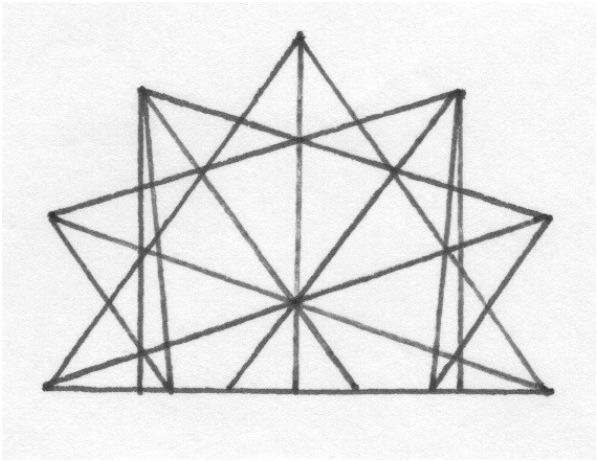
Harmonics in Ancient Calendrics



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The study of harmonics is usually and rightfully associated with musical tuning theory. However, another appropriate context for this branch of arithmetic is the establishment of a calendar. In both situations, the procedure rests fundamentally on the measurement of a time period for a vibratory event. In the case of tuning theory, these cyclical interactions happen very quickly--hundreds, even thousands of periods per second. Consequently it is convenient to use the concept of frequency (cycles per second) as a descriptive device. In the case of calendrics, we are still measuring a physical vibratory event, but the time periods are very long; consequently, the frequency numbers are very low. It becomes more convenient to express measurements by period. For example, the year cycle is about 365 days long. We could convert this number of days to seconds (a big number!), and then invert the ratio to give us the frequency. In other words, frequency and period stand in inverse relation to each other.

In both the musical and calendrical contexts, we have periodicities of vibratory events. We have mechanical vibrations--something is actually vibrating in a periodic manner. The rotation of the Earth around the Sun is such an event, it repeats itself at regular intervals. When we compare the periods of the Sun with the Moon, we now have 'intervallic' relations. Such time dependent events are expressed as a ratio. We say, for instance, that there are about 12 lunations in a year. Thus a month is roughly 1/12th of a year.

The ratios involved in tuning theory are relatively simple, since the strong musical harmonies are the ratios of simple prime numbers and their multiples. On the other hand, the study of calendrics involves more complex primes. The number relations can be relatively 'bizarre' if translated to the musical context. For example, the year is slightly more than 365 days long; in fact, it is 365.2422 if we want high accuracy. In order to harmonize this cycle with the Moon's cycle, we must find a least common multiple between them. A messy number indeed!

The technical aspects of harmonics procedures are simple and arithmetical. If two cycles are to be harmonized or 'integrated' a least common multiple must be found between them. As a simple, hypothetical example, take two cycles of 8 and 60 time units. We could say that they relate by 1/7.5, but that is a bit awkward. It is preferable to express relations in whole numbers wherever possible. The ratio above equals 2/15. More importantly, if we want to integrate these two cycles, we must use a long cycle of 120 time units, because 120 = 8 * 15 and also 120 = 2 * 60. That number is the smallest number that will 'accommodate' both 8 and 60. In other words, the use of 120 permits us to also measure in units of 8 and 60. In fact, it permits a whole 'family' of

harmonies, since 120 = 3 * 40, and 4 * 30, and 5 * 24 and so on. Every number has a unique list of proper divisors which constitutes its 'family' of relations. All such divisors can be derived from the prime factors.

The first theorem of arithmetic is fundamental to the study of harmonics. Every number can be 'decomposed' into a unique product of prime numbers. $120 = 2^3 * 3 * 5$. These prime factors 'define' the number and tell us how it behaves in the harmonics situation.

In setting up a calendar, we must deal with some complex numbers, since the periods of the natural timekeepers (the Sun and Moon) incorporate some 'messy' numbers, and the cycles do not necessarily divide evenly into each other. There may be about 12 lunations in a year, but we must emphasize the 'about.' The solar and lunar cycles do not interact in a simple manner; consequently the ancients devised a Lunisolar calendar of 19 years to achieve a least common multiple. We shall compare how various ancient cultures, namely Babylonia, Egypt, India, China, neolithic Europe and Meso-america deal with the problems of timekeeping.

As a basic time unit with which to compare cycles, the most obvious and practical one is the day (abbr. D), defined by the spin of the Earth using a sidereal and/or solar reference point. We use the solar reference (eg. noon to noon) of 24 hours. The sidereal reference uses a chosen star as the reference point. This period is about 23 hours and 56 minutes-- 4 minutes short of

An important issue is illustrated here. Even though we know that the AY is the true year, we use the JY because it is so convenient and practical. The small price that we pay for this convenience is the need to make a fine adjustment every century or so. We can live with it. There is often a trade-off between accuracy and convenience. Various cultures have drawn the line in different places, and dealt with the consequences.

The ancient Egyptians used what we will call a Wandering Year (WY) of 365 days as their civil year. They consciously ignore the quarter-day discrepancy. As a result, the civil calendar date loses one day every 4 years. Over a period of time, the civil calendar date 'wanders' right through the seasons like a freewheel. It shifts through the whole cycle in 1461 WY; in other words 1461 WY equals 1460 JY. The Egyptians related this cycle to a sidereal reference point (conforming to their religious orientation), namely the star Sothis (modern Sirius, associated with the goddess Isis). Hence we call this long cycle the Sothis Cycle.

We moderns may think that this wandering year is highly quircky. If we adopted this calendar, some generations here in the northern hemisphere would have the month of January in the middle of summer! But it is difficult to separate the calendar from religious concerns. The modern calendar strives to keep Christmas and Easter in a specific season of the year; in other words, it is solar cycle based. We can better appreciate the attitude of the ancient Egyptians (and Babylonians) if we remember that their day-to-day lives and concerns we more closely bound to the lunar calendar than the solar one. What is more, the reference for the agricultural calendar (when to plant, sow, harvest, etc.) can just as easily be sidereal as solar. The heliacal rising of the star Sirius indicated the beginning of the 'flood season' for much of Egyptian history. Thus the lunar calendar year was tied to the rising of Sirius (the first day of the new year).

365 is an interesting number. It's prime factors are 5 * 73. The Babylonians (or perhaps their mentors, the Sumerians) discovered an integrated way of dividing the year into 'weeks.' The year has 73 weeks of 5 days each. The names for these five day weeks could come from the five planets (Mercury, Venus, Mars, Jupiter and Saturn--minus the Sun and Moon). This is a very clever way of measuring the year, because it contains the Ceremonial Year of 360 D. This period equals 72 'weeks,' the 73rd 'week' of 5 days just before the spring equinox (when the new year begins) being the 'crack between the years.' The year of 360 days is innaccurate to the solar cycle to the extent that we will call it the Vague Year (abbr. VY).

The Mayans also used the VY, which they called a Tun, in their calendar. In addition, the Egyptians used a ceremonial calendar of 360 D 'embedded' within their civil calendar of 365 days. The extra five days at the end of the year are epagomenal or somehow 'outside of time.' There are very great similarities

relation to the solar cycle.

The lunar calendar is the most prominant ancient calendar, and probably the earliest; in fact, it probably pre-dates the Patriarchy. It is closely tied to the women's cycle, and it is short enough and visible enough to be highly practical. The lunar motions involve a high degree of complexity, but it is only the synodic period (SM) which is the main concern. This is the time from new moon to new moon. Additional lunar cycles include the Sidereal Month (SiM), the Anomalistic Month (AM), and the Draconitic Month (DM). These later time periods are only of relevance when studying eclipse cycles.

The Babylonians associated the moon with the number 30, an archetypal Babylonian number, since 30 = 2 * 3 * 5. Again we have an 'ideal' lunar number, because the actual SM is slightly less. The accurate SM is 29.53059 D (abbr. ASM), or 29 days, 12 hours, 44 minutes, and 3 seconds. The Babylonians often used the close approximation of 29.53 D, but there was also the widespread use of the practical value of 29.5 D (abbr. PSM). Using this PSM, months were alternatively 29 and 30 days. The Greeks and Romans, who also used a lunar calendar, called these months 'hollow' and 'full' respectively. The 30 day cycle is conveniently divided into 2 * 15 (the approximate number of days from new to full moon or from full to new moon). In relation to the solar calendar examined above, we see that the Babylonians also divided the 30 day period into 6 weeks of 5 days each; and the Vedic culture divided it into 5 weeks of 6 days each. The Egyptians divided it into 3 Decans of 10 days each. We have now covered all of the harmonies contained within the number 30.

Using months which alternate between 29 and 30 days, there are then 354 days in the 'lunar year,' since 354 = 12 * 29.5. This is 11.25 D short of the JY. To be more accurate, 12 lunations make 354.3708 D, another way of saying that there are 12.368 lunations in the AY. How do we reconcile the lunar cycle with the solar cycle? We moderns have abandoned the lunar calendar in favour of the solar calendar--the months are no longer tied to the moon. In fact, the majority of people are not even aware or concerned about the lunar phase. Thus, in the modern calendar, we allow the new moon to 'freewheel' through the monthly cycle; moreover, the months are of different lengths, some 30 D, some 31 D, and so on. This approach reflects Christian attitudes and reforms.

The ancient approach was more closely tied to the moon. Using the PSM, we have 11.25 D left over each year. Consequently, after 3 years, there are 33.75 D left over. The solution is to add another month of 30 days, although that still leaves a left-over. Using this approach, some years have 12 months (354 D), and some have 13 months (384 D). This way of setting up the calendar is called a Lunisolar Year (abbr. LY). The Babylonian new year began at the Spring Equinox (the sidereal reference), but it also began with the first new moon around the equinox. Sometimes this new moon came early, sometimes late. In early Mesopotamian

history, there appears to have been an irregular succession of years with the intercalary 13th month, using the mean value of 29.53 for the cycle. Over time, various resolutions between the lunar and solar cycle were found in order to harmonize the two cycles.

