

CALENDARS & NEW MOONS

Calculated Versus Observed



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Unless otherwise noted, all Scripture
is from the *King James Version* or its revisions.

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“Blow up the trumpet in the new moon, in the time appointed time, on our solemn festival day.”

—Psalm 81:3

PREFACE

God established the sun, moon, and stars “for signs and seasons, and for days and years” (Gen. 1:14). These celestial bodies determine the days, months, seasons, and years. All life on this earth is linked to them. The seasons of spring, summer, autumn, and winter determine when plants grow and produce seeds as well as when animals, fish, birds, and insects procreate. Even the moon affects life on earth with its gravitational tidal effects. Mankind is tied to the life cycle of all living things so everything is dependent upon the seasons that follow the lunar cycle and solar year.

God’s holydays are holy convocations and the underlying Hebrew word means to assemble; He intends people to gather together to observe His holydays. Convocations are vitally important because a relationship with Him is fellowship with all His people.

After the destruction of the Temple, there was no universally accepted or common festival calendar outside of Jerusalem. Observing them was erratic until Hillel II published the Calculated Hebrew Calendar (CHC). It was the only practical solution at the time. Those who observe the holydays have relied upon the Calculated Hebrew Calendar for centuries; however, in the last twenty years or so, Internet access has prompted the spread of several Lunar Observance Calendars. Their main appeal is that proponents claim it based upon the Bible. Are they correct?

CHAPTER 1

Holydays of God

God's holy convocations (holydays) are tied to harvest seasons. Passover and the Days of Unleavened Bread are in early spring when the barley harvest occurs, the Festival of Weeks corresponds to the early wheat harvest in late spring, and the Festival of Ingathering (which includes the Day of Trumpets, Day of Atonement, and Festival of Tabernacles) is in early autumn the large harvest of wheat, fruit, and olive harvests occurs.¹

The Calculated Hebrew Calendar and many of the Lunar Observance Calendars adjust the year, months, and days per month to keep the holydays in their proper seasons. These are called luni-solar calendars. There are some less common calendars that are strictly lunar-based without regard to the length of a solar year and holydays can literally end up being observed well past the time of the harvest seasons so they are too impractical to even consider.

The holydays of God are specific dates on the Hebrew calendar² where months begin on a new moon, so it is the most important celestial body for determining the holydays. There are two types of new moons: the New Moon Conjunction (fully dark) and the First Visible Waxing Crescent. The first day of a month in the Calculated Hebrew Calendar is based upon a fully dark moon, properly called the New Moon Conjunction. Lunar Observation Calendars rely upon visually sighting a First Visible Waxing Crescent as the first day of the month, which is always 24-48 hours after the conjunction. Regardless, new moons determine the "appointed times" of the holydays of God:

PSALM 104:19 He *[the LORD]* appointed *[made]* the moon *[H3394 = yareach]* for seasons *[H4150 = mow'ed]*; the sun knows its going down.

¹ Exod. 9:31-32; 23:16; 34:22; Lev. 23:5-6, 24, 27, 39; Deut 14:23

² Lev. 23: Passover (v5), Unleavened Bread (vv6, 8), Pentecost (vv15-16), Trumpets (v24), Day of Covering (v26), Tabernacles (vv34-36).

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The Hebrew word translated moon here is *yareach* (H3394) and it only means *moon* and *seasons* is translated from *mow'ed* (H4150). *Mow'ed* refers to something that is *appointed* and it could be a time, place, or event. Which one is determined by context. This is why it is translated both *festivals* and *appointed times*:

LEVITICUS 23:4 'These are the **festivals [H4150 = mow`ed]** of the LORD, holy convocations which you shall proclaim at their **appointed times [H4150 = mow`ed]**.

Psalms 104:19 is better understood as, "The LORD made the moon to determine the appointed times."

Months & Moons

In Hebrew, there is no difference between a month and the new moon. In fact, a month portrays a lunar cycle, which is why the Hebrew months are either 29 or 30 days. Over the course of a year, they should average out to the 29.53 days of a lunar cycle where the beginning and middle lunar phases correspond to the first and fifteenth days of a month. These are also the dates of three holydays: the Day of Trumpets that occurs on the first day of the seventh month and first Day of Unleavened Bread and first Day of the Festival of Tabernacles that occur on the fifteenth day of the seventh month:

LEVITICUS 23:6 'And on **the fifteenth day of the same month [H2320 = chodesh] is the Festival [H2282 = chag] of Unleavened Bread** to the LORD ... 24 "Speak to the children of Israel, saying: '**In the seventh month [H2320 = chodesh], on the first day of the month,** you shall have a sabbath-rest, a memorial of **blowing of trumpets**, a holy convocation. ... 34 "Speak to the children of Israel, saying: '**The fifteenth day of this seventh month [H2320 = chodesh] shall be the Festival [H2282 = chag] of Tabernacles** for seven days to the LORD.

Authority of the Priests

The Hebrew word *chodesh* (H2320) refers both to a *new moon* and *month* although it is overwhelmingly translated *month*. In every

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sense, moons and months are synonymous and interchangeable concepts. Regardless of whether a new moon is a conjunction or a visible crescent, the Rabbinic priesthood had the responsibility to determine and announce the dates for the holydays:

NUMBERS 10:8-10 **"The sons of Aaron, the priests, shall blow the trumpets; and these shall be to you as an ordinance forever throughout your generations. ... 10 "Also in the day of your gladness, in your appointed festivals, and at the beginning of your months, you shall blow the trumpets over your burnt offerings and over the sacrifices of your peace offerings; and they shall be a memorial for you before your God: I am the LORD your God."**

It cannot be emphasized enough that the calendar has always been under the authority of the Rabbinic priesthood. In general, judgment for matters pertaining to the Law of God was given to them as noted by Paul:

ROMANS 3:1-2 What advantage then has **the Jew**, or what is the profit of circumcision? 2 Much in every way! Chiefly because **to them were committed the oracles [utterances] of God.**

Jesus Christ also acknowledged their authority:

MATTHEW 23:2-3 saying: "The scribes and the Pharisees **sit in Moses' seat.** 3 "Therefore **whatever [he] [referring to Moses] tells you to observe, that observe and do, but do not do according to their [the scribes and Pharisees] works;** for they say, and do not do.

