

from the sighting point to the middle of the sun. For accuracy this should be done when the center of the sun is at the horizon.

If this is done from anywhere in the north temperate zone, for example Jerusalem (latitude 31.8 degrees north), during the coldest part of the year, the daily marks on the board keep going north (to the right). During the hottest part of the year the daily marks on the board keep going south. For several days while the temperature is getting quite hot, the marks will be at about the spot that is the furthest north of the marks; the middle day of this group is the day of the summer solstice. For several days while the temperature is getting quite cold, the marks will be at about the spot that is the furthest south of the marks; the middle day of this group is the day of the winter solstice. The word “solstice” means “stopping of the sun” which describes the state of the marks at the solstices. At all other times of the year the marks are separated from one another while heading north, or separated from one another while heading south.

The marks on the board are furthest from one another at the midpoint between the solstice marks because the south-north motion of the sun is fastest at these points. The mark closest to the midpoint while the marks are heading north is the mark at the vernal equinox. The mark closest to the midpoint while the marks are heading south is the mark at the autumnal equinox. Although this method determines the equinoxes quite precisely by first knowing the solstices, it is not necessary to know the day of the solstices precisely because the marks barely change for several days about a solstice. Page xii of Sternberg is one of several sources that discusses this.

[34] Equinox and Solstice is in the Bible

The Hebrew word *tkufah*, Strong's number 8622, occurs four times in the Bible, Ex 34:22; I Sam 1:20; II Chr 24:23; Ps 19:7. In 1907 when the BDB lexicon was published (see page 880 for *tkufah*), the Dead Sea Scrolls were not yet discovered and clarifying insightful meanings into some ancient Hebrew words were not yet available. The Dead Sea Scrolls use the Hebrew word *tkufah* in contexts before the first century, and this is now discussed.

The paper by Hoenig discusses a scroll labeled I QH among the Dead Sea Scrolls. On pages 312-313 he explains two expressions found there: one is “*tkufah* of the day” and the other is “at the appointed time of the night at *tkufah*”. Hoenig explains that the former means “zenith of the day” meaning

“noon” and the latter means “at the appointed time of the night at zenith” meaning “midnight”. It is particularly interesting that in the expression “at the appointed time of the night at *tkufah*” the Hebrew word for “appointed time” is *moed*, the same word used for the holy days in Lev 23 and for seasons in Gen 1:14. Thus it is not foreign to ancient Hebrew to use or associate *tkufah* with *moed*. This use of *tkufah* shows two heavenly bodies, the earth and sun, interacting on a daily basis so that at astronomically distinctive points in time *tkufah* refers to those points in time.

In the book chapter by Johann Maier one of the Dead Sea Scrolls is discussed that contains the Hebrew word *tkufah*. On page 146 Maier writes, “The Songs themselves are attached to the thirteen Sabbaths of one quarter or season (*tkufah*) of a year, according to the editor the first quarter (the Nisan season) only.” Here we see the Hebrew word *tkufah* used for the season of spring, which begins with the vernal equinox and ends with the summer solstice. Here also astronomically distinctive points in time involving the earth and sun define a time period called *tkufah*.

The intertestamental apocryphal Book of Sirach (also known as Ecclesiasticus) contains the Hebrew word *tkufah*. This book was written in Hebrew about 190 BCE, but today only incomplete sections of it have survived, having been discovered with thousands of other Hebrew texts in the attic of a synagogue in Cairo, Egypt toward the end of the nineteenth century. The treasure of texts in that attic, which survived for many hundreds of years, is known as the Cairo Geniza. There are many copies of Sirach in Greek translation, and most of the Hebrew words in Sirach 43:7 are preserved, one of them being *tkufah*. The Greek translation for *tkufah* is *suntelia* (Strong's Greek number 4930), which means completion, fulfillment, or destruction. These words indicate a point in time at which some event occurred. In harmony with this idea, the Jerusalem Bible translates Sirach 43:7, “the moon it is that signals the feasts, a luminary that wanes after her full”. Here “her full” refers to the full moon and is translated from *tkufah* or *suntelia*. Here *tkufah* refers to a natural distinctive time of the moon in its movement about the earth.

These contexts from the Dead Sea Scrolls and from Sirach from before 70 CE show that the Hebrew word *tkufah* is used to refer to natural distinctive points or time intervals associated with the heavenly bodies of the earth, sun, and moon.

On page 394 of the lexicon by Holladay the word *tkufah* is defined. The parentheses and square brackets are part of the text of that book by Holladay where he writes about *tkufah* “turning (of sun at solstice) Ps 19:7; (of the year, i.e. end of year, at autumnal equinox) Ex 34:22; (of the days [i.e. of the year] = end of year I Sam 1:20”.

In Ex 34:22 Moses was told, in literal translation, “And you shall celebrate ... the Feast of Ingathering *tkufah* the year”. There is no Hebrew preposition attached to *tkufah* here so that the relationship between this feast and *tkufah* is very indefinite although translations attempt to make it definite by adding some preposition that is not in the Hebrew. This verse does not define an explicit relationship between these events, but merely indicates that there is some vague closeness in terms of the general year. In harmony with the astronomical uses shown above, this refers to the autumnal equinox. Certainly Moses was aware of the equinoxes from the knowledge he gained in his upbringing in Egypt (Acts 7:22), and the fact that the greatest pyramids had one wall aligned exactly east-west. Only on the days of the equinoxes does the shadow of a vertical object fall exactly east-west all day long. The ancients were easily able to determine an east-west line. Therefore the equinoxes are visible signs of the sun in relation to the earth and do fall within the purview of signs in Gen 1:14 “lights in the expanse of the heavens ... for signs and for festivals and for days and years”.

The main points are:

- (1) The Hebrew word *tkufah* found in Scripture does have use outside the Bible before Herod's Temple in Jerusalem was destroyed in 70 CE.
- (2) Contexts with *tkufah* show it to mean distinctive points in time in relation to movements of the heavenly bodies as observed from people on earth. Also, it is used for the time period between the distinctive points, e.g., the Nisan *tkufah* or spring season. The word *tkufah* has multiple uses, as the examples showed.
- (3) Moses used this word. While he did not specifically use it to refer to the vernal equinox, Ex 34:22 refers to the autumnal equinox, at least showing that Moses had a word in Hebrew that refers to an equinox.

Does Ex 34:22 refer to the end of the harvest when it uses the word *tkufah*? There is no ancient context that forces *tkufah* to mean a “point” of time defined by a harvest in contrast to ancient contexts that show it to relate to heavenly bodies. This is simply a matter of finding contexts that bring out meaning that is clear. Incidentally, the three main crops harvested at that

general time of the year are figs, olives, and grapes. Figs are a summer fruit, whose harvest hardly ever extends into fall. The olive harvest occurs in September and October, and is over in most parts of Israel by about the third quarter of October. The grape harvest begins with sour grapes in July but with ripe grapes in some areas of Israel from the beginning of August. The grape harvest continues through about the first third of November in the area of Jerusalem. The uses of *tkufah* in the Dead Sea Scrolls show the meaning of a point in time.

[35] Equal Daytime and Nighttime is Not the Biblical Equinox

The word “equinox” comes from the Latin language and means “equal night” in that language, which implies that daytime and nighttime are equal at the time of an equinox. But did the ancient people that used this Latin name equinox use the meaning of this word in practice, or was it a mere guess that daytime and nighttime are equal on the days of the equinox? It will be shown that this was a mere guess.

Near the dates of the equinoxes the difference in time from sunrise to sunset from one day to the next is about two minutes. In order to determine the date upon which daytime and nighttime are equal at a certain latitude, it is required that a clock exist that can measure time during a 12 hour period to an accuracy that is better than two minutes per day. When ancient Babylonian astronomers recorded an eclipse or the disappearance of a planet behind the moon, they wrote down the time it occurred as well as the month, day of the month, and year of a king's reign. The paper of Stephenson explains that the smallest Babylonian unit of time was called an *us* and equaled 1/360 of a day, which is four minutes. Moreover, the Babylonians never expressed time as a fraction of an *us*. This shows that they made no attempt to express time more accurately than to the nearest four minutes with their water clocks. The paper of Steele showed a summary of a computer study of Babylonian astronomical phenomena from 562 BCE to 41 BCE, all recorded with a time of day. The conclusion was that the average accuracy of the recorded time was two *us*'s which represents eight minutes from the true time. Moreover, accuracy remained the same during this 500-year period; their water clocks used for this purpose did not improve. One reason that water clocks were not accurate is that as temperature changed, the dripping rate changed. Another reason is that the construction of the mechanism and the recording method were not accurate. Page 609 of Ward shows a graph of how the accuracy of time mechanisms improved through

history, based on historical improvements. This chart shows a sudden leap to about two minutes per day in the year 1656 when Christiaan Huygens perfected the pendulum clock. Ancient peoples did not have the ability to determine the day at which daytime and nighttime were equal because their clocks were not accurate enough. The day upon which daytime and nighttime are equal depends on the latitude of the observation because refraction of light increases as one gets closer to the north and south poles.

As already explained from Eccl 1:5-6, the Bible indicates that the sun's annual position was noted on the basis of its south-north movement which was not a matter of measuring the time of day.

The Hebrew noun *tkufah* has an inner stem in common with the Hebrew verb *nahkahf*, which occurs 19 times in the Hebrew Bible. The latter means “to surround” 11 times - I Ki 7:24; II Ki 6:14; 11:8; II Chr 4:3; 23:7; Job 19:6; Ps 17:9; 22:16; 88:17; Isa 15:8; Lam 3:5. It means “to go around” four times - Josh 6:3, 11; Ps 48:12; Isa 29:1 (“add year to year, let feasts ‘go around’”). It means “to destroy” twice - Job 19:26; Isa 10:34. It means “to curve” once - Lev 19:27. It means “to finish” once - Job 1:5. The overall flavor of this word indicates the idea of encirclement, which does not have any implication about accurate clock time measurement. The relationship between *tkufah* and *nahkahf* indicates that encirclement of heavenly bodies provides the basis of the meaning rather than the Latin meaning of equinox (equal night with day). When the word equinox is used, its original Latin meaning is discarded, and instead, the time of its practical determination anciently is meant. This time agrees with the modern astronomer's time for the equinox although the modern astronomer uses a technical definition that ancient peoples could not have used.

Page 124 of Pannekoek states, “Another instrument they [the Greek astronomers living in Egypt after the time of Alexander the Great] used was an equatorial ring, placed before the temples in Alexandria, in Rhodes, and perhaps in other towns, for calendar purposes. It consisted of a cylindrical belt, with its upper and lower borders exactly in the direction of the equatorial plane; the shadow of the southern half upon the inner side of the northern half left a narrow line of light at the upper or at the lower side of the equator. Thus the exact moment of the equinoxes could be fixed.” This modern description of this ancient instrument uses the term “equatorial plane” which the ancient Greeks did not use; they bisected shadow angles at the solstices in order to construct this instrument, which is today called the

equatorial ring. A discussion of the equatorial ring in use by the Greek astronomers and its inaccuracy due to refraction of the light from the sun is discussed on pages 15-17, 24-37 of the book by John Britton 1992. This problem of refraction could cause an error of one day if an equatorial ring were used.

Pages 73-74 of Pannekoek state, “The Babylonians, according to Greek testimony, used a vertical pole for measuring shadow length; thus they could determine the moments of solstice and, as medium points between the solstices, the moments of vernal and autumnal equinoxes.”

The paper by Neugebauer 1980 proposes a simple geometric method by which the Great Pyramid could have been constructed so that it could have achieved its great accuracy in cardinal directions (precise east-west and north-south). Only on the days of the true equinoxes (not when daytime and nighttime are equal) does the shadow of a vertical object fall exactly east-west all of the daytime. This will be discussed further in the next chapter.

Pliny the Elder, writing about the middle of the first century, defines the equinox in two ways that are somewhat contradictory on page 309 of Pliny_1. He writes that “at the season of the equinox sunrise and sunset are seen on the same line”, and this is the east-west line; this definition is practical and accurate, and while stated in a way that is very different from a modern astronomy book, it is nevertheless the same in the time. Pliny also writes “the equal hours of day and night at the equinox”. When rounding off to hours this is correct, but not when rounding off to minutes in the latitude of the Mediterranean Sea where Pliny lived.

On page 81 of Pasachoff we find, “These points are called equinoxes because the daytime and the nighttime are supposedly equal 12-hour lengths on these days. Actually, because the refraction by the earth's atmosphere makes the sun appear to rise ahead of the middle of the sun, at U.S. latitudes the daytime exceeds the nighttime by about 10 minutes on the days of the equinoxes. The days of equal daytime and nighttime precede the vernal equinox and follow the autumnal equinox by a few days.” This is about four or five days for the U.S.

[36] The Vernal Equinox and Ex 12:2

Gen 1:14 mentions the lights in the heavens, and these are the sun, the moon, the stars, the planets, and comets. The cycles of the planets and comets are much too irregular in comparison to repeatable phenomena on the earth to consider in relation to a biblical calendar when considering the lights in the heavens. The stars must be excluded because during every 1000 tropical years the time of the appearance of the stars slowly shifts about 14.1 days further into the tropical year thus losing touch with the earth's seasons; this is called precession of the equinoxes in books on astronomy. Only the sun and moon remain to be considered. The moon determines the months but not which month is the first. Only the sun remains to be considered. The only repeatable time points involving the sun are the two equinoxes and the two solstices. Considering that the barley and wheat in Israel are harvested in the spring, the vernal equinox is the only logical candidate to consider that involves the lights in the heavens on the direct basis on Gen 1:14.

We must seek to know what Moses knew. Acts 7:22 reads [NKJV], “And Moses was learned in all the wisdom of the Egyptians, and was mighty in words and deeds.” Pages 333, 336-337 of Lockyer show that most of the Egyptian pyramids are oriented east-west, and the two largest pyramids at Gizeh built by Cheops and Chephren are oriented east-west, having one wall aligned exactly east-west. Pages 63-64 of Lockyer explain that the sun's shadow on a vertical object from sunrise to sunset fall exactly east-west only on the days of the equinoxes. So it is clear that Moses knew how to determine the days of the equinoxes. When one considers that Gen 1:14 points to the lights in the heavens to determine the festivals and knowing that only the vernal equinox is related to the time of the year under consideration, Moses would naturally think of the vernal equinox in relation to Ex 12:2. That would be Egyptian training, Egyptian thinking, Egyptian context, and in harmony with Gen 1:14, the only explicit Scripture that directly addresses the determination of the festivals. Would Moses think of the vernal equinox if it had not yet occurred by that day? No, it would be premature for him to think of it. The natural thinking from Ex 12:2 in the context of Egypt and what Moses knew would point to the vernal equinox as having occurred.

Would Moses think it was necessary for him to explicitly mention the vernal equinox in the context of Gen 1:14? If this is the only choice there was, he need not think it was necessary. But the real biblical evidence will come when we get to Ezra and Nehemiah..

[37] Karl Schoch's Curve for Predicting Visibility of the New Crescent

During the years 1907-1927 the German astronomer Karl Schoch (1873-1929) developed astronomical tables to predict the visibility of the new crescent. This was first published in German in 1927 and then in English in 1928. Before his death in 1929, he revised his tables downward into one simpler table. When the points are connected in this simpler table, it becomes a curve, which I call Schoch's curve. The revised table is found on page 162 of the paper by Fotheringham, and it is reproduced in appendix B. This is the table that I personally use. It is only useful in the approximate latitudes of Israel and Babylon and below 4000 feet above sea level. (Schoch's revised table is very close to the table that was independently created by Paul Victor Neugebauer.) Although the original theoretical basis of Schoch's curve was eventually rightly criticized because it was partially based upon Babylonian records that were predictions rather than observations, further study based upon his table has verified its usefulness despite the fact that there is a borderline region during which it cannot accurately predict the visibility of the new crescent.

The paper by Fatoohi 1999 examines 209 examples of records of actual sightings of the new crescent by the ancient Babylonians. This involves the correct latitude for applying Schoch's curve, and the altitude is below 4000 feet. On page 66 of this study all 209 examples are plotted on a graph. This graph shows the original first curve of Schoch in 1927 compared with the curve of Paul Victor Neugebauer (this is close to Schoch's revised curve, which I use). It should be noted that the ancient Babylonians did not have the air pollution that prevails in modern society and even c. 1900 in Europe with its factories and smokestacks. The effect of today's general air pollution on visibility of the new crescent is not known. In the graph of the 209 cases, 8 of them fall below both the original Schoch curve and the curve of P. V. Neugebauer, the lowest two cases by about 0.9 degrees. I presume that today's air pollution would prevent those two cases. The fraction $8/209$ is 3.8 percent of error below the curve. In this test there was no opportunity to know the number of cases in which people looked for the crescent above these curves and no one saw it. This graph also shows 8 examples above the lower curve, but not more than half a degree above the lower curve. Thus there are 16 examples out of 209 (which is 7.7 percent) that were borderline cases based upon plus or minus half a degree yet counting the two very low exceptions. If we exclude those two very low cases thinking that they would not be seen with today's air pollution, we have $14/209$, which is 6.7 percent.