The earliest Babylonian solution was to use an 8-year period--in 8-years there are 3 intercalary years. The pattern of regular to extended years would be . . | . . | . | This solution was also used by the Greeks and Romans, who called it the Oktaeteris Cycle. An 8-year period gives 99 PSM, short by about 1.6 days. More accurately, 8 years gives 2921.94 D and 99 Synodic Months gives 2923.53 D. Obviously this approach is practical but not overly accurate. After 24 years, the moon date will be 5 days late to the solar season. Various manipulations were suggested to make the adjustments. The Greek scientist Eudoxus (who studied in Egypt) recommended that we add 3 days every 16th year; after 10 such periods (160 years) omit one intercalary month to adjust to the solar year. This reform never took hold.

The Egyptians used a multiple of 9125 D in order to harmonize the the Moon and the WY. 9125 = 25 * 365; thus 25 WY will yield 309 SM (each 29.530744 D). Then the new moon will fall on the same civil calendar date. It is conceivable that the Jewish 'Jubilee Cycle' of 50 years may be related. Another Egyptian cycle which is a little more accurate is 27 JY (9861.75 D) which contains an integral of 334 months (9863.22 D). Neither of these approaches is overly accurate.

As usual, the Babylonians discovered a much better solution. It is called the Metonic Cycle, after the Greek Meton who 'discovered' it. (The Greeks had a habit of taking the credit for discoveries that the Babylonians had already achieved a millenium before classical Greece). 19 solar years (6939.6 D) closely equals 235 lunar months (6939.69 D). Thus every 19 years the new moons fall on the same calendar date as the civil (solar) calendar. This reckoning of 19 years gives 12 years of 12 months each, and 7 intercalary years of 13 months each. The pattern would be . | . | . . | . . | . . | . . | . | . This Lunisolar calendar was used during the Seleucid empire, and later became the calendar used by the Christians and Jews for computing the date of Easter and Passover. The earliest known astronomical text of India (which is relatively late and was probably derived from the west) also recommends this cycle.

The ancient Chinese also used a lunar calendar, which they pegged to a sidereal reference. The new year began with the heliacal rising of the star Spica (autumn), but later it became the full moon to the right of Spica. Hence the new year began in the spring, as does the Chinese new year today.

The prophet Mohammed introduced a new calendar for Moslems in the Koran. Again we see the calendar closely tied to religious concerns. His calendar is very interesting, since it is purely lunar. The year consists of 12 lunations (354 D), and it is

allowed to 'freewheel' through the solar seasons. It does this in slightly less than 33 years (32.75 JY). This is the most 'lunar' of calendars. Amazingly enough, it echoes a Mayan solution to the lunar cycle. The Mayans found a harmony between the Moon and the Sacred Calendar (Z), using a least common multiple of 11,960 D. This time period equals 405 lunations, and also equals 46 Z. That is 11,960 = 46 * 260 and also 29.530864 * 405. Now this time period represents about 32.75 years, similar to the Islamic cycle.

So far, we have only considered the Synodic Month, but the Moon has a complex orbital relationship to the Earth and indirectly to the Sun. The lunar orbit is tilted by 5.14 degrees from the ecliptic (the plane of the Earth's orbit around the Sun). Hence there is a line of nodes where the two planes intersect. The longitude of these nodes slowly rotates around the cycle every 18.6 years, or 242 sidereal months. As a result, the Moon is higher in the sky at certain times than other times. Every 9.3 years it reaches the Major Standstill, and then in 9.3 years it reaches Minor Standstill. These lunar cycles were encoded in the geometry of Stonehenge.

Note that this 18.6 year nodal cycle is not identical to the 19 year Lunisolar cycle. In other words, the lunar nodes are not in step with the Metonic cycle. The time taken for the Sun to travel from one ascending node to the next is 346.62 D, a period of time called an Eclipse Year. Now 19 Eclipse Years (6585.78 D) about equals 223 lunar months (6585.32 D). In this period of time the Sun, Moon, and the lunar nodes return to about the same relative position. This period of 6585 and a third days (or 18 years plus 11.32 days) is called a Saros Cycle. This eclipse cycle is very good, there being only a small residual, so that the eclipses recur 7 hours and 41 minutes later in each cycle. This cycle was discovered by the Babylonians, who possessed the earliest known eclipse tables in ancient history.

The Saros Cycle harmonizes the various lunar cycles. In particular, 223 synodic months about equals 239 anomalistic months and about equals 242 draconitic months. Since the period is 6585.32 days, one can get an integral number of days by multiplying the cycle by 3. We now have 669 SM or 54 years. The Greeks called this the Exeligmos Cycle of 19,756 D. As usual, the origin is Babylonian.

The Saros Cycle is very good, but it is not the only eclipse cycle which has been historically considered. Other periodicities have been observed at 6, 41, 47, 88, 135, and 358 SM periods, although they are not as good. These patterns result from harmonies between the various cycles. For example, 47 SM about equals 51 Draconitic Months. The best of these is the 358 SM period, which repeats with less than an hour error every 28 years and 345 days. 3 Metonic cycles (57 years) has also been a candidate. None of these periods rival the Saros Cycle and its derivative, the Exeligmos Cycle.

Perhaps it is rather esoteric to try to integrate the complexity of eclipse cycles into the lunar calendar. The Metonic cycle of 19 years is the only period needed to create the harmony of a Lunisolar calendar. The Greek Callipus suggested a 76 year period of 940 months (27,759 D); this cycle appears original, until we notice that 76 = 4 * 19. Thus it is just an integral multiple of the Metonic cycle.

The Sun and Moon are the principal luminaries (the greatest gods) of the ancient world. The astronomical calibrations encoded at Stonehenge deal solely with the Sun and Moon with reference to the stars. However, the other visible planets also became the basis for calendrical computations. Chief among the planets is Venus for its importance in ancient calendrics. This is natural, since Venus, at times, is the brightest object in the sky after the Sun and Moon.

Venus lies within the earth's orbit. Thus it displays phases like the Moon. Also, it appears to swing back and forth on either side of the Sun, being at times the 'Morning Star' and then the 'Evening Star.' The synodic period between superior conjunctions is 584 D (about 19 months and 17 days). During this period it has two conjunctions with the Sun and two greatest elongations as the Morning Star and Evening Star. This is the complete Venus cycle.

Venus is also an exquisitely beautiful astronomical object. For the Babylonians, it was one of the greatest gods, assimilated to the goddess Ishtar. Now the Venus synodic cycle (SV) can be harmonized with the Sun and the Moon. The phenomena nearly repeats itself after 8 years. More precisely, 99 Babylonian months (minus 4 days) yields 5 SV. That is, 99 * 29.53 = 2923.47 D, and 5 * 584 = 2920 D. This 8/5 ratio caused the Babylonians to call every 8th year the 'Year of the Golden Throne.' Note that this 8 year period also ties in with the 8 year Lunisolar calendar. Thus there is a conjunction between the Venus and Sun cycles every 8 years, but each one arrives 2.4 D earlier. During the Seleucid era when astronomical accuracy greatly advanced in its rigour (mostly in order to compile more accurate Ephemeride Tables for astrology), the Babylonians wanted to find a more accurate harmony between Venus and the Sun. Multiplying the 8 year period by 144, they found that 1151 solar years equals 720 SV. This computation must have been very satisfying to them, since both 144 and 720 are prominent Regular Numbers, and highly relevant to musical harmony.

The Egyptians made use of another harmony inherent in the number 584. This number equal 8 * 73; we recognize this high prime from the WY cycle (365 = 5 * 73). Therefore, there is an exact correspondance between 8 WY and 5 SV, using the least common multiple 2920 D. The Mayans also recognized this cycle.

The Mayans gave Venus a very high status among the gods, being assimilated to the feathered serpent Quetzalcoatl. This is reflected in the importance of the Venus calendar, which they brilliantly integrated with the solar calendar and the Sacred

Calendar. Not only did they acknowledge the harmony of 2920 D = 8 WY = 5 SV that we associate with the Egyptians, but they also used a long cycle of 37,960 D (called the great 'Lub' or resting place). Now 37,960 = 65 * 584 or 65 SV. It also equals 104 * 365 or 104 WY. Since 104 = 2 * 52, this is 2 Calendar Rounds. Last but not least (for the Mayans), the Lub equals 146 * 260 or 146 Z. We must consider this the peak of Mayan calendrical genius. Some have conjectured that the 260 D period we call Z was invented mainly to create this harmony between the Sun and Venus. Amazingly enough, we shall see later that it also integrates the synodic orbit of Mars.

There has also been speculation that the 56 Aubrey Posts at Stonehenge were used to calibrate the interaction between Venus, the Sun and Moon. There is a conjunction between the Sun and Moon every 8 years, but 1.6 days late. Therefore, after 7 periods of 8 years (56 years) the conjunction is 11 days later. Meanwhile, during this period, the Venus conjuction with the Sun comes 17 days earlier. Thus they co-incide but 29.5 D earlier (one PSM). Thus one finds a series of dates in pairs 8 years apart following one another at intervals of 56 years. Thus by 'pegging' the 56 holes it is possible to keep track of the three cycles. Although this technique is speculative, there is definitely a high degree of astronomical sophistication embodied in this ancient monument.

After Venus, the next most important planet is Jupiter. Its synodic cycle (SJ) is 399 D. This number in prime factors equals 3 * 7 * 19, not an easy number to harmonize. However, the Babylonians found that 71 years (minus 5 D) equals 6 revolutions of Jupiter (each revolution is 11.86 years) and equals 65 synodic orbits. There is a slight innaccuracy in this harmony, which the Babylonians during the Seleucid era sought to overcome. Thus they multiplied the above cycle by 6, and found that 427 years equals 36 revolutions equals 391 SJ. This harmony is quite good. As an alternative, they also used the equation: 83 years equals 7 revolutions equals 391 SJ. Clearly, Jupiter was an important god, and assimilated to Marduk, the State god of Babylon.