Jesus condemned the scribes and Pharisees for many things but He never questioned their authority to sit in the Seat of Moses. He condemned their works but upheld their authority under the Law.

The Sanhedrin

But all that changed with the destruction of the Jerusalem Temple in 70 AD. God still required the holydays to be observed even though the Temple was destroyed and the Rabbinic priests could no longer perform their required duties, including setting the dates for the new moons and holydays. When the Romans conquered

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Jerusalem, they exiled most of the Jews, making it impossible for any remaining Rabbinic priests to communicate the dates of the holydays to those in the Diaspora. In fact, the lack of agreement on dates for the holydays outside of Jerusalem was a significant source of confusion and conflict in the early centuries.

To address this, Hillel II published a calculation-based calendar in 358-359 AD, referred to today as the Hillel Calendar or the Calculated Hebrew Calendar. It allowed those dispersed abroad to collectively observe the holydays on the same dates and has been in use for the last 1,700 years or so.

The scribes and Pharisees sit in the Seat of Moses but the Sanhedrin had the final authority in all matters pertaining to the Law. It was similar to the Supreme Court of the United States. Traditionally, the Sanhedrin was linked to the 70 elders in the days of Moses. Historically, the Sanhedrin was officially and universally recognized by the time of the Greeks, which was well before the Romans and the days of Jesus Christ. Paul was also a Pharisee who was taught by Gamaliel I:

ACTS 22:3 "**I [Paul] am indeed a Jew, born in Tarsus of Cilicia, but brought up in this city at the feet of Gamaliel [the elder], taught according to the strictness [exactness] of our fathers' law,** and was zealous toward God as you all are today.

It is likely that Paul was also a member of the Sanhedrin as suggested by the fact he voted before his conversion to punish and persecute Christians:

ACTS 26:10-11 "This I [Paul] also did in Jerusalem, and many of the saints I shut up in prison, having **received authority from the chief priests;** and **when they were put to death, I cast my vote against them.** 11 "And I punished them often in every synagogue and compelled *them* to blaspheme; and being exceedingly enraged against them, I persecuted *them* even to foreign cities.

Paul had great respect for Gamaliel I and Hillel II was likely taught exactly the same as Paul when it comes to the Law given to Moses.

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Paul was, in his words, “taught according to the strictness [exactness] of our fathers’ law.” This is important Hillel II was a descendant of Gamaliel I:

Hillel I (the Elder)—circa 20 BC

↳ Simon/Simeon ben (“son of”) Hillel

↳ **Gamaliel I** (the Elder, teacher of Paul)

↳ Simon/Simeon ben (“son of”) Gamliel I

↳ Gamaliel II (of Yavneh)

↳ [Unnamed Son]

↳ Judah ha-Nasi (compiled the Mishnah)

↳ Gamaliel III

↳ [Judah Nesiah]

↳ **Hillel II** (4th century AD)

↳ Gamaliel V

↳ Gamaliel VI (grandson of Gamaliel V, died 425AD)

Hillel II, the seventh from Gamaliel I, was a ranking member of the Sanhedrin when he published the Calculated Hebrew Calendar in 358-359 AD. That was the last Sanhedrin council due to Roman persecution, which ended shortly after the last president Gamaliel VI died in 425 AD.

The authority from God to judge matters of the Law (including the calendar) was originally a hereditary position given exclusively to the Levites. Over time, however, this came to include men who were educated and trained in the Law from other tribes such as Paul who was of the tribe of Benjamin and Maimonides who was a Jew. Instead of the authority of the Seat of Moses being limited to a Kohanim priesthood (descendants of Aaron), it became a Rabbinic priesthood.

There is no question that the Sanhedrin had full legal authority from God to set the dates for the holydays and establish and make changes to the calendar. This is verified by Maimonides, a rabbi

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who lived from 1135 or 1138 until 1204 AD. He was originally named Moshe ben Maimon (commonly known as Rambam) and his many tractates are still influential today. He records in great detail the legal codes and authority of the Rabbinic priests in one of his many works titled *Mishneh Torah* (“Review of the Torah”). In it, he asserts that the Sanhedrin had full authority over the calendar his *Sanctification of the New Moon, Book 2*:

“The **sanctification of the new month** by contrast, has been entrusted to the [High] court. *The new month does not begin* until it has been sanctified by the court ...”

The Sanhedrin refers to a priestly tribunal. The name originated under the Greeks in 57 BC when tribunals called Sanhedrin were established. Several Lesser Sanhedrin were located in various cities but the Great Sanhedrin was at the Temple. The latter is what Maimonides called the High Court. The authority of the Sanhedrin over the calendar was, according to Maimonides, extremely broad:

“The [High] court has the authority to calculate, institute, and decide which year(s) shall be full [*leap years with thirteenth months*] whenever it desires, even several years in advance.”

From time to time, the Sanhedrin had to change or adjust the calendar to address situations that prevented people from gathering for the holydays. Maimonides records examples of uncertainties in the sighting or timing of the new moon as well as travel obstructions—impassable roads, destroyed bridges, flooded rivers, and broken Paschal ovens in his *Mishneh Torah, Sanctification of the New Month 4, Chapter 4*. Some of these were solved by delaying the start of the new year by a month; i.e., proclaiming a leap or “full” year:

There are other factors for which the court makes *the year full* in the case of necessity. Among them: that the roads are not suitable, and it is impossible for the people to make the pilgrimage. *In such an instance*, the year is made full, *to allow time for the rains to stop* and the roads to be fixed. That the bridges have been destroyed and there are rivers

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interrupting the roads, and preventing the people *from continuing their journey*.

But instituting a leap year is not the same as observing the Second Passover. A leap year literally delays the first month Abib by one month, regardless of the equinox and barley green ears.

These example show that claims against postponements in the Calculated Hebrew Calendar are not allowed are not credible—the Sanhedrin did it for centuries before the Calculated Hebrew Calendar. It could even be said that postponements originated with God when He permitted individuals to delay the Passover to the second month if they were unable to observe it in the first month³.