We may tentatively conclude that about 7 percent of the cases are in the borderline region of plus or minus half a degree. This implies that Schoch's curve should be reliable about 93 percent of the time.

Schoch's curve is based upon certain angles of the sun, earth, and moon with respect to one another at the time of sunset, assuming clear weather, no air pollution, a reasonably low altitude above sea level (from today's knowledge we can say, under 4000 feet, which is higher than Mt. Zion), and the observation region is approximately in the latitudes of Israel and Babylon. Schoch observed both with and without binoculars, and correlated data with the results of others. His curve assumes naked eye observations (no binoculars, except perhaps for initial location to examine without binoculars). Above that curve one can expect visibility of the crescent; below that curve, no visibility. In live practice, there is a narrow band near Karl Schoch's curve where it is near borderline and uncertain, so that some people with sharp vision looking at the right spot do see it, and others do not. Before Internet reports of crescent visibility were available, I used a computer program that utilized Karl Schoch's curve. I still use it and can tell whether it is near borderline, which generally should not exceed plus or minus 1/2 of a degree on Schoch's curve. If the humidity is very low or during the autumn when a low crescent looks like a flattened backwards C in the northern hemisphere, it may be seen as much as 1/2 of a degree below Schoch's curve, or possibly slightly lower. At the moment of the sighting of the crescent, if it is above 4 degrees in altitude above the horizon, then the distortion due to refraction is perhaps tolerable enough to consider that it might truly be recognized as the crescent. Below 4 degrees it is very doubtful that it could be recognized.

The principles of Karl Schoch's curve are explained next, without involving ourselves with mathematics. It is simply that the *contrast* between reflected light of the moon and the background sky must be *different* enough to perceive the arc of light.

For example, why don't people see the stars during the day? The stars are most certainly there during the day, but we do not see them because the contrast between the light of the stars (not their size which is much smaller than the center width of arc of the moon!) and the background sky is not enough. In other words, the sun's light is too brilliant to see the stars' light.

The most important word here is *contrast* or *difference*. That is why a nighttime bicycle rider is told to wear reflective or brilliant colored clothes. It does *not* matter whether the rider is fat or thin, but what matters is the *contrast* between his clothing and the blackness of night.

The same is true in seeing the light of the moon. Some computer programs (like Yallop's criterion) are based upon the apparent width across the center of the moon (or the percent reflection of the light of the moon, for example full moon 100 percent reflection).

When the sun sets, and you look at the background sky to the west, the brilliance of the sky is *not* the same everywhere. The further you look from where the sun sets, the *less* brilliant the background sky at that point. Also, it is more brilliant directly above where the sun sets, than the same distance above, but also some distance to the right or left. It is these angles away from where the sun set that is an accurate measure of the *brilliance* of the background sky. If the moon is at a place where the background sky is not very brilliant, then and only then, can you see it. Thus the key is knowing the angles (the curve based on the graph coordinates of two angles) of where the sun is compared to where the moon is. This gives a measure of the contrast between the background sky and light from the moon.

Summary: Use the appropriate angles to determine the contrast, which was used to determine Schoch's curve.

If you take some width of the crescent and put it where the contrast is great, you see it. But if you take the same width of the crescent and put it where the contrast is small, you do not see it. Hence the *width* is *not* the main factor, but instead the *contrast*. This concept is very simple, but the mathematics and astronomy are complex.

I do not use a program that predicts visibility of the crescent! Instead I use a program that gives me the accurate angles I want. Then I use the printed table that Karl Schoch determined (which really makes a curve by connecting the dots) to see if the moon is above the curve or below the curve. *Above* means visible. *Below* means not visible. But borderline is about 1/2 a degree above or below the curve (under 4000 feet) based upon extremes of humidity. As was mentioned above concerning the paper by Fatoohi and others, in ancient Babylon there were two cases among 209 in

which people had reported seeing the new crescent at 0.9 degrees below Schoch's curve, but the air is more polluted today.

The key for borderline cases is humidity. The further you go below Schoch's curve, the lower the humidity must be to see it. For the areas with extremely low humidity one can go 1/2 a degree below Schoch's curve and still just barely see it.

Before modern high-speed communication and astronomical theory, one would have been reduced to local visibility, although I do not know how to define this and have never seen a definition of this that may be applied in a uniform manner considering the case of overlapping geographical areas for individual congregations. The first goal for a proponent of "local visibility" should be to define it so that the definition covers the issues of distance, height above sea level, bad weather, the use of modern communications, et cetera. Perhaps one may give a definition of local visibility in terms of technology that was available about 1800 before the telephone and telegraph, but even the issue of using race horses for separated groups of people to communicate would begin to complicate matters. Can one apply a definition that might have made sense in 1800 to today's society, thus forbidding telephone calls and driving automobiles to learn what others have seen? While some people might say "yes" and want to pretend that we are locally primitive, even that is an arbitrary rule, and many people would want to communicate with others to determine what they individually should do.

[38] Ezra and Nehemiah in Relation to the Vernal Equinox and the Babylonian Calendar

Ezra 6:15 mentions the month Adar and Neh 6:15 mentions the month Elul. These are Hebrew transliterations of month names in the Babylonian calendar, but these verses are in the context of Jerusalem with the stamp of approval from Scripture. This chapter provides historical evidence that the Jews adopted the month names of the Babylonian calendar into their own calendar, apparently from the time of Ezra and Nehemiah onward. This would cause an obvious confusion unless it was true that nearly all of the time the months in Jerusalem would agree with the months in Babylon during the century of Ezra and Nehemiah. The goal is to learn when the first month of the biblical calendar begins by determining when the first month of the Babylonian calendar began during the century of Ezra and Nehemiah. Later, other corroborating evidence will be presented.

Appendix A provides the details that show the first month of the Babylonian calendar in the years from 499 BCE to 400 BCE, and it includes a discussion of the 19-year cycle. This appendix shows that near the middle of this century Ezra and Nehemiah journeyed from Babylon to Jerusalem.

The results from appendix A yield the following rule to determine the day of the vernal equinox in the Babylonian calendar during this century. Find the date containing the noontime that is closest to the time of the vernal equinox. That date is counted as the date of the vernal equinox. The appendix also provides the details showing that the first day of the first month of the Babylonian calendar during this century followed the pattern that the new crescent of Nisan was the new crescent that fell on or soonest after the day of the vernal equinox. This implies that first the new crescent was sighted, and later that same day the vernal equinox was determined to have occurred.

The Jews were apparently willing to replace the use of the name Abib with the name Nisan in the context of Jerusalem because they accepted the Babylonian month names. Neh 8:2, 9 show that Ezra kept the holy day of the first day of the seventh month at the correct time. From this time onward Israel used the Babylonian month names for their calendar, which would have led to confusion unless the Israelite calendar and the Babylonian calendar began Nisan at the same time, almost always, during the century in which Ezra and Nehemiah lived.

The claim has been made that the Persian Empire forced the Jewish leadership in Israel to accept the Babylonian month names into their religious calendar and discontinue all of the original month names. Ezra 7 gives the text of a letter from the Persian King Artaxerxes to Ezra the priest, and in verse 16 the king writes that the religious laws are in the hand (power) of Ezra, showing that the king is respecting the independence of the priest in carrying out the laws of the Bible. Neh 5:14 shows that Nehemiah was appointed governor by the king, and in Neh 13:30 Nehemiah writes, "Thus I cleansed them [the Israelites] of everything pagan." Israel had religious autonomy and self-determination. If the Babylonian Nisan was oftentimes not the Jewish first month, then the Jews would have kept both sets of names to avoid confusion with their numbering of religious months. Or instead, the Jews could have merely used numbers of the months without names for the religious calendar. Another response to this is that the Persian Empire had no control over Scripture, and through inspiration of the Holy

Spirit, Ezra 6:15 and Neh 6:15 could have used the month number rather than the month name in the context of Jerusalem. These verses give approval to the use of Babylonian month names and provide a calendaric witness to us.

The book of I Maccabees covers the history of Israel from about 175 BCE to 130 BCE and was originally written in Hebrew. It shows the military struggle of the Jews to gain independence from Seleucid domination. The Jews had some degree of success, but it was a continual struggle. In this context of greater Jerusalem the Jews use Babylonian month names for their calendar in I Macc 4:52, 59; 7:43, 49; 14:27; 16:14 when the Babylonian Empire and the subsequent Persian Empire no longer existed. Josephus also uses these month names and calls them Jewish, and these names have been kept by the Jews until today. The existing biblical and historical evidence is that the Babylonian month names were not merely a secondary secular alternate method to designate dates apart from the biblical month numbers (as we today use January to December apart from the biblical month numbers), but that the Babylonian month names and the biblical month numbers were synonymous in designating months. For example, I Macc 4:52 reads, “Early in the morning on the 25th day of the ninth month, which is the month of Chislev, ...” This does not say that in this particular year the ninth month happened to be Chislev, but that the ninth month is Chislev. To emphasize this point even more vigorously, verse 59 states, “Then Judas and his brothers and all the assembly of Israel determined that every year at that season the days of dedication of the alter should be observed with joy and gladness for eight days, beginning with the 25th day of the month of Chislev”. Thus this festival of Hanukkah (Feast of Dedication in John 10:22) was always to begin on Chislev 25, thus requiring Chislev to always be the ninth month.

The book of Esther discusses the origin of the Feast of Purim, which has been kept by Jews from that time in 473 BCE in Babylon until today. For the year 473 BCE see the note to Est 8:12 in NIV. The date of the writing of the book of Esther is less certain. On page 718 of NIV we find, “Several scholars have dated the book in the Hellenistic period; the absence of Greek words and the style of the author's Hebrew dialect, however, suggest that the book must have been written before the Persian Empire fell to Greece [Alexander the Great] in 331”. In Est 9:19-23 it is clear that the Jews had decided that every year on the 14th and 15th days of the 12th month Adar they would celebrate Purim. Note the specific wording in Est 9:20-21, “And

Mordecai wrote these things and sent letters to all the Jews, near and far, who were in all the provinces of king Ahasuerus, to establish among them that they should celebrate yearly the 14th and 15th days of the month of Adar,” and verse 23 concludes, “So the Jews accepted the custom which they had begun, as Mordecai had written to them”.

Thus Scripture teaches that the Jews accepted that the month named Adar would always be the month in which the Feast of Purim would fall. Adar is the name of the 12th month in the Jewish calendar as well as in the Babylonian calendar. The month names and month numbers were locked together; they did not slide around with respect to one another.

[39] Nisan and the Jews at Elephantine, Egypt

About 600 BCE a group of Jewish mercenaries were first employed on the island of Elephantine along the Nile River in southern Egypt about 500 miles south of the Mediterranean Sea close to the border of Ethiopia (see pages 7 and 34 of Bickerman 1962). The purpose of this military base was to protect the southern border of Egypt from invasion from the south. When Persia defeated Egypt in 525 BCE under the leadership of Cambyses, this military base became funded by the Persian Empire instead of Egypt because its need still existed.

A number of letters written in Aramaic have been discovered on this island of Elephantine during the late 19th and early 20th centuries. These letters date from the fifth century BCE when the Jewish mercenaries were there. Page 35 of the book by Bickerman states, “The ‘Jewish force’ (as the regiment is officially styled) was divided into companies, the captains of which bear Babylonian or Persian names; a Persian was ‘the chief of the force’.” Since it was called a Jewish force, the bulk of the mercenaries were obviously Jewish, but it was under the command of Persians, so it was not autonomously controlled by Jews. This is a significant difference between Elephantine compared Judea under the governorship of Nehemiah. Judea was autonomous, while Elephantine was totally funded by Persia, under Persian military command, and was not autonomous. This implies that the calendar in use at Elephantine was the Babylonian calendar rather than the Jewish calendar, although it is quite likely that nearly all of the time there was no difference between these calendars at that time. In the paper concerning Elephantine by Richard Parker 1955, on page 274 he wrote, “A Persian military garrison in a Persian satrapy would most probably use the

Persian-Babylonian calendar”. Concerning these letters, B. Porten 1996 wrote on page 152, “Virtually every contract bore a double date, the first usually being the Babylonian date and the second the Egyptian one.”

One of the Aramaic letters found at Elephantine is known in scholarly circles today as the Passover Papyrus. The Hebrew-Aramaic alphabetic characters in this letter along with an English translation are found on pages 56-57 of Lindenberg. In the following quotations from the letter, the square brackets and the contents within them appear on page 57 of Lindenberg. The letter contains “This year, year five of King Darius”, which dates the letter in 419/418 BCE. There are gaps in the letter because it is poorly preserved. The addressing of the letter says “[To] my brothers Yedanyah and his colleagues, the Jewish garrison, from your brother Hananyah”. It was written from one Jew in friendship to the Jews on the island with whom the author had familiarity. Part of the preserved text of the letter says, “Be scrupulously pure. Do not [do] any work [...]. Do not drink any [...] nor [eat] anything leavened [... at] sunset until the twenty-first day of Nisan [...]”. Another translation of this same segment of this letter is on page 283 of Whitters where he adds in square brackets some guesses in gaps in the text as follows, “be pure and take heed. [Do n]o work [on the 15th and the 21st day, no]r drink [fermented drink, nor eat] anything [in] which the[re] is leaven [from the 14th at] sundown until the 21st of Nis”. Note that the final letter of Nisan is missing in the poorly preserved papyrus so only “Nis” is shown. This provides historical evidence that after the return from exile under Ezra and Nehemiah, Jews named the first month Nisan as a substitute for Abib. On page 283 Whitters comments, “The letter came from one Hananiah, who apparently wanted the Jews in Egypt to celebrate Passover and Unleavened Bread appropriately. The address and greeting rule out a local Egyptian official or Persian overlord.” If the name Nisan was not significant for the first month to Jews, the letter could simply have said the first month or Abib.

[40] Gen 1:14; Ezra 6:15; Neh 6:15 Show the Vernal Equinox Starts the Year

Ezra 6:15 and Neh 6:15 tie in with Gen 1:14 to give the biblical and archaeological evidence that together show explicit evidence that Gen 1:14 involves the vernal equinox. The Babylonian cuneiform inscriptions are archaeological clay records that are now mostly in the British Museum. These tablets have eclipse data as well as new moon sighting data that

correlate with computerized astronomy to prove the dating of their calendar. From the knowledge of the Babylonian calendar with the use of these month names in Israel we can say that Nisan 1 is the new moon on or the soonest new moon after the day of the vernal equinox (see appendix A). In discussions above it was pointed out that by the process of logical elimination of choices, about the time of Ex 12:2 and within the parameters of Gen 1:14 involving the lights in the heavens, the vernal equinox is the only candidate for starting the year.

Some people have proposed that merely the 16th day of the first month need be on or after the equinox, and not the first day of the first month. Aside from the fact that this is not a natural thing for Moses to imagine, there is the practical problem of having to predict at the beginning of the month whether the 16th day of the month will be on or after the equinox. From one equinox to the next is 365 or 366 days, and it is not an easy matter to predict between the two because there is no repetitive pattern. However, it is only in unusual cases when the first day of the month will be within a day of the vernal equinox.

If it had originally been true that merely the 16th day of the first month need be on or after the equinox to determine the first month, then about half the time the Israelite first month named Nisan would have been one month earlier than the Babylonian Nisan, and consider what confusion there would be in that case. The confusion would be unacceptable.

[41] Philo explains when the First Month of the Biblical Year begins

There is a Jewish witness whose writings date from the early first century who discusses the meaning of Gen 1:14 and Ex 12:2. This witness is Philo of Alexandria. This witness would be of no consequence and irrelevant if the applied calendar of Judaism at the Temple in the early first century was not correct. It is necessary to establish some relationship between the calendar of Judaism at the Temple and Philo's thinking in order for Philo's comments on Gen 1:14 and Ex 12:2 to be relevant.

In Gen 1:14 where the Hebrew text has the plural of *moed*, which is typically translated seasons, or festivals, or appointed times, the Greek translation of the Hebrew Bible known as the Septuagint has the Greek word *kairos* (Strong's number 2540). The various versions of the Jewish Aramaic paraphrased translations of the Hebrew Bible known as the Aramaic

Targums all interpret *moed* to include the meaning festivals. The Jewish commentaries of the middle ages also agree with this understanding of *moed*. In Lev 23 the Hebrew *moed* occurs six times: Lev 23:2, 2, 4, 4, 37, 44. The association of *moed* with festivals is clear from its use in Lev 23 as well as in Ps 104:19 and elsewhere. In contrast to this, *kairos* occurs in Lev 23:4, but nowhere else in the Septuagint of Lev 23. In Greek, *kairos* is a very general word for time, and it is not noted for being associated with the festivals or any other regular repetitive time. Thus one would not particularly expect Philo to interpret *kairos* as festivals, and indeed Philo does not interpret it that way. But he does use the word *kairos* in discussing this portion of Gen 1:14, indicating that his version of the Septuagint Gen 1:14 is similar to the one that is commonly available to us.

Philo discusses Gen 1:14-16 on pages 34-47 of Philo_1 (On the Creation 45-61). On pages 44-45 (paragraph 59) Philo wrote, “By ‘appointed times’ [*kairos*] Moses understood the four seasons of the year, and surely with good reason.”