Jupiter's sidereal orbit is 11.86 years, which is about 4332 D. In prime factors, this number is $2^2 * 3 * 19^2$. Note the factor of 19 in both the sidereal and synodic orbits. As the patriarchy became more entrenched in the ancient world, the male god Jupiter (Greek Zeus) became more and more prominent over the female Venus and other goddesses. The Babylonians idealized the Jupiter sidereal cycle to 12 years (one year in each Zodiac sign), even though they kept close track of its shortfall. In their mythology, Marduk set up the twelve-fold division of the Zodiac. To this day 12 year festivals, for example those of India, have a largely astrological basis. The ancient Chinese also used 60 year cycles, which were divided into 5 * 12 year periods, in a strong echo of Babylonian harmonics. The Babylonians called the 60 year period one Soss.

Mars was the Babylonian god Nergal. Its synodic orbit is 780 D, in prime factors $2^2 * 3 * 5 * 13$. We associate these numbers

with Mayan harmonics, especially 5 and 13. The period of 780 D equals 3 Z (that is 780 = 3 * 260). This is the only other planet besides Venus to relate harmonically to the Z. The sidereal orbit is 686.9 D. The Babylonians found that 47 years (minus 7 days) equals 25 revolutions of Mars, and equals 22 synodic periods. Alternatively, 79 years (plus 4 D) equals 42 revolutions, equals 37 synodic periods. Then they slightly modified the 47 year cycle (multiplying by 6) to give a long Mars cycle of 284 years, which equals 151 revolutions and 133 synodic orbits.

Saturn was also an important planet in ancient times, since it is the slowest and furthest visible planet. The Greeks called it Chronos, god of time. Its sidereal orbit is 29.46 years, making it relate in a 'macrocosmic' way to the SM of 29.53 days. Naturally, for the Babylonians, its ideal cycle was 30 years. We see here another harmony of the Chinese and Babylonian 60 year cycle, since 60 = 2 * 30. The Babylonians observed that Saturn in 59 years made 2 revolutions plus a small arc of about 1 degree, its annual motion being between 12 and 13 degrees. In other words, 59 years (plus 4 D) equals 2 revolutions equals 57 synodic periods. To increase the accuracy, they observed that 20 circuits equals 589 years. This is quite a long cycle. As an alternative, they noted that 265 years equals 9 revolutions equals 256 synodic periods. (One synodic period is 378 D).

The last classical planet is Mercury, whose sidereal orbit is 87.97 D (practically 88 D) and synodic orbit 116 D. It is the most elusive planet to observe, since it is always so close to the Sun. The Babylonians noted that 46 years (plus 0.3 D) equals 46 revolutions and 145 synodic periods. In a longer cycle, 480 years equals 1513 synodic periods.

The outer planets Uranus, Neptune, and Pluto were unknown by the ancients, and only recently have been integrated (with difficulty) into the pseudo-science of astrology. So we will leave planetary periods and return to earth for a closer look at the ancient measurement of micro-time. We will then end this paper with an examination of the ancient views on macro-time.

The calibration of short time cycles is naturally tied to the day cycle of 24 hours. The division of the day into 24 hours is Egyptian in origin. But these were not the regular (equinoctial) hours that we are accustomed to. Rather, the period of time from dawn to sunset was defined as 12 hours. The other 'half' of the day is also defined as 12 hours. Thus the length of an hour varies according to the time of the year. During winter, daylight hours are short, and nighttime hours are long. In the summer we have the reverse. Moreover, the length of the day varied according to one's latitude.

The Babylonians computed accurate tables for the time of sunset and sunrise throughout the year. In order to do this, they needed a conception of short time periods and a way of measuring them. They used a water-clock to measure short periods. In addition, they had a time period called a Barleycorn, whose

origin may have come from the time taken to grind a small quantity of grain in the mill. They needed this accuracy for precise astronomical calibrations. It is not surprising that the Babylonians (and Egyptians) were ardent star-watchers, since the climate and topography was ideal for stellar viewing. It is now generally accepted that the earliest Egyptian religion was stellar in orientation, and only later became solar in its inclination.

The Greeks introduced the idea of equinoctial or equal hours. These hours were then divided into 60 minutes, and each minute into 60 seconds (3600 seconds in an hour). Such divisions are Babylonian in origin. The early Babylonian division of the day was into 12 Beru (a double-hour). Each Beru was divided into 30 USH or degrees of time. Thus one USH equals 4 minutes--a natural time unit for astronomical work. But they did not stop there. One USH equals 12 Shu-si and also equals 72 Barleycorn. Thus one Barleycorn equals 3 and one-third seconds.

The harmonies between Beru, Hours, USH, Minutes, Shu-si, Barleycorn, and Seconds are presented in table form. It is here in the measurement of micro-time and in the measurement of macro-time that the Babylonians show their genius. For they manage to use the same time division numbers for both contexts. These time units are also numbers of significance for musical tuning theory (which was explored through the monochord). Thus they achieved maximum integration between long and short cyclical interactions.

For example, take the number 72. In micro-time, 72 Barleycorn equals one USH, the 4 minute interval perfect for observing stellar movement, since the annual movement of the stars is 1 degree or '4 minutes earlier' each day. In other words, a given star rises 4 minutes earlier each day, and the USH is the natural unit for the stellar 'clock.' Then the ceremonial year (VY) is divided into 72 'weeks.' We shall see later, when looking at the long (cosmic) cycle of Precession, that the movement is 1 degree of arc in 72 years. Thus we have the musical number 72 integrated into micro and macro time.

Other significant numbers are treated the same way. For example, 24 hour equals 360 USH. The year (VY) is 360 days. One Beru equals 360 Shu-si. The circle is divided into 360 degrees. The number of years in the Precession cycle is 72 * 360 or 25,920 years. Also, the day cycle (24 hours) equals 25,920 Barleycorn. Amazingly enough, one Barleycorn is equal to the average time of a human breath. On average, we breathe 25,920 times per day. The Babylonians achieved the most integrated and humanistic union between various frameworks of time.

We can also see this in their use of base 60 arithmetic along with base 10. This is the only number base which harmonizes all the ancient known systems used. The Mayans and Celts used base 20. Most cultures (like us) use base 10. There is also evidence for the use of base 12. The number 60 is the least common multiple for all of these numbers.

The Babylonian number 60 is the pre-eminent number for the measurement of time. It also has high standing in tuning theory as a major harmonizer of cycles. Ancient astronomy from Greece to India adopted base 60 for astronomical computations, probably in honour of the Babylonian synthesis. We still keep this system in our division of the 360 degree circle into 60 minutes and 60 seconds for astronomical work, as well as our measurement of clock time.

The most important long time cycle is Precession of the Equinoxes (abbr. P). Due to the gravitational pull of the Moon on the bulging equatorial belt of the Earth, the axis of the Earth wobbles like a spinning top. Presently, true north points to the star Polaris, but around the time when the Pyramids were built true north pointed to the star Thuban. 15,000 years from now it will point close to the star Vega. Thus it makes a large 47 degree circle in the sky, surrounding the constellations Draco, Ursa Minor and Cepheus.

The reason that this cycle is called Precession of the Equinoxes comes from the observation that the Sun (whose path relative to the stars is called the ecliptic) crosses the celestial equator at the time of the spring equinox. This point in time slowly shifts in its stellar background position, moving about 1 degree of arc in 72 years. Thus it progresses 'backwards' through the signs of the zodiac.

The modern, accurate meaurement of Precession is 25,776 years or about 9,414,483 D. This is an annual lag of about 50.274 seconds of arc, or 1 degree in 71.6 years.

Orthodox history states that the Greek Hipparchus discovered Precession, even though his computation of it was not very accurate. However, any culture that watched the sky for a long period of time would have observed the shift--in fact, it is one of the easier celestial computations to accomplish. What is more, the stars were gods to the ancients, so that any shift in their positions would have been considered significant. There is now good evidence that the Egyptians and the Babylonians knew of the cycle, and encoded the numbers in various ways in their cosmologies. Precession was probably observed long before the invention of writing, and the knowledge of it preserved through mythological stories that were only later written down. Certain numbers associated with the cycle keep recurring in stories about the death and rebirth of gods.

The ancient value for the cycle is quite close to accuracy, while at the same time converting the number to a highly versatile Regular number, as was the Babylonian practice. It is 50 seconds of arc annually, or 1 degree in 72 years. Thus the complete cycle is 72 * 360 = 25,920 years. This is an important Babylonian number with many sub-harmonies. In prime factors the number equals $2^6 * 3^4 * 5$. We will look at a number of significant divisions of this cycle.

The cycle has been called a 'Platonic Year.' If one divides it by 12, we have an ideal 'Platonic Month' of 2,160 years. This is one astrological 'Age.' Right now, the Sun crosses in the constellation Pisces, but about 500 years from now it will cross in the constellation Aquarius. Egyptian pharaonic history approximately covered the ages of Taurus and Ares. Around 400 A.D. we entered the Age of Pisces. Thus urban civilization and writing have only been around for about a quarter of one Precession cycle.

The concept of a 'Platonic Year' and 'Platonic Month' can be extended. The 'month' can ideally be divided by 4 to give a 'Platonic Week' of 540 years. Again, the 'month' can be divided by 30 to yield the ideal 'Platonic Day' of 72 years. This 'Day' can then be divided into 24 'hours,' each of which last 3 years. The ideal human lifetime is 72 years. Thus the human scale of experience can be harmonized with the cosmic scale using Regular numbers.

There are many ways of dividing the Precession cycle into harmonies. The Babylonians used a 60 year period (as did the Chinese) called one Soss. 60 * 432 = 25,920. The number 432 is an important cosmological and musical number which recurs in many

all of which are thoroughly Babylonian in their make-up. Since the Vedic writings are much later, historically speaking, than the Sumerian texts from which the Babylonians derived their cosmic mathematics, we can conjecture that there must be some influence of the one culture on the other. There was certainly a long trading relationship between the Indus and Mesopotamia, and later between the Babylonians and India. In India, a Sar was called the Bṛhaspati Cycle, and a Great Sar was called a Prajāpati Cycle. Two Great Sars yield the Kali Yuga number.