While the Sanhedrin used lunar observations, Maimonides also records in great detail the use of astronomical calculations to determine the location and position for lunar sightings, when they might be obstructed, if sightings will be questionable, or simply to verify the testimony of witnesses:

“The [High] court would make calculations in a manner resembling the calculations of the astronomers, and would know whether the position of the moon - when it would be sighted - would be to the north of the sun, or to its south, if its *crescent* would be wide or narrow, and the direction in which its corners would be pointed ... It is a positive commandment of the Torah for the [High] court to calculate and determine whether or not the moon will be sighted.”

Aside from Maimonides, there are other historical sources that describe the authority of the Sanhedrin including Josephus, the *Mishnah* and *Tosefta* (*Tractate Rosh Hashanah & Sanhedrin*), the *Cairo Genizah* documents, etc. No one can deny the fact that the priests had authority over the calendar for more than 2,500 years or that Jesus Christ kept the same dates as the Jews, which was an endorsement their authority.

³ Num. 9:10-13.

Sanctification of the Calendar

The main argument about whether holydays should be determined by the Calculated Hebrew Calendar or a strictly Lunar Observation Calendar is not a debate of conjunctions versus the First Visible Waxing Crescent, postponement rules, etc. The real question is: Which method was “sanctified” by the Sanhedrin?

In the *Mishneh Torah, Sanctification of the New Moon*, Book 2, Maimonides asserts that the Sanhedrin had full authority over the sanctifying the new moon:

“The sanctification of the new month by contrast, has been entrusted to the [High] court. The new month does not begin until it has been sanctified by the court ...”

IMPORTANT: The only modern calendar authenticated and authorized by the Sanhedrin council is the Calculated Hebrew Calendar that was sanctified by the last Sanhedrin council in 358-359 AD.

The Sanhedrin sanctified the Calculated Hebrew Calendar ~1,700 years ago and it remains the only calendar sanctified for determining the festival dates. Only with the Internet has a Lunar Observation Calendar even been possible in the last 20-30 years so it is puzzling that there such a desire to reject the Calculated Hebrew Calendar.

IMPORTANT: No modern Lunar Observation Calendar has been authenticated and sanctified by anyone with the authority of the Seat of Moses.

New Moon is a First Visible Waxing Crescent

There is widespread historical consensus that the first day of the month corresponds to a sighting of the First Visible Waxing Crescent rather than a New Moon Conjunction. The Bible, however, never specifies what constitutes a new moon. Maimonides claims the visible crescent was confirmed in a vision to Moses in his *Mishneh Torah, Sanctification of the New Moon*:

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“The Holy One, blessed be He, **showed Moses in the vision** of prophecy **an image of the moon** and told him, **“When you see the moon like this, sanctify it.”**”

Historical literature, in particular the vast works of Maimonides, proves that the ancients did not rely upon lunar observations alone. Maimonides also mentions in his *Mishneh Torah, Sanctification of the New Month 1, Chapter 1* the use sightings, mathematical calculations, and a 19-year cycle of solar years called a Small Cycle (*Machzor Katan*). That is how they could predict ahead of time when the first month of the year occurred for Passover. It is also how the apostles, who traveled the world, knew in advance when the holydays occurred even if they were on long journeys:

ACTS 18:21 but [Paul] took leave of them, saying, “I must by all means **keep this coming festival in Jerusalem**; but I will return again to you, God willing.” And he sailed from Ephesus.

ACTS 20:16 For Paul had decided to sail past Ephesus, so that he would not have to spend time in Asia; for **he was hurrying to be at Jerusalem, if possible, on the Day of Pentecost**.

IMPORTANT: The first day of the month is set by the First Visible Waxing Crescent; however, the Sanhedrin used a combination of lunar observations, calculations, and fixed 19-year patterns of common and leap years to determine the dates for the holydays.

Knowing the dates of the holydays ahead of time is only possible if the calendar did not solely rely upon lunar observations.

Lunar Observation Problems

Lunar observations face number of issues with sighting a First Visible Waxing Crescent. These include orbital phenomena such as the elongation or angular separation between the sun and moon, the time elapsed from the actual New Moon Conjunction, the amount of time the moon is visible after sunset (the velocity of the moon varies), observer latitude, atmospheric clarity, and sky

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brightness. These all affect the visibility of the moon. If the first opportunity for its occurrence is just under the threshold for seeing it, the new moon will be two days after a conjunction. If it is above the threshold, it is one day after a conjunction.

In addition to these difficulties, lunar sightings are dependent upon the observer. Someone with better eyesight may observe it a day before someone who is not as clear-sighted. Sighting the First Visible Waxing Crescent is affected by the sun, and moon, the atmospheric conditions on the earth, and the location of an observer on the earth but also the *eyesight* of the observer. This is one reason multiple witnesses were required to establish the First Visible Waxing Crescent.

Both the Calculated Hebrew Calendar and Lunar Observation Calendars align the solar year with lunar months is by adding an additional month (a leap month) every so often to the calendar at the end of the year. The Calculated Hebrew Calendar does this as part of a repeatable pattern of a 19-year cycle that has twelve common years with 12 months that are interspersed with seven leap years of 13 months each. It is extremely accurate—a solar year in the 19-year cycle is off by about a day every 14,000 years. One advantage of a repeating 19-year cycle is that the first month of Abib is always predictable since the leap year with the thirteenth month is part of a known pattern. That means the month of Passover can be known years in advance.

Not so with calendars based upon strict lunar observation. Whether or not the current year is a common or leap year is unknown until the first month Abib (literally, “green ears”) of the next year is determined by sighting the First Visible Waxing Crescent that coincides with the first appearance of green ears on the barley. Maimonides notes they also had to assess the vernal equinox and the blooming of fruit trees (*Mishneh Torah, Sanctification of the New Moon, Book 2*). Without also going into detail about the vernal (spring) equinox, if green ears are present when the First Visible Waxing Crescent is sighted, that becomes the first day of the first month Abib. If green ears are absent when the anticipated

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First Visible Waxing Crescent is sighted, then a leap month (a thirteenth month) is added to the current year and the next First Visible Waxing Crescent becomes the first month Abib. But knowing whether the current year has twelve or thirteen months is not possible until a new moon is sighted that coincides with the green ears of barley. Technically speaking, the earliest anyone can know when to observe Passover is thirteen days in advance since Passover is the fourteenth day of the month Abib.

