

This letter was written in response to questions of brethren in New Zealand concerning the accuracy of the Hebrew Calendar and its declarations for the feast days of 2002.

April 30, 2002

Dear Steve,

I am happy to hear that you continue to observe the holy days as calculated by the Hebrew Calendar. It is sad that two thirds of the brethren have rejected the Hebrew Calendar because it appears to conflict with their own personal observation. I realize the depth of your concern and have carefully researched the issues you raised in order to accurately present the facts.

Your email listed three issues of concern: (1) the accuracy of Fred's comments regarding the moon being full on Nisan 15 (2) your observation that the full moon of Nisan was full two days later this year; i.e., on Nisan 17 (3) your concern that the full moon of Tabernacles 2002 would apparently occur two days later than declared by the Hebrew Calendar.

In order to address these issues, we must first define the term "full moon." The moon is full when the entire face of the moon reflects sunlight to the earth. Although the moon may *appear* to be full for a prolonged period of time, the astronomical full moon occurs for only a split second, when the level of illumination reaches 100%. This moment in time is the same moment all over the earth.

As the moon approaches the full stage, it is common for it to remain at an illumination above 98% for many, many hours. The same principle applies to the period immediately following 100% illumination. To the human eye, the moon may appear to be full for several days due to sustained levels of illumination.

At your latitude and longitude in New Zealand, the moon entered 98% illumination shortly after moonset the morning of Thursday, March 28. The moon's illumination intensified through 99%, peaking at 100% illumination

for a split second, declined through 99% illumination and finally through 98% illumination. The moon exited a 98% illumination just before 12 noon on Saturday, March 30. Thus for 52 hours it was above a 98% illumination. This was the “full moon” that you and the other brethren observed this Passover season.

The full moon this spring was a special occurrence. The moon appeared bigger than usual and the illumination was 16 to 17% brighter than average. There are two reasons for this: (1) the moon was very close to perigee (the point closest to the earth in its orbit) and (2) the earth was 1.6% closer to the sun. The following report from NASA will explain more fully. (Click on the perigee/apogee hyperlinks for further study if you wish.)

"Not all full Moons are alike," says astronomy professor George Lebo. "Sometimes pollution or volcanic ash shades them with interesting colors. Sometimes haloes form around them -- a result of ice crystals in the air."

"This full Moon is unique in another way," he says. "It will be closer to Earth than usual."

The apparent size of the Moon at [perigee](#) and [apogee](#).

"The moon's orbit around our planet is not a perfect circle," Lebo explains. "It's an ellipse." At one end of the ellipse (called apogee) the Moon lies 406,700 km from Earth. At the other end (called perigee) the Moon is only 356,400 km away -- a difference of 50 thousand km!

When the Moon is full on Feb. 27th it will be near perigee -- close to Earth. As a result the Moon will appear 9% wider than normal and shine 20% brighter.

The extra moonlight is caused, in part, by the Moon's nearness to Earth. But that's not all. The Sun is closer to Earth, too. Lebo explains: "Every year during northern winter, Earth is about 1.6% closer to the Sun than normal. (Like the Moon's orbit around Earth, Earth's orbit around the Sun is elliptical. Our closest approach to the Sun is called perihelion.) The Moon reflects sunlight, so the Moon is brighter during that time."

This effect should not to be confused with the famous "Moon Illusion" -- a trick of the eye that makes Moons rising near the horizon appear swollen. The nearby full Moon this week really will be bigger and brighter.

The brightness of full Moons in 2002 relative to that of an average full Moon. In Feb., for example, the Moon will be 20% brighter than average; in Aug. it will be 12% dimmer. These values take into account the varying distances of the Moon from Earth and of the Earth from the Sun.

The first three full Moons of 2002 are all brighter-than-average. All three happen when the Moon is near perigee, and when Earth is relatively close to the Sun. Full Moons later this year will be smaller and dimmer by comparison. For example, August's full Moon -- an "apogee Moon" -- will be about one-third dimmer than February's.

But will anyone notice the difference?