The Yuga numbers also seem irrelevant to human history, but they are significant in the monochord context. All are Regular numbers:

Dvāpara Yuga = 864,000 = $2^8 * 3^3 * 5^3$
Tretā Yuga = 1,296,000 = $2^7 * 3^4 * 5^3$
Kṛta Yuga = 1,728,000 = $2^9 * 3^3 * 5^3$
Maha Yuga = 4,320,000 = $2^8 * 3^3 * 5^4$
One Kalpa = 4,320,000,000 = $2^{11} * 3^3 * 5^7$
Brahmā = 8,640,000,000 = $2^{12} * 3^3 * 5^7$
Duration of Universe = 155,520,000,000,000 = $2^{16} * 3^5 * 5^{10}$
Purusha number = 311,040,000,000,000 = $2^{17} * 3^5 * 5^{10}$

Most of these numbers do not have P as a harmony, but the Treta Yuga number, the Duration number, and the Purusha number are divisible by P. Nevertheless there does not seem to be a conscious connection between these 'cosmic' numbers and actual astronomical phenomena.

The Mayans were also prone to generating huge numbers that seem to have little relevance to actual human history. They computed cycles of Venus going back millions of years. In fact, their oldest inscription date yet found is at Quirigua, a date set at 400 million years ago! They could easily work with such large numbers since they invented a place-value number system of great elegance. They had a symbol for zero. The other ancient culture to invent the place-value system was the Babylonians (although they certainly took it from the Sumerians, who were the first true mathematical innovators in ancient history). The Babylonians used a space for 0, and had multiplication tables in base 60 as well as base 10. With this tool, huge numbers were easy to deal with, especially in comparison to the cumbersome additive number systems used by the Greeks and Romans. The Greeks reverted to base 60 mathematics for astronomical work.

Returning to the Mayans, they used the Regular number 360 (VY or Tun) as their basic componant for long time cycles, even though the Calendar Round was based on the WY. We could call the Tun a 'year,' but the correspondance to true years quickly breaks down in long cycles. Nevertheless, it assures that long time cycles have day counts that are Regular numbers. They used multiples of 20 to generate huge time frames:

20 Tuns = 1 Katun (7,200 D or about 19.713 AY)
20 Katuns = 1 Baktun (144,000 D or about 394.259 AY)
20 Baktuns = 1 Pictun (2,880,000 D or about 7,885.179 AY)
20 Pictuns = 1 Calabtun (57,600,000 D or about 157,703.57 AY)
20 Calabtuns = 1 Kinchiltun (1,520,000,000 D or 3,154,071.5 AY)
20 Kinchiltuns= 1 Alautun (23,040,000,000 D or 63,081,429 AY)

The Mayans continued on in this manner up to a Hablatun of 460,800,000,000 D! Again we see the use of base 20 (i.e. $2^2 * 5$) as an organization scheme.

This system was used for recording dates. For example, the date 7.16.6.16.18 was recorded on the great Olmec Stele C at Tres Zapotes:

= 7 Baktuns	=	1,008,000 D	
= 16 Katuns	=	115,200 D	
= 6 Tuns	=	2,160 D	
= 16 Uninals	=	320 D	(1 Uninal or Vinal = 20 D)
= 18 Kin	=	18 D	

-or 1,125,698 days since the end of the last great cycle. This example shows that the Mayans were greatly indebted to the Olmecs for their high calendrical mathematics. Indeed, it is difficult to separate the Olmec culture from the later Mayan culture, since they occupied the same geographical area. Perhaps the relationship between them was similar to that between the Sumerians and the Babylonians. It is hard to separate the contributions of the junior partner in the historical relationship.

As seen in the example above, the Mayans used the Baktun as their basic unit of actual human history. 1 Baktun equals 144,000 D or 394.259 AY. This is also 394.521 WY or also 400 VY or Tuns. The period of time which was the origin of the Long Count evident in the date above is 13 Baktuns (the Great Cycle of 1,872,000 D). This period equals 5,200 VY, or 5,128.773 WY or 5,125.366 AY. It is conjectured that the Long Count began in 3113 B.C., a convenient beginning time long before the development of urbanization in Meso-america.

In spite of all the huge numbers and cosmic cycles recorded by the Mayans, they did not consciously integrate the P cycle. However, there is a good approximation. If we consider the accurate cycle to be 9,414,482.9 D, then 5 Baktuns would be in the ball-park. 5 Baktuns = 5 * 360 * 5200 = 9,360,000 D. This is short by 54,482.9 D or about 149.169 AY. The Babylonian value, on the other hand, is over the mark by 144 years, only slightly better, but the deviation itself is a significant harmonic number. The Babylonians manage to express the cycle with a versatile Regular number, whereas the Mayans, in their typical fashion, use a factor of 13.

We can conjecture that the Mayans used factors of 13 in order to deal with the calendrical number 52 (which is 4 * 13). The other factors are the Regular primes that we have defined as 2, 3, and 5. Lastly, they use the high prime 73, because of its relevance to the WY. Looking at the overall Mayan calendrical system, a least common multiple of 1,366,560 D (which equals about 3,741.537 AY) covers most of the sub-harmonics. This large number is expressed in prime factors as $2^5 * 3^2 * 5 * 13 * 73$. Here are a few of the significant factors of the number 1,366,560, which we will call T:

T/13 = 105,120 D or 288 VY
T/52 = 26,280 D or 72 VY

T/72 = 18,980 D, the number of days in a Calendar Round
T/73 = 18,720 D = 52 * 360 and also 72 * 260
T/260 = 5,256 Z
T/360 = 3,796 VY
T/365 = 3,744 WY
T/584 = 2,340 SV
T/780 = 1,752 Synodic Martian cycles
T/2,920 = 468 Venus-solar cycles
T/18,980 = 72 Calendar Rounds
T/37,960 = 36 Lub

Conspicuous in its absence from this list are the two cycles involving the moon; namely, the Z-Moon cycle of 11,960 D and the WY-Moon cycle of 9,125 D. These two cycles do not integrate into the 1,366,560 D cycle. We can see why by looking at the prime factors. $9,125 = 5^3 * 73$. Also, $11,960 = 2^3 * 5 * 13 * 23$. The factor of 23 is the culprit. We can integrate these two cycles into the overall picture by expanding the cycle T to include 5^3 and 23. Thus we get a cycle which can be expressed in prime factors as $2^5 * 3^2 * 5^3 * 13 * 23 * 73$, a huge cosmic number which is 785,772,000 D (about 2,151,372.432 AY). This very long cycle harmonizes all of the Mayan calendrical cycles.

The need to greatly expand the T period demonstrates the one weakness in the Mayan calendrical system. Lunar cycles are not well represented in the calendar. Venus is given more prominence than the Moon, which does not make sense from a practical viewpoint. But in spite of this shortcoming, the Mayan synthesis is nothing short of brilliant.

On the other hand, the Sumerian-Babylonian synthesis and its close variants, the Egyptian and Vedic calendars, placed the Moon first and foremost. Their approach was a highly practical one. By restricting 'ideal' cycles to Regular numbers, they assured that cosmic cycles had close musical analogs. By using the same cosmic numbers for both macro-time and micro-time they achieved an integration of both ends of the temporal spectrum. Possibly their greatest contribution was the establishment of base 60 mathematics, the most useful and appropriate base for both tuning theory and astronomy. Their comprehension of mathematical variables and their ability to handle complex computations were unmatched in the ancient world. Moreover, they were tireless and consistent watchers of the heavens, living in a climatic zone ideal for astronomical work. Last, but not least, they had highly evolved and sophisticated musical cultures, with an appreciation of the ramifications of musical harmony. They sought to apply the laws of musical acoustics to the cosmos in general.

It is easy for moderns to criticize the ancient approach, since their ultimate orientation was toward omen astrology, and later, birth astrology. But for this purpose they needed accurate predictions of planetary positions. The careful measurement of temporal periodicities resulted in a highly evolved calendar. We can also criticize them for being unaware of the outer planets (Uranus, Neptune, Pluto), but an integration of these planets

into the calendar is really a bit esoteric. The only natural cycle to be highly relevant that was unknown or totally ignored was the Sunspot cycle of the Sun. Yet this solar 'seasonal' cycle is highly variable in its periodicity (averaging about 11.2 years). Thus we can be forgiven for ignoring it, since only strong periodicities are relevant for a workable calendar.

Therefore, we must conclude that the ancients covered the field quite well. In a practical sense, it is only the Sun and Moon that are the main elements. Thus the month and the year are the principal reference points. Planetary periodicities are far less relevant to orientation than the two chief luminaries. As a result, we should value the 19 year Lunisolar calendar as the most practical integration of time cycles between the Sun and Moon.

But we have a problem here. 19 is a high prime number. Thus it does not integrate perfectly with the other 'cosmic' Babylonian cycles which are all Regular numbers. If we are looking for a 'master' cyclical number for the Babylonian calendar (as we did above for the Mayan synthesis), we must take some appropriate reference cycle and multiply it by 19 in order to integrate the whole field of periodicities. The most natural candidate is P, that most 'cosmic' of Babylonian numbers. Now 25,920 * 19 = 492,480 years. Again, like the Mayan 'master' cyclical number, we are left with a number which seems remote from human relevance.

Perhaps the lack of a single, simple, master cyclical number for calendrical cycles which is relevant to the human scale reminds us that nature cannot necessarily be ordered according to human criteria. Whereas musical harmony treats simple periodicities, resulting in the establishment of an island of consonance in the sea of dissonance (complexity), calendrical harmony must consist of the acceptance of complexity as a given. A compromise is then found, to establish a provisional harmony relevant to the human situation. The 'uneasy balance' between the solar year and the lunar year reflects the incommensurability between complex numbers. The ancients' desire to use more 'friendly' numbers like 30 and 360 refects a yearning for the simplicity and clarity of the numbers associated with musical harmony. They wanted to see the hierarchies of number harmonies reflected in the heavens.