It would be impossible to observe the Passover in ancient times with less than two weeks notice. It required up to a week to travel from the farthest regions of the land of Canaan to Jerusalem. If Passover was determined only thirteen days in advance and it takes a week to get news to people in the farthest regions, by the time people arrive in Jerusalem the Passover would likely be over.

This is also an issue with the Day of Trumpets, which falls on the first day of the seventh month Tishri. Technically, the exact date is unknown until the First Visible Waxing Crescent for the seventh month is sighted. No one can properly observe the Day of Trumpets if there is no advanced warning. Unlike the Calculated Hebrew Calendar where the first day of each month is fixed, the First Visible Waxing Crescent has an uncertainty of 24 to 48 hours. Calculating the first day of the seventh month is not as simple as adding 29.5 days to the first day of a prior month because the first day of the seventh month could still be off by a day.

Admittedly, there are legitimate ways around establishing the beginning of the first and seventh months but they require **calculations** or **predictions** and have the potential to be in error from the visual sighting of the First Visible Waxing Crescent. Whether it is the mathematically-based Calculated Hebrew Calendar or Lunar Observation Calendars, no practical calendar can avoid calculations entirely.

Many Lunar Observance Calendars also require the sighting of the First Visible Waxing Crescent and the observance of barley green ears to occur in Jerusalem where the Temple and the Rabbinic priests were centered. All festival dates were determined in

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Jerusalem from about 516 BC when the Second Temple was inaugurated until it was destroyed in 70AD. Today, there are several websites in Jerusalem that publish Lunar Observation Calendars and take into account the spring equinox and appearance of local barley green ears to determine the festival dates. It seems reasonable to assume they are all relatively accurate; however, that does not change the fact that none are sanctified by the Sanhedrin.

Of the numerous varieties of Lunar Observation Calendars, they are not all consistent in dating the holydays. There are several reasons, including variations in the maturation of barley crops, the timing of the spring equinox, etc. The differences between lunar calendars can be subtle and difficult to understand and choosing one is not easy. Moreover, Lunar Observance Calendars have several problems in common:

- 1) It can be difficult to see the First Visible Waxing Crescent without visual aids (binoculars, telescopes, etc.). Some Lunar Observance Calendars actually require observations to be made with the naked eye alone (although corrective lenses are permitted). This means sightings can be inconsistent and vary with different observers.
- 2) The many factors that affect sighting a First Visible Waxing Crescent include times when it is not observable at all. That would be a serious problem should it happen when the critical first month is being determined.
- 3) They also require more than visually sighting the new moon. Calendars generally also require observing the spring equinox to determine leap years. Above all, reliable observers require some amount of training and experience.

No one can deny the many difficulties that plague lunar sightings such as when clouds completely obscure the moon. The authority to resolve such issues lay with the Sanhedrin. For example, if the new moon could not be seen, Maimonides records in his *Mishneh Torah, Sanctification of the New Month 1, Chapter 1* that the 30th day of the month is treated as part of the current month and the

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next day is proclaimed as the first day of the next month *regardless* of whether or not it corresponds to the visual sighting of the First Visible Waxing Crescent. The complexity of Hebrew calendars in general, even those used in the days of Jesus Christ, is beyond what most people realize.

Calculated Hebrew Calendar

The Calculated Hebrew Calendar uses an average of the lunar orbital dynamics for all months and the New Moon Conjunction to determine the first day of the month. It is extremely accurate. It also makes practical adjustments, called postponements, just like the ancients did. It is impossible to calculate or predict the First Visible Waxing Crescent and lunar observations are beyond the ability of most people. That is why the Calculated Hebrew Calendar omits all visual sightings of lunar crescents and is based upon a New Moon Conjunction that only requires simple mathematics to determine. The Calculated Hebrew Calendar overcomes the extremely complex calendars that were a mix of lunar observations and calculations maintained by the Sanhedrin prior to the destruction of the Temple. It was excellent choice for the people in the Diaspora who had no other means to determine common festival dates. Above all, it united the people in their observance of the holydays.

Some have argued the Calculated Hebrew Calendar is not valid simply because postponements are not biblical. While true, once again it is important to understand that the Bible does not discuss the details of *any* calendar so that is not a legitimate point. The only calendar in modern times that has been sanctified by the Sanhedrin is the Calculated Hebrew Calendar. Even though they are a concern for some, the four Postponement Rules help resolve some very rationale concerns:

- 1) **RULE #1** prevents the Day of Coverings from falling on the first (Sunday) and sixth days (Friday) of the week so that there are not two consecutive days when all work is prohibited.

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- 2) **RULE #2** advances the date of the New Moon Conjunction to the next day if it occurs at noon or later since the day would be too far gone.
- 3) **RULE #3** prevents a common year from having too many days (356 days).
- 4) **RULE #4** prevents a previous leap year from having too few days (382 days).

Maimonides discusses postponements at length in his *Mishneh Torah, Hilchot Kiddush HaChodesh, Chapters 7-8*. Postponements are required in the Calculated Hebrew Calendar because they provide practical solutions to some specific conflicts as described in the four rules listed above. One of the rules, specifically Rule #2, actually adjusts the New Moon Conjunction to better align with a First Visible Waxing Crescent.

Postponements are also not something new. The ancients used what would be called postponements to account for the realities of life that would interfere with strict lunar observance. These could be simply weather-related phenomena or natural or man-made disasters. The Calculated Hebrew Calendar was a culmination of centuries of work by the Levitical and Rabbinical priesthoods to establish and maintain the festival calendars.