"The human eye can easily discern a 20 or 30% difference in the brightness of two similar light sources," says eye doctor Stuart Hiroyasu. By that reckoning, a sky watcher could tell the difference between a bright perigee Moon and a dimmer apogee Moon. But the two Moons would have to be side by side to effect the comparison -- not likely except in a science fiction movie!

http://science.nasa.gov/headlines/y2002/26feb_bigmoonshine.htm

These facts help to explain the prolonged high level of illumination of the March moon. It is this very phenomenon that prevents the determination of the holy days by observation. The human eye cannot discern the difference between 98% and 100% of disc illumination. Furthermore, since differing levels of illumination may be seen at any given time, depending on one's geographical location, it is important to remember that the point of reference, according to Scripture, is Jerusalem. The determination of the full moon is based on the highest possible illumination for the area of Jerusalem, whether or not illumination in other geographical regions has attained the highest point. In addition, the calculation of the highest illumination possible is not made for the moon of Nisan 15, but for the moon of Tishri 15. This single calculation sets the date of both holy days, since there is a fixed period of 177 days between the two.

Very few of our brethren are aware of the complex mathematics that are involved in the calculations of the Hebrew Calendar. These calculations must take into account the countless irregularities in the orbit of the moon over many centuries, which must be reconciled with the fixed period of days between Nisan 15 and Tishri 15. There are many years in which the orbit of the moon does not allow a full 100% illumination on the eve beginning these two holy days.

The math underpinning the Hebrew Calendar calculates to the highest possible percentage of disc illumination for Tishri 15. The Hebrew Calendar then calculates forward to the month of Elul, the month just before the next Tishri. This is done to ensure the highest possible percentage of disc

illumination for the next Tishri 15. The best possible illumination for Nisan 15 is sandwiched between the best possible illuminations of two Tishri 15's. All of this must be viewed as a continuum within each 19-year cycle, which repeats over periods of centuries. Due to the irregularity of the moon's orbit (over 5,000 perturbations recorded to date), it is an astronomical impossibility that a perfect 100% illumination occur for both holy days in every year continuously over the decades and centuries. Although in most years the level of illumination will reach the 99 percentile and above, in one or two years of each 19-year cycle, illumination may dip to a low of 96-97% in Jerusalem (94-95% in other parts of the world). In view of these facts, let us consider the full moon just observed in New Zealand during the Passover/Unleavened Bread season of 2002.

Auckland Nisan 15, 2002

Viewing from Auckland, New Zealand, the moon rose at 5:48 PM (05:48 UT)* the night of Wednesday, March 27, beginning the High Sabbath of Nisan 15 at 13.0 days of age with a disc illumination of 96.34% waxing. When the moon set Thursday morning, March 28, at 5:12 AM (17:12 UT) Auckland time, it had advanced in age to 13.5 days with a disc illumination of 97.85% waxing. Later that Thursday, March 28, during the daylight hours of the High Sabbath, around 2 PM (02:00 UT), the moon reached a 99% disc illumination. When the moon rose at 6:23 PM (06:23 UT) Auckland time Thursday evening, March 28, it had advanced to an age of 14.2 days with a disc illumination of 99.40% waxing.

The moon above Auckland continued to wax after the end of the High Day. When the moon set at 6:27 AM (18:27 UT) Auckland time, Friday morning, March 29, it had advanced in age to 14.8 days with a disc illumination of 99.80% waxing. The moon reached 100% illumination at 7:25:57 AM (19:25:57 UT), Friday morning, March 29. When the moon

* Daylight Savings Time ended on Sunday, March 17, 2002, at 3:00:00 AM local daylight time. Daylight Savings Time starts on Sunday, October 6, 2002, at 2:00:00 AM local standard time.

rose at 6:56 PM (06:56 UT) Auckland time, Friday evening, March 29, it had advanced to an age of 15.4 with a disc illumination of 99.30 % waning. The moon remained at 99% illumination until 11:44:34 PM (11:44:34 UT), Friday, March 29, Auckland time, when it dropped to 98.99% waning. The moon had remained at 99% illumination for nearly 34 hours.