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After finishing this paper I realized that I would be remiss to omit definitions of the four main lunar cycles, even though only the Synodic cycle was relevant to the calendar. Here they are:
The SYNODIC MONTH (or Lunation, Lunar Month) is a time period of 29.53059 D, the interval of time between successive new moons.
The SIDEREAL MONTH is a time period of 27.32166 D, the time taken by the Moon to complete one revolution around the earth, measured with respect to a background star which is considered fixed in

position.
The ANOMALISTIC MONTH is a time period of 27.55455 D, the time between two successive passages of the Moon through the Perigee of its orbit (the point at which the Moon is nearest to the Earth in its elliptical orbit, opposite of Apogee).
The DRACONITIC MONTH is a time period of 27.2122 D, the time between two successive passages of the Moon through the ascending node of its orbit.

I have also added a couple more diagrams. The first one lays out the 8-fold division of the solar year in a circular fashion, reflecting the four cardinal points (solstices and equinoxes) and their mid-points. The 8 Chinese seasonal Trigrams are included, as well as the 8 principal Celtic high holidays. In the centre of the 'mandala' is a natural division of the day cycle into 8 periods of 3 hours each. Calendars symbolized by the cross, the swastika, and other variations of the 'four directions' were prominent in Amerindian astronomy.

The other diagram is a Concordat of ancient calendars, comparing the weekly civic dates with the dates of our modern calendar. This yearly calendar represents a 'typical' year (not a leap year), with the added distinction of having the new moon fall on the day of the Spring Equinox (March 21st). This 'meta-calendar' shows the variety of ways that the year is divided by the Babylonians, Egyptians, Vedic culture, Mayans, and neolithic Europeans.

Here is the meaning of each column. The left-hand column, marked Day, gives the days of the year numbered 1 to 365, starting at the Spring Equinox, which is the natural date to set for the new year. The second column gives the modern calendar date. The third column, marked Event, marks the equinoxes, solstices, and mid-points, as well as a few other significant events, such as meteor showers and several festivals.

The remaining columns show the various divisions of the year. The column marked (5) gives the number of 5-day (Babylonian) weeks in the year. They are numbered from 1 to 73, the 73rd and final week being the new year festival period. I have emphasized these 5-day divisions as a convenient reference point by using dotted lines. The week number is in bold print, whereas the day of the month is marked on the left. The next column is marked (6), and defines the Vedic 6-day weeks, the weeks numbered from 1 to 60. The third numerical column gives the division in modern, 7-day weeks, numbered 1 to 52. The days of the week are given in short form, with the week number falling on Sunday.

The next column, marked (10), gives the Egyptian division into Decans (which are like Babylonian double-weeks). The Egyptian new year starts with the heliacal rising of the star Sirius, around July 19th by our Julian calendar. Consequently this is the first Decan of the year. The epagomenal 5-day period thus falls between July 14th and 19th. In reality the civic calendar 'wandered' through the seasons in the Sothis cycle, so that the names of the

months did not necessarily reflect these Julian dates. This hypothetical year is the one in which the ceremonial new year falls on the correct calendar date, which happens once every 1460 years.

The next column, marked (20), gives the number of Mayan Vinals in the year. There are 18 such periods, each of which is shown with its appropriate glyph.

The next column, marked (23), gives the neolithic division into 16 periods, most of which are 23 days long. Some are 22 days, and one is 24 days, and these are marked. This calendar closely follows the solstices, equinoxes, mid-points, and the quarter points. Solstices and equinoxes are emphasized with double-solid lines. The division of the year into 8 pages in the layout reflects this natural sub-division of the year.

The column marked 29-30 gives the calendar in Babylonian lunar months. The position at the Spring Equinox is marked 1-NM, which means the first new moon of the year. Under this is bracketed the word (Full), meaning that this cycle is a full 30 days. The mid-cycle is marked FM, meaning full moon. The 1st Quarter, 3rd Quarter, and the day of the cycle are also marked. Note that on the 20th of April there begins the second lunation of the year. This one is marked (Hollow), meaning that this month has 29 days. Full and hollow months alternate.

The last column is marked 30, and gives the civic calendar dates for the 'solar' months of 30 days each; these twelve months, which were derived from the 360 day ceremonial year, were noted by the Babylonians, Hindus, and Egyptians. The Hindus combined them into 'double months' of 60 days each. Note that these double-months of 60 D gradually move 'out of step' with the lunar double-months of 59 D (i.e. 30 + 29). We will need a full Lunisolar cycle to put them back in step. The Babylonian name for the civic month is entered right under the month number. These months are emphasized with a solid line. The Egyptian names are marked diagonally.

It is hoped that this diagram clarifies the relations between the various ancient calendars and our modern calendar.

One more issue must be raised here. This calendar has an 'equinoctial' orientation, since the new year falls on the spring equinox. This focus was chosen because, historically, most cultures have used these bearings. But not all cultures. Note that the Egyptians used the rise of Sirius, which was about a month after the Summer Solstice. We could also use the Autumn Equinox as a change in orientation. It is also possible to use the solstices as the orientation. The modern approach is essentially this, although the January 1st date is rather artificial, and purely religious in function. But it is close enough to the Winter Solstice to at least remind us of this natural orientation. The Egyptian orientation was close enough to the Summer Solstice to be more solsticial than equinoctial.

There is a compelling reason for using the Winter Solstice as the most natural time for new year. Five days before the solstice, there is a syzygy between the Earth, the Sun, and the direction of the centre of our galaxy. In other words, the Sun crosses that region of the stellar background which is the galactic centre. Hence it is a natural orientation of our solar system to the greater centre. It is interesting that the time period of this event is 5 days before the Winter Solstice--one Babylonian Week. Even though our sample calendar has an equinoctial orientation, the 5-day weeks also integrate the syzygy-solstice period. Thus we could convert the orientation to the Winter Solstice with very little change in the calendar, simply by renumbering the weeks. Right now the Solstice is the beginning of Babylonian Week 56. We would simply renumber it as week 1. Then week 55 would become the '73rd week' which is the 'crack between the years.' It would cradle the time between the syzygy and the Winter Solstice. This fact gives added value to the notion of dividing the year cycle into 5-day weeks.

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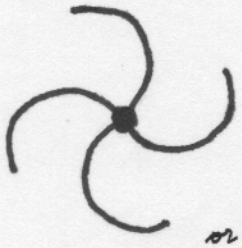
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Babylonian Time-divisions of the Day Cycle (24 hours)

BERU	Hours	USH	Minutes	Shu-si	Barleycorn	Seconds
12	24	360	1,440	4,320	25,920	86,400
10	20	300	1,200	3,600	21,600	72,000
9	18	270	1,080	3,240	19,440	64,400
8	16	240	960	2,880	17,280	57,600
15/2	15	225	900	2,700	16,200	54,000
6	12	180	720	2,160	12,960	43,200
5	10	150	600	1,800	10,800	36,000
9/2	9	135	540	1,620	9,720	32,400
4	8	120	480	1,440	8,640	28,800
3	6	90	360	1,080	6,480	21,600
5/2	5	75	300	900	5,400	18,000
12/5	24/5	72	288	864	5,184	17,280
32/15	64/15	64	256	768	4,608	15,360
2	4	60	240	720	4,320	14,400
9/5	18/5	54	216	648	3,888	12,960
5/3	10/3	50	200	600	3,600	12,000
8/5	16/5	48	192	576	3,456	11,520
3/2	3	45	180	540	3,240	10,800
4/3	8/3	40	160	480	2,880	9,600
6/5	12/5	36	144	432	2,592	8,640
16/15	32/15	32	128	384	2,304	7,680
1	2	30	120	360	2,160	7,200
9/10	9/5	27	108	324	1,944	6,480
5/6	5/3	25	100	300	1,800	6,000
4/5	8/5	24	96	288	1,728	5,760
2/3	4/3	20	80	240	1,440	4,800
3/5	6/5	18	72	216	1,296	4,320
8/15	16/15	16	64	192	1,152	3,840
1/2	1	15	60	180	1,080	3,600
9/20	9/10	27/2	54	162	972	3,240
5/12	5/6	25/2	50	150	900	3,000
2/5	4/5	12	48	144	864	2,880
3/8	3/4	45/4	45	135	810	2,700
1/3	2/3	10	40	120	720	2,400
3/10	3/5	9	36	108	648	2,160
4/15	8/15	8	32	96	576	1,920
1/4	1/2	15/2	30	90	540	1,800
9/40	9/20	27/4	27	81	486	1,620
5/24	5/12	25/4	25	75	450	1,500
1/5	2/5	6	24	72	432	1,440
8/45	16/45	16/3	64/3	64	384	1,280
1/6	1/3	5	20	60	360	1,200
3/20	3/10	9/2	18	54	324	1,080
5/36	5/18	25/6	50/3	50	300	1,000
2/15	4/15	4	16	48	288	960
1/8	1/4	15/4	15	45	270	900
1/9	2/9	10/3	40/3	40	240	800
1/10	1/5	3	12	36	216	720
4/45	8/45	8/3	32/3	32	192	640
1/12	1/6	5/2	10	30	180	600
3/40	3/20	9/4	9	27	162	540
5/72	5/36	25/12	25/3	25	150	500
1/15	2/15	2	8	24	144	480