Ultimate Purpose of the Calendar

The method for dating the holydays until the destruction of the Temple in 70AD generally aligned the first day of the month with the First Visible Waxing Crescent. However, the reality that is often overlooked is that the Rabbinic priesthood never limited the first of months to visual sightings but included calculations that verified lunar observations or, at times, substituted for them. Moreover, the calendar and festival dates were manipulated to account for tangible, real-life situations including broken paschal ovens. The fact that ancient calendars were predictable years in advance cannot be ignored. The appeal of Lunar Observance Calendars is an idealistic perfection over practical application.

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Claiming that the biblical method was directed by visual sightings is disingenuous. The Bible itself does not specify new moons as either crescents or conjunctions and makes no mention of a calendar method. Actually, that allows the Rabbinic priests flexibility to adjust the festival dates for very practical reasons. In other words, it seems that God did not want to over-constrain the Rabbinic priests whom He had given the responsibility and authority to establish the dates for the holydays.

The historical record shows the Rabbinic priesthood used every possible means to sanctify the first day of the month and festival dates and they did not limit themselves to debate of observed versus calculated new moons. Overall, they took their responsibilities seriously for dating the holydays but recognized the ultimate purpose for the calendar was to ensure people could be united in their observance of the holy convocations. Maimonides wrote of this in his *Guide for the Perplexed (Moreh Nevukhim)*, Part 3, Chapter 43:

“... holy days are appointed for rejoicing and for such pleasant gathering as people generally need ...”

And that was the difficult situation that confronted Hillel II. When he considered the needs of the people in the Diaspora, he understood that most people did not have the ability, training, or authority to maintain a calendar so he chose one that was based upon simple mathematics. Such a calendar would not be subject to orbital dynamics, weather, or any of the myriad other challenges and difficulties. The result was the calendar called the Hillel or Calculated Hebrew Calendar today. It was not a new invention and was entirely based upon methods that had been in use for centuries.

Summary

The main objective of a calendar is so that people can collectively observe the holydays. After the destruction of the Temple and dispersion of the Jews, history documents the confusion that reigned for hundreds of years in the Diaspora as people observed the holydays. Hillel II addressed this with the Calculated Hebrew

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Calendar that was sanctified by the last Great Sanhedrin council. It has been the exclusive calendar for almost 1,700 years for determining the holydays of God.

While the methodology of Lunar Observance Calendars is simple in theory, it is extremely complex in practice because of the many uncertainties and difficulties associated with practical sightings of new moons. From a legal perspective, modern Lunar Observance Calendars have never been sanctified by a legitimate priestly authority tied to the Seat of Moses. That has not changed. The only calendar today that has been sanctified is the Calculated Hebrew Calendar of 358-359 AD. Because that was the last Sanhedrin council and there is no Temple, no one today, not even the Jews, has authority to replace the Calculated Hebrew Calendar or establish a new one.

The Calculated Hebrew Calendar has been universally followed for centuries before anyone in the modern era was even born. “God is not the author of confusion” (1 Cor. 14:33) but that is exactly how it seems today. It might be a different matter if there was only one Lunar Observance Calendar but there are countless variations. Choosing one of them rejects the authority of the priesthood that Jesus Himself acknowledged and is effectively deciding for oneself what is right in their own eyes (Deut. 12:8). To say this should be a concern is an understatement since all modern Lunar Observance Calendars were either created or promoted by men without legitimate priestly authority.

Perhaps the main objection to Lunar Observance Calendars is they cause divisions among festival observers. The Calculated Hebrew Calendar only exists today because the Rabbinical priests of the last Sanhedrin were troubled by the lack of common observance of the “holy convocations” (assemblies) mentioned no less than eleven times in Leviticus 23 alone. The festival calendar can be a serious matter because it is a measure of faith and esteeming God’s command to assemble before Him.

CHAPTER 2

Ancient Astronomy

People today imagine the ancients to be primitive and ignorant. However, historical records and calendars prove the ancients had a great deal of knowledge of celestial dynamics and the mathematics to model them. There is even archaeological evidence of manmade glass as far back as 3,500 BC! While the telescope was not invented until 1609 AD, how many little boys have picked up a piece of glass and used it to magnify ants, leaves, and everything else in their wild imaginings? Were the ancients so dull-witted that they never realized the magnification properties of the glass they crafted for jewelry and jars and held them up to see the moon?

Calculations and sightings were the primary method for the festival calendar centuries before the modern Calculated Hebrew Calendar. God established the sun, moon, and stars for the purpose of determining seasons, days, and years and they all have predictable movements that can be measured and calculated. Abraham was skilled in both math and astronomy, as Josephus (37-100 AD) wrote in chapter 8.2 of *Antiquities of the Jews*:

“... He [Abraham] communicated to them [the Egyptians] arithmetic, and delivered to them the science of astronomy; for before Abram came into Egypt they were unacquainted with those parts of learning; for that science came from the Chaldeans [Babylonians] into Egypt, and from thence to the Greeks also.”

While knowledge of mathematics and astronomy is not proof such a calendar existed, there is no question they had the means to calculate one as far back as Abraham (circa 2100 BC). It is doubtful that Hillel II invented the math behind the Calculated Hebrew Calendar. It would have required analyzing a huge amount of observation data. It is more likely that he borrowed or built upon the data and mathematics used by the Sanhedrin for centuries.

In 1900 AD, divers found what is called the Antikythera mechanism. It was a Greek invention of Archimedes (287-212 BC)

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that predicted the movement of the sun, moon, stars, and eclipses. It was ingenious and incredibly precise. It proves the ancients had mastered astronomy and mathematics as well as manufacturing small, precise machinery well before the time of Jesus Christ. The Antikythera mechanism was based upon a 19-year cycle calendar just like the Calculated Hebrew Calendar.

