy 25.7.6).

On 19 June is held the celebration in honour of Minerva (MINERVAE in the calendar). Her temple on the Aventine hill was, according to some sources, dedicated on this date (Ovid, *Fasti* 6.728; Steinby 1993-2000: 3.254; Haselberger et al. 2002: 168). And finally, the entry for 27 June, LARV, may be interpreted at least partly as a reference to a festival celebrating the dedication of a temple to the Lares, the household gods, as Ovid (*Fasti* 6.791) implies for this day. A temple for them stood on the via Sacra in Rome (Platner and Ashby 1926: 314-5; Haselberger et al. 2002: 160). The letter V may then signify another god's festival, which is otherwise unknown (Degrassi 1963: 28).

At the very bottom of the column for June is written XXIX, which simply indicates in Roman numerals the sum of days in the month: 29.

Intercalation in the Republic

The year attributed to Numa, with its non-lunar months of 29 or 31 days, is essentially the calendar of the Republic which lasted until Julius Caesar's reforms in 45 BC, i.e. it is the so-called pre-Julian calendar. Can we get outside the realm of legend and date its introduction? Cicero (*Republic* 1.25) records a solar eclipse on the Nones of June in about the 350th year after the founding of Rome. This should place the event about 400 BC, although the precise year itself is not the significant part of this story. It is rather the notion that an eclipse could take place at a time other than at the actual new moon, which ought to have marked the Kalends, not the Nones. So by about 400 BC the Romans would seem to have given up an observational lunar calendar. The shift is usually associated by historians with the second Board of Ten (the Decemvirate), who, Macrobius tells us (*Saturnalia* 1.13.21), brought a bill relating to intercalation before the people. This would be about 450 BC, if such a Board existed, although doubts have been expressed about its historicity (Drummond 1996: 435).

Macrobius describes how the Romans attempted to introduce an intercalary cycle similar to the Greek octaeteris. The Greeks neatly added three months of 30 days over a period of eight lunar years to bring the lunar cycle pretty well back into line with the solar. The version of this story as told by Solinus (1.42) has these 90 days (expressed in terms of the $11^1/_4$ days' difference between the solar and lunar years multiplied by 8) added by the Greeks holus-bolus at the *end* of the eight lunar years, whereas we saw in Chapter 2 that they were inserted a month at a time in different years, in various formulations of the octaeteris. The Romans, on the other hand, are supposed to have added the requisite 90 days through *four* intercalations, alternately of 22 and 23 days, every two years. Such an awkward length for an intercalary month also suggests that the Romans had decided to forgo any observational correspondence between their calendar and the moon. Over a period of eight years, then, the Roman system covers 2930 days [(355 x 8) + 90], instead of 2922 days [(354 x 8) + 90, or ($365^1/_4$ x 8)], and produces an average year of $366^1/_4$ days, a very close approximation to the solar year of $365^1/_4$ days. This result, in turn, suggests that the Romans abandoned the lunar calendar in favour of an attempt to follow the solar year (Samuel 1972: 159). Unfortunately the intercalary cycle so created is built on the flawed foundation of a year consistently 355 days long, so that the Roman system overshoots both the Greek lunisolar octaeteris and eight solar years by a margin of eight days in that period.

The intercalation itself was inserted in a curious fashion. It was always in February, but the reason given for this is problematic. Varro (*On the Latin Language* 6.13), at one end of the Roman Imperial period, and Macrobius (*Saturnalia* 1.13.14) at the other both say that the insertion was made in February because this was the last month of the year. This reflects a confusing state of affairs, not so much because December was the last month in both authors' times, but more because Macrobius also tells us that Numa added January and February as the first two months of a new 12-month year. So February could not have been the last month of the year in the tradition Macrobius is following at this point in his narrative. It may be that there was another tradition which held that the 12-month year ran originally from March to February but that at some stage, still in the very distant past, the beginning of the year was shifted by Numa to January. Adding to the confusion, Ovid (*Fasti* 2.47-54) has January as the first month, while February originally came last, a situation which requires February then to have been inserted between January and March at some point. The insertion of an intercalary month is often made in ancient calendars either in the middle of a year or at its end, so there may still be some truth in the tradition that February was originally the last month of the year (Ginzel 1906-14: II, 227-8; cf. Samuel 1972: 164-5). The surviving physical Roman calendars do not help on this score. The Republican calendar from Antium simply places the intercalary month right at the end of the year in a 13th column following December, presumably because of the difficulty of representing the reality of the insertion (Michels 1967: 25).

Both Varro and Macrobius state that rather than coming at the end of the month the 22 or 23 intercalary days were placed after the 23rd day of February. The remaining five days of this month were then tacked on to the end of the intercalary month (called *mensis intercalaris*, but also nicknamed 'Mercedinus' or 'Mercedonius', according to Plutarch, *Numa* 18.3, *Caesar* 59.2), thus bringing it effectively to 27 or 28 days' length. Censorinus (*On the Birthday* 20.6) puts the intercalation 'in February between the Terminalia and the Regifugium', i.e. between two religious festivals, the former falling normally on the 23rd, the latter on the 24th. Varro (*On the Latin Language* 6.13) calls the day of the Terminalia the last day of the year. He was writing at the end of the Republic in the mid-first century BC – the work was partly dedicated to Cicero, who died in 43 BC – and so reflects a situation with which he would have been very familiar, unlike Macrobius or Censorinus, who wrote a considerable time after the Julian reform, and who therefore may have been trying to explain something which they had difficulty understanding. Because of its name the festival of the Terminalia may seem appropriate as a calendrical boundary-marker, but in fact Terminus, the god honoured, guarded physical, geographical boundaries, not, it seems, temporal ones (Ovid, *Fasti* 2.639-84).

At one point of his Roman history, Livy (43.11.13) tells of the beginning of an intercalary month being 'on the third day after the Terminalia', which, by Roman inclusive reckoning, translates to 25 February. But at another point (45.44.3) he has the beginning of another intercalary month falling 'on the day after the Terminalia', which means 24 February. The calendar from Antium has a fixed 27 days in the separate column after December which is identified as the intercalary month, so it admits of no variation in length for the month. The resolution to these apparently inconsistent pieces of evidence may be that the intercalary month was always of 27 days' length, but that it might begin on either 24 February or 25 February, thus effectively giving the intercalary year an extra 22 or 23 days respectively (Michels 1967: 161).

What biennial intercalation, with alternating additions of 22 and 23 days, could do to the calendar year with respect to the solar year may be gauged from the following hypothetical cycle of four Roman civil years set next to four years run according to our present calendar, which is effectively the Julian calendar which replaced the Republican. In Year 2 in the following Table, February stops at the 23rd, then an intercalary month of 22 days plus the remaining five days from the end of February are inserted. In Year 4, February stops at the 24th, then 23 days plus the remaining four from February make up the intercalary month. For simplicity's sake, the fourth year in the cycle is the Julian leap year.

By the end of the sequence, the Roman year (in the left-hand column) has run four days out of alignment with the solar year. Correction of this error, Macrobius informs us, was achieved by intercalating not 90 days but 66 days every third octennium, that is, 24 days fewer than expected, on the basis that the 24 supernumerary days that the Roman system would have generated over three eight-year cycles could thus be suppressed. Intercalation of 66 days would represent three 22-day periods in the third eight-year cycle, instead of two 22-day and two 23-day intercalations.

It is disputed whether this refinement of biennial intercalation was ever

Civil dates	Julian dates
Year 1	
1 – 29 January	1 – 29 January
1 – 28 February	30 January – 26 February
1 – 31 March	27 February – 29 March
1 – 29 April	30 March – 27 April
1 – 31 May	28 April – 28 May
1 – 29 June	29 May – 26 June
1 – 31 Quintilis	27 June – 27 July
1 – 29 Sextilis	28 July – 25 August
1 – 29 September	26 August – 23 September
1 – 31 October	24 September – 24 October
1 – 29 November	25 October – 22 November
1 – 29 December	23 November – 21 December
Year 2	
1 – 29 January	22 December – 19 January
1 – 23 February	20 January – 11 February
1 – 27 Intercalary	12 February – 10 March
1 – 31 March	11 March – 10 April
1 – 29 April	11 April – 9 May
1 – 31 May	10 May – 9 June
1 – 29 June	10 June – 8 July
1 – 31 Quintilis	9 July – 8 August
1 – 29 Sextilis	9 August – 6 September
1 – 29 September	7 September – 5 October
1 – 31 October	6 October – 5 November
1 – 29 November	6 November – 4 December
1 – 29 December	5 December – 2 January
Year 3	
1 – 29 January	3 – 31 January
1 – 28 February	1 – 28 February
1 – 31 March	1 – 31 March
1 – 29 April	1 – 29 April
1 – 31 May	30 April – 30 May
1 – 29 June	31 May – 28 June
1 – 31 Quintilis	29 June – 29 July
1 – 29 Sextilis	30 July – 27 August
1 – 29 September	28 August – 25 September
1 – 31 October	26 September – 26 October
1 – 29 November	27 October – 24 November
1 – 29 December	25 November – 23 December
Year 4	
1 – 29 January	24 December – 21 January
1 – 24 February	22 January – 14 February
1 – 27 Intercalary	15 February – 12 March
1 – 31 March	13 March – 12 April
1 – 29 April	13 April – 11 May
1 – 31 May	12 May – 11 June
1 – 29 June	12 June – 10 July
1 – 31 Quintilis	11 July – 10 August
1 – 29 Sextilis	11 August – 8 September
1 – 29 September	9 September – 7 October
1 – 31 October	8 October – 7 November
1 – 29 November	8 November – 6 December
1 – 29 December	7 December – 4 January

Table 5. Roman biennial intercalation.

utilised for any great period of time, if at all. The system is not mentioned anywhere else beyond Macrobius and so it may be nothing more than a later theorist's attempt to make Roman biennial intercalation work, which has then been reported uncritically by Macrobius (Michels 1967: 169). It is then assumed that instead the Romans, like the Greeks, practised intercalation on a haphazard basis.

Another feature of the Antium calendar that is worth noting in this context is how it arranges the nundinal days for the intercalary month. The month of February starts at its Kalends with the letter F, and ends on 28 February with an A. March then follows with a B on the Kalends. The intercalary month, on the other hand, starts with a G (this part is lost but can be restored from what survives) and runs through to its 27th day where it has an A. Since the month was inserted after 23 February (a D day) or 24 February (an E day), we might expect the Kalends of the intercalary month to follow with an E or F day so as to continue February's sequence. But what must have driven the nundinal series in this month was more how it dovetailed into March, and therefore kept the overall annual sequence running normally. March, we saw, begins with a B. Therefore the day before it, whether it be in February or the intercalary month, would have to be an A day. And this is precisely what we find in the calendar: both February and the intercalary month end with an A day. In the case of the intercalary month, the devisers of the calendar must then have worked backwards from this point until they reached the Kalends, which has to be a G day (Michels 1967: 25-6).

The announcement of a forthcoming intercalation could certainly be left very late in the piece, which could mean well into February. It seems to have been a matter open to persuasion at times, to judge from Cicero's wondering, on his way in June–July 51 BC to his province of Cilicia for a year, whether he should ask his friend Atticus back in Rome to 'fight any intercalation' (*Letters to Atticus* 5.9.2, 5.13.3). Even by 13 February 50 BC Cicero does not know whether an intercalation has been decided upon (*Letters to Atticus* 5.21.14). Although some delay must be expected between an announcement of the decision in Rome and the arrival of news of it at Laodicea in Phrygia, where Cicero had based himself by then, this is still perilously close to the 23rd of the month.

By this stage Cicero's frustration at the prospect of his year of office in the province being extended by a month, thus keeping him longer from the real business in Rome, has been replaced by a concern that the date of some religious 'Mysteries' might be affected by an intercalation. Which Mysteries are meant is not made clear here, but the Liberalia of 17 March seem likely, since Cicero refers to them later as the occasion on which he will bestow the *toga uirilis* on his nephew 'as if there were no intercalation'

(*Letters to Atticus* 6.1.12; Brind'Amour 1983: 97); intercalation, of course, would have delayed the Liberalia and the boy's coming of age by a month.

By 20 February continued uncertainty about the state of the calendar has driven Cicero to date his letter of that day from the Terminalia, rather than from the Kalends of the next month (the normal Roman practice), because he does not know whether that month will be called March or the intercalary month (*Letters to Atticus* 6.1.12). Only a letter from Caelius Rufus to Cicero happens to tell us that in the end there was no intercalation that year (Cicero, *Letters to Friends* 8.6.5), so it looks as though Cicero's contacts back in Rome had won the day on his behalf.

Elsewhere Cicero (*On Laws* 2.29) lists negligence as one of the causes for haphazard intercalation in the past, but his own hopes of persuasion by his friends in his absence overseas imply other causes. Indeed other authors are more open and damning, accusing the priests of impropriety and corruption on behalf of their business and political friends, who would have reasons driven by hopes of personal gain for shortening or lengthening the year (Suetonius, *Caesar* 40; Censorinus, *On the Birthday* 20.7; Solinus 1.43; Ammianus Marcellinus 26.1.12).

Certainly over the last two centuries BC something went seriously awry in the calendar on occasion, yet at other times it seems to be reasonably in harmony with the seasons. A discrepancy between calendar and sun would be felt acutely in the Roman system at the interface between the political and the military worlds (Warrior 1992: 131-7). A consul absent from Rome on a military campaign was bound by the campaign season, which was necessarily a function of the seasonal year. Yet he was also locked into the political year, which began in mid-March and which could require him to be in Rome to conduct business. This very disjuncture occurred in 193 BC, when the civic and military years were badly out of alignment. Both consuls were out on campaigns, but to one of them had fallen the lot of conducting the elections for the coming year. His campaign was not yet finished, so he sought leave from the Senate for the elections to be run by his colleague or by an *interrex*, a senator brought in especially for the purpose. The issue was resolved by the coincident availability of the other consul, whose military campaign happened to be over, and who could therefore return to Rome to conduct the elections in his colleague's absence (Livy 35.6.2-3).

For 190 BC Livy records:

> On those days, in which the consul [L. Cornelius Scipio] set out for war, during the Games of Apollo, five days before the ides of Quintilis, in a clear sky in the daytime the light was obscured, when the moon went under the circle of the sun.
>
> Livy 37.4.4

'Five days before the ides of Quintilis' equates to 11 July. A solar eclipse did occur in 190 BC and was visible from Rome, but by modern calculation it happened on 14 March, not 11 July. This leaves a four-month discrepancy between calendar and sun, which presumably resulted from very poor intercalation practices over a considerable period of time. That this calculation is accurate for this particular year is demonstrated by the continuation of Livy's narrative, in which the praetor, L. Aemilius Regillus, sets out from Rome on the same day (37.4.5) for the Piraeus at Athens, sails across the Aegean, stopping at Chios, and eventually anchors at Samos (37.14.1-4). A meeting takes place there at which one participant, Eumenes, the king of Pontus, happens to refer to the forthcoming summer (Livy 37.15.3). Yet allowing for the passage of time since 11 July, the meeting should have occurred at the end of that month if not in August, already well into the season of summer. So the calendar in 190 BC was certainly running well in advance of the seasons (Brind'Amour 1983: 145).