It is a little humorous that he puts this interpretation in Moses’ mind as if to say this is what Moses knew it to mean rather than this is Philo's interpretation. Since the four seasons are bounded by the equinoxes and the solstices, he certainly believes that Gen 1:14 includes these astronomical events. On pages 46-47 (paragraph 60) Philo continues, “The heavenly bodies were created also to furnish measures of time: for it is by regular revolutions of sun, moon, and the other bodies that days, and months, and years were constituted.” Since the calendar is based on these units and he declares these units to be based on measures of time of the heavenly bodies, he leaves no place for the barley to be the determining factor for the first month. The reader might be curious about why Philo wrote here “and the other bodies”. While we know that the Greek astronomer Hipparchus proved that the stars drift very slowly from the equinoxes, and he discovered this about 100 years before Philo was born, this knowledge had not been popularized and accepted, so that Philo does not know this. Thus Philo implies the thought that the cycle of the appearance of stars agrees with the sun’s signs of the equinoxes and solstices that make the seasons. If Philo had been familiar with the Hebrew text of Gen 1:14, he would have made the association of the Greek *kairos* with the Hebrew *moed*, and then would have linked this to the festivals using the contexts of *moed* in Lev 23. Instead of linking *kairos* to the festivals, he links it to the four seasons, indicating the equinoxes and solstices.

Philo wrote on page 151 of Philo_7 (Special Laws I.90), “Who else could have shewn us nights and days and months and years and time in general except the revolutions, harmonious and grand beyond all description, of the sun and the moon and the other stars?” ***Notice that the way Philo asks this question emphatically shows that agriculture is not the way to determine years and the first month.*** Again Philo leaves no place for the use of barley in calendaric determinations. If, on an annual basis, the Jews in Alexandria had to wait for a report on the state of the barley from the priests in Judea in order to know when to leave for a journey to keep the feast of unleavened bread at the Temple in Jerusalem, Philo would not neglect such an important annual event in its role to determine the time of the first month. In this matter the Septuagint has no distortion that would give Philo a reason to have a prejudice against the use of barley, but he surely knows nothing of the role of barley in the early first century to determine the first month.

Having examined Gen 1:14 in Philo's writings, the next step is to consider his comments on Ex 12:2. In order to properly evaluate this, certain terminology of Philo and his age needs to be discussed first. One concern is the meaning of “the Ram” (also called Aries which is the Latin word for Ram) in the sense of the first of the twelve annual signs of the zodiac. According to pages 594-595 of HAMA (volume 1) secular writers of the first century wrote that the eighth day of the Ram is when the vernal equinox occurred. However, the elite group of Greek astronomers who employed mathematics considered the first day of the Ram as the day of the vernal equinox (page 600); it took a few centuries for Roman society to gradually accept the astronomer's definition, which modern astronomers have also accepted.

Philo was not studied in the area of astronomy and would have used the secular meaning. Hence Philo speaks of the vernal equinox as being in the Ram instead of occurring at the start of the Ram. Secular society also considered the autumnal equinox to occur on the eighth day of the sign of the zodiac called the Scales.

With the help of a little sloppiness in the existing translations it is easy for readers to become confused about what Philo means. To help explain one confusing part of Philo's writings I made a word for word translation from the Greek. Here is my literal translation of Philo's On the Creation, paragraph 116 (in chapter 39) on pages 92-95 of Philo_1: “The sun, too, the

great master of the day, bringing about two equinoxes each year, spring and autumn, the spring in [the] Ram and the autumn in [the] Scales, supplies very clear evidence of the sacred dignity of the seventh [number], for each of the equinoxes occurs [near a] seventh month, and during them [these seventh months] there is enjoined by the law the keeping of the greatest national festivals, since [during] both of them [these seventh months] fruits of the earth ripen, [in the] spring indeed grain produce and all else that is sown, and [in] autumn the [fruit] of the vine and most of the other fruit trees.”

One peculiar thing to notice here is that Philo uses the word “spring” twice as though it meant “spring equinox” and the word “autumn” twice as though it meant “autumn equinox”. Elsewhere he seems to use the word “equinox” to mean the season that it begins; for example, he writes separately of the feast of trumpets at/in the autumn equinox and the feast of tabernacles at/in the autumn equinox. Philo enjoys analogies, symmetry, and approximation in his writings.

Philo discusses Ex 12:2 on pages 2-5 of Philo_QE (Exodus, Book 1.1). On page 2 he wrote, “‘This month (shall be) for you the beginning of months; it is the first in the months of the year.’ (Scripture) thinks it proper to reckon the cycle of months from the vernal equinox. Moreover, (this month) is said to be the ‘first’ and the ‘beginning’ by synonymy, since these (terms) are explained by each other, for it is said to be the first in order and in power; similarly that time which proceeds from the vernal equinox also appears (as) the beginning both in order and in power, in the same way as the head (is the beginning) of a living creature. And thus those who are learned in astronomy have given this name to the before-mentioned time. For they call the Ram the head of the zodiac since in it the sun appears to produce the vernal equinox.” Then on page 3 he writes, “And that (Scripture) presupposes the vernal equinox to be the beginning of the cycle of months is clear from the notions of time held in the ordinances and traditions of various nations.”

As a commentary to this last sentence, page 391 of Samuel states, “In the areas of Syria and the East controlled by the Seleucid kings, the Macedonian calendar was adjusted to make its months coincide with the months of the Babylonian calendar, which was in turn regulated locally by a nineteen-year cycle. The system was in general use in the East, and persisted in an adjusted form in cities all over the eastern regions well into the period of Roman domination.” The first day of Nisan in the Babylonian calendar since 499

BCE fell on or after the vernal equinox. Although Parker and Dubberstein show an exception to this in the year 384 (page 34), this alleged exception should be corrected because it is now regarded to be a faulty examination of a cuneiform text; see pp. 14 and 16 in Aaboe and others 1991.

When Philo speaks of the “traditions of various nations”, from Samuel’s statement he is referring to the continuation of the Babylonian calendar whose first month did not begin before the day of the vernal equinox. This is the only place where Philo makes a statement about the first month that is capable of some explicit comparison with the vernal equinox.

In none of this is there any use of barley to determine the first month, and the Septuagint does not force Philo to take his position. There is never a hint that the Jews in Alexandria waited with anticipation to hear the news of barley reports so they could begin their plans for the Passover.

[42] Declaration of the Vernal Equinox in Ancient Israel

Based upon Num 10 as discussed above, it should be accepted that the Levitical priesthood had the authority to declare the new moon days and thus regulate the calendar for ancient Israel. This priesthood performed specific animal sacrifices on the new moon days (Num 28:11-15; 10:10), so the priesthood had an essential role. This role was highly visible and authoritative before all the people as long as the Temple stood, but after it was destroyed in the year 70, the priesthood’s visibility ceased. There is some scholarly controversy over who controlled the calendar from the Temple in the early first century and much could be said about it, but this is not our concern now. As already shown above, the vernal equinox was significant to determine the first month, Nisan or Abib.

The first question is whether the vernal equinox was determined by observation or by a calculation in ancient Israel. To answer this question, a summary of several points from above along with a few related matters are now brought together.

(A) There is no word in biblical Hebrew for “astronomer”, although there is a Hebrew word for “astrologer”, *havar*, Strong’s number 1895. This word only occurs once, in Isa 47:13, a negative statement against a practice in Babylon.

(B) Neither the Dead Sea Scrolls, nor archaeology from Israel, nor the Bible, nor Philo of Alexandria, nor Josephus indicates any native development of mathematical astronomy in Israel.

(C) Biblical Hebrew for the expression of numbers along with the Dead Sea Scrolls and archaeology indicate that ancient Israel had no positional numbering system with a zero, so that general multiplication and long division, especially of fractions, would have been prohibitive. This is a heavy strike against any suspicion that ancient Israel could have had a native mathematical astronomy.

(D) Ancient Egypt did not possess mathematical astronomy until the Greek astronomers moved to Alexandria after 330 BCE. Thus Israel could not have inherited such knowledge when Moses led them out of Egypt.

(E) Mathematical astronomy began in Babylon roughly 500 BCE. On pp. 51-52 of Britton and Walker we note, "Around 500 BC Babylonian astronomy began a process of transformation which led to the development of radically new techniques for predicting celestial phenomena. These techniques were mathematical in nature, rational in approach, and entailed separating complex phenomena into components which could be described by mathematical functions which could then be combined to predict the phenomena in question." In some ways planetary theory is less complicated than lunar theory, and David Brown's book concludes that during the period c. 750 BCE to c. 612 BCE the Babylonians first developed predictive planetary theory; see pages 8-9. This mathematical astronomy was developed and recorded by the pagan priests of Babylon only in the Akkadian language, with its hundreds of symbols, at a time when this language was no longer in general use, having been supplanted by the Aramaic language. It was only after Alexander the Great defeated the Persian Empire in 331 BCE that Alexander apparently commanded that the Babylonians make their astrology-astronomy available to the Greeks for study. Not long after this, the Greeks were using Babylonian period relationships of the heavenly bodies, and also Babylonian horoscope techniques.

(F) Both Philo of Alexandria and Josephus were Jews from the first century who wrote extensively and were well educated. Neither of them implied any significant abilities in themselves or other Jews concerning mathematics or astronomy. Josephus likes to exaggerate the achievements of the Jews, and

he only does this in science through bragging about Abraham's knowledge of arithmetic and astronomy, and that Abraham taught this to the Egyptians. This claim must be historically false because at the time of Abraham neither the Egyptians nor the Assyrians (later Babylonians) possessed mathematical astronomy, although the ancient Babylonians did record observed eclipses and other heavenly phenomena, and the ancient Egyptians did record the approximate time of certain appearances of heavenly bodies. Such recorded observations are not mathematical astronomy.

(G) The Rabbinical writings do not claim any advanced mathematical knowledge in their history. In the Talmud, Gamaliel II is claimed to give credit to his grandfather Gamaliel I for handing down the length of a month, yet this was derived by the Babylonian astrologer-astronomers as part of their astronomical System B in Babylon c. 300 BCE.

(H) Conclusion: It would be folly to think that ancient Israel had a calendar that was based on mathematical astronomy. The same conclusion should apply to the determination of the vernal equinox.

The vernal equinox is only known from the light of the sun or shadows from the sun. This can only occur during the daytime. Thus, while the new crescent is sighted near the time of sunset and most often during the middle of twilight, the vernal equinox must be determined during the daytime, based upon some commonly known definition.

The biblical months do not have an alternation of 29 and 30-day months, so that the pattern is not predictable. About half of the biblical months have 30 days, so that when the new crescent is sought in the hope of its sighting at the end of the 29th day of each month, no one can generally know whether the new crescent will be seen anywhere in ancient Israel. Since there will be full darkness that night, no one expects witnesses from far off to walk to some authority in Jerusalem during that night of darkness. Also, no one would expect people to be at the top of hills at night to signal a declaration of the new moon by the Levitical priesthood. All the questioning of witnesses, the subsequent declaration of the new moon through the blowing of the two silver trumpets, the fire signals to spread the news, and the commanded sacrifices associated with the arrival of the new moon, along with singing praises at the Temple where all the nearby people could travel to witness and participate in the festivities through singing, would have to wait until the daytime.

It would be during that same daytime of questioning witnesses concerning the new crescent that the Levitical priesthood would also examine the sign of the sun for the vernal equinox.

The obvious correlation of Nisanu 1 with the vernal equinox acknowledges this day in the Babylonian calendar, and Philo is a historical witness that corroborates the same thing. Gen 1:14 also points to this through the process of elimination of other possibilities.

Previously, Pliny the Elder from the mid-first century was quoted to show that he regards the day on which “sunrise and sunset are seen on the same line”, which means that the sun’s shadow makes a straight line, as the day of the vernal equinox. This is the true east-west line and it shows the vernal equinox. The alignment of one wall along the east-west line for each of the most prestigious pyramids of Egypt shows that ancient Egypt knew how to determine the vernal equinox. Moses was trained in the knowledge of Egypt (Acts 7:22) and would be expected to know this. This only requires observation, no calculation, and no mathematical astronomy.

On page 158 of the book by Robert Newton there is a chart of 20 equinox observations by Hipparchus. These are dated from 162 to 128 BCE. He is considered to be the greatest of the ancient Greek mathematical astronomers. Even with his gifted application of trigonometry to attempt to use observation to calculate the time of the equinox, he is nevertheless off by an average of several hours. But ancient Israel did not use a calculation. By observation alone it is impossible to judge the hour of an equinox.

Now consider the borderline situation of both the new crescent starting the day and the vernal equinox later on the same day in ancient Israel. Suppose witnesses saw the new crescent at the beginning of the day, and on the next daytime they appear to testify as would be typical. Further suppose that the typical investigation of the sun’s shadow line compared to an exact east-west line by the priesthood that next morning showed that the vernal equinox had arrived. Such an observation *cannot* be so precise that one can judge the hour of the equinox. Only its day is known. On the previous daytime there was no vernal equinox yet, but this next morning the vernal equinox is seen true. At the same time they also examine witnesses of the new crescent and this is determined true. They know that both occurred.

This should be the first month because both arrived. The priests declare both simultaneously.

There is another example to consider as a precedent for accepting this reasoning. For 40 years in the wilderness, manna arrived in the morning each day except on the Sabbath. The arrival of manna was a morning activity just as the examination for the vernal equinox would be sometime in the morning. That the morning is the arrival time for the manna is seen in Ex 16:8, 12, 21. Now note the literal translation of Ex 16:23, “And he [Moses] said to them, ‘That is what YHWH said, tomorrow is a rest, a holy Sabbath to YHWH. Bake what you will bake and boil what you will boil. And all that remains lay up for yourselves to be kept until the morning.’”

On the ordinary six days, the manna would spoil and have worms in the morning, and there would be a new supply of manna on the ground in the morning. In Ex 16:23 note the word “tomorrow”, which is translated from the Hebrew word *machar*, Strong’s number 4279. This word refers the next daytime. The next daytime includes the morning, which is normally the time that any manna from the previous day would be seen spoiled and manna would be seen on the ground. Tomorrow would be an exception due to the Sabbath. Ex 16:23 states that “tomorrow is a rest, a holy Sabbath”. Although the Sabbath is from sundown to sundown, in order to emphasize that tomorrow is when they would see the exception of no spoilage in the manna and no manna on the ground, Moses said, “tomorrow is a rest, a holy Sabbath”. ***By what they would notice tomorrow, they would be able to verify that the whole day was the Sabbath.*** Similarly, by what the priests would notice on the morning of the day of the vernal equinox, they would be able to verify that the whole day was the day of the vernal equinox. The time of the equinox would have to be identified with one sundown-to-sundown day. The most obvious way to identify this is to take the day whose noontime is the closest to the time of the vernal equinox. That daytime would most be identified with the vernal equinox by visual inspection. This does agree with the conclusion from appendix A.

[43] The International Date Line, the Sabbath, and the New Moon

Beginning with this chapter, the subject of how to determine the first day of the month for the various parts of the world is treated. In order to avoid forcing the curious reader to wander ahead to discover the conclusion, I will give a brief summary of the next group of chapters here. Summary for the

next group of chapters: The sighting of the new crescent for the purpose of defining the start of a new month should be from within the biblical boundaries of Israel, and sundown at the International Date Line should begin each first day of the month before anyone in Israel would be able to see it. This implies that on some occasions people to the east of Israel would begin a new month that later was determined to be one day prior to the new month. This would primarily matter on the first day of the seventh month, when they might keep two successive days as was sometimes done in ancient Israel.

Many people do not realize that there is a need for an International Date Line (IDL), and they need to be convinced that there is such a need. During the 19th century the international community recognized the need for an IDL, and they established it in the Pacific Ocean by agreement of some of the most influential nations. Perhaps the most obvious need was seen in simply recording the date and time of events in various parts of the world. If it is noon on Saturday in England, what time and day is it in Australia? The answer partially depends upon where the IDL is placed. If the IDL is placed between Australia and Japan, you get one answer. If the IDL is placed between Australia and Hawaii, you get another answer. The IDL also affects the day for keeping the Sabbath in some parts of the world, as we shall explore next.

If a group of people in Israel performed the following experiment, consider the outcome. Let half of them travel east 1000 miles during the course of six days and rest on the seventh, and the other half travel west 1000 miles during the course of six days and rest on the seventh. Since there are about 24,000 miles around the earth at the latitude of Israel, each 1000 miles represents one hour of time. At the end of the six days in the experiment, the group that traveled east will start their Sabbath two hours earlier than the group that traveled west, because they are 2000 miles further east. If this is continued for another week in the same direction, the group that traveled east will be start their Sabbath four hours earlier. If this experiment is continued for 12 weeks and boats are available for water travel, the two groups will meet in the Pacific Ocean. The group that traveled east will start their Sabbath 24 hours sooner than the group that traveled west, so that while neither group lost track of the days and both groups had sincere intentions, if they got together on the same boat there would be confusion on which day to begin the Sabbath.

If ships had carried colonists from countries that had previously adopted the seven day weekly cycle to North America, and if they had originally traveled east across the Pacific Ocean instead of west across the Atlantic Ocean, then they would have given the name Sunday in North America to the day we now call Saturday, and their week would be shifted one day.