The fact that the moon did not reach its highest illumination before the holy day ended in New Zealand should not be construed as evidence of the inaccuracy of the Hebrew Calendar. New Zealand is the first major country in the world to observe the holy days. Since the days designated by the Hebrew Calendar as Nisan 15 and Tishri 15 arrive several hours earlier in New Zealand than in Jerusalem, and the full moon is calculated from Jerusalem, the level of illumination in New Zealand may be noticeably lower than that in Jerusalem. During the current 19-year cycle, for example, the full moon of Nisan 15 at Auckland drops to 96.34% in 2002 and to 94.45% in 2013. During the other 17 years, however, illumination will range from 97.44% in 1997 to a high of 99.88% in both 2004 and 2011 (see Appendix A). In 7 of the 19 years, Nisan 15 will begin with a 99%+ disc illumination. And, in another 7 of the 19 years, the degree of illumination will reach 98% +. The average illumination for the current cycle at Auckland is 98.46%.

Comparing these facts with those of Jerusalem for the same 19-year period, we learn that 14 of the 19 years will have a 99%+ disc illumination, and 3 years will have a 98%+ disc illumination. Only 2 years will have a lower disc illumination, one of 96.25% and the other of 97.98% (see Appendix B). The average illumination for the current cycle at Jerusalem is 99.20%. This factors to .74% above Auckland's average illumination.

When we lay the figures side by side, we can see that the level of illumination for Nisan 15 in Auckland this year is not an aberration or error in calendrical calculations. Typically, one or two years out of each 19-year cycle will dip in disc illumination below 97%. This phenomenon, which is a result of the variations in the moon's orbit, has existed since Old Testament times. It was in effect long before the birth of Jesus, and remained in effect throughout His ministry. In 27 AD (the first full year of His ministry), the level of illumination for Nisan 15 at Jerusalem dipped to a low of 96.96%. In 33 AD, however, disc illumination for Nisan 15 reached a high of 99.98%. The average for that 19-year cycle was 99.00%.

The highest degree of illumination for Auckland during the present 19-year cycle will be 99.88% waxing in 2004 AD and again in 2011 AD. The highest degree of illumination for Jerusalem during this cycle will be 99.93% waxing in 2003 AD—a mere .05% above that of Auckland. The average illumination for Auckland during this cycle will be 98.46%, while Jerusalem’s will be 99.20%—a mere .74% difference.

The fact that disc illumination at Jerusalem does not consistently attain 100% for the days that the Hebrew Calendar designates as Nisan 15 and Tishri 15 may be quite disturbing to many brethren. They view each year as a unit of time independent of the years that must follow, and therefore see no problem in observing Nisan 15 one or two days later than the date designated by the Hebrew Calendar. Let us compare the illumination for Nisan 15 and Nisan 16 at Jerusalem to see the result of postponing Nisan 15 for one day.

Jerusalem Nisan 15, 2002

Viewing from Jerusalem, Israel, the moon rose at 4:31 PM (14:31 UT), Jerusalem time, Wednesday evening, March 27, beginning the first High Sabbath of Nisan 15 at 13.4 days of age with a disc illumination of 97.98% waxing. The moon reached a 99% disc illumination on the High Sabbath at 3:18:19 AM (01:18:19 UT) Jerusalem time, Thursday morning, March 28. When the moon set at 5:29 AM (03:29 UT) Jerusalem time, Thursday morning, March 28, it had advanced in age to 14.0 days with a disc illumination of 99.19% waxing. When the moon rose at 5:43 PM (15:43 UT) Jerusalem time, Thursday evening, March 28, it had advanced in age to 14.6 days with a disc illumination of 99.83% waxing.

An analysis of the above data reveals the following regarding the length of disc illumination at or above 99%:

Moonrise	4:31 PM	March 27	97.98% waxing
Moon Transit	3:18:19 AM	March 28	99.00% waxing*
Moonset	5:29 AM	March 28	99.19% waxing
Moonrise	5:43 PM	March 28	99.83% waxing

* Moment at which 99% illumination reached.