By 168 BC the misalignment between calendar and sun had shrunk from four months to two and a half. A reduction on this scale over this number of years indicates that there must have been intercalation in more than just alternate years, and therefore sometimes in successive years during this period (Warrior 1992: 137-44).

For the period from about 150 to the 60s BC reasonable synchronisms between the calendar and the seasons seem to exist. For 109 BC, for instance, the historian Sallust (writing around 40 BC) records that soldiers were summoned from their winter quarters in January for active service, and marched in severe wintry weather, which turned a muddy plain into a marshy lake with the winter rains (*The Jugurthine War* 37.3-4). The association here between January and winter is better than what pertained in 190 BC, and the same may be said for 62 BC, when hoar frost and snow accompany Catiline's troops at Pistoria in early January (Cicero, *For Sestius* 12).

Nevertheless, however close the correspondences between season and calendar may have been in these years, a significant drift away from synchrony occurred through the 50s, to the point that it would take the insertion of 90 days in 46 BC to bring everything more or less back in order.

The Julian calendar

In 46 BC Julius Caesar ordered a wholesale revision of the calendar to the point of dismissing the quasi-lunar calendar of the Republic and adopting a purely solar one. The new calendar had an average year of 365¼ days, with the quarter-day being absorbed into an extra single whole day added every fourth year. After describing the corrupt practices of the *pontifices* with regard to intercalation down to Caesar's time, Censorinus gives the story of the changeover:

> Things had deviated so much that Gaius Caesar, as *pontifex maximus*, in his third consulship and that of M. Aemilius Lepidus, in order to correct the past mistake, inserted between the months of November and December two intercalary months of 67 days, since he had already intercalated 23 days in the month of February, and made that a year of 445 days, at the same time taking care that the mistake would not be repeated in future; for with the intercalary month done away with, he shaped the civil year to the course of the sun. And so to the 355 days he added ten, which he distributed through the seven months which had 29 days as follows: two days were added to January, Sextilis, and December, and one to the others; and he placed these days at the ends of the months, evidently so that the religious ceremonies of each month might not be moved from their place. Therefore now, although there are 31 days in seven months, nevertheless four are distinguished by this feature of the original tradition, that they have the Nones on the seventh day, while the other three remaining ones have them on the fifth.
>
> Moreover, to take account of the quarter of a day, which in fact would appear to complete the year, he ordered that after a period of four years had been completed, a single day, which is now called the bissextile, should be intercalated after the Terminalia, where a month formerly used to be. From this year, thus regulated by Julius Caesar, the rest down to our lifetime are called Julian, and they start in the fourth consulship of Caesar.
>
> Censorinus, *On the Birthday* 20.8-11

Macrobius (*Saturnalia* 1.14.6-12) tells the same tale at even greater length, and we shall return to some of his details soon. This solar year of $365^1/_4$ days had been discovered earlier, but had never been put to use. In Chapter 3 we noted that in 330 BC the Greek astronomer Kallippos proposed a method of achieving it by combining four Metonic cycles of 19 years each into a period of 76 years, from which one day was to be dropped (Geminos, *Introduction to Astronomy* 8.59-60). This gave a total of 27,759 days over 76 years, and therefore an average year of $365^1/_4$ days. Only astronomers, however, appear to have used this cycle. Then we saw in Chapter 4 that in 238 BC Ptolemy III Euergetes had decreed the addition of an extra day every fourth year into the Egyptian calendar of 365 days, so as to create an average year of $365^1/_4$ days and thus to correct the drift of the Egyptian year from the solar year, but even this royal decree too was ignored.

Significantly, in his own calendar reform Caesar had the services of Egyptian astronomers, whose expertise he called on while he was in Alexandria helping to put Cleopatra back on the throne (Appian, *The Civil War* 2.21; Cassius Dio 43.26). Pliny ascribes the assistance specifically to 'Sosigenes, skilled in this knowledge' (*Natural History* 18.211). The astronomer's name suggests that if he was Egyptian, he was also Greek, as we would expect of someone living in the Alexandria of the Ptolemies.

Agricultural calendars

Just what the nature of the collaboration was between the Roman politician and the Alexandrian astronomer, we do not know. Pliny refers to Caesar's reform in the context of naming the sources of star observations for his farmer's calendar, and it is plain from this that Caesar himself was credited with observations for a parapegma. We have already seen how Greek parapegmas were essentially solar in their basis, so some link between his own star observations, the solar year and the dreadful disorder of the Roman calendar at the time may have drawn Caesar to seek the assistance of an astronomer like Sosigenes.

That the kind of information provided by the parapegmas – of star-rise and star-set, of the concomitant weather changes, and of the seasonal boundaries – did not become obsolete for the Romans with the introduction of the solar calendar by Caesar, is demonstrated by the continued use of such data both in the massive 'sundial' (*horologium*) built for Augustus in 10/9 BC in the Campus Martius in Rome (Buchner 1982), and in the farmer's almanacs written after the time of the calendar reform.

Varro in 37 BC wrote a treatise, in which he incorporated solar, stellar and meteorological observations to mark out the main divisions of the agricultural year (*On Farming* 1.27-36). In the 60s AD Columella wrote the most systematic work on the agricultural cycles, and, like Varro, he structured the various activities into periods which were bounded by astronomical observations, as is demonstrated by the following extract on bee-keeping – whose product, honey, was as important to the ancient world as sugar is to ours (McLeod 2003) – drawing on Hyginus' book on the same subject of about 30 BC:

> Next comes the management [of bees] over the year, as the same Hyginus has most usefully published. From the first equinox, which occurs in the month of March, about eight days before the Kalends of April in the eighth degree of Aries, until the rising of the Pleiades [*Vergiliae*], 48 days of springtime are counted. During these, he says that the bees should be looked after first by having the hives opened, so that all dirt, which has built up during wintertime, may be removed, and, after the spiders, which ruin the honeycombs, have been removed, smoke may be introduced, made from burnt cattle dung. For this is very suitable for bees as if from some affinity of kind.
>
> Columella 9.14.1

A decade later Pliny included star observations in the farmer's manual which occupies Book 18 of his *Natural History*. The period marked out by Hyginus and Columella is here filled even more richly with astronomical markers by Pliny, in his usual telegrammatic style:

> The vernal equinox appears to occur on 25 March. From then to the morning rising of the Pleiades [*Vergiliae*]: 1 April according to Caesar signifies [a change in the weather]. On 3 April in Attica the Pleiades are hidden in the evening, and the same on the next day in Boeotia, but for Caesar and the Chaldaeans on 5 April, while for Egypt Orion and his sword begin to be hidden. For Caesar on 8 April rain is signified by the setting of Libra. On 18 April for Egypt the Piglets set in the evening, a violent constellation and boisterous on land and sea; the 16th for Attica, the 17th for Caesar signifies [a change in the weather] for four successive days, but for Assyria on the 20th. This constellation is commonly called Parilicium, because 21 April, the birthday of the city of Rome, on which fine weather usually returns, has given clarity for observation, although on account of the clouds the Greeks call it the Hyades, which our people, from the similarity of the Greek name, supposing it in their ignorance to have been given with reference to 'pigs' [*sues*], have called the Piglets [*suculas*]. For Caesar on 24 April also the day is marked. On 25 April for Egypt the Kids rise, on 26 April for Boeotia and Attica the Dog sets in the evening, the Lyre rises in the morning. On 27 April for Assyria all of Orion is hidden, but on the 28th the Dog. On 2 May for Caesar the Piglets rise in the morning, and on 8 May rainy Capella, but for Egypt on the same day the Dog sets in the evening. Thus generally to 10 May, which is the rising of the Pleiades, do the constellations run.
>
> Pliny, *Natural History* 18.246-8

The extended catalogue of stars presented here is not unusual in Pliny's manual, but, as though in self-conscious awareness of the degree of unnecessary detail he has just gone into with the constellations, he soon afterwards waxes lyrical with a remarkably poetic (not to say articulate) hymn in praise of nature's own land-based 'stars', the glow-worms, whose well-timed light makes the star observations otiose (*Natural History* 18.250-3).

The one detail in the catalogue which may strike one as irrelevant – the nicknaming of the Hyades/Piglets as 'Parilicium' – is in fact directly to Pliny's purpose. The name is a reference to the appropriately agricultural festival of the Parilia on 21 April. It is marked as PARIL in the calendar from Antium, and appears on others later. Held in honour of a divinity called Pales, the festival was essentially one of reparation for any wrong done to the gods by a farmer in the course of the year, and hence of prayer for good fortune on his flocks and crops. Ovid provides a lengthy account of such a farmer's prayers (*Fasti* 4.721-82). The day of the Parilia was also supposed to be the day on which Rome was founded by Romulus and Remus, the latter of whom died in the process (Ovid, *Fasti* 4.807-62: 'the rites of Pales were at hand', the poet records at 820). The date remains today the one on which Rome celebrates its founding.

Apart from showing that the parapegma is alive and well, albeit in a different form and perhaps more to delight the armchair farmer than to assist the real tiller of the fields, another significant feature of these almanacs is that they represent the centrality of the seasonal, and therefore solar, year to the Roman mentality at this time. Yet this is not to say that the old lunar aspect of the calendar has been completely erased by the Julian reform.

On the contrary, we find in these agricultural guidebooks even more reference to lunar influences than we ever did in the Greek world. Early in the Greek tradition, Hesiod had listed days of good or bad omen in the lunar months, though without explicitly tying them to the moon's influence. After him, however, Greek literature is reticent on this issue (West 1978: 347-8). In contrast, Varro and his fellow armchair agriculturalists provide an astonishing amount of folklore to do with the lunar influences on farming activity. According to this lore, crops should be planted generally just before the moon begins to wax, or during the waxing period: as the moon grows, so too, the Romans seem to have believed, will the plants. And by the same token, harvesting should take place during the waning moon. Variations are allowed, depending on the nature of the end product: grapes, for instance, may be picked under the waning moon if they are to be dried, but under the waxing moon if they are meant for making wine (Taverner 1918). These rules lead to some amusing offshoots, so to speak: the time for having one's hair cut was supposedly governed also by the moon, and one should avoid having it cut at the time of the waning moon, for fear of going bald (Varro, *On Farming* 1.37).

Intercalation in the Julian calendar

To return to Caesar's calendar: 90 days were added by him to the year which we call 46 BC, making it 445 days long. This was achieved by inserting not only the normal intercalary month after February (of the 23-day variety on this occasion), but two further intercalary months, totalling 67 days, between November and December. What is interesting here is firstly that the sum of intercalary days in the year is the same as would normally have been required in an octennium in the Roman biennial intercalary cycle. This tends to confirm our reading of the last couple of decades of the late Republic, that the gross mismanagement of the calendar, which led to so large a discrepancy, is a phenomenon just of recent years. Secondly, from the 90 extra days one 23-day month had already been parcelled off into February, as usual, leaving in effect two further months of 22 days and one of 23 days to be inserted later. One wonders why Caesar did not then insert three such months between November and December, rather than the culturally alien two-month supplement of 67 days. Intercalations of 22 or 23 days would have been much more recognisable periods of time to his fellow citizens.

Not surprisingly, this extraordinarily long year was called 'the final year of confusion' (Macrobius, *Saturnalia* 1.14.3). From 1 January 45 BC a normal year of 365 days was instituted, with months of the same length as they are nowadays in our western calendar.

If we adopt a recent reconstruction of the calendar which attaches Julian dates to the Kalends of January for the last years of the Republican calendar (Brind'Amour 1983: 123), and extrapolate from those New Year dates through to the rest of the months in 46 and 45 BC, we can see both the seasonal discrepancy and the effect of the Julian transformation more readily:

46 BC

Civil month	**Days**	**Julian date of Kalends**
January	29 days	14 October 47 BC
February	23	12 November
Intercalary 1	28	5 December
March	31	2 January 46 BC
April	29	2 February
May	31	3 March
June	29	3 April
Quintilis	31	2 May
Sextilis	29	2 June
September	29	1 July
October	31	30 July
November	29	30 August
Intercalaries 2-3	67	28 September
December	29	4 December
TOTAL:	445 days	

45 BC

Civil month	**Days**	**Julian date of Kalends**
January	31 days	2 January 45 BC
February	28	2 February
March	31	1 March (assuming a leap day in this year)
April	30	1 April
May	31	1 May
June	30	1 June
Quintilis	31	1 July
Sextilis	31	1 August
September	30	1 September
October	31	1 October
November	30	1 November
December	31	1 December
TOTAL:	365 days	

From this stage on, an extra day was meant to be inserted every fourth year after the day called 'the sixth before the Kalends of March' (*ante diem VI kalendas Martias*), i.e. 24 February. This had been the regular point of insertion for the intercalary month under the Republic, and now it became the date at which the intercalary day was to be added. The new day was called *ante diem bis sextum kalendas Martias* ('the sixth doubled before the Kalends of March'), and so the year in which it occurred was called *annus bissextus* ('the year with the sixth doubled'); hence the English term 'bissextile' for a 'leap' year.

Caesar was assassinated in 44 BC, too soon after his reform to ensure that the instructions for intercalating the leap day were correctly followed. And in fact, as several authors inform us, the priests initially inserted the extra day by mistake every three years. This continued for 36 years, and therefore down to 9 BC, by which time 12 leap days had been added instead of the requisite nine. Put schematically, with O standing for an ordinary year of 365 days and I for an intercalary, or leap, year of 366 days, the sequence of 36 years would look like this (starting with 44 BC):
OOI OOI OOI OOI OOI OOI OOI OOI OOI OOI OOI OOI.
This gives 12 leap years, with three too many leap days in comparison with the correct system, which would run thus over the same period of time:
OOOI OOOI OOOI OOOI OOOI OOOI OOOI OOOI OOOI.
Inserting a leap day has the effect of slowing a calendar down. In this case, it means that by the time the mistake was recognised after 36 years, the calendar was running three days behind the solar year.

Order was eventually restored by Augustus, who decreed that there should be no further intercalation after 9 BC for the next 12 years, thus omitting the leap days in 5 BC, 1 BC and AD 4, and thereby recouping the three surplus leap days. So the Julian leap-year cycle, and hence the Julian year itself, began to function properly only from AD 5-8. Augustus also ordered that the proper arrangement of the calendar be engraved on a bronze tablet, so that it could be maintained forever (Pliny, *Natural History* 18.211; Suetonius, *Augustus* 31.2; Solinus 1.46-7; Macrobius, *Saturnalia* 1.14.13-15).