These examples show the absolute need for an IDL to officially start the day for the purpose of keeping the Sabbath and avoiding confusion on the day it begins. If an IDL were proposed that crossed land where people lived, then neighbors on one side of the line would keep a different day as the Sabbath compared to others across the line. This destroys spiritual unity and is a source of confusion.

Jewish scholars since Talmudic times have recognized that a spherical earth requires an IDL for the purpose of keeping the Sabbath. Pages xxiii-xxiv of Sternberg give his translation of a passage in the Babylonian Talmud (RH 20b) that relates to the IDL. Page xxv gives the opinion of Chazon Ish that this implies that the IDL occurs at the end of the Asian continental landmass. On page 343 of the article by Jakobovitz, he states, "The international dateline has also been endorsed by the rabbinate in Jerusalem in its reply of 1942 to the inquiry received from the refugees in Japan." This means that society's IDL has been accepted by Jewish authorities as the IDL for the Sabbath, thus overruling the Babylonian Talmud, a very rare event. It is interesting to note that modern Jews desired to have a ruling come from Jewish authorities in Jerusalem, and this occurred in 1942, before Israel was recognized as a nation in the geopolitical sense.

Scientists today believe that the land surface of the earth was once together as one mass of land with one very large ocean around it. This is evident from examining the globe's landmasses and noticing how they fit together, such as mentally pushing North America and South America into Europe and Africa. This is also noted by matching geological rock formations and plant species with corresponding parts of matching areas across the Atlantic Ocean. At the time when the world only had one land mass it was only sensible that the IDL run through the one ocean to avoid neighbors keeping the Sabbath on two different dates, thus avoiding confusion. As the one land mass separated, the IDL should not change. This would put the IDL in the middle of the Pacific Ocean as men have decided to do in the nineteenth century. But the creation shows the mind of the Creator in establishing the IDL at

that place to avoid confusion on when to start the Sabbath day. The biblical principle is found in I Cor 14:33.

If it is confusing, annoying, or disruptive to run some line along a landmass and imagine that people on one side of the line keep the Sabbath on one day and people on the other side of the line keep the Sabbath on the next day, why shouldn't it also be equally confusing when the first day of a biblical month is considered in the same way? In my mind it would be confusing to begin a month with a disruptive line on a landmass that separated the month start on one side of the line from the month start on the other side of the line. This is especially true if the line were to change from month to month, and it would even be more discomforting if the line was wide and fuzzy with pockets of exception in various places due to humidity, height above sea level, and bad weather. Considering the philosophical principle of avoiding confusion, it is natural to extend this from the Sabbath to the start of a month using the IDL.

The Sabbath cycle is much simpler than the monthly cycle because the former is always a seven day cycle, while the latter is a cycle of 29 or 30 days, which does not necessarily alternate between 29 and 30 days. There are some natural reasons for desiring to take simplifying concepts that apply to the Sabbath, such as the IDL, and also transfer them to the start of each month. Lev 23 discusses all of the days of holy convocation. Relating to all the festivals as well as to the seventh day Sabbath, the words *holy convocation(s)* occur in verses 2, 3, and 4 of Lev 23. Lumping the seventh day Sabbath together with the festivals in the same chapter under the larger umbrella of *holy convocations* does seem to be a reason to transfer simplifying concepts that apply to the Sabbath to the festivals as well.

It must be admitted that the confusion primarily stems from the fact that we have modern methods of communication today. Not only do we have the Internet and telephones, but we also have automobiles and jet planes, so that we may travel for attendance on the Sabbath and on the festivals. If modern technology was completely removed and each family was an island unto itself without contemplation of travel, the confusion would disappear. But no one expects society to give up modern technology for travel and communication, so there is a need to face and solve the resulting issues.

[44] How the MCJC achieves Spiritual Unity using the IDL

From a strictly mathematical viewpoint, the IDL is not part of the computation of the day of each month of each year that is performed according to the rules of the MCJC. But in a practical sense the Jewish use of the MCJC includes the Jewish adoption of the IDL, so that Jews in the modern world would have a method to determine when to keep the festivals in their area of the world. From this *applied* mainstream Jewish viewpoint, the MCJC is used with the IDL. Since spiritual unity on the holy convocations is a philosophical goal, let us consider for a moment how the MCJC achieves spiritual unity. First it determines a specific date for the start of each numbered month. Once the beginning of the month is established, mainstream Judaism respects the IDL, so that the first place for the start of a new day (including the Sabbath, a festival day, or a new moon day) is at this IDL at sundown. Then sundown flows to the west on the earth, and each place begins the new day as sundown comes to that place. This achieves a simplicity and spiritual unity that is in harmony with Sabbath observance around the world by multitudes of groups that are motivated to keep the Sabbath. Moreover, this method extends to the festivals and the days of the new moon. The big problem with the MCJC is that the computation of the first day of each month is incorrect about 77.5 percent of the time within the borders of Israel (see appendix D), and the determination of the month number is off by one month in some years. One exceptional aspect was overlooked in this explanation. When people on the earth are near the North Pole or the South Pole, sundown as well as the ability to see the moon are greatly distorted, especially during certain long periods of the year. In such cases, people typically resort to choosing 6:00 pm on modern clocks as the time to begin each day.

The Jewish approved IDL-applied aspect with the MCJC has the advantages of (1) Attaining spiritual unity; (2) Respecting the universal method for observing the Sabbath; and (3) Being in agreement with the time that ancient Israel kept the Sabbath. In a certain sense the IDL is not arbitrary because some place for an International Date Line is a necessity and the Pacific Ocean is where the one major body of water on the earth was originally placed. The only aspect of the IDL that may be considered arbitrary is the specific way that it wiggles around certain groups of islands in the Pacific Ocean. If a correction would be made to the MCJC to arrive at the first day of each numbered month that was much more in harmony with the calendar of ancient Israel, then the philosophical goals originally expounded would be met.

[45] Avoiding Confusion (I Cor 14:33)

If there is a significant density of people around the earth desiring to keep the festivals, any boundary that began the new month that cut across a landmass would cause confusion among the people. Even though people may be organizationally independent, that should not hinder friendships and occasional visits away from one's normal attendance site during biblical festival days whose dates depend upon determining the first day of the month. If there are different dates by different people who come together to keep the festivals, there are likely to be date conflicts and disunity. All biblical contexts that mention the festivals seem to take it for granted that there are no conflicts and that there is just one day that is holy for each specific commanded assembly. The only exception might be the start of the seventh month where ancient Israel could occasionally keep two successive days unless the first day of the two was confirmed to be the first day of the month.

Organizational independence need not require confusion on the determination of the start of the first and seventh months. In order to avoid confusion, the first day of each month should respect the IDL rather than cause it to change every month with a new curved line. Such a proposed curved line of first visibility is in reality a fiction because it depends on the observer's altitude above sea level, humidity (high humidity hinders visibility and low humidity favors it), air pollution, rain, etc. The approximate angle of such a curved line will change from month to month because the moon's path changes somewhat with respect to the earth's axis (the orbit of the moon does not lie in the plane of the earth's orbit, and in fact this approximately repeatable pattern follows the Saros eclipse cycle of 18.03 years). Any such curved line is not a sharp narrow line because it will depend on the eyesight of individual people who are striving to see it. There will be regions where some percentage of the people will see it and others will not. Such a curved line will not be one neat pattern because humidity variations will cause it to wiggle in significant ways, and oftentimes, altitudes that are at least above 4000 feet above sea level will produce geographical areas of visibility that are isolated from other larger regions of visibility. Regions of high humidity will sometimes cause local regions of non-visibility in the midst of much larger regions of visibility. When people do not see the crescent at their dwelling place and others some distance off do see it, the question remains concerning the conditions that would cause the individual to accept the sighting of others. It may matter to some people

if others that attend the same congregation did see it, although such people may have traveled quite a distance to get to the meeting place. If two different organizations that had overlapping geographical areas of attendees came to different conclusions based upon who saw the crescent within each congregation, wouldn't that be a cause of confusion if they wanted to meet together for a festival?

For the purpose of establishing the beginning of the month, using so called local visibility of the new crescent from outside Israel leads to arbitrary decisions and confusion. The first aspect of arbitrary decisions and confusion is defining local visibility. Suppose the new crescent can be seen from Fort Worth, but cannot be seen from Dallas, which is 30 miles to the east. Should people in Dallas accept the testimony of people in Fort Worth for visibility of the new crescent to start a month? What distance should be the limit for accepting someone else's testimony? Suppose the only places in the United States from which people can see the new crescent are over 8000 feet above sea level in the Rocky Mountains. Should people elsewhere in the United States accept their testimony? If no one in the United States can see the new crescent, but some people in Baja, Mexico can see it, should their testimony be accepted in the United States? In order for local visibility of the new crescent to be applied in today's world, it must first be defined so that there is a principle to apply. In order to be practical it should be defined in some manner so that any proposed definition may be applied in different areas of the world, not merely on one small island.

If someone proposes that the first place on the earth that any two witnesses see the new crescent starts the new month for the whole world, there are still problems. The most significant philosophical problem is that whenever this place is to the west of Israel's time for sighting the new crescent and still before the IDL, Israel would be made to keep any festivals of that month one day sooner than Israel would keep it if the Levitical priesthood existed and functioned exclusively within the boundaries to which they were anciently confined among the original tribes. Another problem with this proposal is that people on one side of the sundown line at that time will not be in the same day as those on the other side of the sundown line. Thus people who are geographically very close will potentially be keeping the festivals one day apart, so that confusion will still exist by this method. Another potential problem is that if some two people in one very remote area of the world post a message on some web site that they saw the new crescent, how would people know whether they were not pranksters? In Israel today, those who

are witnesses to the sighting of the new crescent are known by those who post the sightings, so the problem of pranksters is virtually eliminated. To some people, another problem with this proposal is that one segment of the world that did not see the crescent would be deprived of seeing the new crescent on the day that they would be expected to begin the month; this latter reason is the cause for those specific people today to be zealous supporters of their concept of "local" visibility, although there is a problem in defining local visibility for various circumstances without inventing arbitrary rules.

If someone proposes that some mathematical calculation substitute for the actual sighting of the new crescent, there would be the objection that this would not always agree with actual sighting of the new crescent from Israel, which was anciently used. A mathematical calculation would only be attractive if modern methods of communication broke down, and this was attractive before timely web site postings of sightings of the new crescent were available.

[46] Dwelling in Spiritual Unity Through the Declaration of the Priesthood

Ps 133:1, "A song of the upward-steps, by David, Behold how good and how pleasant [is the] dwelling of brothers, yes-indeed in-unity."

Ps 133:2, "[It is] like the good oil upon the head, descending upon the beard, Aaron's beard, descending upon the edge of his garments."

Ps 133:3, "Like the dew of Hermon descending upon the mountains of Zion, because there YHWH commanded the blessing of life forever."

Verse 2 mentions Aaron, the first High Priest, who thus represents the Levitical priesthood. It also mentions good oil, which represents the holy spirit (Mat 25:3-4; Rom 8:11; John 8:12; I Cor 6:17; Mat 5:15-16; John 12:36). In flowery language this is saying that dwelling in spiritual unity is like the holy spirit upon the Levitical priesthood, because spiritual unity can only come if the priesthood properly teaches the law (Lev 10:8, 11; Mal 2:7), so that the people are motivated to keep it. Only then can there be spiritual unity, and this will result in the blessing of eternal life (note verse 3). The priesthood was supposed to promote spiritual unity by proper teaching. The appointed-times, the days of holy convocation, were announced by this priesthood through the blowing of the two silver trumpets (Num 10:1-2, 8-10), and this was a means of promoting unity in worship and unity of the days of holy convocation.

I Cor 14:33, “The Almighty is not of confusion, but-oppositely of peace, as in all the congregations of the saints.” If knowledge to achieve spiritual unity is attained, it should produce uniformity in recognizing the days of holy convocation, the appointed-times. Once the ability for widespread communication exists to make spiritual unity possible, biblical principles that promote unity in recognizing the days of holy convocation should be promoted. If people in their own areas around the world attempt to determine the start of a month by individually sighting the new crescent, it will most certainly lead some people who are relatively close to one another to have conflicting days for the appointed-times.

We do not have any Levitical priesthood today, but if we are given the same information that they could have through postings on a web site, then we could presumably arrive at the same decision they would.

[47] Does Deut 16:1 Command Everyone to Look for the New-Moon?

Deut 16:1 has been used by various peoples to promote highly specific viewpoints regarding the calendar, each of these viewpoints conflicting with the others, but all from the same verse. I have about a one inch thick folder with photocopies from a wide variety of sources just on this verse, and I have looked this up in about 40 different translations and many commentaries.

One basic principle of properly understanding the Bible is that a technical expression should have the same meaning wherever it is used. This is especially true if the writer is the same in all instances of its use. All of the six places that *chodesh ha aveev* occurs were written by Moses, and two of these places are in Deut 16:1. This technical expression *chodesh ha aveev* should mean the same thing in both places of its use in Deut 16:1.

In the second instance of its use in Deut 16:1, *chodesh ha aveev* refers to the time that the Israelites were freed from Egypt in the middle of the first month, not at the start of the month. Consequently, although the word *chodesh* in the general situation can mean either new-moon or month, in the specific expression *chodesh ha aveev* it needs to have one fixed meaning, and from its second use in Deut 16:1, its meaning must be “month”, not “new-moon”.

From the above reasoning, Deut 16:1 should NOT mean approximately “Go out looking [in the sky] for the new crescent of Abib”. Otherwise the second half of this same verse would mean that in the new crescent of Abib the Israelites were freed from Egypt, and this is not true according to Num 33:3. Those who interpret Deut 16:1 in the sense of a commandment to watch for the new crescent would use the examples of I Sam 19:11; Ps 59:1; 130:6; Eccl 11:4 where the Hebrew word *shamar*, Strong's number 8104, could mean to watch with one's eyes.

One conclusion is that Deut 16:1 is not a specific commandment for everyone to go out looking for the new-moon that begins the first month.

[48] Ancient Israel did not Practice Local Visibility

Knowing that two priests in ancient Israel were commanded to blow two silver trumpets on the first day of each month to officially declare the beginning of the month (Num 10: 1-2, 8-10), when the time arrived at which the Israelites were to keep the three annual festivals in one place (Deut 16: 5-6, 10-11, 13-16; 12:5-21), Israel did not practice "local" visibility to begin the month and determine the festival dates since, when gathered together at the festivals they were all together in one place with one High Priest. Thus Israel was united in keeping the festivals on the same days and united on beginning the months on the same days, which is against local visibility in different parts of Israel.

[49] Confusion of a Difference of a Whole Month in the Calendar

In some years local visibility (assuming this may be defined in a satisfactory way) could make the difference between a month being considered as the 13th month for part of the earth and as the first month for the remainder of the earth. This would cause the festivals to be kept one month apart for different parts of the earth in such a year, resulting in greater confusion. The year 2007 provides an example.

[50] The Role of the Land of Israel

The role of the land of Israel must be appreciated in the plan of Scripture. This land is called the inheritance of Israel (Num 26:51-56; Deut 4:21; 31:7) while the resurrection to eternal life is called the inheritance of the saints (I Pet 1:3-6). Entering the land of Israel is called a rest (Deut 12:9; 25:19; Josh

22:4; Ps 95:11; Heb 3:11), which is a type of the rest of the resurrection to eternal life (Heb 4:1, 8, 11). Among the adults in Israel who left Egypt, only Joshua and Caleb were allowed to receive the inheritance by faith (Num 14:6-9, 24, 30, 38; Heb 4:2), which is a type of the faith of the saints that is needed to receive eternal life. The land promise to Abraham, Isaac, and Jacob (Gen 12:1; 15:7, 18; 17:8; 26:1-3; 28:10-15; 35:12; Deut 34:4) was a theme for over 430 years (Ex 12:41; Gal 3:16-17) before the beginning of its literal fulfillment. A stranger could become a full citizen in Israel through fleshy circumcision, which made him become like a native of the land (Ex 12:48), which is a type of the circumcision of Christ (Col 2:11-12). The land was to have a Sabbath rest (Lev 25) which is a type of the Sabbath rest of the saints (Heb 4:4). Finally, according to Deut 11:11-12, the eyes of YHWH are always upon this specific land. From time to time through the history of Israel in this land, the priesthood moved from place to place. The first Passover in the land was kept at Gilgal by all of Israel (Josh 5:10). Soon Shiloh became the political center (Josh 18; I Sam 1:3, 24). At first King David reigned from Hebron (II Sam 2:11), but afterward he reigned from Jerusalem (II Sam 5:5). For approximately the first 400 years of Israel's history in the land, the political headquarters was not Jerusalem, but the calendar continued regardless of the political center.

There is a biblical principle that in the mouth of two or three witnesses a matter shall be established (Deut 17:6; 19:15; Mat 18:16; II Cor 13:1; I Tim 5:19). Does it make sense that if the weather is rainy at wherever the political center of Israel happens to be, no citizens of Israel from elsewhere in Israel may appear as witnesses before the priests for having observed the new crescent? No.