But the problem of dating the holydays would have been an issue when Judah was taken captive to Babylon around 585 BC. Even if they established the first day of the months by lunar observations, how did they determine the first month Abib? In fact, many of the people of God resided in Turkey, Iran, Iraq, Arabian Peninsula, Israel, and elsewhere over the centuries. It is impossible that someone could travel from Israel to Babylon in time to announce the green ears, so it would not be surprising if they incorporated calculations as well. Did they rely upon locally-grown barley? What about the errors in sighting the new moon that increase as one moves farther north or south of the equator? The problem of dating the holydays seems similar to those in the Diaspora after the destruction of the Temple in 70AD. However they determined the months and holydays, it is likely their methods were somewhat different then when they lived in the land of Canaan

The Flood of Noah

Perhaps the best biblical anecdotal evidence that the ancients had knowledge of a calculated calendar is the story of the flood. Recall that leap years in the Calculated Hebrew Calendar are 383, 384, or 385 days. Those years are 30 days longer than a common year (353, 354, or 355 days). The reason for leap years—years with 13 months—is to average out the common years to maintain the 365.24 days in a true solar year. Interestingly, the Noachian flood of 2350 BC was a leap year. The date of the start of the flood as well as the duration of each stage—rain, prevailing water, abating water—is recorded in the Bible from which it can be determined that the year of the flood was a 385-day leap year.

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The story of the flood begins, “In the six hundredth year of Noah's life, **in the second month, the seventeenth day of the month**, on that day all the fountains of the great deep were broken up, and the windows of heaven were opened.” (Gen. 7:11) and “the **rain was on the earth forty days and forty nights**.” (Gen. 7:12). Verse 24 says that “the **waters prevailed on the earth one hundred and fifty days**.” After the rain stopped, “the waters receded continually from the earth. **At the end of the hundred and fifty days the waters decreased**.” (Gen. 8:3). Finally, “it came to pass in the six hundred and first year [of Noah], **in the first month, the first day of the month, that the waters were dried up** from the earth” (Gen. 8:13). The flood record is from the seventeenth day of the second month to the first day of the first month of the next year. Adding them up shows the year of the flood was 385 days, the same number of days as in a Calculated Hebrew Calendar ‘abundant’ leap year:

VERSE	DESCRIPTION	DAYS	NOTES
Gen 7:11	Abib (first month) 1 to Iyar (second Month) 17 when the flood began.	46	Year 600 of Noah. Abib has 30 days plus 16 days into Iyar.
Gen 7:12	40 days and 40 nights of rain.	40	
Gen 7:24	Waters prevailed on the earth.	150	
Gen 8:3	Days waters abated from the earth.	150	Year 601 of Noah, Abib (first month) 1.
Gen 8:13	First day of next year	-1	Abib 1 of the next year is not counted.
	TOTAL	385	

Jonathan Predicts the New Moon

While some claim that the Bible allows only visual sighting of new moons, there is not one verse that supports that; it simply notes the fact of a new moon occurrence:

1 SAMUEL 20:18 Then Jonathan said to David, “**Tomorrow is the new moon [H2320 = chodesh]**; and you will be missed, because your seat will be empty.

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There is nothing in context about observing a new moon. It simply states that the new moon would definitely occur the next day. But if that was determined only by visual observation, it would be an amazing feat since visual sightings can vary by 24 hours. Somehow Jonathan *knew* when the new moon would occur *before* it became visible. Therefore, it is completely illogical to claim he could predict in advance something that can only be confirmed by visual observation especially if it can vary up to 24 hours.

While some might argue he predicted it from the Last Visible Waning Crescent just before the conjunction, it too has an uncertainty of 24-48 hours and is just as uncertain. There is *always* uncertainty of a day when sighting a first or last visible crescent. Logically, he could only know the new moon would occur the next day if it had been determined ahead of time. This cannot support strict lunar observation of new moons as some have suggested.

Full Moon—Psalm 81:3

Psalm 81:3 is an interesting case because it mentions a Full Moon:

PSALM 81:3 Blow the trumpet at the time of the New Moon
[H2320 = chodesh], at the full moon [H3677 = kece'], on our
solemn festival [H2282 = chag] day."

At face value, it seems to support a calculated calendar because of the two holydays that fall on the fifteenth of the month. There is no controversy about the disposition of a Full Moon—it is the moment that the visible moon is fully lit by the sun. A Full Moon occurs fourteen days after the New Moon Conjunction (half of the 29.53-day lunar cycle = 14.75 rounded up). The First Visible Waxing Crescent is always 1 or 2 days after a conjunction so the Full Moon, by design, falls on the thirteenth or fourteenth of the month. It is impossible for a Full Moon to occur on the fifteenth day of the month in strict Lunar Observance Calendars.

If Psalm 81:3 correlates a festival with a Full Moon, then the first day of the month must be a New Moon Conjunction, not a First Visible Waxing Crescent. However, the Hebrew word *kece'* is also translated "appointed time" in the only other place it is used:

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PROVERBS 7:19-20 For my husband is not at home; he has gone on a long journey; 20 he has taken a bag of money with him, *and* will come home on the appointed day [**H3677 = kece'**].”

There is little reason to translate *kece'* as *Full Moon* in this verse because it is impossible the wife could accurately predict her husband would return from a *long* journey in ancient times exactly on the Full Moon. Moreover, the context of the story has nothing to do with the moon so there is nothing that prevents translating *kece'* as “appointed time” as in other translations:

[KJV+] PSALM 81:3 Blow up the trumpet in the new moon, in the time appointed [**H3677 = kece'**], on our solemn festival day.

In fact, the original Hebrew leans more toward “appointed time.” Note the highlighted prepositional phrases:

[Interlinear] PSALM 81:3 tiq'ū baḥōdeš šōwpār bakkêshe leyōwm ḥaggênū.

[BibleHub] PSALM 81:3 Blow on the new moon the shofar on the Full Moon at the day of our Festival.

Grammatically speaking, it is confusing to blow the trumpet “on the new moon on the full moon at the festival.” Is the trumpet to be sounded on the new moon or full moon? It cannot be both because *festival* is singular so even inserting “and” after *shofar* is not a viable solution. This refers to a single festival so it is more sensible to render it as “on the new moon on the appointed time at the festival.” Psalm 81:3 likely has nothing to do with a Full Moon and there is only one festival that falls the new moon—the Day of Trumpets, which is supported by the context:

PSALM 81:1, 14 Sing aloud to God our strength; make a joyful shout to the God of Jacob. ... 14 I would soon subdue their enemies, and turn My hand against their adversaries.

Psalm 81:3 does not favor any position in the debate of whether the first day of the month is a New Moon Conjunction or a First Visible Waxing Crescent.