Just why the priests in Rome intercalated initially every third year is not entirely clear. Macrobius reports:

> For although they should have intercalated the day, which is completed from the quarters, when the fourth year has also been completed, before the fifth has begun, they intercalated not when the fourth year had been completed but when it was beginning.
>
> Macrobius, *Saturnalia* 1.14.13

This expresses the problem in terms of Roman inclusive reckoning. In our terms, it means that the officials believed that they had to add the leap day at the start (in February) of the third year, rather than after the end of the third year and so in February of the fourth year. This may seem a straightforward error, but a leap year every three years produces an average year of 365$^1/_3$ days, which would appear to be sufficiently different from the requisite 365$^1/_4$-day year that we must still wonder how the mistake was made. Were the priests innumerate or incompetent?

A recent hypothesis suggests that the error may be a function of the vicissitudes of the life of M. Aemilius Lepidus, the *pontifex maximus* from 44 BC to 13 or 12 BC and so the principal priestly official charged with care of the calendar. While he may have known when the leap day was meant to be inserted, his enforced removal from public life from the mid-30s BC may, it is argued, have led to his priestly colleagues, uninitiated in the proper rule, slipping in the leap day incorrectly (Bennett 2003: 232-3).

It might help us understand the error if we knew precisely when it was discovered and how. The year 9 BC itself was a leap year, with the bissextile day added. The next leap year would have been in 6 BC according to the mistaken method. So somewhere between 9 BC and 23 February 6 BC Augustus was advised that the calendar had been running adrift from the sun, since the final indication that the method was being corrected would have been the absence of an insertion of the bissextile day in February 6 BC (Sherk 1969: 336).

The date of the change of name of the month Sextilis to August may provide a point between 9 and 6 BC by which the leap-year error had been recognised. Macrobius (*Saturnalia* 1.12.35) records the decree of the Senate authorising the change of name, Cassius Dio (55.6.6) and Censorinus (*On the Birthday* 22.16) provide the date in the equivalent of 8 BC, while Suetonius (*Augustus* 31.2) reports it in the same breath as the leap-year reform. So the alteration in the month's name may provide the year, 8 BC, by which the correction of the Julian leap-year cycle had occurred (Samuel 1972: 155; Rich 1990: 224-5).

By 9 BC the calendar year was only three days askew from the solar year, a discrepancy that would hardly strike ordinary observers as patently obvious, especially as it would not have affected the celebration of festivals or the running of business. But it may have struck educated observers looking for precise alignments with equinoxes or solstices, or even with certain stars. A celestial event which would be expected to fall on a given date would have occurred three days earlier in the calendar reckoning, and perhaps been missed. The autumn equinox, for instance, while actually falling on 25 September (Julian), would be signalled for 24 September in public calendars, but under the incorrect calendar that solar day occurred on 21 September, and the phenomenon would have been missed or have failed to align with the instruments measuring it. Measuring such a degree of error for an equinoctial date had been well within the capabilities of the Alexandrian astronomers from the time of Hipparkhos in the second century BC (Taub 2002: 135-8).

So it will have been the astronomers, rather than the priests, who discovered the mistake, and who perhaps realised in the process that the argument for the 365¼-day year and the method of inserting it had not been demonstrated in enough detail. Three treatises attributed by Pliny to the astronomer Sosigenes, who helped Caesar construct the calendar, would seem to have been on the subject of the correction of the leap-year system, to judge from the context in Pliny's account (*Natural History* 18.212).

Furthermore, it may not be coincidence that in the years 10/9 BC Augustus erected in the Campus Martius in Rome a huge 'sundial' (*horologium*), focused on an Egyptian obelisk as its gnomon (Buchner 1982). Lining up the equinoxes and solstices is an integral part of constructing such a sundial, even if it consists only of a single meridian line (which runs north–south). As we shall see later, there may have been particular attention paid to the equinoctial point, or its extended line, with this sundial. But even without that special attention, the process of constructing the sundial could have drawn the astronomers' attention to a growing and measurable misalignment between the calendar and the solar year.

The temporary disorder of extra and omitted leap days is ignored by historians when they date events in antiquity according to the Julian calendar. For this purpose an ideal retrojection of the Julian calendar is used (sometimes called the proleptic Julian calendar), which runs as if the leap day were correctly inserted from 45 BC backwards and forwards. According to this scheme, the years AD 4, then 1 BC, 5 BC ... 41 BC, 45 BC, etc. are Julian intercalary years (cf. Chapter 4, and Bickerman 1980: 120, Table III). In our tabulation of the Kalends of each month in 45 BC, we started the year with a Julian date of 2 January for the Kalends of January. This discrepancy of one day irons itself out in February, as the following table illustrates:

Day	Civil date	Julian date
1	1 February	2 February
2	2 February	3 February
3	3 February	4 February
4	4 February	5 February
...		
22	22 February	23 February
23	23 February	24 February
24	24 February	24 February
25	25 February	25 February
26	26 February	26 February
27	27 February	27 February
28	28 February	28 February

The insertion of the bissextile day on 24 February in the retrojected Julian calendar allows the civil and Julian dates to coincide from that point on. This synchrony continues until the error in intercalating the leap day occurs in 42 BC:

Day	Civil date	Julian date
1	1 February	1 February
2	2 February	2 February
3	3 February	3 February
4	4 February	4 February
...		
22	22 February	22 February
23	23 February	23 February
24	24 February	24 February
25	24 February	25 February
26	25 February	26 February
27	26 February	27 February
28	27 February	28 February
29	28 February	1 March

Once again, we have a single day's discrepancy between the two calendars from 24 February onwards, so that to a given civil date we must add a day to reach the proper Julian date. This shift will disappear in the following year, 41 BC, when the retrojected Julian calendar is given a leap day in February, as part of the proper four-year cycle. So February will run as it did in 45 BC above.

If we plot out these shifts between the actual and the ideal calendars over the years down to AD 8, when the Julian calendar system starts to operate properly, we are able to see the fluctuation in the error, year by year, so that we can calculate how many days need to be added to a given civil date in the Roman calendar to render it in terms of the ideal Julian calendar. The following Table provides the appropriate correction factors, which are to be added after 24 February.

But we need to remember that this version of the Julian calendar is a back-formation, seen with the benefit of hindsight, and need not represent how the Romans viewed the situation as it unfolded ahead of them.

Let us assume that 45 BC was in fact an ordinary year of 365 days. Only in this way does the testimony regarding the discovery of the error make sense: if the mistake persisted for 36 years, in which twelve years were made leap years instead of nine, and if we count from 45 BC as an ordinary year, and have the first incorrect leap year in 42 BC, then the second comes in 39 BC, and so on every three years to the twelfth in 9 BC. The correct leap years, on the other hand, should run from the first in 41 BC, to the second in 37 BC, and so on every four years until the ninth in 9 BC. The two cycles coincide only in 9 BC (see the table in Samuel 1972: 157).

Year	Add	Year	Add	Year	Add	Year	Add
45 BC	0	31	1	17	2	3	2
44	0	30	2	16	2	2	2
43	0	29	1	15	3	1	1
42	1	28	1	14	3	1 AD	1
41	0	27	2	13	2	2	1
40	0	26	2	12	3	3	1
39	1	25	1	11	3	4	0
38	1	24	2	10	3	5	0
37	0	23	2	9	3	6	0
36	1	22	2	8	3	7	0
35	1	21	2	7	3	8	0
34	1	20	2	6	3		
33	1	19	2	5	2		
32	1	18	3	4	2		

Table 6. Number of days to be added to a given civil date in the Roman calendar to render it in terms of the ideal Julian calendar.

In so far as 42 BC is the fourth ordinary year since 45 BC, there is an argument for assuming that that year, rather than 41 BC, should have been the first proper leap year to bring the calendar back into line with the sun. By this argument an intercalation in 42 BC, however odd it may now look, could well have been what Caesar intended. By the same token, however, the next intercalation should then have been made in 38 BC, whereas instead the priests inserted a leap day in 39 BC. The only plausible explanation for this seems to be that 45 BC could have been regarded as a kind of 'year 0', which brought the Roman calendar back into synchrony with the sun; that the new calendar built up in the years 44, 43 and 42 BC enough of a discrepancy as to require adjustment by a leap day in 42 BC, the third year; and that this cycle of three years since 'year 0' had to be repeated, with leap years therefore occurring, mistakenly, in 39, 36, 33 BC, etc. (Brind'Amour 1983: 11-15).

Festivals in the new calendar

Seven months were affected by the changes wrought by Julius Caesar: January, Sextilis and December with two extra days; and April, June, September and November with one extra day. February had no additional days, which may seem a lost opportunity, since it left the month shorter than any other, but, Macrobius tells us (*Saturnalia* 1.14.7), this was 'so as to avoid change to the religious ceremony for the gods of the underworld'. March, May, Quintilis and October gained no extra days either, so that 31 days remained the limit on the length of a month. While these four months also retained their Nones on the seventh day, the three new 31-day months (January, Sextilis, December) preserved their Nones on the original fifth day:

> because Caesar wanted to insert those days which he added neither before the Nones nor before the Ides, for fear that he might ruin, by an unprecedented two-day postponement of the Nones or Ides, a religious ceremony which was on an appointed date. But neither did he want to insert soon after the Ides, for fear that the declaration of all the holidays might be dishonoured, but when the holidays of each month had been completed, he made a place for the foreign days.
>
> Macrobius, *Saturnalia* 1.14.8-9

There is a strong sense of a fear of religious outrage running through this story, demonstrable in the original Latin that was used by Macrobius. It would be difficult to find a parallel for this sensibility today in the western secular world, where one can find expressed open disgruntlement at the feeling of disorder occasioned by the timing not only of a mobile Christian festival like Easter but also of a fixed one like Christmas, as their occurrences impinge on a society's regular economic or multicultural life.

But the Romans took these matters very seriously (and they too were very multicultural by this stage), and adapted practical life to suit the religious, to the point that Caesar is reported to have delayed the insertion of the extra days in the affected months until all the religious festivals of a given month had run their course. Thus, the new days were added at different points near the end of each of the seven months (Macrobius, *Saturnalia* 1.14.9).

A major aim of the process of insertion was to ensure that the festivals kept their relative positions in each month:

> The arrangement of the holidays of each month, however, was preserved. For if a festival day or a holiday was usually the third day after the Ides of whatever month and formerly was called the sixteenth day before the Kalends, even after the increase of days, the religious ceremony was preserved, so that it was celebrated on the third day after the Ides, although after the increase it was not now called the sixteenth day before the Kalends but the seventeenth, if one day was added, or the eighteenth, if two days were added.
>
> Macrobius, *Saturnalia* 1.14.11

What the Romans were at pains to do was to maintain the position of any given festival relative to the Nones or Ides of the month in which it fell. So after the reform any festival held on a day up to the Ides of a month retained its traditional date, expressed in terms of so many days before the Nones or Ides. This encompassed a majority of the festivals in the Republican era. But those festivals celebrated after the Ides were dated according to the number of days which lay between them and the following month's Kalends. What happened to these festivals was that they remained the same number of days from the Ides (and hence from the start of the month), but their distance from the next Kalends increased and therefore the expression of their dates changed. Thus, a festival formerly held on 21 December remained eight days from the Ides on the 13th (or nine by Roman inclusive reckoning). But, since the day fell after the Ides and its notation used to read *ante diem X kalendas Ianuarias* ('the tenth day before the Kalends of January'), this now changed to *ante diem XII kalendas Ianuarias* ('the 12th day before the Kalends of January'), because the month now had 31 days instead of 29.

The birthday of Augustus

If, in the seven months affected by the change, we compare the festivals in the Republican calendar from Antium with those listed in calendars postdating the introduction of the Julian calendar, we find that all festivals continue to fall on the same days after the Ides of those months, but also that they have new dates (Michels 1967: 181). Perhaps the most interesting example is provided not by one of the traditional religious festivals, but by a new one, which was established after the introduction of the Julian calendar, yet which celebrated an event predating that introduction. This is the birthday of the first emperor, Augustus.

Annual birthdays as we know them seem to be a relatively late phenomenon in the Greek world. The gods had birthdays but these were celebrated on a monthly basis. So, for example, the seventh day of any month was sacred to Apollo (see Chapter 2), and the sixth to his sister Artemis, who was born before her twin and, miraculously, assisted at his birth. For mortal Greeks the day of birth itself was celebrated, but before the Hellenistic period there is little evidence for celebrations of the day on either a monthly or a yearly basis, and even then the practice seems to have been limited to acknowledging rulers or significant individuals. The philosopher Epikouros, for instance, who died in 270 BC, left in his will a bequest to his followers and their heirs 'for the customary celebration of my birthday every year on the 10th of Gamelion' (Diogenes Laertius 10.18). Among Romans, on the other hand, even private birthdays were celebrated annually (but not monthly) with gifts, prayers and banquets (Mikalson 1996: 244).

The calendars which survive from after the time of the Julian reform record that the birthday of Augustus was celebrated on the day called *ante diem IX* (or *VIIII*) *kalendas Octobres* (e.g. the *Fasti Vallenses*, after AD 7: Degrassi 1963: 150-1). The same date is provided by several Roman authors, such as Suetonius:

> Augustus was born in the consulship of M. Tullius Cicero and C. Antonius on the ninth day before the Kalends of October a little before sunrise ...
>
> Suetonius, *Augustus* 5

Under the Julian calendar (the one in force for both the inscribed calendars and the authors), this notation translates as 23 September. The same formula, however, would translate differently under the old Republican calendar, in which September had only 29 days, not 30, and so by which it would be read as 22 September. It was, of course, under the old Republican calendar that the future Augustus was born. So does *ante diem IX kalendas Octobres* stand for 22 September (Old Style, as it were) or 23 September (New Style)?

On the other hand, was Augustus born in fact on 23 September (Republican), i.e. *ante diem VIII kalendas Octobres*, a date which had to be translated after the reform into *ante diem IX kalendas Octobres* because of the extra day in the month? After all, how do we explain the use of the date *ante diem VIII kalendas Octobres* (Julian), and therefore of 24 September, in some notices of the birthday celebrations (Michels 1967: 180-1)? Was he in fact born on a day called *ante diem VIII kalendas Octobres*, and was that formula sometimes retained under the Julian calendar, even though it translated into a day later?

There is no certain answer to these questions. We noted above that other festivals kept their relative positions with respect to the Ides in the new calendar and therefore had their notation changed in those seven months which were given extra days by Caesar, so it would seem likely that Augustus' birthday underwent the same transformation. Furthermore, 23 September in the new Julian calendar (i.e. *ante diem IX kalendas Octobres*) was also the date of dedication – a kind of birthday – of an ancient temple of Apollo in Rome. This date had presumably shifted from the Republican *ante diem VIII kalendas Octobres*. Apollo was a god to whom Augustus was especially devoted, so this coincidence of date may have drawn him to adopt the new Julian date for his birthday also (Michels 1967: 181). But the fact that there are instances of two-day celebrations under the Empire covering 23-24 September suggests that doubt existed in antiquity, and that people hedged their bets as to which was the proper day for celebration.