[51] The Boundary of Israel

Since Israel is prominent in the eyes of YHWH according to Deut 11:11-12, the subject of its boundaries is now discussed.

In a covenant with Abraham, the southwest border of Israel is stated in Gen 15:18. There, for the southwest, it states the River of Egypt. J. H. Hertz comments on this verse that the River of Egypt is “the Wady-el-Arish, which is the boundary between Egypt and Palestine”. A map on page 71 of the atlas by J. Carl Laney shows the Wadi el-Arish at the place where other maps show the Wadi of Egypt or Brook of Egypt that starts at the Mediterranean

Sea and goes toward Eilat (also spelled Elath or Eloth), but appears to stop in the desert before reaching Eilat.

The Tanakh translation of I Ki 9:26 states, “King Solomon also built a fleet of ships at Ezion-geber, which is near Eloth on the shore of the Sea of Reeds [Red Sea which goes into the Gulf of Aqaba] in the land of Edom”. Ex 23:31 states, “I will set your borders from the Sea of Reeds [Red Sea at Elath] to the Sea of Philistia [Mediterranean Sea], and ...”. Map 4 in the NIV shows the region labeled Edom and continuing down through Elath (using a color marking and an identifying legend) to be part of the Empire of David and Solomon. Because the southern desert down toward Elath was not populated due to lack of rain and opportunity for crops, most maps ignore it and even cut off the map before it reaches Elath. The use of Beersheba in II Sam 24:2 in the expression “from Dan to Beersheba” indicates that Beersheba was the most southern populated city, not that the territory of the kingdom ended there.

Some years ago when Israel agreed to give back the Sinai region to Egypt for a peace treaty, I was very surprised until I investigated and learned that according to Jewish scholars (as summarized in Gen 15:18; Ex 23:31; I Ki 9:26, mentioned above), Israel was only giving Egypt what Israel considered to be reaching up to the boundary specified in Scripture. The modern southwest boundary of Israel is believed to be the boundary stated or directly implied by the three verses.

[52] The law will go forth from Zion - Isaiah 2:3 and Micah 4:2

Scripture does not give an explicit comprehensive discussion of the biblical calendar as it applies to the entire world with modern technology, but those who recognize the need to observe the festivals, desire to understand when to keep the festivals. In an effort to understand the will of YHWH concerning the biblical calendar, certain principles of application are sought. Attention is now turned to one biblical principle that has been used by various people who discuss the biblical calendar, including the Jerusalem Talmud and the Babylonian Talmud.

Isa 2:3 and Micah 4:2 say, “... the law will go forth from Zion and the word of YHWH from Jerusalem.” This is a prophecy of the future when the Messiah will reign. It relates to the seat of government where decisions are made.

John 4:21 says, “Woman, believe Me, the hour is coming when you will neither on this mountain, nor in Jerusalem, worship the Father.” In a very narrow sense the “you” in this verse refers to the woman, but the nature of the statement in its context implies that it refers to people in general. More specifically the context is worship, and this brings to mind such Scriptures as Jer 7:1-2 and Zech 14:16-17, which relate to holy convocations on the Sabbath and the festivals. John 4:21 is a prophecy (not a commandment) that was fulfilled when Jerusalem was destroyed by the Romans in 70 CE, and was more strictly fulfilled in 135 CE when the Jewish rebellion under Bar Kochba was defeated by the Romans. Nevertheless, eventually Jews returned to Jerusalem. Since Israel became an independent nation in 1948, even some Sabbath keeping Christians have settled in Jerusalem and Israel. Thus the period of the relevance of this prophecy has been fading. Historically, when the prophecy of John 4:21 was in fulfillment, the law did not go forth from Zion (Isa 2:3 and Micah 4:2), because Zion was not the seat of priestly or theocratic government.

When seeking guidance from the Scriptures on any matter, there are examples of biblical derivation and interpretation that provide a pattern. Three examples are now presented.

Mat 22:40, “On these two commandments hang all the Law and the Prophets.”

In other words, all of the teaching of the Hebrew Scriptures contains laws and principles that grow out from the two general commandments found in Deut 6:5 and Lev 19:18. A narrow contextual view is not taken of these two verses of the Hebrew Scriptures in Mat 22:40.

I Cor 9:9-10, “For it is written in the law of Moses [Deut 25:4], ‘You shall not muzzle an ox while it treads out the grain.’ Is it oxen the Almighty is concerned about? Or does He say it altogether for our sakes? For our sakes, no doubt, this is written, that he who plows should plow in hope, and he who threshes in hope should be partaker of this hope.”

In other words, Paul is not taking a narrow contextual view of Deut 25:4, but is broadly applying it beyond the animal realm to those who devote full-time energies to preaching and teaching.

Gal 3:8, “And the Scripture, foreseeing that the Almighty would justify the nations by faith, preached the gospel to Abraham beforehand, saying, ‘In you all the nations shall be blessed’”.

Gal 3:16, “Now to Abraham and his seed were the promises made. He does not say, ‘And to seeds’, as of many, but as of one, ‘And to your seed’, who is Christ.”

The above two verses extract quotations from the following.

Gen 22:17, “blessing I will bless you, and multiplying I will multiply your seed as the stars of the heaven and as the sand which is on the seashore; and your seed shall possess the gate of their enemies.”

Gen 22:18, “In your seed all the nations of the earth shall be blessed, because you have obeyed My voice.”

Gen 26:4, “And I will make your seed multiply as the stars of heaven; I will give to your seed all these lands; and in your seed all the nations of the earth will be blessed;”

Gen 26:5, “because Abraham obeyed My voice and kept My charge, My commandments, My statutes, and My laws.”

The Hebrew word *zarah* (Strong's number 2233), is the word translated “seed” that occurs twice in verse 17, once in verse 18, and three times in verse 4. In all these places the form of the word *zarah* is the same. Page 253 of volume 1 of TWOT makes the following comment, “Commencing with Gen 3:15, the word ‘seed’ is regularly used as a collective noun in the singular (never plural). This technical term is an important aspect of the promise doctrine, for Hebrew never uses the plural of this root to refer to ‘posterity’ or ‘offspring.’” Although Gen 22:17 and Gen 26:4 relate the number of the stars to the number of “seed”, so that the context implies that a plural number is intended, the Hebrew word occurs in the singular form regardless of whether the intended number is singular or plural. The apostle Paul was inspired to use this grammatical aspect of the Hebrew word in Gal 3:16 in order to attach the word “seed” to the singular “Christ”. Nevertheless, the original context implies that the intended original use is plural. Hence the New Testament interprets the literal context of the promise to Abraham in a non-contextual way.

These three examples of the use of quotations of the Hebrew Scriptures in the New Testament show that when using the Scriptures, one is not required to use a narrow contextual interpretation if none is available. If there is no Scripture that applies like a hand in a glove in its natural context, then one

has the liberty of generalizing and broadening the context of the Scripture in order to find guidance in an attempt to avoid arbitrary subjective decisions.

The explanation above provides one reason that Isa 2:3 and Micah 4:2 may be used with regard to the biblical calendar before the arrival of Messianic rule from Jerusalem. However there is yet another reason that should be given some thought. Both the Jerusalem Talmud (c. 400 CE) and the Babylonian Talmud (c. 600 CE) give parallel yet slightly different accounts of the same incident involving the Jewish sage Hananiah. Jacob Neusner dates this event c. 145 CE (see page 120 within pages 113-121 of the original 1965 discourse by Neusner, and page 129 within pages 122-130 of the 1984 reprint). The account of this event in both Talmuds uses Isa 2:3 and Micah 4:2 to settle this calendaric dispute c. 145. They use these verses as the single greatest factor, as a general principle, as a biblical weapon to decide the issue.

Since I will shortly discuss this incident involving Hananiah occurring in both Talmuds, which quote from Isa 2:3 and Micah 4:2, the reader may well ask for some justification for quoting from the Talmud. Understand that my goal here is to explore a *method of reasoning* from these verses, not whether the incident from the Talmud is historically accurate. The reader must decide whether the method of reasoning is sensible. How do I view the Talmuds? I will now briefly digress to answer this.

When I first began to study the biblical calendar in depth, I realized that Rabbinical writings from c. 200 CE to c. 600 contained many statements about the calendar, and I began to collect this material along with all the rest of the calendar information. The arduous and discouraging task of attempting to evaluate the worth of the Rabbinical writings loomed massive in my path to seek knowledge. I did not shy away from this decades-length battle of evaluation, which waxed and waned in spurts. Jewish scholars themselves often clashed on the issue of the value of these writings, which compounded the effort of my task. It is beyond the scope of this present study to attempt to adequately explain and document the fruit of my effort to evaluate the Rabbinical writings, but it is my duty to at least say a few words because of its relevance here.

The Mishnah is the first Rabbinical document. It is roughly the size of the Bible, and it is primarily a Jewish legal document. It is not written in a manner that is easy to grasp without a commentary. I am convinced that

when the Mishnah was first released to its scholarly audience (i.e., “published”, in the primitive sense) c. 200, that its contents reflected the opinions of its primary author, Judah the Nasi, at that moment in time, and it was not largely based upon extensive and detailed written records that were carefully preserved from before the destruction of the Second Temple in 70 CE. The elite among the Jews were trapped in Jerusalem during the war from 66 to 70 CE, and the relatively few that escaped did not have the luxury to take extensive writings with them. Jerusalem and the Temple were burned by the Romans, and according to Josephus, only a small number of writings survived. The Jewish scholars who survived the destruction of the Second Temple did not have reason to quickly imagine that there would be no substitute for the Temple within a reasonable amount of time. After Solomon's Temple was destroyed in 586 BCE, it took 70 years to initially complete the Second Temple in 516 BCE (see Ezra 6:15 and commentary notes there from various sources). Beginning in the second century BCE Herod the Great magnificently enhanced the Second Temple. There was no motivation for the immediate scholarly survivors of the destruction of Jerusalem to rush to write down everything they could remember of the details of how the priesthood and the Sanhedrin did everything. The years 132 to 135 saw the second great Jewish war with the Romans known as the Bar Kochba revolt, and it is not known whether more Romans died in this war or the war from 66 to 70. When Judah the Nasi published the Mishnah c. 200, he no doubt had sources that could give him reliable history since the year 135, and there were probably some reasonably reliable legends from the years between 70 and 135. But it is doubtful that there were many legal details that survived from before 70.

In the name “Judah the Nasi” as the primary author of the Mishnah, the title Nasi is sometimes translated Prince, and it refers to the primary leadership role among so-called mainstream Judaism, although there is debate among Jewish scholars concerning whether there was truly a mainstream Judaism throughout all of Judea and Galilee in the first century, and even during the next few centuries. Jewish history suffers from a lack of documents that represents a broad based history as well as a very credible history. Before the destruction of the Temple in 70, the title Nasi was equivalent to the President of the Sanhedrin, according to Rabbinical writings. Jewish scholars debate the issue of whether there was any primary “Sanhedrin” within Judaism after the Temple was destroyed.

According to Rabbinical writings, there continued to be one leader called the Nasi after 70. Undoubtedly some legendary sketches of written material were preserved by some scholars, but no one knows how much. Judah the Nasi had control over the contents of the Mishnah, and his motivations were varied concerning what to include and why to include it. There were many Gamaliel's in a genealogical succession beginning with Gamaliel the Elder (Gamaliel I), who taught the apostle Paul, and this line was descended from King David according to the Rabbinical writings.

The line of Gamaliel was given a greatly exaggerated role in the Rabbinical writings, especially for the first century, compared to what is justified in historical reality. In Rabbinical writings Gamaliel I, a Pharisee according to Acts 5:34, is given the role of the Nasi (President) of the Sanhedrin in Jerusalem, contrary to the Gospels and Acts in the New Testament, which, except for Acts 5:34-40 generally gives the greatest attention, in the sense of spokespersonship, to whoever is serving as the High Priest in the context. Many Jewish scholars have recognized this conflict and have postulated the existence of at least two most prominent Sanhedrins having different roles before 70, so that the apparent conflict between the New Testament and the Rabbinical writings could be resolved with the latter retaining its credibility. But the existence of such multiple primary Sanhedrins in the area of the Temple has not withstood the test of scholarly debate, and the Rabbinical writings have suffered a great credibility gap in the process. There are other reasons for the credibility gap besides this. Of course the Orthodox Jewish position is that all Rabbinical writings are inspired and fully true, and by "Orthodox", I refer to its meaning as held by Jewish culture in the United States, not Israel, where "Orthodox" has come to have a different meaning. The male succession in the line of Gamaliel is Gamaliel I, Simon I, Gamaliel II, Simon II, Judah the Nasi, etc. From this lineage is it obvious that Judah the Nasi, the primary author of the Mishnah, might have some motivation to exaggerate the importance of his own lineage in his account of the snippets of supposed history of Judaism from the first century onward.

When the Rabbinical writings mention that a Gamaliel or a Simon made an official proclamation that he was adding an extra month to the calendar for a combination of reasons, I do not at all believe in the historical validity of such a claim, nor do I believe that the combination of reasons stated were in fact operative during the first century! Philo of Alexandria only mentions the vernal equinox. The Mishnah claims that a select committee within the Sanhedrin made such a decision, so this contradicts Talmudic claims that a

Gamaliel or a Simon made the decision. The Mishnah is the first part of the Talmud; thus the Talmud is self-contradictory. Based upon the authority that I see vested in the chief priests in the Temple area according to the New Testament, it seems to me that the chief priests made such calendaric decisions rather than a select committee that was heavily represented by non-priests.

Rabbinical writings say absolutely nothing about any Jewish sage before 70 having any abilities in mathematical astronomy, and this even includes Daniel and Abraham. When Gamaliel II is said to have mentioned the length of a synodic month in the Babylonian Talmud, this exact time period including the fraction of a second comes from Babylonian astronomer-astrologers whose calculation originated c. 300 BCE. The Talmud does not claim that Gamaliel II himself directly possessed such mathematical and astronomical skills, although some later Orthodox Jewish commentators interpret a text in the Mishnah so as to infer that Gamaliel II possessed such skills. The Babylonian Talmud does ascribe much mathematical skill to Mar Samuel (c. 250 CE), who is said to have had the ability to compute a calendar for many years into the future. Commentators on this matter claim that Mar Samuel's proposed calendar was not accepted.

I believe that the Talmuds contain some remnants of historical value from the first century, but with some fabricated embellishments. Some of it represents false tradition and some true tradition. In some cases Josephus and the Talmud do agree on legal details not directly discussed in Scripture, but this may reflect only the Pharisaical position rather than practiced reality. In general, I do not accept Talmudic teachings as binding.

My primary reasons for introducing the account of Hananiah (c. 145) are to provide the reader with additional thoughts regarding the use of Isa 2:3 and Micah 4:2, as well as to provide the Orthodox Jewish viewpoint on how these verses may be applied to the calendar. With regard to the sighting of the new crescent in order to establish the day of the new moon, the Karaites in Israel today only accept witnesses who sight the new moon from within Israel. There are significant matters concerning which I disagree with the Karaites from Israel.

An interesting source and commentary on the Hananiah event is pages 106-111 of the book by Gafni. Hananiah was a Jewish sage (scholar) who was a native of Palestine and educated there. A rough guess of the year of his birth

is 100. Due to unfavorable conditions for the Jews after the Bar Kochba revolt against the Romans began in 132, Hananiah emigrated to Babylonia where he continued to gain respect as a sage. The setting of the event is with Hananiah in Babylonia. On page 108 Gafni has a translation of the account from the Jerusalem Talmud (Sanhedrin 1.19a), and he provides useful comments of his own in ordinary parentheses as follows. “Hananiah the nephew of R. Joshua intercalated (i.e. proclaimed leap-years) abroad. Rabbi (here the term means the Patriarch, most probably Rabban Shimon b. Gamaliel [Simon II], circa 150 CE) sent him three letters with R. Isaac and R. Nathan. In one he wrote: ‘To his holiness Hananiah’, in one he wrote: ‘The lambs you left behind [in Palestine] have become rams [scholars]’, and in one he wrote: ‘If you do not accept upon yourself (our authority), go out to the desert of Atad and there be a slaughterer [no longer a sage], and Nehunion a sprinkler.’ He [Hananiah] read the first [letter] and honored them, the second and honored them, the third – and wished to dishonor them. They told him: You cannot [dishonor us now], for you have already honored us. R. Isaac stood up and read in the Torah: ‘These are the festivals of Hananiah the nephew of R. Joshua!’ They [with Hananiah] said: ‘These are the festivals of the Lord!’ (Lev. 23:4). He [R. Isaac] replied: By us! R. Nathan arose and completed (read the *haftarah* from the prophets): ‘For out of Babylonia shall come Torah and the word of God from Nehar Pekod.’ They [with Hananiah] said: ‘From out of Zion shall come Torah and the word of God from Jerusalem’ (Isa. 2:3). He [R. Nathan] said to them: By us! He (Hananiah) went and complained about them [R. Isaac and R. Nathan] to R. Judah b. Bathyra at Nisibis [for advice]. He (Judah) said to him [Hananiah]: After them, after them ... He (Hananiah) rose up and rode on his horse. Whither he reached he reached (and corrected the local calendar), and whither he did not reach – they observe in error.”