Jerusalem Nisan 16, 2002

Viewing from Jerusalem, when the moon rose at 5:43 PM (15:43 UT) Jerusalem time, Thursday evening, March 28. It had advanced in age to 14.6 days with a disc illumination of 99.83% waxing. At the setting of the moon, 7:07 AM (04:07 UT) Jerusalem time*, Friday morning, March 29, the moon had advanced to an age of 15.2 with a disc illumination of 99.69% *waning*. It remained at 99% illumination until about 1 PM (10:00 UT) Jerusalem time, Friday afternoon, March 29, when it dropped to 98.99% *waning*. The moon had remained at 99% illumination for nearly 34 hours. When the moon rose at 7:53 PM (16:53 UT) Jerusalem time, Friday evening, March 29, it had advanced in age to 15.9 days with a disc illumination of 98.32% *waning*.

* Daylight Savings Time started on Friday, March 29, 2002, at 1:00:00 AM local standard time. Daylight Savings Time will end on Monday, October 7, 2002, at 1:00:00 AM local daylight time.

An analysis of the above data reveals the following regarding the length of disc illumination at or above 99%:

Moonrise	5:43 PM	March 28	99.83% waxing
Moonset	7:07 AM	March 29	99.69% <i>waning</i>
Moon Transit	1:00 PM	March 29	98.99% <i>waning</i>
Moonrise	7:53 PM	March 29	98.32% <i>waning</i>

As this comparison shows, the point of 100% illumination occurred on Nisan 16 rather than on Nisan 15. Although it might seem more accurate to postpone the observance of Nisan 15 until the following day, the facts presented below demonstrate that the High Day could not have been postponed for even one day without detracting from the observance of Tishri 15 this year. Remember that the Hebrew Calendar calculates to the greatest possible illumination at Jerusalem for Tishri 15, not for Nisan 15.

Jerusalem Tishri 15, 2002

Viewing from Jerusalem, Israel, the moon will reach a 99% disc illumination just before moonrise at 4:54:46 PM (14:54:46 UT) Jerusalem time, Friday evening, September 20. At moonrise 6:27 PM (15:25 UT) Jerusalem time, Friday evening, September 20, it will advance in age to 13.9 with a disc illumination of 99.03% waxing. When the moon sets at 6:02 AM (03:02 UT) Jerusalem time, Saturday morning, September 21, it will have advanced in age to 14.4 days with a disc illumination of 99.54% waxing. When the moon rises at 6:56 PM (15:56 UT) Jerusalem time, Saturday night, following the High Day, September 21, it will have advanced to an age of 14.8 days with a disc illumination of 99.75% *waning*.

An analysis of the above data reveals the following regarding the length of disc illumination at or above 99%:

Moonrise	6:27 PM	September 20	99.03% waxing
Moonset	6:02 AM	September 21	99.54% waxing
Moon Transit	5:00 PM	September 21	100%
Moonrise	6:56 PM	September 21	99.75% <i>waning</i>

Daylight Savings Time started on Friday, March 29, 2002, at 1:00:00 AM local standard time. Daylight Savings Time will end on Monday, October 7, 2002, at 1:00:00 AM local daylight time.

These astronomical facts confirm the accuracy of the Hebrew Calendar in declaring the full moon of Tishri 15. Although the moon's illumination will actually be higher on the following night, beginning Tishri 16, the moon will already be in the *waning* phase. Before the end of Tishri 16, the level of illumination will drop below 99%, as illustrated below.

Jerusalem Tishri 16, 2002

When the moon rises at 6:56 PM (15:56 UT) Jerusalem time, Saturday night, September 21, it will have advanced to an age of 14.8 days with a disc illumination of 99.75% *waning*. When the moon sets at 6:55 AM (03:55 UT) Jerusalem time, Sunday morning, September 22, it will have advanced in age to 15.3 days with a disc illumination of 99.61% *waning*. When the moon rises at 7:23 PM (16:23 UT) Sunday evening, September 22, it will have advanced to an age of 15.7 days with a disc illumination of 98.63% *waning*.