The horoscope of Augustus

The development of the commemoration of birthdays on an annual basis may well have been given a boost in the Hellenistic world by the burgeoning interest in horoscopal astrology. This itself is another result of the intermixing of the cultures of Greece and the Persian Empire, through which Babylonian ('Chaldaean') astrology filtered across the Hellenistic kingdoms which developed in the wake of Alexander the Great's conquests, and thence to Greece and Italy.

Horoscopal astrology is up to a point solar-based, but not in the simplified way that we find it in our daily newspapers and weekly magazines, according to which a horoscope is driven fundamentally by the placement of the sun along the zodiac at the moment of one's birth. Thus, one is called 'Piscean' if the sun was, supposedly, in Pisces at the time of one's birth. The zodiac as we know it in the west is an invention of the Babylonians, which the Greeks adopted and then transmitted to the Romans (Figure 2; there are other, quite different zodiacs, such as that used by the Chinese in their form of astrology).

By the third century BC the ecliptic had been divided into artificially equal sectors of 30°, which are called 'signs', and are named after their resident zodiacal constellations. Astrology makes use of the rising and setting of the zodiacal signs, and indeed in one form it seems that the placement of these signs is more important than the situation of the planets within them (as is suggested by the method implied in the astrological poem *Astronomica*, by the Augustan poet Manilius).

In antiquity these risings and settings of the signs more or less matched the risings and settings of the original constellations. Since Roman times, however, the place of the signs has been fixed in the sky, despite the apparent shift of the zodiacal constellations themselves by about 30° from those ancient positions because of the phenomenon known as the precession of the equinoxes (see Chapter 1). So, for instance, where we would place Aries astrologically is where the Romans placed it, but this is now a good twelfth of the sky away from its true astronomical position, and the constellation Pisces now occupies Aries' former position. This fossilisation of the positions of the signs is a characteristic of the practice of astrology which makes it much more of a superstitious, even broadly religious, activity than a scientific one.

Furthermore, unlike the modern popular variety of the practice, ancient astrology generally sought to ascertain the character and future development of an individual (or a city, even the world, or a venture), through the placement and relative configuration of all seven known planets as the ancients understood them – the Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn – at the time of his or her conception or birth.

At this given moment the astrologers would look at charts and discover where the planets were situated along the zodiac, and then gauge the various influences from the position of the planets at the four cardinal points – rising, setting, upper culmination (*medium caelum*) and lower culmination (*imum caelum*) – and from their configuration with respect to one another (e.g. diametric opposition, or trine aspect). Surviving planetary charts are remarkably accurate in their placements. There were also 12 'houses' with various influences, which were not fixed but dynamically defined with the first house as the rising point over the horizon (see Firmicus Maternus' fourth-century AD treatise, *Mathesis* [*Instruction*], for a sample of ancient astrological practice). In other words, the position of the sun itself need not have been the most important diagnostic for a given horoscope. This is the case, it seems, with Augustus.

Suetonius provides a dramatic rendering of the casting of the horoscope:

> While in retirement at Apollonia, Augustus climbed with his companion Agrippa to the school of the astrologer Theogenes. Agrippa consulted him first, and when great and almost incredible things were predicted for him, Augustus persisted in keeping quiet about the time of his birth and in not wanting to declare it, through fear and shame that he might be found to be inferior. But when after much urging it was declared with difficulty and reluctance, Theogenes sprang up and revered him. From then on Augustus had so much confidence in his destiny, that he made his horoscope public and struck a silver coin with the sign of the constellation Capricorn, under which he was born.
>
> Suetonius, *Augustus* 94

Cassius Dio (56.25.5) also records the publication of the horoscope by Augustus. Suetonius elsewhere indicates that Augustus' sojourn in Apollonia occurred early in the future emperor's career, between Julius Caesar's victory at Munda in Spain in 45 BC and the dictator's assassination in 44 (Suetonius, *Augustus* 8.1-2). Augustus was therefore only about 18 and not yet the powerful political figure that he would soon become, but as he had already featured publicly at his great-uncle's African triumph in 46 BC, he was a known entity, and the astrologer might have had more than luck on his side when he cast the horoscope of his reticent client.

There are other texts concerning Augustus' zodiacal sign, but they confuse rather than clarify matters. While Manilius (*Astronomica* 2.507-9) and Germanicus (*Aratea* 558-60) agree with Suetonius in giving Capricorn as the sign, other authors, notably Virgil (*Georgics* 1.32-5) but also, frustratingly, Manilius again (*Astronomica* 4.546-51, 773-7), suggest that we should be looking to Libra instead.

Certainly coins were struck by Augustus with the image of Capricorn on one side, and other works of art were similarly decorated. All may have been intended to allude to the whole horoscope through a significant part of it, but we perhaps ought not too readily put to one side the fact that Suetonius mentions only the sign, and not any planetary influences, and that he may therefore be reflecting the same sign-oriented version of astrology as the poet Manilius does.

The original horoscope cast by Theogenes has not survived, so, naturally, endless attempts have been made to reconstruct it, based on the earlier information also provided by Suetonius that Augustus was born just before sunrise on 23 (or 22) September (Barton 1995). If we look for where the planets were at the time of Augustus' birth, a curious feature of modern reconstructions of the chart is that Capricorn was occupied only by the moon, and was situated at the *imum caelum* below the horizon. While this is an odd place for one's 'birth sign', it is one of the four cardinal positions of a chart, so Capricorn and the moon would hold some value. The sun, meanwhile, occupied Libra, which was at the more telling position of the ascendant. Of the other planets, Jupiter occupied Cancer at the *medium caelum*, Saturn and Mars were in Taurus, Venus was in Scorpio, and Mercury in Virgo (Brind'Amour 1983: 72, using 22 September as the birthday). While this confirms Virgil's view of the matter by giving the ascendant and the sun the sign of Libra, it seems a poor chart overall and hardly worth Theogenes' histrionics. At best, it gives Jupiter and Mercury some prominence (e.g. both are in their 'exaltation'), and it shows some distant relationship to the supposed horoscope of the beginning of the world (the *thema mundi*, described by Firmicus Maternus, *Mathesis* 3.1). This also draws attention to the same signs at the cardinal points, but even then they are at different points (Cancer in the ascendant, Capricorn at descendant, Aries at *medium caelum*, and Libra at *imum caelum*): small cause, it seems, for reading cosmic significance into Augustus' birth horoscope, as some have done (cf. Barton 1995: 40).

Other scholars have sought to explain the pre-eminence still given by Augustus to Capricorn, in the face of this chart, by reference to a rare Roman belief that the moon's position was sometimes more significant than that of the sun. A more convincing case, however, can be made that Theogenes cast Augustus' *conception* horoscope, not (or not just) his natal. If we do the same, using ancient assumptions for the length of a pregnancy in astrology and assuming a dawn conception to match the timing for the birth, the resultant date of sunrise on 23 December 64 BC gives a much more compelling chart. Capricorn, it turns out, is not only in the ascendant on the eastern horizon, but is occupied by no fewer than three planets: the Sun, the Moon and Mercury. Mars, meanwhile, is in his own House of Scorpio, a powerful position for the god of war. Saturn occupies Aries, Jupiter is in Gemini, and Venus resides in Sagittarius (Brind'Amour 1983: 62-76). The sun is also at the winter solstice, and so on the verge of being reborn for the coming year. Such a chart deserves a closer reading, following the principles of ancient astrology, ambiguous though they necessarily are (Barton 1994, 1995; cf. Hannah 1996 for the method applied to another case). But our interest here is in the calendrical significance.

It may well be that we do not have to choose between these two charts for Augustus, but that Theogenes used both to maximise his chances of procuring a formidable horoscope for his Roman visitor, especially if he already knew something about his status and identity. The coincidence of Augustus' conception with the winter solstice, and of his birth then with the autumn equinox provided him, or his advisers, with a store of associations which were used to great effect through his reign. One instance lies in the giant 'sundial' (*horologium*) already mentioned a couple of times. This was erected in 10/9 BC in the Campus Martius. Its gnomon, about 30m high in all, comprised a reused obelisk, itself well known as a sun symbol, one of a pair brought back from Egypt by Augustus. Indeed, the base of the obelisk carried an inscription commemorating the settlement of Egypt by Augustus and dedicating the monument to the sun: this was no ordinary timepiece, but bore significant political import.

Part of the meridian line (which runs north–south) has been unearthed (Buchner 1982), but the excavator believed that an extensive pavement was laid out with a net-like grid of bronze lines and inscriptions, which marked out the various seasons, months and hours – a supposition which only further exacavation can definitively prove. The surviving inscriptions on the meridian line name, in Greek, the zodiacal signs of Aries, Taurus, Leo and Virgo, and signal 'the beginning of summer' in mid-Taurus, and 'the cessation of the Etesian winds' at the junction of Leo and Virgo. The last inscription is a feature drawn directly from a Greek source, presumably a parapegma, as it is irrelevant to the western Mediterranean.

A remarkable feature of this remarkable monument is the fact that the shadow cast by the obelisk-gnomon in the evening around the time of the equinoxes will have pointed towards the newly built Altar of Augustan Peace (*Ara Pacis Augustae*). The Altar was voted in 13 BC by the Senate, to commemorate Augustus' return from the western provinces of Gaul and Spain, and stood beside the Via Flaminia, the road along which Augustus will have travelled on his way back into the city (it corresponds to the modern via del Corso). It was completed in 9 BC, the year the *horologium* was also completed. Whether or not the Altar stood at the end of a physical equinoctial line on an enormous net-like grid (a feature cast into some doubt: Schütz 1990), the general effect at the equinoxes would still hold (Beck 1994: 100-5; cf. Buchner 1993-4).

That effect gains in political and ideological import when we take into account the fact that Augustus' birthday fell within a day or so of the autumn equinox. On his birthday observers could be reminded of Augustus' prime role in bringing peace back to the Roman world after a century of violence, through his settlement of Egypt (the source of the obelisk), and of the western provinces (symbolised by the Altar). At the same time, they would be made aware of his cosmic status, as the sun itself drew his monuments together on his conception day and his birthday: the northern extremity of the meridian line marks the turning point of the noonday sun's shadow at the winter solstice, when the sun entered Capricorn, while the equinoctial shadow in March and, more significantly, in September pointed towards the Altar of Peace around the time of Augustus' birthday. The whole complex emphasises how useful to Augustus was the serendipitous timing of his birthday in the Roman calendar.

6

Afterwords

Augustus and New Year's Day

The leap-year reform by Augustus by no means represents the end of the story about the Julian calendar in antiquity. The process of its accommodation by different regions of the Empire is a study in itself, only parts of which can be touched on here. The case of the calendar of the league of Greek cities in the Roman province of Asia gives us an insight into the process of assimilation at its very start.

We have a decree from about 9 BC which was passed by a number of the Greek cities in the Roman province of Asia. Its purpose was formally to adopt Augustus' birthday as New Year's Day, the first day of the year. This was expressly in gratitude for the emperor's many benefactions, and its promoter, the proconsul Paullus Fabius Maximus, gained through this show of loyalty a wreath offered as a prize for the best way to honour the emperor, and thereafter public proclamation of his honour at the games:

> It was decreed by the Greeks in the province of Asia, ... :
>
> ... whereas the birthday of the god was the beginning of the good tidings for the world through him, and [the cities of] Asia decreed in Smyrna ... that there was to be a crown to gain for the one devising the greatest honours for the god; and whereas Paullus Fabius Maximus, proconsul of the province sent for its safety by that god's right hand and purpose, benefited the province with countless benefits ... and devised for the honour of Augustus the thing until now unknown by the Greeks, namely, that the time for life begins from his birth;
>
> therefore, with Good Fortune and under the power of Safety, it has been decreed by the Greeks in the province of Asia that the New Year shall begin in all the cities on the ninth from the Kalends of October, which is the birthday of Augustus;
>
> and, so that the day always corresponds in every city, that the Greek day also is named with the Roman day;
>
> that the first month, Kaisar, as was also previously decreed, be reckoned as beginning with the ninth from the Kalends of October, the birthday of Caesar ...
>
> The months shall be reckoned thus: Kaisar 31 days; Apellaios 30 days; Audnaios 31 days; Peritios 31 days; Dystros 28; Xandikos 31; Artemision 30;

Daisios 31; Panemos 30; Loos 31; Gorpiaios 31; Hyperberetaios 30; altogether 365 days.

And in the year, because of the intercalation, Xandikos will be reckoned as 32 days.

So that from now the months and the days may correspond, the month of Peritios which is now current will be reckoned until its 14th day; and on the ninth from the Kalends of February we shall celebrate the first day of the month Dystros, and for each month the ninth from the Kalends will be the beginning of its first day; and the intercalary day will always be that of the intercalary Kalends of the month Xandikos, with two years coming in between ...

OGIS 458.II.30-77

While flattery no doubt played a large part in the promotion of this calendar change, there was no great difficulty involved in effecting it. Fabius was helped by the fortuitous coincidence that New Year's Day in calendars in this region already happened to fall about the time of the autumn equinox (as we saw in Chapter 4), and so of the birthday of Augustus. In addition, if any of these cities used parapegmas in some public capacity, as we know Miletos did (though this city was not party to this decree), then there would already have been an awareness of the solar year divided into 12 months, running in some fashion alongside the traditional lunar calendar – perhaps, as we saw in Chapter 3 with the parapegmas of Meton and Euktemon, with the parapegma used as a regulator for an 8- or 19-year cycle to bring the lunar and solar years back into realignment.

The older of the two parapegmas found in Miletos, MI, dating to the late second century BC, is organised into zodiacal, or solar, months, but it is too fragmentary to regain all their lengths. Of more use is the compilation of parapegmas at the end of Geminos' *Introduction to Astronomy*, a work belonging to the mid-first century AD although none of the parapegmas is more recent than the third century BC. These are set into a zodiacal scheme, which may be borrowed from the mid-fourth-century astronomer-parapegmatist Kallippos. If we start the parapegmas with the summer solstice and apply notional Julian dates, from 24 June for the solstice (though it could begin on 25 or 26 June according to different sources: Degrassi 1963: 473), it would run as follows:

Zodiacal sign	**Days**	**First day of solar month**
Cancer	31	24 June
Leo	31	25 July
Virgo	30	25 August
Libra	30	24 September
Scorpio	30	24 October
Sagittarius	29	23 November
Capricorn	29	22 December

Aquarius	30	20 January
Pisces	30	19 February
Aries	31	21 March
Taurus	32	21 April
Gemini	32	23 May
TOTAL:	365 days	

After Aujac 1975: 98-108

Admittedly, there is no allowance in this scheme for a leap day, and we do not know how one might have been incorporated. The most recent guess is that post-Julian parapegmas were 'self-calibrating' by ignoring the leap day (Lehoux 2000: 106-8). This may be only a little awkward in practical terms with respect to inscribed astronomical versions, as the peg could stay in place for an extra day if the leap day was not inscribed, or if it was, then it would have to be ignored in ordinary years. All the same, the use of parapegmas in the period leading up to the Julian reform will have inured people to the solar year, albeit in a slightly different guise from what Julius Caesar established.