BERU	Hours	USH	Minutes	Shu-si	Barleycorn	Seconds
1/18	1/9	5/3	20/3	20	120	400
1/20	1/10	3/2	6	18	108	360
2/45	4/45	4/3	16/3	16	96	320
1/24	1/12	5/4	5	15	90	300
1/30	1/15	1	4	12	72	240
4/135	8/135	8/9	32/9	32/3	64	640/3
1/36	1/18	5/6	10/3	10	60	200
1/40	1/20	3/4	3	9	54	180
5/216	5/108	25/36	25/9	25/3	50	500/3
1/45	2/45	2/3	8/3	8	48	160
1/48	1/24	5/8	5/2	15/2	45	150
1/54	1/27	5/9	20/9	20/3	40	400/3
1/60	1/30	1/2	2	6	36	120
2/135	4/135	4/9	16/9	32/6	32	320/3
1/72	1/36	5/12	5/3	5	30	100
1/80	1/40	3/8	3/2	9/2	27	90
5/432	5/216	25/72	25/18	25/6	25	250/3
1/90	1/45	1/3	4/3	4	24	80
1/100	1/50	3/10	6/5	18/5	108/5	72
1/108	1/54	5/18	10/9	10/3	20	200/3
2/225	4/225	4/15	16/15	16/5	96/5	64
1/120	1/60	1/4	1	3	18	60
3/400	3/200	9/40	9/10	27/10	81/5	54
1/135	2/135	2/9	8/9	8/3	16	160/3
1/144	1/72	5/24	5/6	5/2	15	50
1/150	1/75	1/5	4/5	12/5	72/5	48
1/160	1/80	3/16	3/4	9/4	27/2	45
1/180	1/90	1/6	2/3	2	12	40
1/200	1/100	3/20	3/5	9/5	54/5	36
1/216	1/108	5/36	5/9	5/3	10	100/3
1/225	2/225	2/15	8/15	8/5	48/5	32
1/240	1/120	1/8	1/2	3/2	9	30
3/800	3/400	9/80	9/20	27/20	81/10	27
1/270	1/135	1/9	4/9	4/3	8	80/3
1/288	1/144	5/48	5/12	5/4	15/2	25
1/300	1/150	1/10	2/5	6/5	36/5	24
1/360	1/180	1/12	1/3	1	6	20
1/400	1/200	3/40	3/10	9/10	27/5	18
1/432	1/216	5/72	5/18	5/6	5	50/3
1/450	1/225	1/15	4/15	4/5	24/5	16
1/480	1/240	1/16	1/4	3/4	9/2	15
1/540	1/270	1/18	2/9	2/3	4	40/3
1/600	1/300	1/20	1/5	3/5	18/5	12
1/720	1/360	1/24	1/6	1/2	3	10
1/800	1/400	3/80	3/20	9/20	27/10	9
1/900	1/450	1/30	2/15	2/5	12/5	8
1/1,080	1/540	1/36	1/9	1/3	2	20/3
1/1,200	1/600	1/40	1/10	3/10	9/5	6
1/1,440	1/720	1/48	1/12	1/4	3/2	5
1/1,800	1/900	1/60	1/15	1/5	6/5	4
1/2,160	1/1,080	1/72	1/18	1/6	1	10/3
1/2,400	1/1,200	1/80	1/20	3/20	9/10	3
1/3,600	1/1,800	1/120	1/30	1/10	3/5	2
1/7,200	1/3,600	1/240	1/60	1/20	3/10	1

Ancient Chinese-Celtic Annual Calendar:



Lughnasad or Lammas (Aug. 1)

Litha
≈June 22
Summer Solstice
Heaven-creative

Beltane or May Eve (May 1)

≈May 4
Joyous Lake

≈August 4
Wind-Gentle

Tui

Ch'ien

Sun

♊ ♋

South

≈March 22
Spring Equinox
Clinging Fire

♉ ♌

9:00 AM
Mid-morning

3:00 PM
Mid-afternoon

Noon
12:00 AM

Li

♈ East

6:00 AM
Sunrise

6:00 PM
Sunset

West ♎

K'an

Mabon

♓ ♍

12:00 PM
Midnight

3:00 A.M.

9:00 PM
Mid-evening

Eostar

≈Sept. 22
Autumn Equinox
Water-Abysmal

♒ ♑

North

Chên

♑ ♐

K'un

Kên

≈February 4
Arousing Thunder

≈November 4
Keeping Still Mountain

Brigid or Candlemas (Feb. 2)

≈December 22
Receptive Earth

Samhain or Halloween (Oct. 31)

Yule

Day	Date	Event	⑤	⑥	⑦	⑩	⑳	㉓	29-30	㉚
1	MAR 21	Spring Equinox	1	1	1	6	1	1	1—NM	1
2	22	(Eostar)	2	2	M	7	POP	2	(Full)	'Nisannu'
3	23		3	3	T	8		3	3	
4	24		4	4	W	9		4	4	
5	25		5	5	T	10	5	5	5	
6	26		2	6	F	26	6	6	6	Egyptian 9th Month: PACHON
7	27		7	2	S	12	7	7	7	1st of the 'Harvest Months'
8	28		8	8	2	13	8	8	8 1st Q.	
9	29		9	9	M	14	9	9	9	
10	30		10	10	T	15	10	10	10	
11	31		3	11	W	16	11	11	11	
12	APR 1		12	12	T	17	12	12	12	
13	2		13	3	F	18	13	13	13	
14	3		14	14	S	19	14	14	14	
15	4		15	15	3	20	15	15	15	
16	5		4	16	M	27	16	16	FM	
17	6		17	17	T	22	17	17	17	
18	7		18	18	W	23	18	18	18	
19	8		19	4	T	24	19	19	19	
20	9		20	20	F	25	20	20	20	
21	10		5	21	S	26	2	21	21	
22	11		22	22	4	27	UO	22	22	
23	12		23	23	M	28		23	23 3rd Q.	
24	13	Quarter part	24	24	T	29		2	24	
25	14		25	5	W	30	5	2	25	
26	15		6	26	T	28	6	3	26	
27	16		27	27	F	2	7	4	27	
28	17		28	28	S	3	8	5	28	
29	18		29	29	5	4	9	6	29	
30	19		30	30	M	5	10	7	30	
31	20		7	6	T	6	11	8	2-NM	2
32	21		2	2	W	7	12	9	(Hollow)	'Aiaru'
33	22		3	3	T	8	13	10	3	Egyptian 10th Month: PAYNI
34	23		4	4	F	9	14	11	4	2nd of the 'Harvest Months'
35	24		5	5	S	10	15	12	5	
36	25		8	6	6	29	16	13	6	
37	26		7	7	M	12	17	14	7	
38	27		8	8	T	13	18	15	8 1st Q.	
39	28		9	9	W	14	19	16	9	
40	29		10	10	T	15	20	17	10	
41	30		9	11	F	16	3	18	11	
42	MAY 1	Beltane (MayEve)	12	12	S	17	ZIP	19	12	
43	2		13	8	7	18		20	13	
44	3		14	14	M	19		21	14	
45	4		15	15	T	20	5	22	15	
46	5	Mid-point	10	16	W	30	6	23	FM	

Day	Date	Event	(5)	(6)	(7)	(10)	(20)	(23)	29-30	(30)
46	MAY 5	Mid-point	**10**	16	W	**30**	6	23	FM	
47	6		17	17	T	22	7	**3**	17	
48	7		18	18	F	23	8	2	18	
49	8		19	**9**	S	24	9	3	19	
50	9		20	20	**8**	25	10	4	20	
51	10		**11**	21	M	26	11	5	21	
52	11		22	22	T	27	12	6	22	
53	12		23	23	W	28	13	7	23 3rd Q.	
54	13		24	24	T	29	14	8	24	
55	14		25	**10**	F	30	15	9	25	
56	15		**12**	26	S	**31**	16	10	26	
57	16		27	27	**9**	2	17	11	27	
58	17		28	28	M	3	18	12	28	
59	18		29	29	T	4	19	13	29	
60	19		30	30	W	5	20	14	3-NM	
61	20		**13**	**11**	T	6	**4**	15	(Full)	**3**
62	21		2	2	F	7	ZOTZ	16	3	'Simanu'
63	22		3	3	S	8		17	4	
64	23		4	4	**10**	9		18	5	
65	24		5	5	M	10	5	19	6	
66	25		**14**	6	T	**32**	6	20	7	
67	26		7	**12**	W	12	7	21	8 1st Q.	
68	27		8	8	T	13	8	22	9	
69	28		9	9	F	14	9	23	10	
70	29		10	10	S	15	10	24	11	
71	30	Quarter Part	**15**	11	**11**	16	11	**4**	12	
72	31		12	12	M	17	12	2	13	
73	JUN 1		13	**13**	T	18	13	3	14	
74	2		14	14	W	19	14	4	15	
75	3		15	15	T	20	15	5	FM	
76	4		**16**	16	F	**33**	16	6	17	
77	5		17	17	S	22	17	7	18	
78	6		18	18	**12**	23	18	8	19	
79	7		19	**14**	M	24	19	9	20	
80	8		20	20	T	25	20	10	21	
81	9		**17**	21	W	26	**5**	11	22	
82	10		22	22	T	27	TZEC	12	23 3rd Q.	
83	11		23	23	F	28		13	24	
84	12		24	24	S	29		14	25	
85	13		25	**15**	**13**	30	5	15	26	
86	14		**18**	26	M	**34**	6	16	27	
87	15		27	27	T	2	7	17	28	
88	16	Syzygy	28	28	W	3	8	18	29	
89	17		29	29	T	4	9	19	30	
90	18		30	30	F	5	10	20	4-NM	
91	19		**19**	**16**	S	6	11	21	(Hollow)	**4**
92	20		2	2	**14**	7	12	22	3	'Duzu'

24 days of 'month' of 3 long

Egyptian 11th Month: EPIPHI
3rd of the 'Harvest Months'

Day	Date	Event	(5)	(6)	(7)	(10)	(20)	(23)	29-30	(30)
92	JUN 20		2	2	14	7	12	22	3	
93	21	Summer Solstice	3	3	M	8	13	23	4	
94	22	(Litha)	4	4	T	9	14	5	5	Egyptian 12th Month: MESORI 4th of the 'Harvest Months'
95	23		5	5	W	10	15	2	6	
96	24		20	6	T	35	16	3	7	
97	25		7	17	F	12	17	4	8 1st Q.	
98	26		8	8	S	13	18	5	9	
99	27		9	9	15	14	19	6	10	
100	28		10	10	M	15	20	7	11	
101	29		21	11	T	16	6	8	12	
102	30		12	12	W	17	XUL	9	13	
103	JUL 1		13	18	T	18		10	14	
104	2		14	14	F	19		11	15	
105	3		15	15	S	20	5	12	FM	
106	4		22	16	16	36	6	13	17	
107	5		17	17	M	22	7	14	18	
108	6		18	18	T	23	8	15	19	
109	7		19	19	W	24	9	16	20	
110	8		20	20	T	25	10	17	21	
111	9		23	21	F	26	11	18	22	
112	10		22	22	S	27	12	19	23 3rd Q.	
113	11		23	23	17	28	13	20	24	
114	12		24	24	M	29	14	21	25	
115	13		25	20	T	30	15	22	26	
116	14	Quarter Part	24	26	W	(37)	16	23	27	Egyptian Epagomenal Days
117	15		27	27	T 2		17	6	28	
118	16		28	28	F 3		18	2	29	
119	17		29	29	S 4		19	3	5-NM	
120	18		30	30	18		20	4	(Full)	
121	* 19	Sirius Rising	25	21	M	1	7	5	3	5
122	20	Actual	2	2	T	2	YAXKIN	6	4	'Abu'
123	21	Egyptian	3	3	W	3		7	5	
124	22	New Year	4	4	T	4		8	6	
125	23		5	5	F	5	5	9	7	
126	24		26	6	S	6	6	10	8 1st Q.	Egyptian 1st month: THOTH 1st of the 'Flood Months'
127	25		7	22	19	7	7	11	9	
128	26		8	8	M	8	8	12	10	
129	27		9	9	T	9	9	13	11	
130	28		10	10	W	10	10	14	12	
131	29		27	11	T	2	11	15	13	
132	30		12	12	F	12	12	16	14	
133	31		13	23	S	13	13	17	15	
134	AUG 1	Lammas	14	14	20	14	14	18	FM	
135	2		15	15	M	15	15	19	17	
136	3		28	16	T	16	16	20	18	
137	4		17	17	W	17	17	21	19	
138	5	Mid-point	18	18	T	18	18	22	20	