One obvious important point here is that the Jerusalem Talmud (as well as the Babylonian Talmud’s account of the same incident) accept the application of Isa 2:3 and Micah 4:2 to the situation. In this context this implies that some sage in Israel must make the decision rather than some sage in Babylonia. To what extent this is a fully true account we do not know, but it does portray the acceptance of the sages in Babylonia to the reasoning based upon Isa 2:3 and Micah 4:2. Modern Jewish commentators such as Gafni and Neusner (and others that I have seen) do not question the reasoning based upon these prophetic Messianic contexts applied to a non-Messianic age.

My conclusion to this discussion concerning Isa 2:3 and Micah 4:2 is that because the New Testament does not require an exact contextual match in order to apply a verse in the Hebrew Bible to some situation, and since Jews generally have no problem applying the principle in these verses to give weight to the testimony of those who have situated themselves in the land of Israel, neither do I have any problem with applying this principle in limited ways. Certainly if a clearly illogical ruling comes from someone in Israel, I do not have any motivation to accept such a ruling.

In 1997 someone asked me whether I would accept the calendaric decisions of a new Jewish Sanhedrin in Israel if it began to function and make rulings on the calendar. My response was that if such a Sanhedrin made rulings that were based upon the biblical calendar, I would accept those rulings. But, for example, if arbitrary postponement rules were adopted by that Sanhedrin, I would not accept it. Nevertheless, a reconstituted Levitical priesthood should make the determination of the calendar based on Num 10, not a Sanhedrin. It does bother me that Jews go to the Talmud to substantiate a Sanhedrin rather than to the Bible. The Talmud views the choosing of the 70 elders in Num 11:16-17, 24-25 as the first Sanhedrin, and uses this to show that the ideal body of elders for Israel is the Sanhedrin. This command for Moses to select 70 elders was a response to Moses' complaint to have the burden of dealing with all the problems of all the people lifted from him (Num 11:14-15). These 70 were to be disbursed throughout the people to deal with individual problems and disputes between parties, not to convene as one body as a substitute for Moses. You never see any example of this body of 70 meeting together in one place.

[53] Two Days for the Start of the Seventh Month

Should there occasionally be times that the first day of the seventh month will be celebrated for two successive days today? This is the subject of the present chapter. This partially concerns the question of whether people to the east of Israel up to the IDL should begin to observe the first day of the seventh month before anyone in Israel has an opportunity to observe the new crescent.

Isa 2:3; Micah 4:2 says, "the law will go forth from Zion". I take this to imply that when the Messianic kingdom is established, the declaration of the first day of the numbered new moons will be made from Zion. I also take this to imply that witnesses for the visibility of the new crescent from Israel

will be accepted by the governing authority in Zion, and that such witnesses will have to testify that they saw the new crescent before the governing authority in Zion. It might happen that some audiovisual technology may be used so that witnesses may appear before some technology station away from Zion and be questioned from Zion. Maybe some transportation device will convey witnesses to Zion using automation so that they will not have to ride a horse or a camel. Maybe a biometric device for identification along with the Internet will be used, and no travel will be necessary.

In today's society witnesses for having seen the new crescent communicate to at least one of two web site hosts. Then the result is sent out via email to individuals who have signed on to the emailings. In other words the Internet is used as a modern technology tool to inform people concerning witnesses for the sighting of the new crescent.

If the astronomical conditions for sighting the new crescent are borderline so that no one can accurately predict whether the new crescent will be seen (if the weather is clear), then all people who live to the east of Israel up to the IDL should begin to celebrate the first day of the seventh month in advance of receiving Internet reports. It may turn out that such people will indeed celebrate two successive days for the first day of the seventh month, just as would occasionally have happened to ancient Israel as indicated by I Sam 20:27, 34.

In ancient times transportation methods were slow, so that if witnesses of the new moon had to travel from far off in Israel, the priesthood might have to wait several days for the witnesses to arrive. If no witnesses testify for the first day and the second day, how long should the priesthood wait? Why not wait up to the time of the ninth day of the month to accommodate the fast day, the tenth day of the seventh month? Priests can accept the testimony of witnesses retroactively before the tenth day of the seventh month and thus avoid artificially limiting the location of witnesses within Israel. This is sensible and workable in ancient times. Anciently camels could run at 40 miles per hour and walk for long periods at half that speed so that within a couple of days it would be possible to travel from the southernmost part of ancient Israel to Jerusalem.

Without predictive mathematical astronomy in ancient Israel, there was often uncertainty of the first day of the new month during several days of waiting for witnesses to testify for having seen the new crescent. In the case

of the first day of the seventh month, it is virtually certain that they often kept two successive days for that festival because of no reports of visibility on the first of the two possible days for sighting the crescent. Today, due to computer calculations, there is uncertainty under rare circumstances, assuming we accept visibility from desert regions of Israel where it almost never rains. When actual witnesses from Israel are available, if we reject their testimony and only use a computer calculation, it is certainly true that we make matters easy for ourselves, but then we set ourselves up as an authority that contradicts the ancient use of human instruments for sighting as originally intended. In this modern age, people often want to be able to plan everything precisely in advance. If we have uncertainty due to a borderline case in a rare circumstance, we can still plan for two successive days and have ourselves covered. People can plan an airplane trip one extra day ahead of time so that either event will work out okay.

[54] What if the Whole Earth may Sight the Crescent to start the Month?

If the boundary for ending the sighting point for visibility of the new crescent does not stop at the borders of the land of Israel, where does it stop? The further to the west one goes, the easier it becomes to see the new crescent, although higher than about 4000 feet above sea level it gradually becomes ever easier to see the crescent, and low humidity favors seeing the new crescent. How far to the west can one go? The natural answer based upon its modern acceptance is the IDL in the Pacific Ocean. If one goes there, then everyone's attention would be focused on the IDL to give the very last look to the most western line before deciding that that day will not suffice for starting the new month. In other words, some islands in the Pacific Ocean would get all the attention instead of the land of Israel or its headquarters, Jerusalem. That would mean that local or worldwide visibility to determine the new crescent would be redefined to visibility at some islands in the Pacific Ocean. This makes no sense.

If one proposes that the IDL should be totally ignored and the exact moment of the first sighted crescent should be used to determine the start of the new crescent for the whole earth, this method will often cause some line along a landmass to separate one day beginning at sundown from the next day on the eastern side of the line. The reason for this is that a new day begins at sundown rather than some random time within a day. Thus neighbors will not be in harmony on the day that begins the new month and confusion will result. Another problem is that this method will sometimes produce a one

day difference with the day that would have been selected for the new moon day in Israel under ancient circumstances of the Levitical priesthood.

[55] The Ancient Situation Outside of Israel

Suppose some ancient Israelites went exploring on a ship to North America. How would they begin a month? Without the Internet, without long distance telephone service, et cetera, they could not contact (even through intermediaries) the High Priest for a knowledge of when each month began. They would have no choice but to use visibility of the crescent from wherever they were. If such a ship gave rise to two colonies separated by 100 miles, and if these colonies remained isolated from one another, there would no doubt be months in which they began a month one day apart. If they kept in contact with one another, then it is reasonable to think that the colony with rainy weather would accept the witness of the other colony, so that both would be in harmony on the start of a month. As we add more colonies it becomes ever more difficult to hypothesize how one could define local visibility. Nevertheless, with primitive isolation of settlements outside of ancient Israel, there is no confusion so that I Cor 14:33 would not apply. It is only after significant communication is possible and the modern age enters the scene that confusion enters.

[56] Modern Technology makes a difference

Anciently, if appropriate technology were available, the ideal situation implied by Num 10:10; Isa 2:3, Micah 4:2 would result in all people everywhere accepting the word of the High Priest, whose responsibility would include questioning witnesses who came from the Israel. Some people imagine that it is “not fair” to use modern technology to report on such visibility, and instead we must pretend we only have what people had in the days of ancient Israel. Such pretending should also include pretending we have no telephones, pretending we have no automobiles, pretending we do not have modern computers, pretending there is no Internet, even pretending we are in ancient Israel, i.e., in the Promised Land because that is where people had access to Scripture. Certainly in Israel all were united on the day, following the lead of the High Priest. Hence rainy areas accepted testimony from clear weather areas in Israel.

[57] Num 10:10 Avoids Confusion

According to Num 10:1-2, 8-10 the Levitical priesthood is commanded to blow two silver trumpets on the first day of each month. The Levites were commanded to be disbursed in 48 cities throughout the 12 tribes (Num 35:2-8), not all over the world. The priests must observe, or reliable witnesses must inform them where they are, concerning the new crescent (Deut 17:6; 19:15; Mat 18:16; II Cor 13:1; I Tim 5:19). In concept, even though we do not have the Levitical priesthood functioning today, one must still view matters from the standpoint of the priesthood blowing trumpets on the first day of the month using two silver trumpets, implying they were being blown from one location. The biblical focus of attention for world government is on Israel, and specifically Jerusalem (Deut 11: 11-12; Ps 132: 13-14; Isa 2:3; Micah 4:2).

[58] Differences between the Sabbath and the New Moon

In ancient Israel there was certainly a difference between how each Sabbath began throughout Israel and how each month began throughout Israel. Each Sabbath began based on sundown for each person. While the time of sundown might vary by a minute throughout Israel, the beginning of the month did not begin this way. According to Num 10:10 the Levitical priesthood was commanded to blow two silver trumpets to officially announce the beginning of each new month. If someone and his neighbor observed the new crescent together in a difficult to observe circumstance and they neglected to appear as a witness before the appropriate priests, and if no one else appeared before the priests to testify for having seen the new crescent, the priests would not have blown the trumpets and the new month would start a day later. Thus those two witnesses who failed to appear before the priests would not begin the new month when “it came to them”, but would have to use the starting of the new month according to the determination by the priests, when they blew the silver trumpets. In ancient Israel when the holy days were kept in one central place (Jerusalem after the first six years of King David's reign), those two witnesses could not argue with the priests when they appeared for the festival at the middle of the month. The priests would have no choice but to say to the two witnesses: “Why didn't you come to us near the start of the month and testify at that time? If you had done so, then we would be starting the feast one day sooner. Now it is too late to testify.”

The point being made here is that merely because we keep the Sabbath when it comes to us according to the IDL, that is not a deep enough or thorough

enough examination and explanation of the different issues involved with the start of the month. The concepts for the month start and the Sabbath start were different in ancient Israel, yet the need for avoiding confusion is the same. Levitical priests did not have to blow the trumpets to officially notify everyone in Israel that the Sabbath had begun. It is certainly true that the Levitical priesthood does not exist today, but one must consider how one might sensibly approach this matter today given what we do know and the ever present need to avoid confusion among saints that are spread out in the world, often in close proximity to one another (I Cor 14:33).

Since we cannot define "local visibility" to cover all circumstances away from the north and south poles, and since our Creator who wants us to worship Him on the festivals is not the author of confusion (I Cor 14:33), the way to avoid it is to use the implication of Paul in Acts 18:21 in which he showed respect for the determination of the calendar by the Levitical priesthood by wanting to be there for the feast. Num 10:10 is there to achieve unity in ancient Israel. The central declaration of the new moon by the priesthood was not needed for the Sabbath even though the trumpets were still blown on the Sabbath as well because they are also appointed times according to Lev 23:1-4. The announcement for the new moon of the seventh month had to reach all of Israel quickly if the ending month had only 29 days, or else people would needlessly keep two days as the new moon of the seventh month. Such an announcement all over Israel was not needed for the Sabbath.

When people live some distance outside the temperate zones, even with clear weather there will occasionally be a 31 day month based upon the concept of only personal eyeballs doing the looking (no phone calls, no Internet, no automobiles, no carrier pigeon communication, no fire signals, etc.). Thus the basic principle of a maximum 30-day month can no longer be used from outside of Israel with only personal eyeballs doing the looking. Then what does one do when it is raining or very cloudy and only depending on personal eyeballs (do you sometimes have a 32 or 33 day month)?

[59] Does the priesthood of all saints (I Pet 2:9) change the calendar?

The Levitical priesthood is a genealogical priesthood with physical duties, physical objects, and a physical service, although it was expected to teach spiritual laws and principles. The priesthood of all saints is a spiritual priesthood without the physical objects such as the silver trumpets to blow

and announce the new months. Just as the priesthood of all believers does not have the authority to wave the sheaf during the Days of Unleavened Bread, it does not have authority to blow the two silver trumpets and announce the start of each month. If two different organizations of believers were in the same geographical area outside of Israel and observers in both organizations came to different conclusions of the day to start the month based upon what they saw separately in each organization, and then members within each organization separately blew their silver trumpets on two different days, wouldn't that have to be regarded as confusion in the same area?

Heb 7:12 points out that there is a change in the priesthood and a change in the law relating to it for the saints. Yet Heb 9:7 points out that when this was written, the High Priest still functioned and entered the holy of holies once per year, showing that this was still a continuing practice of the Levitical priesthood, which was not shown disrespect by the author of the letter to the Hebrews. Heb 10:11 shows the continuation of the Levitical priesthood, yet with its limitations of effectiveness.

If different members of the priesthood of all saints were to blow two silver trumpets on the days that they thought the new moons were, but they differed from one another, perhaps when even a few miles apart, is this not confusion and is this what YHWH wants? Does He desire to sanctify multiple pairs of days for the same festivals when people have modern communication? Num 10:10 was there to avoid this in ancient times. Since we can know whether the new moon was sighted in Israel today by means of mass communication, this is a unifying principle and taken out of the hands of one human organization or authority.

It is true that there is no Levitical priesthood functioning today, yet the principle in the law is that in the mouth of two or three witnesses a matter is established (Deut 19:15), and this principle was applied in other situations later (Mat 18:16). To avoid confusion the witnesses should be drawn from where the Levitical priesthood was to reside, namely the boundaries of ancient Israel.

[60] Historical Evidence for Sighting the New Crescent

In the early first century, Philo of Alexandria reported that the new month for Jews began with the sighting of the new crescent after the conjunction

(see page 333 of Philo_7, Special Laws 2:41). Historical evidence concerning testifying about having witnessed the new moon does not exist before the Mishnah, which dates from about 200 CE. While I do not accept the Mishnah as an inspired document or for an accurate valid statement concerning Jewish history, by combining the written witness of Philo with corroboration from the Mishnah, it is sensible that witnesses of the sighting of the new crescent were expected to testify.

[61] Should only Jerusalem be used to Sight the New Crescent?

If we today were to propose that only the sighting of the crescent from Jerusalem mattered (avoiding areas of Israel outside of Jerusalem), then since there are people today who report on the sighting of the crescent on the Internet, we would often be changing at the beginning of the first and seventh months based on rain or heavy clouds over Jerusalem, even if other areas of Israel were clear, it was not a borderline case, and humidity was not an issue. This shows that Jerusalem sighting does not make matters easier, but actually complicates matters because there would be more uncertainty on more occasions than using visibility throughout Israel, which includes desert regions so that computer predictions would only fail in some rare borderline cases.

If we had no reports of actual sighting from Israel in the modern world, but wanted to avoid confusion and utilize the concept of sighting the crescent based upon Gen 1:14-18, then a calculation of the high probability of sighting the crescent is the only choice, and the vast majority of the time (no borderline condition or slightly under borderline where low humidity is a question) the calculation and actual sighting will agree. The calculated dates will work over 90 percent of the time in the latitude of Israel under 4000 feet above sea level.

[62] Starting the Month when it comes to you

Today the part of the world east of Israel always starts the Sabbath before Israel, and the part of the world west of Israel always starts the Sabbath after Israel. Thus India starts the Sabbath before Israel and the United States starts the Sabbath after Israel. To be consistent with the way we keep the Sabbath, we should also begin the start of the month according to the same principle: the people in India begin the start of the month before the people in Israel and the people in the United States begin the start of the month after the

people in Israel. This principle extends to the IDL and is what mainstream Judaism uses.

[63] Actual Sighting from Israel Today

In September 2004 a new problem arose when the Karaites in Israel introduced a new concept of what constituted a valid observation. They allowed momentary sightings of something that would not even have been recognizable anciently as a crescent to be validly considered a sighting of a crescent. This was done on the basis of having observed the moon with binoculars and a tripod for steady viewing for some time, so that they “knew” it was the crescent, although no one in ancient times could have known it was the crescent. If an alleged sighting from the Karaites is more than half of one degree below Karl Schoch's curve, then I do not trust that sighting as having been acceptable in ancient times, most especially if the sighting is not done from a place of low humidity. Details must be provided by those who issue reports in such unusual circumstances.

[64] The Process of Declaring the New Moon

(A) Israel as the Geographical Anchor

Num 10:10 shows that the Levitical priesthood was to blow two silver trumpets to declare that a new month had begun. Through this brief statement we can at least say that the priesthood had the responsibility to gather testimony concerning the sighting of the new moon and make a decision of whether to declare it. Since the priesthood was commanded to dwell within the boundaries of ancient Israel, that place is the region from which testimony would have been taken as long as the Levitical priesthood existed. Jumping to today's society in the modern world, if multiple peoples around the world were to arrive at an independent determination based upon individual arbitrary regional decisions of “locally” sighting the new crescent, that implies that YHWH declares regional feast days that may overlap and conflict in certain geographical areas, making two different days holy even in the same place where two different organizations may overlap in geography. This makes YHWH the author of confusion, contrary to I Cor 14:33. Different people may invent different concepts of how to determine a new moon in their own area in terms of distance and height above sea level, and there is no biblical guideline for such a definition. As long as people elsewhere are able to communicate with people in Israel, the only way to

avoid making YHWH the author of confusion and also respect the concept of Num 10:10 (even recognizing that the Levitical priesthood no longer exists), is to use the boundaries of Israel as the geographical anchor for visibility of the crescent.