The month-names of the Asian Greek calendar in the decree of 9 BC will be recognised, apart from the first, as the old Macedonian names. Dios has been replaced by Kaisar, sometimes written as Kaisarios. It reflects the object of the decree's flattery and the fact that the New Year from now on will begin on Caesar Augustus' birthday. Close in time to the date of the decree is a calendar which is known only through a few excerpts made in the Byzantine period but dating originally to about AD 15. Emanating from somewhere in Asia Minor, this calendar includes the notation 'New Year' at 23 September (Weinstock 1948). The later 'hemerologia', which collate the Julian calendars of various provinces and cities, preserve this solar calendar under the cities of Ephesos and Asia-Pamphylia, starting on 23 September but still with Dios as the first month; Kaisar(ios) as the name of the first month in this region is preserved in other sources (Kubitschek 1915: 18, 50, 92; Samuel 1972: 182). The months then follow on in the normal Macedonian order, but from this point onwards they are given fixed lengths which allow the year to correspond with the Roman Julian year of 365 days, rather than having lengths based on the moon and adding up to 354 days. Furthermore, the system operates in such a way that each month starts on the ninth day, by Roman reckoning, before the Kalends of the following month. The new Greek calendar then runs alongside the Roman as follows:

Greek month	Days	Julian date of first day of month
Kaisar	31 days	23 September
Apellaios	30	24 October
Audnaios	31	23 November
Peritios	31	24 December

Dystros	28	24 January
Xandikos	31	21 February
Artemision	30	24 March
Daisios	31	23 April
Panemos	30	24 May
Loos	31	23 June
Gorpiaios	31	24 July (formerly Quintilis)
Hyperberetaios	30	24 August (formerly Sextilis)
TOTAL:	365 days	

The leap day required by the Julian calendar is decreed to be created by doubling the first day of Xandikos. Since Xandikos would start on 21 February on the new Graeco-Roman scheme, doubling it would mean that the Greek leap day would correspond closely, although not exactly, with the Roman leap day of 24 February repeated. A similar discrepancy of no more than four days and sometimes none at all, we might note, lies between the dates of the months in the Asian Julian calendar and those in the Geminan parapegma, suggesting again that there may have been little mental adjustment needed by the Greeks to adopt the Julian calendar.

A fragment of a bilingual appendix to the decree describes as 'according to the Roman practice' the intercalation rule, translated above as requiring 'two years coming in between' (*OGIS* vol. 2, 52 n.23). A two-year gap would give only a three-year cycle for intercalation, which means we would be dealing here with the mistaken intercalary cycle introduced by the priests straight after the introduction of the Julian calendar. On this basis the decree has been dated to about 9 BC and just before Augustus corrected the leap-year cycle – we saw in the previous chapter that the correction probably belongs to 9 BC or a little afterwards. The cities of Asia in 9 BC, the argument goes, were not yet aware of the move by Augustus to reform the leap-year cycle by omitting the next three leap years and starting again properly with a four-year cycle (Brind'Amour 1983: 13-14).

An alternative interpretation has been promoted, however, according to which Paullus' proposal would date to 7 BC, and the phrase describing the intercalation rule should read 'two years having come in between', to indicate that the leap year should fall not in 6 BC, as would have been expected following the incorrect three-year rule, but in 5 BC, in accordance with the recently promulgated four-year rule (Buxton 2003: 300-4). By this argument the Greek cities of Asia, which have never had even the incorrect Roman leap-year cycle and so do not need to catch up with the solar year in the same way as Rome does, are being told in which year the first leap year should be inserted.

Despite having the old lunar month-names, it is usually argued, the calendar in Asia at this time was not running in synchrony with the moon, since the months do not accord with the lunar phases in 9 BC. According to this decree, the last day of the old calendar is to be 14 Peritios. If this were a lunar month, the day number should indicate that we are close to the full moon. However, the day after 14 Peritios – the ninth from the Kalends of February and the start of the month of Dystros – equates with 24 January in the uncorrected version of the Julian calendar. To this date we must add three days to align it with the proper, retrojected Julian calendar, and so make it 27 January. The nearest full moon in 9 BC was on either 8 January or 7 February. So we are obviously not dealing with the period of the full moon on 14 Peritios, but rather something closer to its opposite (Brind'Amour 1983: 14). On the other hand, it may be of some interest that in both 8 BC and 5 BC a full moon did occur on 26 and 24 January respectively, according to modern calculations – coincidences which may cause us to reconsider not only the date of the decree in question or its implementation, but also the accuracy of late Hellenistic lunar calendars in the region of Asia (Bennett 2004; Buxton and Hannah, forthcoming).

One further point of interest is that the new calendar did not start operating on its New Year's Day of 23 September and the month Kaisar, nor did it delay until then, but instead it started with the month following the passing of the decree, Dystros, in late January. Other new calendars, such as the Gregorian calendar, have begun likewise in midstream.

As we noted in Chapter 4, the Egyptian calendar was also made to adopt a leap-year system, probably from 26 BC. This alteration was effected so that the Egyptian calendar, like its Greek neighbours' calendars, could be brought into a correspondence with the Roman Julian calendar. Whether the Egyptian calendar necessarily absorbed the three-year leap-day error of the calendar in Rome from the start, or instead adopted the ideal Julian calendar's four-year leap-day rule, is moot (cf. Snyder 1943: 393-5; Jones 2000b; Bennett 2003). The extra day was inserted as a sixth epagomenal day before 1 Thoth. Since the Egyptian year starts on 29 August, this means that Egyptian Julian leap years begin part-way through the year before the Roman equivalent. The sixth epagomenal day falls on 29 August in AD 3, 7, 11, etc. The Egyptian leap years then begin on the equivalent of 30 August in the Roman calendar, while the New Years in AD 4, 8, 12, etc. revert to 29 August, since Roman Julian equivalents for Egyptian dates return to normal after the insertion of the Roman leap day in February.

Confusion in diffusion

The new Julian calendar was adopted at great speed over a large area and by a diverse mixture of cultures in the Roman world. One index of this rapidity is the number of copies of the Julian calendar which survive in the inscriptional record from the early Imperial period (Crawford 1996: 426).

But there are signs that keeping up with the change may not have been so easy for some.

One problem arises from an apparent shift of a whole month in the correspondence between the Macedonian calendar and its Babylonian counterpart in the eastern part of the old Seleucid Empire, which came under Iranian Parthian control from the later second century BC. We saw in Chapter 4 how a particular correspondence between the Babylonian and Macedonian lunisolar calendars underlies Ptolemy's synchronisms for astronomical observations made between 237 and 229 BC. According to this, Babylonian Nisannu matches Macedonian Artemisios, and so on month for month to Addaru standing beside Xanthikos. This relationship between the two calendars changes in the east between AD 15/16 and AD 46/47, to judge from coins from Seleuceia on the Tigris. A Seleucid foundation originally but now under Parthian control, this city retained its Macedonian-Greek institutions, including its calendar. Inscriptions from Palmyra, a semi-independent city in the borderlands between the Roman and Parthian Empires, show the same shifted synchronism from AD 17 (Samuel 1972: 143, 178-80). The new month-by-month relationship looks like this (with the Jewish equivalents added for future reference):

Macedonian	**Babylonian**	**Jewish**
Xanthikos	Nisannu	Nisan
Artemisios	Aiaru	Iyyar
Daisios	Simanu	Sivan
Panemos	Du'uzu	Tammuz
Loios	Abu	Av
Gorpiaios	Ululu	Elul
Hyperberetaios	Tashritu	Tishri
Dios	Arahsamna	Marheshvan
Apellaios	Kislimu	Kislev
Audnaios	Tebetu	Teveth
Peritios	Shabatu	Shevat
Dystros	Addaru	Adar

We still do not know why the change in the synchronism happened. A single one-month intercalation by a Parthian king has been suggested as the cause, but why such a manoeuvre should have been made and over what period of time, we do not know (Bickerman 1980: 25).

Meantime, in the west of the old Empire another change was taking place. Here the original order of the Macedonian months, from Dios as first to Hyperberetaios as last, tended still to prevail, as the later 'hemerologia' illustrate (Kubitschek 1915), and as is demonstrated by the proverb recorded by Zenobios in the second century AD that Hyperberetaios was the last month of the year among the Macedonians. But like the Greeks in the Roman province of Asia around 9 BC, the inhabitants of cities along the

Palestinian coast changed their previously lunisolar calendars, with the Macedonian month-names, to various forms of the Julian calendar in the late first century BC or early first century AD. Again, like the Asian Greeks, they did not necessarily adopt the Roman form of the calendar, but adopted calendars which presumably suited their civic, economic or religious needs better. Thus, Gaza and Askalon, in the south of Palestine, went the Egyptian way, making their Macedonian months each 30 days in length, and adding five epagomenal days in ordinary years and six in leap years. Gaza, however, retained the Macedonian New Year's Day in autumn, with 1 Dios falling on 28 October rather than 29 August, yet with the epagomenal days staying on 24-28 August (or through to 29 August in leap years) and therefore between Loos and Gorpiaios and not at the end of the Gazan year in Hyperberetaios. In Askalon's case, the same structure as was applied in Gaza held, but we do not have enough evidence to know whether the year started with 1 Dios (= 27 November) or 1 Hyperberetaios (= 28 October). Further north, Sidon chose the Roman model, making its Macedonian months coincide in length with the Roman Julian, and setting the start of its year at 1 Dios to coincide with 1 January. Several variations on this theme of diversity in adoption occur elsewhere in the region (Mercier 2001; Meimaris 1992).

Caught somewhere between these two quite different calendrical shifts is the Jewish-Roman historian, Josephos, in the late first century AD. Let us take this passage from his *Jewish Antiquities*:

> This disaster [the Flood] occurred in the six hundredth year of the rule of Noah, in the second month, called Dios by the Macedonians but Marsouan by the Hebrews; for in Egypt they had organised the year in this manner. But Moses appointed Nisan, which is Xanthikos, as the first month for the festivals, because he led the Hebrews out of Egypt in this month; and with this month he began [the year] for all divine worship, but for selling and buying and other administration he maintained the original order.
>
> Josephos, *Jewish Antiquities* 1.80-1

Several things are happening in this passage. Firstly, Josephos is anachronistically ascribing to a much earlier period (the time of Moses) a situation which applied to his own time. Secondly, while two modes of calendrical reckoning certainly existed among the Jews, with 1 Nisan marking New Year for the festival calendar and regnal years, but 1 Tishri, six months later, denoting New Year for the agricultural cycle, these systems coexisted, rather than one historically following the other. What Josephos is doing is reflecting not a chronological sequence, but a conceptual precedence, which was granted to the 'old' festival/administrative calendar on the grounds that the Creation was believed to have taken place in Tishri, and that it is from Tishri that the months of the Flood story are counted (Herr 1976: 843-4).

Finally, and more importantly for our present purposes, the historian provides correspondences between the Jewish (and implicitly the Babylonian) months and the Macedonian, which do not match the system which obtained in the third century BC. The Macedonian month Dios now matches the Jewish month Marsouan (or Marheshvan), that is, Babylonian Arahsamna; while the Jewish month Nisan, or Babylonian Nisannu, now corresponds to the Macedonian month Xanthikos.

This shift of one month in the former synchronism is confirmed elsewhere by Josephos, when, in the course of a discussion of the reign of the Persian king Darius, he names Dystros as the last month of the year (*Jewish Antiquities* 11.107). In the passage quoted above, Josephos' description of the month Dios as the second of the (administrative) year fits into this altered synchronism, as it implies a shift of a month in the same direction. Hyperberetaios has now become the first month, matching Tashritu/Tishri, in a revision of the Seleucid Macedonian sequence.

Josephos uses, or implies, this redefined calendrical relationship for events ranging in time from the Flood, to the historical destruction of the Temple in Jerusalem by Nebuchadnezzar (*Jewish War* 6.4.5), to the contemporary siege of Jerusalem by the Roman Titus, in which Josephos himself participated (*Jewish War* 6.2.1). This is chronologically indiscriminate of the historian, who thereby ignores the shift that had taken place from one synchronism to another over part of that time. But even if we allow him to have simplified a more complex situation for whatever narrative purpose, how are we to explain his identification, right down to the same days of the month, of Jewish lunar months with Macedonian months which had been absorbed for the better part of a century into a solar framework in this part of the Roman world?

Two explanations for Josephos' behaviour currently stand. Since he is writing in Greek, he may be using the Macedonian month-names simply as Greek translations for Jewish names, irrespective of any lunar or solar associations. Otherwise (or even while he is also doing the former), he may be perpetuating, anachronistically and out of confusion, the lunisolar calendrical traditions. This may have been a time of rapid change for local systems towards the Julian calendar, to which he and his readers have not quite adjusted (Stern 2001: 35-8). The situation will hardly have been helped by the lack of identical month-for-month coordination between the cities in the region which had gone Julian. The 'hemerologia' record Gaza's calendar running one month out of synchronisation with Askalon's, so that Gazan Dios coincides with Askalon's Hyperberetaios, and so on.

The Chronicle of 354

At the other end of the story of the Julian calendar in antiquity there is the question of how it was absorbed by Christianity, whose culture came to dominate the Roman Empire from the fourth century onwards. Much of this phenomenon lies beyond the scope of this book, but an instructive insight into the transition is given by a mid-fourth-century Roman codex. Its contents allow us to get a sense of how much of the pagan past was preserved by the emerging Church early in the medieval period.

In AD 354 a certain Valentinus was presented with a gift in the form of a large codex, or book. The work is known as the Chronicle (or Chronographer) of 354, but also as the Calendar of Filocalus, after the name of its calligrapher, Furius Dionysius Filocalus, who may also have been responsible for the illustrations which decorated parts of the work. The recipient, Valentinus, has been plausibly identified as a member of the aristocratic Symmachus family, and, on the basis of the contents of the whole codex, as a Christian. Filocalus too was a Christian (Salzman 1990: 199-202). As we shall see, this membership of the emerging church did not preclude Valentinus or Filocalus from appreciating pagan elements of Rome's culture as integral parts of their own.