Day	Date	Event	⑤	⑥	⑦	⑩	⑳	㉓	29-30	㉚
138	AUG 5	Mid-point	18	18	T	18	18	22	20	
139	6		19	**24**	F	19	19	23	21	
140	7		20	20	S	20	20	**7**	22	
141	8		**29**	21	**21**	**3**	**8**	2	23 3rd Q.	
142	9		22	22	M	22	MOL	3	24	
143	10		23	23	T	23		4	25	
144	11		24	24	W	24		5	26	
145	12	Perseids	25	**25**	T	25	5	6	27	
146	13		**30**	26	F	26	6	7	28	
147	14		27	27	S	27	7	8	29	
148	15		28	28	**22**	28	8	9	30	
149	16		29	29	M	29	9	10	6-NM	
150	17		30	30	T	30	10	11	(Hollow)	
151	18		**31**	**26**	W	**4**	11	12	3	**6**
152	19		2	2	T	2	12	13	4	'Ululu'
153	20		3	3	F	3	13	14	5	
154	21		4	4	S	4	14	15	6	
155	22		5	5	**23**	5	15	16	7	
156	23		**32**	6	M	6	16	17	8 1st Q.	
157	24		7	**27**	T	7	17	18	9	
158	25		8	8	W	8	18	19	10	
159	26		9	9	T	9	19	20	11	
160	27		10	10	F	10	20	21	12	
161	28		**33**	11	S	**5**	**9**	22	13	
162	29	Quarter Part	12	12	**24**	12	CH'EN	**8**	14	
163	30		13	**28**	M	13		2	15 FM	
164	31		14	14	T	14		3		
165	SEP 1		15	15	W	15	5	4	17	
166	2		**34**	16	T	16	6	5	18	
167	3		17	17	F	17	7	6	19	
168	4		18	18	S	18	8	7	20	
169	5		19	**29**	**25**	19	9	8	21	
170	6		20	20	M	20	10	9	22	
171	7		**35**	21	T	**6**	11	10	23 3rd Q.	
172	8		22	22	W	22	12	11	24	
173	9		23	23	T	23	13	12	25	
174	10		24	24	F	24	14	13	26	
175	11		25	**30**	S	25	15	14	27	
176	12		**36**	26	**26**	26	16	15	28	
177	13		27	27	M	27	17	16	29	
178	14		28	28	T	28	18	17	7-NM	
179	15		29	29	W	29	19	18	(Full)	
180	16		30	30	T	30	20	19	3	
181	17		**37**	**31**	F	**7**	**10**	20	4	**7**
182	18		2	2	S	2	YAX	21	5	'Tashritu'
183	19		3	3	**27**	3		22	6	
184	20		4	4	M	4		**9**	7	

Short 'month' of 22 days

Short 'month' of 23 days

Egyptian 2nd Month: PHAOPHI
2nd of the 'Flood Months

Day	Date	Event	⑤	⑥	⑦	⑩	⑳	㉓	29-30	㉚
184	SEP 20		4	4	M	4	4	9	7	
185	21	Autumn Equinox	5	5	T	5	5	2	8 1st Q.	
186	22	(Mabon)	**38**	6	W	6	6	3	9	Egyptian 3rd Month: ATHYR
187	23		7	**32**	T	7	7	4	10	3rd of the 'Flood Months'
188	24		8	8	F	8	8	5	11	
189	25		9	9	S	9	9	6	12	
190	26		10	10	**28**	10	10	7	13	
191	27		**39**	11	M	**8**	11	8	14	
192	28		12	12	T	12	12	9	15	
193	29		13	**33**	W	13	13	10	FM	
194	30		14	14	T	14	14	11	17	
195	OCT 1		15	15	F	15	15	12	18	
196	2		**40**	16	S	16	16	13	19	
197	3		17	17	**29**	17	17	14	20	
198	4		18	18	M	18	18	15	21	
199	5		19	**34**	T	19	19	16	22	
200	6		20	20	W	20	20	17	23 3rd Q.	
201	7		**41**	21	T	**9**	**11**	18	24	
202	8		22	22	F	22	SAC	19	25	
203	9		23	23	S	23		20	26	
204	10		24	24	**30**	24		21	27	
205	11		25	**35**	M	25	5	22	28	
206	12	Quarter Part	**42**	26	T	26	6	**10**	29	
207	13		27	27	W	27	7	2	30	
208	14		28	28	T	28	8	3	8-NM	
209	15		29	29	F	29	9	4	(Hollow)	
210	16		30	30	S	30	10	5	3	
211	17		**43**	**36**	**31**	**10**	11	6	4	**8**
212	18		2	2	M	2	12	7	5	'Arahsamna'
213	19		3	3	T	3	13	8	6	
214	20		4	4	W	4	14	9	7	
215	21		5	5	T	5	15	10	8 1st Q.	
216	22		**44**	6	F	6	16	11	9	Egyptian 4th Month: CHOIAK
217	23		7	**37**	S	7	17	12	10	4th of the 'Flood Months'
218	24		8	8	**32**	8	18	13	11	
219	25		9	9	M	9	19	14	12	
220	26		10	10	T	10	20	15	13	
221	27		**45**	11	W	**11**	**12**	16	14	
222	28		12	12	T	12	CEH	17	15	
223	29		13	**38**	F	13		18	FM	
224	30		14	14	S	14		19	17	
225	31	Halloween	15	15	**33**	15	5	20	18	
226	NOV 1		**46**	16	M	16	6	21	19	
227	2		17	17	T	17	7	22	20	
228	3		18	18	W	18	8	**11**	21	
229	4		19	**39**	T	19	9	2	22	
230	5	Mid-point	20	20	F	20	10	3	23 3rd Q.	

Short 'month' of 22 days

Short 'month' of 22 days

Day	Date	Event	⑤	⑥	⑦	⑩	⑳	㉓	29-30	㉚
230	NOV 5	Mid-point	20	20	F	20	10	3	23 3rd Q.	
231	6		**47**	21	S	**12**	11	4	24	
232	7		22	22	**34**	22	12	5	25	
233	8		23	23	M	23	13	6	26	
234	9		24	24	T	24	14	7	27	
235	10		25	**40**	W	25	15	8	28	
236	11		**48**	26	T	26	16	9	29	
237	12		27	27	F	27	17	10	9-NM (Full)	
238	13		28	28	S	28	18	11		
239	14		29	29	**35**	29	19	12	3	
240	15		30	30	M	30	20	13	4	
241	16		**49**	**41**	T	**13**	**13**	14	5	**9** 'Kislimu'
242	17		2	2	W	2	MAC	15	6	
243	18		3	3	T	3		16	7	
244	19		4	4	F	4		17	8 1st Q.	
245	20		5	5	S	5	5	18	9	
246	21		**50**	6	**36**	6	6	19	10	Egyptian 5th Month: TYBI 1st of the 'Seed Months'
247	22		7	**42**	M	7	7	20	11	
248	23		8	8	T	8	8	21	12	
249	24		9	9	W	9	9	22	13	
250	25		10	10	T	10	10	23	14	
251	26		**51**	11	F	**14**	11	**12**	15 FM	
252	27	Quarter Part	12	12	S	12	12	2		
253	28		13	**43**	**37**	13	13	3	17	
254	29		14	14	M	14	14	4	18	
255	30		15	15	T	15	15	5	19	
256	DEC 1		**52**	16	W	16	16	6	20	
257	2		17	17	T	17	17	7	21	
258	3		18	18	F	18	18	8	22	
259	4		19	**44**	S	19	19	9	23 3rd Q.	
260	5		20	20	**38**	20	Z	10	24	
261	6		**53**	21	M	**15**	**14**	11	25	
262	7		22	22	T	22	KANKIN	12	26	
263	8		23	23	W	23		13	27	
264	9		24	24	T	24		14	28	
265	10		25	**45**	F	25	5	15	29	
266	11		**54**	26	S	26	6	16	30	
267	12		27	27	**39**	27	7	17	10-NM (Hollow)	
268	13	Geminids	28	28	M	28	8	18		
269	14		29	29	T	29	9	19	3	
270	15		30	30	W	30	10	20	4	
271	* 16	Syzygy	**55**	**46**	T	**16**	11	21	5	**10** 'Tebetu'
272	17		2	2	F	2	12	22	6	
273	18		3	3	S	3	13	23	7	
274	19		4	4	**40**	4	14	**13**	8 1st Q.	
275	20		5	5	M	5	15	2	9	
276	21	Winter Solstice (Yule)	**56**	6	T	6	16	3	10	