(B) A minimum of Two Witnesses for sighting the New Crescent

Deut 17:6; 19:15 declares, “on the mouth of two witnesses or on the mouth of three witnesses a matter shall be established”. This is quoted in Mat 18:16 and II Cor 13:1 as applying to other situations.

(C) Only a continuous Naked Eye sighting should be admitted as a Witness

As an avid student of the history of ancient astronomy I can say that the invention of the telescope is not provable before 1608, but in that year several Europeans constructed telescopes about the same time. Galileo first constructed one in 1609 and made important improvements. See pages 326-329 in the book by John North. Ancient peoples showed great interest in the moon, yet there is no ancient drawing that shows details of the surface of the moon that would require a telescope, nor is there any historical evidence that ancient peoples invented a telescope.

When people discuss the sighting of the crescent today, it seems generally agreed that evidence for the new crescent should not be accepted by methods that were not available in the days of the functioning of the Levitical priesthood. This means that if an individual is in an airplane flying over Israel, that altitude would prevent accepting such a testimony for having seen the new crescent. In fact, it means that the observer should be standing on the ground or sitting on some object that is on the ground, and certainly using naked eye observation at the time of declaring having seen the new crescent. Furthermore, the sighting should be a continuous one rather than one that lasted only about a second, even if separately repeated later for about a second. This prevents a vivid imagination from fooling a sincere mind. The question of how much use of a telescope or binoculars may be acceptable is treated next.

(D) Partial use of a Telescope or Binoculars

The principle that evidence for the new crescent should not be accepted by methods that were not available in the days of the functioning of the

Levitical priesthood is generally accepted, although there are exceptions to almost everything when human opinions are taken. But sometimes observers go to great lengths to enhance the likelihood that they will see a new crescent with the naked eye. For example, they will use a knowledge of modern astronomy and mathematics to correctly predict where and when in the sky the crescent should be seen, and then focus a telescope upon an accurate mounting pointing to that location. When they finally see it at that location through the telescope, they will then try to locate it with binoculars. Then they will periodically remove the binoculars to try to see it with the naked eye. Then upon seeing it continuously with the naked eye, they will declare they have seen the new crescent. Obviously different people will have different opinions about this process.

One aspect that relates to mathematics and binoculars deserves special comment. This has to do with the refraction of light from an astronomical body as it travels to the eye of an observer. Having watched some new crescents as they lowered down to the horizon from my sighting location that has been near the latitude of Israel (especially the area around Dallas, Texas), I noted that they changed shape significantly during last part of the descent. This change of shape is due to the increasing effect of refraction as the light from that object neared the surface of the earth. The density of the earth's atmosphere increases as one approaches sea level. As the density of the atmosphere increases, refraction also increases. This increasing refraction distorts the shape of what one sees. When it gets low enough, it ceases to have the characteristic appearance of the new crescent, and what one sees can be confused with a cloud or a piece of a cloud. If one sees this for the first time in its very low position in the sky, one will be very uncertain that this is the new crescent, but if one has seen it that way all along for the previous 15 minutes, there will be no reason to doubt that it is the new crescent.

When the crescent is seen from the northern hemisphere, it looks different near the time of the vernal equinox compared to near the time of the autumnal equinox. Near the vernal equinox it looks somewhat like a bowl whose bottom is horizontal and down. Near the autumnal equinox it looks somewhat like a backwards letter "C". In the spring when it gets near the horizon, the bowl shaped crescent gets flattened to a very short horizontal straight line, and anyone seeing this who had not already been watching it before would not think this was a crescent since all the curvature would be gone. In the autumn when it gets near the horizon, the backwards "C"

shaped crescent gets flattened to the outline of what appears to be an extremely narrow squashed tip of a cigar, but not filled internally, and anyone seeing this who had not already been watching it before could easily mistake it for the outline of a cloud.

Armed with the above information, let us contemplate the following. Consider two observers, observer “A” using the sophisticated modern techniques of an aimed mounted telescope and binoculars, and observer “B” who is nearby with only his eyes to see, but “B” is not in contact with “A”. If this is a very difficult case in which to imagine seeing the new crescent and both of them happen to first see it with their naked eye at the same time, and moreover, the moon is very close to the horizon, the thoughts in their minds are likely to be quite different. Observer “A” is likely to think as follows. I have been watching this crescent all along for many minutes with binoculars and now I finally see with my naked eyes what I have been looking at all along, so I know it is the new crescent. Observer “B” is likely to think as follows. I see something out there, but I'm not quite sure what I am looking at, because it doesn't have the typical characteristic appearance of the new moon; it could be the latter stage of what a new moon looks like, but it is so low that it's difficult to be sure if this is a crescent or perhaps a piece of cloud.

If one accepts the principle that evidence for the new crescent should not be accepted by methods that were not available in the days of the functioning of the Levitical priesthood, then one must consider the difference between the thinking of observer “A” and the thinking of observer “B”. While I would not object to an observer knowing where to look and even using a telescope and binoculars to pinpoint the direction to look, upon seeing the object with my naked eye, I would have to make a judgment of whether the appearance of the object is sufficiently close to a crescent that if I were seeing this for the first time, I would be convinced this is a crescent rather than a piece of cloud. If the appearance alone is not convincing, even though I would in reality know it is the new crescent because I had been observing it for a number of minutes with binoculars, it should not be admitted as evidence for seeing the new crescent because it would be unconvincing to an ancient observer.

This means that when a report is given by observers of the new moon in a difficult situation where binoculars or a telescope was used, the report should include details of approximately how long it was seen continuously

with the naked eye, how its shape appeared to the naked eye, and a judgment of whether it would have been convincing to an ancient observer who knew approximately how it ought to appear at this time of the year. If it would not have been convincing to an ancient observer, then it should not be accepted as a witness to the new crescent.

Summary: The problems with using local visibility are:

- (1) How is it defined in today's world?
- (2) How is it consistent with Num 10:10 where the priests determine the new month from Israel?
- (3) How can it avoid confusion (I Cor 14:33)?
- (4) Does it avoid arbitrary decisions of distance for accepting witnesses?

The advantages of using visibility of the new crescent within Israel are:

- (1) The definition is simple.
- (2) It is consistent with Num 10:10.
- (3) It avoids confusion.
- (4) Over 90 percent of the time it is not a borderline situation and it is predictable.
- (5) This, along with the IDL, best fulfills the philosophical principles stated at the beginning of this study.

The use of the IDL for the 24-hour day, starting with sundown as it gradually sweeps across the globe, has attained worldwide acceptance by keepers of the Sabbath, and this principle for the start of a month has been accepted by mainstream Judaism (Orthodox, Conservative, and Reformed), and the Karaites also accept it, but typically starting one or two days later than the MCJC. This method does cause people to the east of Israel up to the IDL to begin to observe the first day of the seventh month prematurely, perhaps on some occasions causing two days of observance. In ancient times Israel did the same thing as indicated in I Sam 20:27, 34. Hence this is not a significant fault. The sighting of the new crescent from within the boundaries of Israel should determine the day, and this day should be accepted around the world based upon the IDL with sundown as it sweeps across the globe.

[65] Two Web Sites with New Crescent Reports from Israel

There are two web sites hosted from Israel that report on new moon sightings from Israel, and they do not consider reports from outside Israel to be significant. One of them is hosted by Dr. Roy Hoffman, who works for

the Department of Organic Chemistry of The Hebrew University in Jerusalem (see www.geocities.com/royh_il/). I have seen some emails forwarded to me that make it clear that Dr. Hoffman favors the Rabbinic writings and the commentaries by Orthodox Jewish sources. Some of his reports of borderline sightings of the new crescent are more detailed than the other web site. The other one is hosted by Nehemia Gordon, a spokesman for the Karaites in Israel (see www.karaite-korner.org). These web sites provide information of sightings, and then those that receive the emails are free to decide whatever they want on the basis of these reports. Nehemia Gordon tends to make statements that state what month this is on the basis of his tenets, but no one is forced to agree with his conclusions.

[66] Appendix A: Nisanu 1 in the Babylonian Calendar Compared to the Vernal Equinox during the Century of Ezra and Nehemiah

The use of Babylonian month names in Ezra 6:15 and Neh 6:15 in the context of Jerusalem makes it relevant to examine the actual dates of the vernal equinox compared to Nisanu 1 of the Babylonian calendar during the 100 years from 499 to 400 BCE, which is the century of Ezra and Nehemiah. The month name Nisanu was transliterated to Nisan by the Jews in the context of Jerusalem. The first chart shown in this appendix makes it clear that the vernal equinox separated the first month Nisanu from the last month of the old year. The adoption of the Babylonian month names in Scripture shows the acceptance of the rule of the vernal equinox in the calendar of Jerusalem.

Before the year 499 BCE the Babylonian calendar year's first month named Nisanu did not follow any regular pattern with respect to the vernal equinox. From that date onward a 19-year cycle was accepted for Nisanu by the Babylonians. By this I mean that there were 235 lunar months in each successive 19 years, and among these 235 months, the month numbers that were called Nisanu were numerically repeated. Each 19 years in the cycle had 12 years that contained 12 months and 7 years that contained 13 months. The sequence of the years among the 19 that had 13 months was repeated in each successive 19 years. In the years that had 13 months, the extra month is called the intercalary month. This cycle was begun by the Babylonians.

The first day of Nisan in the Babylonian calendar since 499 BCE fell on or after the vernal equinox. Although Parker and Dubberstein show an exception to this in the year 384 (page 34), this alleged exception should be

corrected because it is now regarded to be a faulty examination of a cuneiform text; see pp. 14 and 16 in Aaboe and others 1991

This appendix features a chart consisting of the 100 years from 499 to 400 BCE. For each year the date and time of the vernal equinox is stated and the date of the first day of the first month, Nisanu 1, is stated. Both dates are according to the Julian calendar. For each Julian date given, the Babylonian day began on the evening that came before the Julian date (the latter is based upon a midnight-to-midnight day). Determination of the vernal equinox for these 100 years was made using the computer program BRESIM (see the bibliography). This program is noted for its accuracy into ancient times for the vernal equinox, but not for the position of the moon.

The book by Richard Parker and Waldo Dubberstein 1956 contains data that has its origin in the writings on the cuneiform inscriptions on ancient clay tablets from Babylon, most of which are in the British museum. The two keys to the whole enterprise are: (1) The eclipse records on the clay tablets; and (2) The number of years of the reign each of the of the kings who ruled over the Mesopotamian region. The lengths of reign of these kings are in the writings of Claudius Ptolemy (c. 150). The results of this book are based upon modern astronomy and calculations that go backwards in time to verify the accuracy in time of the data on the clay tablets. The Julian calendar dates that equate to Nisanu 1 during these 100 years are taken from pages 29 –33 of this book.

The book by Richard Parker and Waldo Dubberstein provides Julian calendar dates for the ancient Babylonian calendar. Eclipse records from ancient Babylon were used to determine those years that had 13 months rather than 12 months. The underlying data that was used by Parker and Dubberstein was examined by Fatoohi and others in a paper from 1999. The conclusion on page 52 is that only 209 out of about 8670 new moons in this book are provably based upon actual sighting by the Babylonians. All the other new moons in this book are calculated based upon the methods of Karl Schoch (see page 57 of Fatoohi and others). None of the 100 months that began Nisanu in the chart below are among these 209 actual sightings of the new crescent from Babylon. One day errors in Parker and Dubberstein may be due to: (1) Any borderline case in Schoch's curve at the end of the 29th day where the true result is different (this might be true about 7 percent of the time); (2) Poor weather that caused an otherwise visible crescent at the

end of the 29th day to not be seen; and (3) A mistake in calculation noting that this book was prepared before the general availability of computers.

The chart does verify that the vernal equinox is indeed the borderline that determines the beginning of Nisanu, the first month in the Babylonian calendar. But additional care must be exercised in the small number of cases where Nisanu 1 occurs on the vernal equinox or one day away from it. The critical cases are examined separately in another chart afterward. For this second purpose the time of the astronomical new moon that is published in Goldstine is first used. This source takes into consideration the value of delta T, which is the cumulative effect of the change of the length of the day, which is the result of the slowing of the earth's rate of rotation on its axis due to tides, the wind against the land, the drag of the earth's semi-liquid core against its outer mantel, etc. According to page 60 of Fatoohi and others, the estimate of delta T is 4.66 hours in 501 BCE. Most computer programs do not have great accuracy that far back in time.

Then the number of hours from the astronomical new moon to sunset is computed, and this is used to check the reasonableness of the date in Parker and Dubberstein.

A friend of mine, Rob Anderson, wrote a computer program based upon the Hewlett-Packard 3000 minicomputer and its unique operating system in 1980-1982. This program was modeled after Schoch's curve, and all the months of the 20th century near the equinoxes were used in order to determine the minimum required time from the astronomical new moon to sunset in order to be able to see the new crescent, but only the latitude of Jerusalem was used. This program determined that during the vernal equinox the minimum required time varied from 16 to 24 hours, and during the autumnal equinox the minimum required time varied from 18 to 48 hours. This is corroborated by page 46 of Wiesenberg. This range of hours depends on the angle between the ecliptic (the angle of the path of the sun) and the western horizon. This means that for Nisanu 1 the benchmark for comparison is the time interval between 16 and 24 hours. For the critical years in our situation, it happens that this rule alone is sufficient to determine the first day of visibility of the new crescent, provided the weather was clear.

The journey of Ezra to Jerusalem mentioned in Ezra 7:7-9 is stated there to have occurred in the seventh year of Artaxerxes. According to page 32 of

Parker and Dubberstein this was in the year 458 BCE, accepting that Ezra entered Jerusalem before Nehemiah. The books by Horn and Wood, by Bo Reicke, and by Kenneth Hoglund, accept or favor Ezra as settling in Jerusalem before Nehemiah, and this is the traditional understanding. Eventually Ezra and Nehemiah are in Jerusalem together (Neh 8:9; 12:26). While opinions may be found that favor the opposite (Nehemiah preceding Ezra), such opinions doubt the veracity of the stated accounts in Ezra and Nehemiah. Discussion of this may be found on pages 89-93 of Horn and Wood, pages 14-19 of Reicke, pages 40-44 of Hoglund, and pages 98-106 of Grabbe 1991. Since Ezra 7:7 mentions the seventh year of King Artaxerxes and Neh 2:1 mentions the 20th year of King Artaxerxes, it appears that Nehemiah journeyed to Jerusalem about 13 years after Ezra. I accept Ezra's entry in 458 BCE and Nehemiah's entry about 445 BCE, but only with the understanding that if the method of numbering the year of reign was shifted by half a year in Judah compared to Babylon, then these years might instead be 457 BCE and 444 BCE. The commentaries differ on this and I do not have a firm opinion.

In the table below the time is based on Greenwich, England as given in the program BRESIM. Conversion to the time zone of Babylon could be accomplished by adding three hours. The critical years for the vernal equinox compared to the new moon in this table are 484, 465, 446, 427, and 408. These years are used for further analysis in the second table below.

There are three times in the 100 years when the day prior to the vernal equinox was a new moon day. All three times this new moon day began an intercalary month (a month added beyond the 12 normal months) called the second Adar, the 13th month. These dates are March 25, 454 BCE, March 25, 435 BCE, and March 25, 416 BCE.