APPENDIX A

Calculated Hebrew Calendar Basics

The rotation of the earth and its orbit around the sun establish two important time factors—the length of a day and a solar year. A third time element, the month, is determined by the orbit of the moon around the earth. Tracking the movements of these celestial bodies is necessary to know when to plant and harvest or when a festival begins. However, it is impossible to align days, months, and years without some manipulation. A solar year is 365.24 days (365 days, 5 hours, 48 minutes, and 46 seconds) and the cycle of the moon from a conjunction (fully dark) to fully lit and back again is 29.53 solar days (29 days, 12 hours, 44 minutes, 3 seconds). Neither a year nor month is a whole number of days. Aligning the sun and moon on a calendar with fractional days requires adjusting the length of a solar year or the number of days in the months or both. That is the only way to synchronize the sun and moon and maintain 24-hour days. These are called luni-solar calendars. The modern Gregorian calendar and its predecessor, the Julian calendar, are luni-solar calendars. The Julian calendar was replaced by the Gregorian calendar on October 10, 1582.

The Calculated Hebrew Calendar, also called the Hillel Calendar, is also a luni-solar calendar meaning it accounts for both the orbit of the moon around the earth and the orbit of the earth around the sun. It uses a pattern of years where the number of days in some months and the number months in some years varies to synchronize the lunar months with solar years. The Calculated Hebrew Calendar uses a 19-year cycle of twelve ‘common’ years and seven ‘leap’ years. Common years have 353, 354, or 355 days in 12 months whereas leap years have 383, 384, or 385 days in 13 months. Ten of the thirteen months have fixed numbers of days. Months 1, 3, 5, 7, and 11 have 30 days whereas months 2, 4, 6, 10, and 13 have 29 days. The months 8, 9, and 12 are either 29 or 30 days, depending upon when they occur within the 19-year cycle and whether or not it is a leap year.

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The number of days in each of the first seven months of all years is fixed, alternating between 29 and 30 days. The average number of days per month for the first six months is 29.50 days, which is almost exactly the 29.53 days of a lunar cycle (~44 minutes longer). This is an important factor for dating the holydays. Since all holydays occur in the first seven months, knowing when the first day of a month falls for any one of the seven months means it is simply a matter of counting the days—forward or backward—to figure out the dates for the holydays (except for Pentecost).

Names of Months

The Bible does not name either the days of the week or the months; instead, preferring numbers. The names of the months are mostly Babylonian, the result of Judah being held captive in Babylon. Not all months have names mentioned in the Bible:

NAME	SCRIPTURE
Nisan	Esth 3:7; Lev 23:5; Exod 13:4; 23:15; 34:18; Deut 16:1
Iyar	1 Kings 6:1
Sivan	Esth 8:9
Tammuz	Not mentioned
Av	Not mentioned
Elul	Neh 6:15
Tishri	1 Kings 8:2
Cheshvan	1 Kings 6:38
Kislev	Neh 1:1
Tevet	Esth 2:16
Shevat	Zech 1:7
Adar	Zech 1:7
Adar II	Not mentioned (only used for leap years)

19-Year Cycle

The Calculated Hebrew Calendar uses a 19-year (metonic) cycle to keep the months and years aligned with a true solar year. This is

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similar to the modern Gregorian calendar that inserts a leap day every four years on February 29. This results in common years with 365 days and a leap year with 366 days such that the four-year average is 365.24 days. In the Calculated Hebrew Calendar there are twelve months in a common year and thirteen months in a leap (intercalary) year:

MONTH	NAME	COMMON			LEAP		
		353	354	355	383	384	385
1	Nisan	30	30	30	30	30	30
2	Iyar	29	29	29	29	29	29
3	Sivan	30	30	30	30	30	30
4	Tammuz	29	29	29	29	29	29
5	Av	30	30	30	30	30	30
6	Elul	29	29	29	29	29	29
7	Tishri	30	30	30	30	30	30
8	Cheshvan	29	29	30	29	29	30
9	Kislev	29	30	30	29	30	30
10	Tevet	29	29	29	29	29	29
11	Shevat	30	30	30	30	30	30
12	Adar	29	29	29	30	30	30
13	Adar II				29	29	29

NOTES:

- A common year is 353, 354, or 355 days.
 - A year with 353 days is called a *deficient* common year.
 - A year with 355 days is called an *abundant* common year.
- A leap year is 383, 384, or 385 days.
 - A year with 383 days is called a *deficient* leap year.
 - A year with 385 days is called an *abundant* leap year.
- The calendar is organized into 19-year cycles to maintain alignment with the true solar year. Each 19-year cycle has the same pattern of common and leap years although their length

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can vary (common years are 353, 354, or 355 days and leap years are 383, 384, or 385):

YEAR	TYPE
1	Common
2	Common
3	Leap
4	Common
5	Common
6	Leap
7	Common
8	Leap
9	Common
10	Common

YEAR	TYPE
11	Leap
12	Common
13	Common
14	Leap
15	Common
16	Common
17	Leap
18	Common
19	Leap

NOTES:

- Adjustments:
 - The 8th month Cheshvan is *increased* 1 day for abundant years (common and leap).
 - The 9th month Kislev is *reduced* 1 day for deficient years (common and leap).
 - The 12th month Adar is *increased* 1 day for leap years.
- Each 19-year cycle has a total of 6939, 6940, 6941, or 6942 days.
 - There have only been two cycles with 6942 days: 854 to 836 BC and 607 to 589 BC.

There are 14 unique patterns of 19-year of cycles due to the variations in the number of days per year (deficient, normal, abundant).

Tishri 1 (Day of Trumpets) Declaration

The primary purpose of the Calculated Hebrew Calendar is to determine when the New Moon Conjunction of the seventh month Tishri occurs. This is called the Molad of Tishri. The only festival that occurs on the first day of a month is the Day of Trumpets. Because the number of days in each of the first seven months is fixed, the Molad of Tishri determines all other holydays by counting the number of days before or after the Day of Trumpets.