Day	Date	Event	⑤	⑥	⑦	⑩	⑳	㉓	29-30	㉚
276	DEC 21	Winter Solstice	56	6	T	6	16	3	10	
277	22	(Yule)	7	47	W	7	17	4	11	
278	23		8	8	T	8	18	5	12	
279	24		9	9	F	9	19	6	13	
280	25	Christmas	10	10	S	10	20	7	14	
281	26		57	11	41	17	15	8	15	Egyptian 6th Month: MECHIR
282	27		12	12	M	12	MOAN	9	FM	2nd of the 'Seed Months'
283	28		13	48	T	13		10	17	
284	29		14	14	W	14	4	11	18	
285	30		15	15	T	15	5	12	19	
286	31		58	16	F		6	13	20	
287	JAN 1	'New Year'	17	17	S	17	7	14	21	
288	2		18	18	42	18	8	15	22	
289	3		19	49	M	19	9	16	23 3rd Q.	
290	4	Quadrantids	20	20	T	20	10	17	24	
291	5		59	21	W	18	11	18	25	
292	6		22	22	T	22	12	19	26	
293	7		23	23	F	23	13	20	27	
294	8		24	24	S	24	14	21	28	
295	9		25	50	43	25	15	22	29	
296	10		60	26	M	26	16	23	11-NM	
297	11		27	27	T	27	17	14	(Full)	
298	12	Quarter Part	28	28	W	28	18	2	3	
299	13		29	29	T	29	19	3	4	
300	14		30	30	F	30	20	4	5	
301	15		61	51	S	19	16	5	6	11
302	16		2	2	44	2	PAX	6	7	'Shabatu'
303	17		3	3	M	3		7	8 1st Q.	
304	18		4	4	T	4		8	9	
305	19		5	5	W	5	5	9	10	
306	20		62	6	T		6	10	11	Egyptian 7th Month: PHAMENOTH
307	21		7	52	F	7	7	11	12	3rd of the 'Seed Months'
308	22		8	8	S	8	8	12	13	
309	23		9	9	45	9	9	13	14	
310	24		10	10	M	10	10	14	15	
311	25		63	11	T	20	11	15	FM	
312	26		12	12	W	12	12	16	17	
313	27		13	53	T	13	13	17	18	
314	28		14	14	F	14	14	18	19	
315	29		15	15	S	15	15	19	20	
316	30		64	16	46		16	20	21	
317	31		17	17	M	17	17	21	22	
318	FEB 1		18	18	T	18	18	22	23 3rd Q.	
319	2	Candlemas	19	54	W	19	19	23	24	
320	3		20	20	T	20	KAYAB	15	25	
321	4		65	21	F	21	17	2	26	
322	5	Mid-point	22	22	S	22		3	27	

Day	Date	Event	(5)	(6)	(7)	(10)	(20)	(23)	29-30	(30)
322	FEB 5	Mid-point	22	22	5	22	2	3	27	
323	6		23	23	47	23	3	4	28	
324	7		24	24	M	24	4	5	29	
325	8		25	55	T	25	5	6	30	
326	9		66	26	W	26	6	7	12-NM	
327	10		27	27	T	27	7	8	(Hollow)	
328	11		28	28	F	28	8	9	3	
329	12		29	29	S	29	9	10	4	
330	13		30	30	48	30	10	11	5	
331	14		67	56	M	22	11	12	6	12 'Adaru'
332	15		2	2	T	2	12	13	7	
333	16		3	3	W	3	13	14	8 1st Q.	
334	17		4	4	T	4	14	15	9	
335	18		5	5	F	5	15	16	10	
336	19		68	6	S	6	16	17	11	Egyptian 8th Month: PHARMUTI 4th of the 'Seed Months'
337	20		7	57	49	7	17	18	12	
338	21		8	8	M	8	18	19	13	
339	22		9	9	T	9	19	20	14	
340	23		10	10	W	10	20	21	15	
341	24		69	11	T	23	18	22	FM	
342	25		12	12	F	12	CUMHU	23	17	
343	26		13	58	S	13		16	18	
344	27	Quarter-Part	14	14	50	14		2	19	
345	28		15	15	M	15	5	3	20	
346	MAR 1		70	16	T	16	6	4	21	
347	2		17	17	W	17	7	5	22	
348	3		18	18	T	18	8	6	23 3rd Q.	
349	4		19	59	F	19	9	7	24	
350	5		20	20	S	20	10	8	25	
351	6		71	21	51	24	11	9	26	
352	7		22	22	M	22	12	10	27	
353	8		23	23	T	23	13	11	28	
354	9		24	24	W	24	14	12	29	
355	10		25	60	T	25	15	13	13-NM	
356	11		72	26	F	26	16	14	(Full)	
357	12		27	27	S	27	17	15	3	
358	13		28	28	52	28	18	16	4	
359	14		29	29	M	29	19	17	5	
360	15		30	30	T	30	20	18	6	
361	16		(73)	(61)	W	25	(19)	19	7	(13)
362	17		2	2	T	2	VAYEB	20	8 1st Q.	
363	18		3 New Year Festival	3	F	3		21	9	
364	19		4	4	S	4		22	10	
365	20		5	5	(53)	5		23	11	
1	21	Spring Equinox	1	1	M	6	1	1	12	1
		(Eostar)	2	2	T	7	2	2	13	
			3	3	W	8	3	3	14	

The Mayan Calendar-Complex (derived from the Olmecs)

one day = one **Kin** [or Sun]
20 days = one **Vinal** [derived from their Base 20 Arithmetic]
260 days (13 x 20) = one **Tzolkin** (z), the 'Sacred Calendar'
360 days (18 x 20) = one Vague Year (VY) = one **Tun**
365 days (5 x 73) = one Wandering Year (WY)
584 days (8 x 73) = one Synodic Venus orbit (SV)
780 days = one Synodic Mars orbit (SM) = 3 z (3 x 260)
2,920 days = 8 WY (5x73) = 5 SV (8x73)
18,980 days = 52 WY (4x13) = 73 z = one 'Calendar Round'
37,960 days = one **Lub** ('resting place') = 65 x 584 or 65 SV
= 104 x 365 or 104 WY
= two Calendar Rounds
= 146 x 260 or 146 z

Using a least common multiple of 1,366,560 days (≃ 3,742 years) (called **T** and consisting of prime factors $2^5 \times 3^2 \times 5 \times 13 \times 73$), then:
T/13 = 105,120 days or 288 VY
T/52 = 26,280 days or 72 VY
T/72 = 18,980 days or one Calendar Round
T/73 = 18,720 days = 52 x 360 = 72 x 260
T/260 = 5,256 z
T/360 = 3,796 VY
T/365 = 3,744 WY
T/584 = 2,340 SV
T/780 = 1,752 SM
T/2,920 = 468 Venus-solar cycles
T/18,980 = 72 Calendar Rounds
T/37,960 = 36 Lub

Certain Mayan calendrical information has been omitted in the interest of simplicity. For example, 11,960 days = 405 lunations (29.530864 days) = 46 z. Including this cycle warrants an additional factor of 23. The Mayan WY-Moon cycle of 9,125 days is also omitted. Inclusion of

all known factors requires a cycle of $2^5 \times 3^2 \times 5^3 \times 13 \times 23 \times 73$ or 785,772,000 days (about 2,151,372 years!) Using 1,366,560 as the master cycle, we get these factors in use:

2 × 683,280
3 × 455,520
4 × 341,640
5 × 273,312
8 × 170,820
13 × 105,120
18 × 75,920
20 × 68,328
36 × 37,960
52 × 26,280
65 × 21,024
72 × 18,980
73 × 18,720
104 × 13,140
146 × 9,360
260 × 5,256
288 × 4,745
360 × 3,796
365 × 3,744
468 × 2,920
584 × 2,340
780 × 1,752

-information is extracted from my article: Harmonics in Ancient Calendrics
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We can convert this information into a musical scale by taking the numbers 683,280 : 1,366,560 as our octave, and converting the other numbers to sequence numbers between these two, through repeated doublings. Sometimes several numbers result in the same pitch. The numbers are expressed in an 'up' direction (frequency) rather than a 'down' direction (monochord). The resulting scale, re-shuffled in order of interval size is shown over the page. Figures are rounded off to one cent.

Source Numbers	Doublings to one octave	Ratio	Cents
170,820 – 341,640 – 683,280	683,280	1.0	0
VY 360	737,280	1.0790306	132 (132/24)
WY V-sol. 365 – 2,920	747,520	1.0940171	156 (156/87)
3	786,432	1.1509659	243 (243/27)
SM 780	798,720	1.1689498	270 (270/89)
13,140 – 26,280 – 105,120	840,960	1.2307692	359 (359/23)
13 – 52 – 104	851,968	1.2468798	382 (382/89)
1,752	897,024	1.3128205	471 (471/27)
455,520	911,040	1.333̇	498 (498/88)
468 – 3,744	958,464	1.4027397	586 (586/24)
3,796	971,776	1.42222̇	610 (610/131)
2-4-8	1,048,576	1.5346212	741 (741/27)
Z 65 – 260	1,064,960	1.5585997	768 (768/46)
68,328 – 273,312	1,093,248	1.6	814 (814/131)
18-36-72-288	1,179,648	1.7264489	945 (945/24)
SV 73-146-584	1,196,032	1.7504274	969 (969/3)
2,340 – 9,360 – 18,720	1,198,080	1.7534247	972 (972/24)
Cal. Rotund 4,745 – 18,980 – 75,920 (37,960 Lub)	1,214,720	1.777̇	996 (996/132)
5 – 20	1,310,720	1.9182765	1128 (1128/45)
5,256 – 21,024	1,345,536	1.9692308	1173 (1173/27)
1,366,560	1,366,560	2.0	1200

- a few numbers are highlighted emphasizing key ratios. For example 360:365 = 72:73 (the calendrical Prime Ratio - a 24 cents comma) slightly wider than the syntonic comma 80:81 – it falls on several places in the scale, eg. cents 132-156 and 945-969. Also the cents 969 well 'simulates' a 4:7 to the reference position, there's also a 5:8 (814 cents) and 9:16 (996 cents) and 3:4 (498 cents)

-**Note**: Procedures such as these can be applied to alternative ancient calendar-systems, for example, the Babylonian, Egyptian, Vedic, etc. – has possibilities for new and complex-interval scales. Have Fun!

Siem

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