Vernal Equinoxes compared to Nisanu 1 in Babylonian Calendar

Date BCE	Time V.E.	Nisanu 1	Date BCE	Time V.E.	Nisanu 1
3-27-499	00:29	4-11	3-26-449	03:07	3-29
3-27-498	06:22	3-31	3-26-448	08:50	4-16
3-26-497	12:10	4-18	3-26-447	14:36	4-06
3-26-496	18:04	4-08	3-26-446	20:30	3-26
3-26-495	23:43	3-28	3-26-445	02:26	4-13
3-27-494	05:36	4-16	3-26-444	08:14	4-03
3-26-493	11:35	4-04	3-26-443	14:02	4-22

3-26-492	17:13	4-23	3-26-442	20:00	4-11
3-26-491	23:06	4-12	3-26-441	01:50	3-31
3-27-490	04:56	4-02	3-26-440	07:37	4-18
3-26-489	10:40	4-19	3-26-439	13:27	4-07
3-26-488	16:30	4-09	3-26-438	19:17	3-28
3-26-487	22:08	3-30	3-26-437	01:06	4-14
3-27-486	03:57	4-18	3-26-436	06:48	4-04
3-26-485	09:52	4-06	3-26-435	12:33	4-23
3-26-484	15:27	3-26	3-26-434	18:28	4-13
3-26-483	21:17	4-14	3-26-433	00:20	4-01
3-27-482	03:15	4-03	3-26-432	06:04	4-20
3-26-481	09:05	4-21	3-26-431	11:50	4-09
3-26-480	15:03	4-11	3-26-430	17:39	3-29
3-26-479	20:50	3-31	3-25-429	23:26	4-16
3-27-478	02:40	4-19	3-26-428	05:09	4-05
3-26-477	08:38	4-08	3-26-427	10:56	3-26
3-26-476	14:16	3-28	3-26-426	16:50	4-14
3-26-475	20:04	4-15	3-25-425	22:42	4-03
3-27-474	01:59	4-05	3-26-424	04:27	4-22
3-26-473	07:42	4-22	3-26-423	10:18	4-11
3-26-472	13:30	4-12	3-26-422	16:18	3-31
3-26-471	19:13	4-01	3-25-421	22:10	4-18
3-27-470	01:01	4-21	3-26-420	03:59	4-07
3-26-469	06:59	4-09	3-26-419	09:47	3-27
3-26-468	12:40	3-29	3-26-418	15:37	4-15
3-26-467	18:27	4-17	3-25-417	21:28	4-04
3-27-466	00:22	4-06	3-26-416	03:09	4-23
3-26-465	06:07	3:25	3-26-415	08:53	4-13
3-26-464	11:56	4-13	3-26-414	14:44	4-02
3-26-463	17:43	4-03	3-25-413	20:25	4-19
3-26-462	23:32	4-22	3-26-412	02:07	4-08
3-26-461	05:28	4-11	3-26-411	07:55	3-29
3-26-460	11:09	3-31	3-26-410	13:50	4-17
3-26-459	16:58	4-19	3-25-409	19:46	4-05
3-26-458	22:57	4-08	3-26-408	01:34	3-26
3-26-457	04:49	3-27	3-26-407	07:22	4-14
3-26-456	10:40	4-15	3-26-406	13:20	4-03

3-26-455	16:29	4-04	3-25-405	19:07	4-21
3-26-454	22:16	4-23	3-26-404	00:52	4-10
3-26-453	04:06	4-12	3-26-403	06:45	3-30
3-26-452	09:46	4-02	3-26-402	12:34	4-18
3-26-451	15:29	4-20	3-25-401	18:25	4-07
3-26-450	21:22	4-10	3-26-400	00:10	3-27

The table below has the five critical years from the above table that the new moon occurs in close proximity to the vernal equinox. The column headed “Astronomical New Moon” has data that comes from the reference Goldstine (its computation is based on the time zone from Babylon), but three hours were subtracted to convert from the time zone of Nineveh to Greenwich time. The column headed “Sunset” has data that comes from the computer program “LoadStar Professional”; this has an adjustment for delta T and it verifies the dates for Nisanu 1 according to Schoch’s curve for the years below as given in Parker and Dubberstein. The ancient city of Nineveh was used as the location in Babylon. It is located where Mosul, Iraq is today, and its coordinates are longitude 43 degrees east, latitude 36 degrees 9 minutes north.

Vernal Equinox BCE	Astro-nomical New Moon	Sunset Nineveh (Greenwich time)	Hours from conjunction to sunset	Expected New Moon (from hours)	Parker & Dub. Prior New Moon	Number of days in the prior month
3-26-484 15:27	3-24-484 02:02	3-24 15:18	13:16	3-26	2-24	30
3-26-465 06:07	3-23-465 14:55	3-24 15:18	24:23	3-25	2-25 leap yr	29
3-26-446 20:30	3-24-446 11:35	3-25 15:19	24:44	3-26	2-25	29
3-26-427 10:56	3-24-427 12:09	3-25 15:19	27:10	3-26	2-25	29
3-26-408 01:34	3-24-408 11:07	3-25 15:19	28:12	3-26	2-25	29

In the above table the expected new moon always agrees with the computed date from Schoch’s curve as given in Parker and Dubberstein. In all cases except 465 BCE the expected new moon is the date of the vernal equinox. In 465 BCE it is possible that bad weather did not allow the new crescent to be seen, so that the old month had 30 days instead of 29 days, and the actual Nisanu 1 was March 26 instead of March 25. Three hours would have to be added to attain the time zone of Nineveh. In all of these cases the following rule would work out correctly. Find the date of the noontime which is closest to the time of the vernal equinox. That date is counted as the date of the vernal equinox.

[67] Appendix B: Karl Schoch's Table for Visibility of the New Crescent

This chart is taken from page 162 of Fotheringham. It was created using apparent geocentric coordinate positions. I usually use LoadStar software.

The azimuth of the sun at the time of sunset is taken. Then the azimuth of the moon at the time of sunset is taken. The smaller of these two numbers is subtracted from the larger, and the result is called the azimuth difference. For a given azimuth difference, if the altitude (= angular height) of the moon at sunset is greater than the table value, the moon is likely to be visible in that evening. Plus or minus half a degree in altitude is considered borderline.

Azimuth difference in degrees, at sunset	Altitude of the moon in degrees, at sunset	Azimuth difference in degrees, at sunset	Altitude of the moon in degrees, at sunset
0	10.4	11	9.1
1	10.4	12	8.9
2	10.3	13	8.6
3	10.2	14	8.3
4	10.1	15	8.0
5	10.0	16	7.7
6	9.8	17	7.4
7	9.7	18	7.0
8	9.5	19	6.6
9	9.4	20	6.2
10	9.3	21	5.7

Borderline example 1: Cisco, Texas. Latitude: 32 degrees 30 minutes north. Longitude: 99 degrees 0 minutes west. Date: Friday, March 31, 1995. A group of people were together in Cisco, and all were looking for the new crescent. About half of them were able to see it and point to it, but the others with them could not see it. The humidity was about 35 percent, and the skies were clear. Sunset converted to Greenwich time was 0:55 April 1, 1995. The azimuth of the sun at sunset was 275 degrees 36' 39" (= 275.61 degrees). The azimuth of the moon at sunset was 275 degrees 1' 47" (= 275.03 degrees). Hence the azimuth difference is 0.58 degrees. The altitude of the moon at sunset was 10 degrees 10' 0" (= 10.17 degrees). According to Schoch's curve, for an azimuth difference of 0.58 degrees the moon's

altitude needs to be 10.4 degrees, but it was only 10.17 degrees, which is 0.23 degrees below Schoch's curve. This borderline case for sighting was achieved at 0.23 degrees under Schoch's curve.

Borderline example 2: Location is 20 miles northwest of Eilat, Israel. Latitude: 29 degrees 48 minutes north. Longitude: 34 degrees 53 minutes 24 seconds east. Date: Thursday, September 28, 2000. A group of 10 people were together with tripods and binoculars in the dry desert on top of a small hill, and all were looking for the new crescent. Only three of the 10 were able to see the crescent with the naked eye although they all knew exactly where to look. The humidity was low, perhaps 20 percent, and the skies were clear. Sunset converted to Greenwich time was 15:29. The azimuth of the sun at sunset was 267 degrees 45' 45" (= 267.7625 degrees). The azimuth of the moon at sunset was 262 degrees 17' 56" (= 262.2989 degrees). Hence the azimuth difference is 5.4636 degrees. The altitude of the moon at sunset was 9 degrees 36' 44" (= 9.612 degrees). According to Schoch's curve, for an azimuth difference of 5.4636 degrees the moon's altitude needs to be 9.907 degrees, but it was only 9.612 degrees, which is 0.295 degrees below Schoch's curve. This borderline case for sighting was achieved at 0.295 degrees under Schoch's curve.

Conclusion: It would seem to be very difficult to see the new crescent with the naked eye from the latitudes of Israel below 4000 feet above sea level when the altitude of the moon is below 0.3 degrees under Schoch's curve. The likelihood of seeing the new crescent with the naked eye clearly recognizable for a while below 0.5 degrees under Schoch's curve seems almost impossible.

[68] Appendix C: Time from Sunrise to Sunset to compare with the Vernal Equinox

This table has the number of hours of daylight for four cities that represent four latitudes in the United States. The time of daylight is the time from sunrise to sunset. Only the dates near the two equinoxes are shown.

	New Orleans 30 deg N	Memphis 35 deg N	Philadelphia 40 deg N	Minneapolis 45 deg N
Mar.15	11:57	11:57	11:55	11:53
Mar.16	12:00	11:58	11:57	11:55
Mar.17	12:02	12:00	12:00	11:58
Mar.18	12:03	12:03	12:03	12:03
Mar.19	12:05	12:05	12:05	12:05
Mar.20	12:07	12:08	12:08	12:08
Mar.21	12:09	12:10	12:11	12:12
Sep.22	12:09	12:09	12:11	12:11
Sep.23	12:07	12:07	12:08	12:08
Sep.24	12:06	12:06	12:05	12:06
Sep.25	12:03	12:03	12:03	12:03
Sep.26	12:01	12:01	12:00	11:59
Sep.27	12:00	11:58	11:57	11:56
Sep.28	11:58	11:57	11:55	11:53
Sep.29	11:57	11:54	11:52	11:50

The above data is calculated from tables in SUNRISE. This data is based upon values for 1966, which may vary by one or two minutes in certain years. The vernal equinox occurred on March 21, 1966 at 01:53 Greenwich time. The autumnal equinox occurred on September 23, 1966 at 11:43. This shows the influence of refraction near the eastern and western horizons at varying latitudes. Equal day and night do not occur on the same dates for all latitudes. Equal day and night occur a few days before the vernal equinox and a few days after the autumnal equinox.

[69] Appendix D: Comparing the Sighting of the New Crescent with MCJC

This appendix compares the theoretical sighting of the new crescent from Jerusalem with the first day of the first and seventh months in the modern calculated Jewish calendar (= MCJC) using the software written by Rob Anderson (see the Preface). This study is based upon 200 months in the years 1901 to 2000 inclusive. In order for a month to be included in the table, it had to be declared the first month (Nisan) or the seventh month (Tishri) according to the MCJC.

In the table below each year has six columns to its right, the first three relate to the first day of the first month based upon the MCJC, and the last three relate to the first day of the seventh month based upon the MCJC. All of the dates are based upon the daylight part of the day, although the biblical day begins the previous numbered day at sundown. The date of a conjunction is the sundown-to-sundown day upon which the astronomical new moon occurred, but the date of the daylight part of the day is used. To make the comparison with the MCJC simpler, the columns with the conjunction show the number of days of adjustment to the MCJC that must be made to obtain the conjunction. The columns that are labeled “New crescent” are based upon the daylight part of the day for which the new crescent was theoretically visible the previous evening based upon Karl Schoch’s curve as computed by Rob Anderson’s computer program. The number in that column shows the number of days to add to the MCJC column at its left in order to obtain the date of the new crescent.

The conjunction agrees with the MCJC 26 times out of 200, which is 13 percent. The new crescent agrees with the MCJC 45 times out of 200, which is 22.5 percent.

Year	Conjunction	MCJC	New crescent	Conjunction	MCJC	New crescent
1901	-1	Mar.21	1	-2	Sep.14	1
1902	0	Apr.8	2	-1	Oct.2	2
1903	0	Mar.29	2	-1	Sep.22	1
1904	0	Mar.17	2	-1	Sep.10	2
1905	-2	Apr.6	1	-2	Sep.30	1
1906	-3	Mar.27	0	-2	Sep.20	0

1907	-2	Mar.16	0	-2	Sep.9	1
1908	-1	Apr.2	1	-1	Sep.26	1
1909	-2	Mar.23	0	-2	Sep.16	0
1910	-1	Apr.10	1	-1	Oct.4	1
1911	0	Mar.30	2	-1	Sep.23	2
1912	-1	Mar.19	2	-1	Sep.12	1
1913	-2	Apr.8	0	-2	Oct.2	0
1914	-2	Mar.28	1	-2	Sep.21	1
1915	-1	Mar.16	2	0	Sep.9	3
1916	-2	Apr.4	0	-1	Sep.28	2
1917	-1	Mar.24	1	-1	Sep.17	2
1918	-2	Mar.14	0	-2	Sep.7	1
1919	-1	Apr.1	1	-1	Sep.25	2
1920	0	Mar.20	2	-1	Sep.13	2
1921	-1	Apr.9	1	-2	Oct.3	0
1922	-2	Mar.30	0	-2	Sep.23	0
1923	-1	Mar.18	1	-1	Sep.11	2
1924	-1	Apr.5	1	-1	Sep.29	2
1925	-2	Mar.26	0	-1	Sep.19	1
1926	-2	Mar.16	0	-2	Sep.9	0
1927	-1	Apr.3	1	-2	Sep.27	1
1928	-1	Mar.22	1	-1	Sep.15	1
1929	-2	Apr.11	0	-3	Oct.5	0
1930	0	Mar.30	2	-1	Sep.23	1
1931	0	Mar.19	2	0	Sep.12	2
1932	-1	Apr.7	1	-1	Oct.1	1
1933	-2	Mar.28	0	-2	Sep.21	1
1934	-2	Mar.17	0	-1	Sep.10	1
1935	-1	Apr.4	1	-1	Sep.28	2
1936	-1	Mar.24	1	-2	Sep.17	1
1937	-1	Mar.13	1	-2	Sep.6	1
1938	-2	Apr.2	0	-3	Sep.26	0
1939	0	Mar.21	2	-1	Sep.14	2
1940	-2	Apr.9	1	-2	Oct.3	0
1941	-2	Mar.29	1	-1	Sep.22	1
1942	-3	Mar.19	0	-2	Sep.12	1
1943	-2	Apr.6	1	-1	Sep.30	1
1944	-1	Mar.25	1	-1	Sep.18	1

1945	-1	Mar.15	1	-2	Sep.8	0
1946	0	Apr.2	2	-1	Sep.26	1
1947	0	Mar.22	2	-1	Sep.15	1
1948	-1	Apr.10	1	-2	Oct.4	1
1949	-2	Mar.31	0	-2	Sep.24	0
1950	-1	Mar.19	1	0	Sep.12	2
1951	-1	Apr.7	1	0	Oct.1	2
1952	-2	Mar.27	0	-1	Sep.20	2
1953	-2	Mar.17	0	-2	Sep.10	1
1954	-1	Apr.4	1	-1	Sep.28	2
1955	0	Mar.24	2	-1	Sep.17	2
1956	-1	Mar.13	1	-2	Sep.6	1
1957	-2	Apr.2	0	-3	Sep.26	0
1958	-2	Mar.22	0	-2	Sep.15	1
1959	-1	Apr.9	1	-1	Oct.3	1
1960	-2	Mar.29	0	-2	Sep.22	1
1961	-2	Mar.18	0	-1	Sep.11	1
1962	-1	Apr.5	1	-1	Sep.29	2
1963	-1	Mar.26	1	-2	Sep.19	1
1964	0	Mar.14	2	-1	Sep.7	1
1965	-1	Apr.3	1	-2	Sep.27	0
1966	0	Mar.22	2	-1	Sep.15	1
1967	-2	Apr.11	1	-2	Oct.5	1
1968	-2	Mar.30	1	-1	Sep.23	2
1969	-2	Mar.20	0	-2	Sep.13	1
1970	-1	Apr.7	1	-1	Oct.1	2
1971	-1	Mar.27	1	-1	Sep.20	2
1972	-1	Mar.16	1	-2	Sep.9	1
1973	0	Apr.3	2	-1	Sep.27	2
1974	-1	Mar.24	2	-1	Sep.17	1
1975	-1	Mar.13	2	-1	Sep.6	2
1976	-2	Apr.1	0	-2	Sep.25	1
1977	-1	Mar.20	2	0	Sep.13	2
1978	-1	Apr.8	1	0	Oct.2	2
1979	-1	Mar.29	1	-1	Sep.22	1
1980	-2	Mar.18	0	-2	Sep.11	0
1981	-1	Apr.5	1	-1	Sep.29	1
1982	0	Mar.25	2	-1	Sep.18	1

1983	-1	Mar.15	1	-1	Sep.8	1
1984	-2	Apr.3	0	-2	Sep.27	0
1985	-2	Mar.23	0	-2	Sep.16	1
1986	-1	Apr.10	1	-1	Oct.4	2
1987	-2	Mar.31	0	-1	Sep.24	1
1988	-1	Mar.19	1	-1	Sep.12	2
1989	0	Apr.6	2	-1	Sep.30	3
1990	-1	Mar.27	1	-1	Sep.20	2
1991	0	Mar.16	2	-1	Sep.9	2
1992	-1	Apr.4	1	-2	Sep.28	1
1993	0	Mar.23	2	0	Sep.16	2
1994	-1	Mar.13	1	-1	Sep.6	2
1995	-1	Apr.1	1	-1	Sep.25	2
1996	-2	Mar.21	0	-2	Sep.14	1
1997	-1	Apr.8	1	-1	Oct.2	2
1998	0	Mar.28	2	-1	Sep.21	2
1999	-1	Mar.18	1	-2	Sep.11	1
2000	-2	Apr.6	0	-3	Sep.30	0

On the evening that ends September 28, 2000 the new crescent was seen by three people in a group of 10 that specifically went to a good sighting location about 20 miles northwest of Eilat, Israel (see appendix B). This made September 29 the day of the new crescent, so that for the year 2000, the actual number was –1 instead of 0.

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