The book's contents open with images of the personifications of the four major cities of the Roman Empire – Rome, Alexandria, Constantinople and Trier – followed by a list of the official birthdays of the apotheosised emperors from Augustus to Constantine and of the current emperor, Constantius. Then come a calendar of days linked to the seven planets of antiquity (a relationship to which we shall return later) and, more significantly for our present purposes, an illustrated calendar of the months. This segues into a series of lists, first one of the consuls of Rome, then a table of Easter Sundays, followed by a list of the prefects of Rome. Then come calendars of the days on which the bishops of Rome were buried (this being a precursor to the later *Liber Pontificalis*, the Book of the Popes) and of the feasts of the martyrs. Bringing the book to a close are two chronicles of Rome, and a description of the city itself (Stern 1953: 15-16; Lietzmann 1953: 238-40).

From the calendar of the months (overleaf) let us take a look at June, which we examined earlier in the Republican calendar from Antium.

The month begins with its name: *Mensis Iunius* means simply 'month of June'. Below this is the total number of days in the month, 30, which had been placed at the bottom of the month in the Antium calendar. Also still retained from the calendrical tradition is the column of alphabetic letters, from a to h, marking the nundinal days. Here they occupy the third column of the month.

				Mensis Iunius
				dies xxx
B	e	h	kal·	iun Fabarici · C M · xii
	f	a	iiii	non·
	g	b	iii	senatus legitimus
C	a	c	pr	ludi in Minicia
	b	d	Non	
	c	e	viii idus	Colossus coronatur
D	d	f	vii	Vesta aperit · dies egyptiacus
	e	g	vi	
	f	h	v	Vestalia
E	g	a	iiii	
	a	b	iii	Matralia
F	b	c	pr	
	c	d	idib·	N Musarum · senatus legitimus
	d	e	xviii	kal iul·
G	e	f	xvii	Vesta cluditur · Sol cancro
	f	g	xvi	
	g	h	xv	
H	a	a	xiiii	Annae sacrum
	b	b	xiii	
	c	c	xii	dies egyptiacus
I	d	d	xi	
	e	e	x	
	f	f	ix	
K	g	g	viii	Fortis Fortunae · solsticium
	a	h	vii	
	b	a	vi	
A	c	b	v	
	d	c	iiii	
	e	d	iii	
B	f	e	pr	

Degrassi 1963: 248-9

In the fourth column the Kalends, Nones and Ides are all noted, in abbreviated form (*kal. iun* for *kalendis Iuniis*, 'on the Kalends of June', *Non* for *Nonis*, 'on the Nones', and *idib.* for *Idibus*, 'on the Ides'). Now, in addition, we also have the notation for the intervening days as they relate to these three principal markers with Roman prospective and inclusive counting. Thus 2 June is marked as *iiii*, standing for *ante diem iiii nonas iunias*, the fourth day before the Nones of June. The abbreviation *pr* stands for *pridie*, 'the day before'. This method of marking each day is used from Augustus' time, for instance in the calendar known as the *Fasti Praenestini* of AD 6-9 (Degrassi 1963: 107-45).

The first column of the calendar comprises the first ten letters of the Roman alphabet, from A to K, run continuously from A on the Kalends of January. By the Kalends of June it has reached B again, and then runs through to K and on to B again on the last day of the month. These letters indicate the lunar cycle through the months of the year. They run through their cycle completely 12 times in the year, finishing at 20 December after 354 days, and another series then starts with A on the 21st. This matches the difference between the lunar and solar years.

In addition, looking at the whole calendar it can be seen that the lunar letters usually have a space of two days in between each pair of letters, but in every second month (in February, April, June, August, October and December), there is an instance of an interval of only one day between letters. What this means is that, if we add up the days covered by each of the 12 complete sets of letters, they comprise alternately 30 and 29 days per set. In other words, each set of letters from A to K is a lunar month of the traditional form, consisting of either 30 or 29 days (Degrassi 1963: 326).

This further suggests that through this mechanism a system has been devised for indicating the phases of the moon in a given solar year. A quick check through the lunar phases for the year AD 354, the year of presentation of the Chronicle to Valentinus, shows no particular correlation between, say, new moon and the letters A in the calendar. But for AD 355, the year following the presentation, examination indicates that the true conjunction for the new moon occurred just one day before a letter A in eight months, and two days before in the other four (July, September, October and November). First visibility of the lunar crescent, therefore, would have occurred with or very soon after a letter A in the calendar. This may be coincidence, although a curiously apposite one, or it means that the calendar was intended practically as an almanac for the following year. Why should lunar phases be included at all? A likely answer lies in the contemporary fascination with astrology, which is demonstrated elsewhere in the calendar (Stern 1953: 55-7; Lietzmann 1953: 238). Astrological calculations involving the moon could be made on the basis of these lunar letters without the concern that one might not observe the moon itself because of topographical or climatic factors.

The second column in the calendar consists of the seven letters from a to g, which mark the seven days of the week. This seven-day week was a relatively late innovation in the Roman calendar, introduced in the time of Augustus, to judge from a few pieces of evidence. The tell-tale column of seven letters occurs on the fragmentary *Fasti Sabini* (after AD 19) and *Fasti Nolani* (early Imperial), and just two letters of it survive on the Augustan *Fasti Foronovani* (Degrassi 1963: 51-4, 156, 229-31, 326), but as we can see it does not necessarily replace the original eight-day week which was focused on the market-days.

The names of the weekdays are derived originally from those of the seven planets of antiquity in the following order: Saturn, Sun, Moon, Mars, Mercury, Jupiter and Venus. A fragmentary inscription from Pompeii presents six of these in this characteristic sequence, with a gap where the seventh, Mercury, must be placed (*CIL* 4.6779: Degrassi 1963: 326). The Augustan poet Tibullus (1.3.18) refers to 'Saturn's holy day', meaning what we call Saturday, and indicating that the naming of the weekdays occurred early in the process of adoption, even though contemporary calendars simply acknowledge them through the letters from a to g.

To arrive at the desired sequence of the planets, and hence of the weekday names, we can simply repeat the list of the planets according to their supposed distance from the earth, from furthest away to closest in the geocentric system, and then nominate every third planet in this series:

Saturn, Jupiter, Mars, *Sun*, Venus, Mercury, *Moon*
Saturn, Jupiter, *Mars*, Sun, Venus, *Mercury*, Moon
Saturn, *Jupiter*, Mars, Sun, *Venus*, Mercury, Moon
Saturn ...

While this works, it fails to tell us why such a system might be adopted. Cassius Dio (37.19) provides an insight into a possible cause.

First we need to arrange the names of the planets as above: Saturn, Jupiter, Mars, Sun, Venus, Mercury and Moon. Although Cassius Dio attributes this order to 'the Egyptians', Macrobius calls it the 'Chaldaean' order, as opposed to the 'Egyptian', which placed the Sun further down the line next to the Moon (Macrobius, *Dream of Scipio* 1.19.1-2). It became the dominant convention late in the Hellenistic period, probably as a result of the influence of astrology, whose practitioners were often called 'Chaldaeans', without the name necessarily signifying that particular ethnicity (Beck 1988: 4-6).

We maintain the precedence given to Saturn in this sequence by then starting with that planet's day, Saturday. Each planet is then considered to rule over the successive hours of each day and night, from the first to the 24th. Thus, Saturn rules the first hour of Saturday, Jupiter its second, Mars its third, and so on to the 24th hour, which Mars again rules. The first hour of the following day was then ruled by the Sun (hence, Sunday, derived from the English for Sol, the Roman sun god), the second by Venus, and so on to the 24th, which was ruled by Mercury. The first hour of the next day was therefore ruled by the Moon (hence, Monday from Moon's Day, a translation of Roman Luna), and so on. As shown in Table 7 opposite, the eventual sequence of the planets as rulers of successive days of the week was therefore: Saturn, Sun, Moon, Mars, Mercury, Jupiter, and Venus, which agrees with the simpler rule applied earlier.

In English, but more so in Romance languages, some of these Roman planetary names are reflected still in the names of the weekdays, e.g. French *lundi* and Italian *lunedi* (Monday) from Luna (Moon); *mardi* and

Saturday:		**Sunday:**	
Saturn	1, 8, 15, 22	Saturn	5, 12, 19
Jupiter	2, 9, 16, 23	Jupiter	6, 13, 20
Mars	3, 10, 17, 24	Mars	7, 14, 21
Sun	4, 11, 18	*Sun*	1, 8, 15, 22
Venus	5, 12, 19	Venus	2, 9, 16, 23
Mercury	6, 13, 20	Mercury	3, 10, 17, 24
Moon	7, 14, 21	Moon	4, 11, 18
Monday:		**Tuesday:**	
Saturn	2, 9, 16, 23	Saturn	6, 13, 20
Jupiter	3, 10, 17, 24	Jupiter	7, 14, 21
Mars	4, 11, 18	*Mars*	1, 8, 15, 22
Sun	5, 12, 19	Sun	2, 9, 16, 23
Venus	6, 13, 20	Venus	3, 10, 17, 24
Mercury	7, 14, 21	Mercury	4, 11, 18
Moon	1, 8, 15, 22	Moon	5, 12, 19
Wednesday:		**Thursday:**	
Saturn	3, 10, 17, 24	Saturn	7, 14, 21
Jupiter	4, 11, 18	*Jupiter*	1, 8, 15, 22
Mars	5, 12, 19	Mars	2, 9, 16, 23
Sun	6, 13, 20	Sun	3, 10, 17, 24
Venus	7, 14, 21	Venus	4, 11, 18
Mercury	1, 8, 15, 22	Mercury	5, 12, 19
Moon	2, 9, 16, 23	Moon	6, 13, 20
Friday:		**Saturday:**	
Saturn	4, 11, 18	*Saturn*	1, 8, 15, 22
Jupiter	5, 12, 19	Jupiter	2, 9, 16, 23
Mars	6, 13, 20	Mars	3, 10, 17, 24
Sun	7, 14, 21	Sun	4, 11, 18
Venus	1, 8, 15, 22	Venus	5, 12, 19
Mercury	2, 9, 16, 23	Mercury	6, 13, 20
Moon	3, 10, 17, 24	Moon	7, 14, 21

Table 7. The planets as rulers of the hours of the day and of the days of the week.

martedi (Tuesday) from Mars; *mercredi* and *mercoledi* (Wednesday) from Mercury; *jeudi* and *giovedì* (Thursday) from Jupiter; *vendredi* and *venerdi* (Friday) from Venus. But in English the equivalent Norse gods' names have superseded most of the original Roman ones, to give us our present names, i.e. Tuesday from Tiw, Wednesday from Wodin, Thursday from Thor, Friday from Frig. And in French and Italian, the names for Saturday and Sunday – *samedi* and *dimanche*, and *sabato* and *domenica* respectively – come from Judaeo-Christian associations, the former from 'Sabbath', the latter from 'the Lord's Day'.

The early Christian bishop, Ignatius of Antioch, writing to the people of Magnesia in Caria around AD 100, talks of 'those no longer keeping the Sabbath but living according to the Lord's Day', in what is probably the earliest use of the term 'the Lord's Day' for Sunday (Kubitschek 1928: 33). Despite this early occurrence in Christian literature, it is apparent elsewhere in the Chronicle of 354 that the week still begins with Saturn's day, not the Sun's nor the Lord's day (Salzman 1990: 30-1). Astrologers, we noted, used the 'Chaldaean' sequence of the planets, which set Saturn at the head of the list. But when detailing the positions of the planets in their horoscopes, they placed the Sun and Moon ahead of Saturn and the other planets: Sun, Moon, Saturn, Jupiter, Mars, Venus and Mercury. Others in the Roman Empire also prioritised Saturn over the Sun. For the adherents of the Mysteries of Mithras, the planets each protected one of the Mysteries' seven grades of initiation in the sequence: Saturn, Sun, Moon, Jupiter, Mars, Venus and Mercury. This is an unusual adaptation of the order of the planets by distance from the earth, with the Sun and Moon being transposed together to sit between Saturn and Jupiter (Beck 1988: 1-11).

The Chronicle of 354 could presumably have opted to follow the Christian sequence of weekdays, but does not. It may be that the main influence on the arrangement of the week in the codex is astrology, as other parts of the book reflect this interest (Salzman 1990: 30-2).

Returning to June, two of the pagan festivals of the Republican calendar have been retained across the centuries and reappear in the Chronicle: the Vestalia on 9 June, and the Matralia on 11 June. In fact, the notice of the Vestalia is bookended between two other related dates. On 7 June we are told the temple of Vesta is opened (*Vesta aperit[ur]*), while on 15 June it is closed again (*Vesta cluditur*). This latter notice corresponds to the Antium calendar's acronymic *Q. ST. D. F.*, which marked the day when the temple of Vesta was cleaned out.

Otherwise, the fourth-century calendar shows a loss of Republican festivals. Gone are those in honour of Mars and Juno (1 June), Dius Fidius (5 June, the Nones), Fortuna (11 June), and Minerva (19 June). Others have taken their place, and not always on the same dates.

The Kalends of June, Macrobius tells us,

> are commonly called the Kalends of the Beans (*fabariae*), because in this month ripe beans are added to sacrifices.
>
> Macrobius, *Saturnalia* 1.12.33

This explains the first entry on the Kalends in the Chronicle, *Fabarici*, which gives the month an agricultural character straightaway. This is emphasised further by the illustration of the month of June presented in the Vienna manuscript of the calendar. A nude male figure is shown from behind, gesturing up at a sundial on a column. Between him and the column, in the background, grows a large, flowering plant, perhaps a bean plant. The man holds a lit torch in his left hand, and carries a cloak draped over that arm, while behind him a basket of fruit, perhaps apples, stands on the ground, and a sickle hangs in mid-air above it (Salzman 1990: fig. 37). The imagery signifies mature growth and harvesting, presumably at some important solar moment in the year. What that moment probably is we shall soon discover.

Three other festivals occur in the month of June. One is the Birthday of the Muses (*N[atalis] Musarum*) on 13 June, which may be taken as a celebration of cultural heritage without religious overtones, although pagan deities are honoured elsewhere in this month and in the calendar generally. Another festival on 24 June honours the goddess Fors Fortuna (*Fortis Fortunae*), whose cult on this day Ovid also knew in Augustus' time (*Fasti* 6.771-84). About 'the rite of Anna' (*Annae sacrum*) on 18 June nothing more is known. The Anna referred to may be Anna Perenna, who is worshipped as a goddess of prosperity for the years to come on 15 March, as many sources tell us (Degrassi 1963: 423-4).