The Calculated Hebrew Calendar sometimes adjusts the Molad of Tishri for practical reasons. These are Postponement Rules that shift the date of the New Moon Conjunction 0, 1, or 2 days:

- 1) If the Molad of Tishri or another Postponement Rule would result in the Day of Trumpets occurring on a Sunday, Wednesday, or Friday, the Day of Trumpets is advanced one day to Monday, Thursday, or Saturday respectively. This prevents the Day of Coverings ('Atonement') from falling on a Friday or Sunday so that there are not two consecutive days when all work is prohibited.
 - a) NOTE: The weekly Sabbath and Day of Atonement forbid all work (Heb. *m'la'kah*) whereas all other holydays forbid servile work (Heb. *'abodah m'la'kah*).
- 2) When the Molad of Tishri occurs at noon or later, the Day of Trumpets is advanced to the next day; otherwise, the day would be too far gone. This adjusts the conjunction closer to the First Visible Waxing Crescent.
- 3) When the Molad of Tishri of a common year falls on Tuesday at or after 9 hours, 204 parts (there are 1080 parts/hour) the Day of Trumpets is advanced to Wednesday. This also triggers the application of Postponement Rule #1 to advance the declaration one more day to Thursday. This prevents a common year from having 356 days (making the year one day too long) by limiting it to 354 days.

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- 4) When the Molad of Tishri of a common year immediately following a leap year occurs on a Monday at or after 15 hours, 589 parts the Day of Trumpets advanced to Tuesday. This prevents the previous leap year from having 382 days (making the year one day too short) by increasing it to 383 days.

Days of the Week

The following chart shows which days of the week are permissible for each of the holydays:

HOLYDAY	SUN	MON	TUE	WED	THU	FRI	SAT
Passover	Never		Never		Never		
UB Day #1		Never		Never		Never	
Wavesheaf	Always						
UB Day #7	Never		Never		Never		
Pentecost	Always						
Trumpets	Never			Never		Never	
Atonement	Never		Never			Never	
FOT Day #1	Never			Never		Never	
FOT Day #8	Never			Never		Never	

The limited possible days of the week mean the holydays can only have one of four patterns in a particular year:

HOLYDAY	#1	#2	#3	#4
Passover	Wed	Fri	Sat	Mon
UB Day #1	Thu	Sat	Sun	Tue
Wavesheaf Offering	Sun	Sun	Sun	Sun
UB Day #7	Wed	Fri	Sat	Mon
Pentecost	Sun	Sun	Sun	Sun
Trumpets	Sat	Mon	Tue	Thu
Atonement	Mon	Wed	Thu	Sat
FOT Day #1	Sat	Mon	Tue	Thu
FOT Day #8	Sat	Mon	Tue	Thu

Holyday Dates

The first seven months of the Hebrew calendar have fixed number of days regardless of the number of days in the year. Starting with the first month and continuing through the seventh month, the months alternate 30 → 29 → 30 → 29 → 30 → 29 → 30 days. This is fundamentally important. Since all the holydays occur during the first seventh months, they always occur on the same day of a Hebrew month every year. The only exception is Pentecost, which is fifty days after the Wavesheaf Offering. The dates for all holydays are specified in the Bible:

HOLYDAY	DATE	SCRIPTURE
Passover	Nisan 14	Lev 23:5
UB Day #1	Nisan 15	Lev 23:6
Wavesheaf Offering	Nisan 15, 16, 18, or 20	Lev 23:11
UB Day #7	Nisan 21	Lev 23:8
Pentecost	Sivan 5, 6, 8, or 10	Lev 23:15-16
Trumpets	Tishri 1	Lev 23:24
Atonement	Tishri 10	Lev 23:27
FOT Day #1	Tishri 15	Lev 23:34
FOT Day #8	Tishri 22	Lev 23:36

NOTE: The 50-day count to Pentecost begins with the day of the Wavesheaf Offering, which always falls on the first day of the week (Sunday) during the Festival of Unleavened Bread. Because the Wavesheaf Offering only occurs on the 15th, 16th, 18th, or 20th day of the first month, Pentecost only occurs on the 5th, 6th, 8th, or 10th day of the third month (Sivan).

Once the Day of Trumpets is determined, all other holydays can be determined by subtracting or adding the appropriate number of days relative to the date for the Day of Trumpets:

HOLYDAY	NUMBER OF DAYS RELATIVE TO TRUMPETS
Passover	SUBTRACT 164 DAYS = Nisan 17 + Iyar 29 + Sivan 30 + 29 Tammuz 29 + Av 30 + Elul 29
UB Day #1	SUBTRACT 163 DAYS = Nisan 16 + Iyar 29 + Sivan 30 +

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HOLYDAY	NUMBER OF DAYS RELATIVE TO TRUMPETS
	29 Tammuz 29 + Av 30 + Elul 29
UB Day #7	SUBTRACT 157 DAYS = Nisan 10 + Iyar 29 + Sivan 30 + 29 Tammuz 29 + Av 30 + Elul 29
Pentecost	49 days after the Wavesheaf Offering. See note above.
Trumpets	Molad of Tishri + postponements (0, 1, or 2 days).
Atonement	ADD 9 DAYS
FOT Day #1	ADD 14 DAYS
FOT Day #8	ADD 21 DAYS

This means only the date of the Day of Trumpets is required to calculate the dates of all other holydays for other years:

YEAR	TRUMPETS
2025	Tue Sep 23
2026	Sat Sep 12
2027	Sat Oct 2
2028	Thu Sep 21
2029	Mon Sep 10
2030	Sat Sep 28
2031	Thu Sep 18
2032	Mon Sep 6
2033	Sat Sep 24
2034	Thu Sep 14
2035	Thu Oct 4
2036	Thu Sep 22
2037	Mon Sep 10

YEAR	TRUMPETS
2038	Sat Sep 30
2039	Thu Sep 28
2040	Thu Oct 17
2041	Thu Sep 26
2042	Mon Sep 15
2043	Mon Oct 5
2044	Thu Sep 22
2045	Tue Sep 12
2046	Mon Oct 1
2047	Sat Sep 21
2048	Tue Sep 8
2049	Mon Sep 27
2050	Thu Oct 17