The Bean festival on the Kalends of June is accompanied by something which is certainly more common at this period than it was in the Republic – the notice of public games. *C M • xii* stands for *Circenses, Missus xii*, which means 'circus games, 12 races'. Other games are mentioned on 4 June: these *ludi in Minicia* are theatrical games held in honour of Hercules at the temple of Hercules Custos at the Porticus Minucia (Salzman 1990: 126; Steinby 1993-2000: 4.137-8; Haselberger et al. 2002: 137). In the whole calendar there are 177 holiday or festival days set aside for games of either the theatrical or the circus variety. This contrasts markedly with the 77 days for such celebrations in Augustus' time (Salzman 1990: 120, 178). We can pinpoint the main source of the increase. Of the 177 days for games, 98 are associated with the imperial cult, and most of these (69) focus on the family of the current dynasty of Constantine, who died in 337. These games served a variety of purposes – political, in allowing the emperor contact with his people; social, in providing opportunity for prominent families to compete for the honour of putting on the games; and religious, as they honoured the divine in the current and past rulers (Salzman 1990: 136, 181-2).

Games in the circus had a further religious significance, in that the circus itself was imbued with cosmic symbolism, and the races were associated with the sun and the planets (Salzman 1990: 182). Other links to the sun and its cult are to be found in the calendar under June. On the 6th the entry reads *Colossus coronatur* ('the Colossus is crowned'). This is probably a reference to a ceremonial crowning of the colossal statue of the Sun which stood near the Colosseum, to which amphitheatre it gave its name (Salzman 1990: 151). The statue had been erected by Nero as a self-portrait, but Vespasian had replaced Nero's identity with that of Sol, the Sun. Then, more prosaically, on 15 June we are informed of the sun's entry into the zodiacal sign of Cancer (*Sol cancro*), and towards the end of the month we are reminded that this is the time of the summer solstice (*solsticium* on 24 June). The zodiacal notice ties in with the increasing reference to astrological elements in the calendar, such as the seven-day week. We may also now understand the image of the sundial in the illustration of June described earlier: the solstice is one of the key turning-points of the solar year.

On another superstitious front, there are two further days, 7 and 20 June, which are each designated 'an Egyptian day' (*dies egyptiacus*). Such a day was reckoned unlucky for business and to be avoided, as we learn from later Christian writers like Ambrose and Augustine, who disparage the practice (Degrassi 1963: 362-3).

Despite the increased number of columns of letters in this calendar, we have actually lost one of the characteristic markers of the calendar from Antium and early Imperial calendars: the list of days for public business, which were signalled by the letters F (*fastus*), C (*comitialis*), N (*nefastus*), and NP (*nefastus publicus*?). The most we get in June are two notices for 'a regular meeting of the Senate' (*senatus legitimus*) on the 3rd and 13th of the month. Two such days are set aside in every month, while January has a third as well. These fixed meetings of the Senate date from the time of Augustus, who had limited them to the Kalends and Ides of each month so as to ensure better attendance at meetings (Suetonius, *Augustus* 35.3; Cassius Dio 55.3.1). In the Chronicle, however, several of the Senate meetings have shifted from the Kalends to the 3rd day of the month (in February, March, June, August, October, December), some have moved from the Ides (in January, March, July, August and November), and the extra one in January occurs on the 23rd. Why these shifts have taken place remains a puzzle. In some cases, it may be to avoid clashes with circus games on the same day, but this does not apply to all instances (Degrassi 1963: 363).

The major increase in public holidays of a certain kind gives the Chronicle a value over and above its usefulness as a timepiece. It offers a window onto a different cultural world from what pertained in the Republic. In place of reminders to citizens of the Republic of the times when they could exercise their own political rights and worship the state's gods, we find now notices of when citizens of the Empire can acknowledge the emperor's dominant role in both political and religious life (Michels 1967: 143-4).

A new era

More than a change in the placement of New Year's Day was asked of the Greek cities in Asia in 9 BC, fundamental enough though that may seem. Rather, the Roman governor Paullus wanted the community to accept

Augustus' birthday as an epoch, a date from which other events, even life itself, may be measured. He had expressed this idea a couple of times in the letter he sent to the Greek cities with his proposal:

> We could justly conceive the birthday of the most divine Caesar to be equal to the beginning of all things ... Therefore one could justly conceive this to have been the beginning of life and existence for oneself, which is a limit and end to regretting that one has been begotten.
>
> *OGIS* 458.I.4-10

Admittedly it does not seem to be the case that the Greeks dated their years subsequently from the birthday of Augustus. But we might appreciate the formal aspects of a move such as Paullus', if we think in terms of, say, the British Commonwealth establishing the reigning monarch's actual birthday not only as New Year's Day, but also as the date from which we measure all subsequent events. That sounds improbable enough, of course, but it would be completely impossible to match the sentiment behind Paullus' proposal nowadays outside the religious sphere. For the notion is soteriological: it expresses the belief that through Augustus' very birth the people in Asia have been saved from the sense of hopelessness that the actual living of life generates.

Other eras had long existed in the Greek and Roman worlds based on similar notions of 'a new start'. The liberation of a city could be the cause for the establishment of a new era. Tyre may have been the first to do this in 275/4 BC to mark the end of the local dynasty, but certainly did it later in 126/5 BC when breaking free of Seleucid rule, and its era lasted a very long time: a church council in that city in AD 518 still used it to date its proceedings – by then it was year 643 of the era – while a Christian gravestone in Tyre, recording the year 734 of the era, shows its continuation to AD 609 (Kubitschek 1915: 109; Meimaris 1992: 60). Somewhat different is the case of the Seleucid Era itself, which we examined in Chapter 4. The capture, and therefore possession, of the symbolically significant royal city of Babylon in 312 BC gave Seleukos I the occasion from which to start counting his regnal years, and his successors continued the system; it persists still in parts of the Near East (Meimaris 1992: 53-4). Augustus' victory against Antony and Cleopatra at Actium in 31 BC became the start of another type of era for parts of the eastern Empire (Kubitschek 1894: 650-1; Bickerman 1980: 73).

Soteriology, of course, lies at the heart of Christianity, and not surprisingly, as the Julian calendar becomes increasingly christianised in the early medieval period, we can trace religious sentiments similar to those of the liberated or otherwise grateful cities of the eastern Mediterranean.

Bound in the Chronicle of 354 is a plain, unillustrated list of the consuls of Rome. This list comprises first a column bearing a date in terms of the number of years since the founding of the city of Rome (*ab urbe condita*); then the two consuls' names for each year for the years we recognise as 509 BC – AD 354; followed by another column indicating on which day of the week 1 January occurred; and finally a column giving the age of the moon on 1 January, in terms of the number of days since the moon was new. For example, here are the years equivalent to 12 to 9 BC:

742	Messala et Quirino	Ven.	xxx
743	Tuberone et Maximo	Sat.	xi
744	Africano et Maximo	Sol.	xxii
745	Druso et Crispino	Lun.	iii

After *CIL* I, 546 and Mommsen 1892/1961: 56

The weekday names (Ven., Sat., Sol., Lun.) are recognisable successively as Friday, Saturday, Sunday and Monday. The day-count in the lunar phase column (30, 11, 22, 3), it may be noted, jumps forward at the rate of 11 days per year, with a maximum of 30 days to a phase, after which point it returns to 1. This rate corresponds to the differential between the lunar year of 354 days and the solar year of 365 days (ignoring fractions). This column comes to be called the 'epact' column, from a Greek word meaning 'addition', to signify the regular annual increase of 11 days. Along with the column giving the weekday it plays a pivotal role in the calculation of the date of Easter, being used to help fix the date of the first full moon after the spring equinox and hence of Easter Sunday (cf. Bede, *The Reckoning of Time* 20-3, 50, 52, 55; Wallis 1999: 293-9, 340-6). Indeed, these two features of the consular list in the Chronicle help explain the presence of the table of Easter Sundays for the years AD 312-411, which lies between the list of consuls and the list of prefects (Mommsen 1892/1961: 62-4).

In the consular list the phases of the moon are evidently calculated on the basis of a repeating lunisolar cycle. By the start of the fourth century there existed in the western Empire a table of Easter Sundays, which was based on an 84-year cycle known as the 'Roman *Supputatio*' ('computation'). Its dates differ sometimes from those preserved in the Chronicle of 354's list of Easter Sundays and it used to be thought that the Chronicle's own dates were based on the continuation of an older, alternative 84-year cycle, which began in AD 213. This particular genealogy is now considered unlikely – although, as we shall see, the date still has some attraction – while the Chronicle's list of Easter Sundays is taken to be a set not of calculated dates but of actual Easters at least until AD 354, which sometimes demonstrate compromises between the Roman tradition of calculating Easter and that of Alexandria, which we shall look into soon (O'Connell 1936: 71; Wallis 1999: xliv-xlv).

The 84-year lunisolar cycle requires some explanation, especially as we are now in the world of the Julian calendar. 84 Julian years amount to 30,681 days ($365^1/_4$ x 84). If we try to express this in lunar terms, we have 84 lunar years, each of 12 months alternating with 29 and 30 days, which amount to 29,736 days (84 x 12 x $29^1/_2$); plus 31 intercalary 30-day months, which give a further 930 days; plus the 21 Julian leap days which accrue over the 84-year period; producing a total of 30,687 days. But this sum overshoots the Julian year day-count by six days, which must somehow be dropped over the full period to bring the lunar cycle back into line with the Julian years.

It is not a matter of adding six days to the Julian calendar to enable it to catch up with the lunar cycle – that would simply increase the distortion from reality – but of pulling the lunar cycle back to the solar year by making the moon apparently run ahead of itself by six days. This is achieved by increasing the age of the moon by a day in the 'epact' column six times through the 84-year period. To use the instance above of epacts of 30, 11, 22, 3 at the start of four successive years, one could increase one of these epacts by a day so that the column would read 30, 12, 23, 4. Thus the moon is a day older at the start of years 2, 3 and 4. Such a jump by the moon is called the *saltus lunae* ('leap of the moon').

This leap of the moon could be simply spread over the full 84-year period by having the epact jump forward a day once every 14 years (84/6). But instead from the early fourth century AD we find that the leap occurs once every 12 years, i.e. after years 12, 24, 36 ... and 72, but not after year 84, since that would produce a seventh leap. Such is the system underlying the list of Easter Sundays in the Chronicle of 354 (Schwartz 1905: 43; O'Connell 1936: 70-1).

To return to the consular list in the Chronicle of 354, the lunar phases here are quite accurate to within a day or two of modern calculations the nearer the date is to AD 354, but they become increasingly variable and inaccurate the further back in time one goes from about AD 130. This would be consistent with an origin for the Chronicle's cycle at around AD 213, if an 84-year cycle was projected forwards and backwards in time from then (cf. Stern 1953: 55-6). The bulk of the phases in the Chronicle would then be considerable backward projections from some such date, and certainly not direct observations.

Of more interest in this context, however, are the first two columns with the date and the consuls' names. Rather like the dating of the Christian epoch in modern times (was Christ born in 7 BC, or 4 BC, or 1 BC?), no consensus on the precise date of the foundation of Rome was reached in antiquity. Solinus, writing probably soon after AD 200, summarises various estimates made between the third and first centuries BC:

Cincius decided Rome was founded in the 12th Olympiad; Pictor the eighth; Nepos and Lutatius, approving the view of Eratosthenes and Apollodorus, the second year of the seventh Olympiad; Pomponius Atticus and M. Tullius the third year of the sixth Olympiad. After collating our chronologies and those of the Greeks, we have found that Rome was founded at the beginning of the seventh Olympiad, in the 433rd year after Troy was captured.

Solinus 1.27

The 'Pomponius Atticus and M. Tullius' mentioned here are the same Atticus and [M. Tullius] Cicero whom we met in Chapter 5, corresponding over the issue of the possible intercalation of 50 BC. According to Cicero himself, it was his friend who made the calculation (Cicero, *Brutus* 19.72-4). Others agreed with Atticus:

That the founding was on this day, the 11th before the Kalends of May, it is agreed; and the Romans celebrate this day, calling it the birthday of the fatherland. ... But even before the founding, they had a pastoral festival on that day, and called it Parilia. ... On this day, on which Romulus founded the city, ... a conjunction with an eclipse of the moon in front of the sun occurred, which they believe Antimakhos, the Teian epic poet, saw happen in the third year of the sixth Olympiad.

Plutarch, *Romulus* 12.1-2

Most influentially, the scholar Varro also arrived at this date, although his calculation comes down to us expressed in a slightly different form. In a context in which he is discussing the three ages of time devised by Varro, Censorinus says of the year in which he is writing (AD 238) that

... this year, of which the consulship of ... Pius and Pontianus is a sort of touchstone and a kind of marker, is the 1,014th since the first Olympiad, at least from the summer days, in which the Olympic Games are celebrated, and the 991st since the founding of Rome, and indeed from the Parilia, from which point the years of the city are counted.

Censorinus, *On the Birthday* 21.4-6

The sixth Olympiad means the sixth celebration of the Olympic Games. The count starts with the first Olympic Games, conventionally written as Ol. 1, 1. The second celebration, Ol. 2, 1, follows four years later, in the year after Ol. 1, 4. So 'the third year of the sixth Olympiad', Ol. 6, 3, means 23 years from the first Olympic Games, which equates with the difference between the first Olympiad and the founding of Rome reported here by Censorinus.

We shall need to return to this date for the founding of Rome, but for now let us go back to the consular list in the Chronicle of 354. The list is punctuated on a few occasions by brief historical notes. In the Republican period these are limited to notices of the election or omission of dictators, and these remain the only secular references in the whole list. Under the Empire, on the other hand, the notes shift focus to events concerning the Christian Church, including the birth and passion of Jesus Christ, the arrival of Peter and Paul in Rome, and their martyrdoms. So, for the years 754 and 782 *a.u.c.* (i.e. AD 1 and 29) we have the entries:

754 Caesare et Paulo Sat. xiii
Hoc cons. dominus Iesus Christus natus
est viii kal. Ian. d. Ven. luna xv
...
782 Gemino et Gemino Sat. xxiii
His consulibus dominus Iesus Christus
passus est die Ven. luna xiiii
CIL I, 548; Mommsen 1892/1961: 56-7

For 754 *a.u.c.* we are told that Caesar (i.e. Augustus) and Paulus (i.e. Aemilius Paullus) were the consuls, that 1 January fell on a Saturday, and that the moon was 13 days old on that day. For 782 *a.u.c.*, the consuls were the two Gemini (Fufius and Rubellius), the weekday was again Saturday, and the moon was 23 days old. According to modern calculations, the moon was 18 days old on 1 January AD 1, and 27 days old at the start of AD 29. The discrepancies demonstrate the deficiency of using a lunisolar cycle whose inherent inaccuracy is magnified markedly the further backwards (or forwards) it is projected in time.

The annotations under the two consular listings mean: for 754 *a.u.c.*, 'In this consulship the lord Jesus Christ was born on the eighth before the Kalends of January, Friday, 15th [day of the] moon'; and for 782 *a.u.c.*, 'Under these consuls the lord Jesus Christ suffered, Friday, 14th [day of the] moon'.

The entry for Christ's birth is interesting on several counts. Firstly, the date meant by 'the eighth before the Kalends of January' is, of course, 25 December. The Chronicle of 354 is one of the earliest pieces of evidence that the feast of the Nativity had become attached to 25 December. This date was also taken to be that of the winter solstice, and had been recorded as such in the Roman calendar tradition since the first century AD (Columella, *On Agriculture* 9.14.12, Pliny, *Natural History* 18.57), although in reality the tropic occurred then around 23 December, and around 21 December in the time of the Chronicle. It looks as though a much earlier observation has been fossilised in the Roman tradition, one which may well go back to the Greek Hipparkhos in the mid-second century BC (Ideler 1825-6: II, 124). Regardless of the slight error in timing, the Romans linked the tropic with the 'Birthday of the Unconquered Sun', as is noted in the calendar of days within the Chronicle (Degrassi 1963: 261). It is very much a characteristic of the Church in the west, and especially in Rome itself, to celebrate the Nativity on this day. Before the mid-fourth century other dates had been suggested – 28 March or 20 May were proposed in the second and third centuries – while in the eastern Empire 6 January, the feast day of the Epiphany, or the 'appearance' of Christ, was a regular choice, and still is a more prominent festival than the western Christmas in the eastern Mediterranean (Ginzel 1906-14: III, 195-8; Lietzmann 1953: 239, 315-22).

Secondly, the consular list gives the Nativity in the year of the consulship of Augustus Caesar and Aemilius Paullus. This consulship belongs to AD 1, and from 1 January of that year. Ovid, writing contemporaneously with the period, reflects this tradition of the beginning for the consular year on 1 January (*Fasti* 1.81; cf. Meslin 1970). Yet the Nativity, we would normally understand, occurred in 1 BC. What the list seems to reflect is a contrary tradition that the Roman consular year at that time began before 1 January, perhaps on 25 December itself, a practice which is found in the Church in Rome, as the calendar of the feasts of the martyrs in the Chronicle indicates. We find 25 December as the start of the year later in the medieval period still attributed to the Romans and associated with the winter solstice (Ginzel 1906-14: III, 167; Bede, *On Times* 9; Harrison 1973: 53; cf. McCarthy 2003, who argues that 1 BC is indeed meant).

Thirdly, the moon's age on 25 December is given as 15 days, and therefore the moon is full. Yet according to the same entry in the consular list, only seven days later on 1 January the moon is supposed to be 13 days old. The lunar phases for the events of 782 *a.u.c.* – the beginning of the year and the Passion – are equally incommensurate. (Assuming the Nativity is meant for AD 1 produces no better match.) Once again, the incoherence between calculation in one part of the list and tradition in another underlines the artificiality of the use of a retrojected lunisolar cycle (Stern 1953: 56-7).

Nothing better illustrates the list's mixture of secular tradition and religious innovation than these brief notes appended to a few days. The old Roman systems of dating via the foundation epoch (*a.u.c.*) and the annual consular names are used to pinpoint in time the key events of the new religion, the birth and death of Christ. As we shall see, they prove crucial in the future development of Christian calendars. The use of the consulship as a dating mechanism continues until the sixth century AD, when it eventually dies out (Bagnall et al. 1987: 7).

If we now move ahead a century, we step into the middle of what we would expect to be a controversy of purely internal interest in the Christian Church: the means of calculating the proper date of Easter. Yet the pagan past has a necessary role to play even here. In Rome at this time there were two competing methods for plotting the future dates of Easter. One was Roman, the 84-year cycle already encountered in the Chronicle of 354. It may be regarded as four 19-year 'Metonic' lunar cycles with an octaeteris appended at the end (Wallis 1999: xlix). The other method was a more accurate 95-year cycle of five 19-year 'Metonic' cycles. This table was constructed in the mid-fifth century for the years AD 437-531, and was attributed, incorrectly, to Cyril, bishop of Alexandria. Apart from its greater accuracy over the 84-year cycle, the Alexandrian scheme also had the advantage of being adapted from its parent Egyptian Julian calendar base, which began the year on 29 August and inserted five epagomenal days, to the Roman Julian year, which begins on 1 January and inserts the leap day after 24 February. But despite these benefits, it was an import from Alexandria and so met with stubborn resistance in Rome because of the continuing push from Rome for overall primacy in the Church.

In AD 457 Victorius of Aquitaine (in western France), in response to a request from the Pope's archdeacon, Hilarus, issued a new set of Easter tables based on the 95-year cycle. Although the tables' usefulness was undermined by inaccuracies throughout, they were nevertheless adopted, Hilarus' election to the papacy soon afterwards probably helping (Stevens 1995: I.40; Wallis 1999: l-lii). In Victorius' tables the type of information that had been given in the religiously mixed Chronicle of 354 veers, naturally, much more towards Christian interests, but the old Roman chronological system persists. The columns of the tables comprise the year of the cycle, the consuls' names for that year, and the day of the week for the Kalends of January. The cycle begins in the year of the consulate of the two Gemini, which, as we saw in the consular list from 354, marked the year of the passion and death of Christ (Mommsen 1892/1961: 686). Thus Victorius chooses as his epoch the appropriate time of the first Easter, in which, as he states explicitly in his letter to Hilarus, Christ was crucified, died and then rose again from the dead (Mommsen 1892/1961: 683). Others around this time chose this epoch too – we find it, for instance, in the slightly earlier table from Zeitz of AD 447 (Mommsen 1892/1961: 503-10; Wallis 1999: xlix n.88). It is effectively the same as the Hellenistic liberation epochs which we encountered earlier, but this time is of a spiritual nature rather than a physical one.

The errors that beset Victorius' tables ensured the continuation of the Easter controversy. Close to the time when the Alexandrian 'Cyrillic' tables were due to run out, the monk Dionysius Exiguus in AD 525 computed for the Roman Church a new table of dates for the celebration of Easter. For this he started from the Alexandrian table, taking the last 19-year cycle (AD 513-531 in our terms) from it, and added to it an additional 95-year cycle, thus extending the table to the equivalent of AD 626. Only this time, the date attached to the final year was '626', which is the era we still use. How did Dionysius do this?

The last year of the older Alexandrian table was actually called year 247 of Diocletian (Dionysius Exiguus, *PL* 67.493). The 'Era of Diocletian' is a late invention, starting from the date when Diocletian became emperor in AD 284. It is an artificial construct, like the earlier Seleucid Era, inasmuch as by beginning on 29 August it predates the actual accession of Diocletian which took place later that year on 20 November (Ideler 1825-6: I, 163-4; Ginzel 1906-14: I, 229). But 29 August had been New Year's Day according to the Julian calendar in Egypt ever since the takeover of the country by Augustus (see Chapter 4). The Era of Diocletian, then, maintains continuity with that system in Egypt.

Others in Egypt appreciated this sense of continuity long after Diocletian had gone, notably astronomers and astrologers, who date observations and horoscopes according to this era. In the late fourth century AD, for instance, both the astronomer Theon and the astrologer Hephaisteion refer to observations via this system: 'in the 39th year of Diocletian, according to the Alexandrians or the Greeks, 10 Tybi', (Theon, *Commentary on the Almagest*, ed. Rome, p. 908.1-5); 'in the 97th year from the reign of Diocletian, Athyr 30', (Hephaisteion, *Apotelesmatica* 87.3-4). Christians too used the era. When writing a letter to the bishops of Aemilia in AD 386, Ambrose, bishop in Milan, discusses the right time for celebrating Easter Sunday and recalls the celebration of the festival over 20 years earlier:

> ... and if the 14th day of the moon falls on a Sunday, another week must be added, just as was done in the 76th year from the time of Diocletian. For then on the 28th day of the month Pharmouthi, which is the ninth from the Kalends of May, we celebrated Easter Sunday without any doubt from the majority.
>
> Ambrose, *Epistle* 23.21

The 76th year in the Era of Diocletian began on 30 August AD 359, and this particular Easter belongs to 23 April 360, the differently situated leap days in the Alexandrian and Julian calendars having cancelled each other out by then. The same letter also contains references to Easter celebrations in the 89th and 93rd years in this era, i.e. in AD 373 and 377 (*Epistle* 23.14).

Christians certainly had cause to remember Diocletian, though not at all favourably, as he instituted a notorious series of persecutions against them. As a result, the Church in Egypt also later established an 'Era of Martyrs' to commemorate the losses they suffered in the time of Diocletian. The Coptic Church has retained this version of the Era of

Diocletian (Meimaris 1992: 314-5; Bagnall and Worp 2004: 63-87). Because of these persecutions under Diocletian, Dionysius expressly sought to remove the connection between the pagan emperor and the ecclesiastical calendar. For a new epoch he calculated backwards in time to the Incarnation of Christ:

> Because indeed holy Cyril began his first cycle from the 153rd year of Diocletian, and ended his last in the 247th; we, rather than beginning from the 248th year of that tyrant, have refused to tie to our cycles the memory of that impious persecutor; but we have chosen instead to designate the periods of the years from the Incarnation of our Lord Jesus Christ: in so far as the beginning of our hope would be more obvious to us, and the cause of human salvation, that is, the passion of our Redeemer, might shine more clearly.
>
> Dionysius Exiguus, *Letter to Petronius* 20

In his new table, the last year of Cyril's table was followed by the 532nd year 'of the Incarnation' of Christ (*PL* 67.495). The shift of epoch is theologically similar to that proposed much earlier around 9 BC by the proconsul Paullus for the Greek communities in the province of Asia, when he recommended that the year, even life itself, start with the birthday of Augustus. Turning the clock back, as it were, 532 years from the start of his new Easter cycle took Dionysius to the other significant event noted in the consular list in the Chronicle of 354, namely the traditionally accepted date for the birth of Christ, 25 December in the year preceding the consulship of Augustus Caesar and Aemilius Paullus.

It seems from Dionysius' own testimony, and is evident from later chronologists like Bede in the eighth century, that the number 532 in itself played a significant role in establishing the date of the new Christian epoch. As Bede points out, a cycle of 532 years had been drawn up by Victorius. It provided a means of coordinating the lunar and solar calendars together with the seven-day-week cycle, so as to bring the same phase of the moon not only back to the same date in the solar calendar but back to the same weekday as well (cf. Bede, *The Reckoning of Time* 47).

If Easter were tied solely to a full moon and therefore to the lunar calendar, it would run, just as Islamic holidays still do, through all the seasons. But Easter is tied both to the full moon and to the spring equinox, a solar event. Both phenomena in this equation, we must realise, are defined by calculation rather than by observation: the equinox is artificially fixed to a calendar date, 21 March being the standard now but others were used and the differences caused immense anxiety to ecclesiastical chronologists and trouble in the Church generally; and the full moon is a function of calculation by the 19-year cycle. To coordinate the lunar and solar calendars, we have seen already that the 'Metonic' cycle had been devised. Easter, however, is also tied to a particular day of the seven-day week, the first Sunday after the spring full moon. So Easter tables had to show a way of combining the lunar, solar and weekday cycles.

The 532-year cycle provides the means. Combining the weekday cycle of seven days with a four-year cycle of the Julian calendar (7 x 4 = 28) acknowledged the fact that every 28th year a given solar calendar date would recur on the same weekday, e.g. if 1 January fell on a Tuesday in AD 513, it would do so again in 541. The use of the four-year cycle in this calculation allowed for the additional leap day every fourth year. The alternative 84-year cycle managed this much, since it is divisible by seven, and may have originated as an octaeterid-type cycle of 112 years (= 14 x 8) less one such solar cycle of 28 years (O'Connell 1936: 71). But combining this 28-year cycle with the 19-year 'Metonic' cycle (28 x 19 = 532) also brought a desired phase of the moon into line with a solar date on a given weekday. Victorius knew of the 532-year cycle, but did not understand its basis. So the attraction of the period of 532 years to Dionysius and Bede was that it had an aura of completeness about it: a full 532-year Paschal cycle lay between the first year of Dionysius' new table of Easter dates and the Incarnation. This fascination with a particular number may go some way towards explaining Dionysius' shift from the epoch of the Passion to the earlier one of the Incarnation.

We still live with Dionysius' epoch, but under different names. Dionysius' year 'of the Incarnation' is used in the eighth century by Bede, who also abbreviates it to *anno domini* ('in the year of the Lord'), which we still use (*Ecclesiastical History* 5.24). Although a year given as 'from the Incarnation' should technically begin from 25 March (nine months before the Nativity at Christmas, itself a week before 1 January), Bede keeps his year aligned with the Julian and begins it on 1 January (Harrison 1973). This is not adhered to uniformly everywhere, however, so early medieval accounts can provide a series of divergent dates for the same event simply because they begin the year from different points.

An alternative form, 'APV', may be found at times. Machiavelli's tomb in Florence, for instance, bears the date of his death as APV MDXXVII, which stands for 'ab partu Virginis MDXXVII' ('from the birthing of the Virgin 1527'), thereby providing the mother's perspective of 'AD'. The English term 'BC', for 'Before Christ', stems ultimately from Bede again, who uses the phrase *anno ante incarnationem dominicam* ('in the year before the Lord's Incarnation'). The modern renderings, 'CE' for 'Common Era' and 'BCE' for 'Before the Common Era' are a twentieth-century convention designed to acknowledge the non-Christian and secular sectors of societies, although the epoch remains the same Christian one.

With the new epoch we can finally apply a date to the foundation of Rome and the years following it. The date accepted by Atticus, Cicero and

Varro, and expressed by Censorinus as 991 years before the consulship of Pius and Pontianus, computes to 753 before Christ's Incarnation, or 753 BC. Ironically, as far as the historical date for the birth of Christ is concerned, it is currently generally accepted that the scraps of historical evidence available to us tend towards a date in the region of 4 BC rather than 1 BC. With the inauguration of the epoch, the medieval world explicitly cuts its ties with its pagan past, however much that past underwrites its construction of time.

As for the question with which we began this book – did our new millennium start with 1 January 2000 or 1 January 2001? – the answer depends on our appreciating how the first century of the era began. Since there is no year 0 in the era which Dionysius established, the first century of it must run from AD 1 to AD 100, the second from AD 101 to AD 200, and so on to the twenty-first century, which technically began with AD 2001. The first century BC, on the other hand, runs backwards from 1 BC to 100 BC, the second from 101 BC to 200 BC, and so on. In either case, however, we tend to take more notice of the change of numeral at the start of the hundreds or thousands (*1*00, *2*00, ...), and assume that this signals the beginning of a new century or millennium.

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Abbreviations

CIA = Corpus Inscriptionum Atticarum.
CIL = Corpus Inscriptionum Latinarum.
FD = Fouilles de Delphes.
ID = Inscriptiones Deli.
IG = Inscriptiones Graecae.
OGIS = Orientis Graeci Inscriptionis Selectae.
PG = Patrologia Graeca.
PL = Patrologia Latina.
SGDI = Sammlung der Griechischen Dialekt-Inschriften.

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