An analysis of the above data reveals the following regarding the length of disc illumination at or above 99%:

Moonrise	6:56 PM	September 21	99.75% <i>waning</i>
Moonset	6:55 AM	September 22	99.61% <i>waning</i>
Moonrise	7:23 PM	September 22	98.63% <i>waning</i>

As this scenario shows, a one-day postponement of Tishri 15 would place this High Day in Jerusalem *after* the occurrence of the full moon. Thus the Jerusalem moon would already be *waning*. A one-day postponement of Tishri 15 in 2002 would also pose a major problem in the years to come. When we project a one-day shift through the rest of this 19-year cycle (2003 – 2015 AD), we find that the declarations of Tishri 15 would be pushed beyond their best illumination periods (see Appendix D).

Because the determination of the full moon is calculated from Jerusalem, the exact age and illumination of the moon at the beginning of a High Day will of course vary from one geographical location to another and from one time zone to another. To demonstrate this fact, let us consider Fred's comment regarding the fullness of the moon of Nisan 15, 2002.

San Jose **Nisan 15, 2002**

The moon rose at 5:28 PM (01:28 UT) San Jose time, the night of Wednesday, March 27, beginning the High Sabbath of Nisan 15 at 13.9 days of age with a disc illumination of 99.20% waxing. When the moon set at 7:16 AM (14:16 UT) San Jose time, Thursday morning, March 28, it had advanced in age to 14.6 days with a disc illumination of 99.81% waxing. The point of 100% illumination occurred during the daylight hours of March 27, after which the level of illumination began to decline. When the moon rose at 7:42 PM (02:42 UT) San Jose time, Thursday night, March 28, it had advanced to an age of 15.2 days with a disc illumination of 99.59% *waning*. Thus, viewing from San Jose, the moon sustained a level of 99%+ of illumination through the entire High Day.

The high level of illumination that Fred observed from the San Jose region gave the moon of Nisan 15 an appearance of fullness; but brethren in Auckland who observed the moon that night did not see a moon nearly as full. This same circumstance may also occur in the fall, as the full moon of Tishri 15 approaches. Let us compare the level of disc illumination for Tishri 15 this year in Auckland and in San Jose.

Auckland **Tishri 15, 2002**

Viewing from Auckland, New Zealand, the moon will rise at 4:52 PM (04:52 UT)* Friday evening, September 20, beginning the High Sabbath of Tishri 15 at 13.5 days of age with a disc illumination of 98.29% waxing. The moon will reach a 99% disc illumination Saturday morning, September 21, at 4:24:26 AM (16:24:26 UT) Auckland time. When the moon sets Saturday morning, September 21, at 6:15 AM (18:15 UT) Auckland time, it will have advanced in age to 14.0 days with a disc illumination of 99.19% waxing. When the moon rises at 5:49 PM (05:49 UT) Saturday evening, September 21, it will have advanced in age to 14.5 days with a disc illumination of 99.77% waxing.

* Daylight Savings Time ended on Sunday, March 17, 2002, at 3:00:00 AM local daylight time. Daylight Savings Time will begin on Sunday, October 6, 2002, at 2:00:00 AM local standard time.

San Jose Tishri 15, 2002

Viewing from San Jose, California, the moon will reach 99% waxing disc illumination between 9 and 10 AM Friday morning, September 20, a few hours after moonset. When the moon rises at 7:13 PM (02:13 UT) San Jose time, Friday evening, September 20, it will have advanced to an age of 14.3 days with a disc illumination of 99.57% waxing. When the moon sets at 6:51 AM (13:46 UT) San Jose time, Saturday morning, September 21, it will have advanced to an age of 14.8 days with a disc illumination of 99.80% waxing. The point of 100% illumination will occur during the daylight hours. When the moon rises at 7:37 PM (02:37 UT) San Jose time, Saturday evening, September 21, it will have advanced to an age of 15.2 with a disc illumination of 99.49% *waning*.

As with Nisan 15, the disc illumination for Tishri 15, 2002, will be greater in San Jose than in Auckland. When the High Day begins, the moon above Auckland will appear at 98.20% illumination, but will be surpassed by 99.57% illumination above San Jose. In addition, the moon above San Jose will reach 100% illumination during the daylight hours of Tishri 15. In Auckland, however, the moon will not reach the point of 100% illumination before the High Day has ended. This difference is due to the fact that Auckland is located far to the south and east of Jerusalem, whereas San Jose is located far to the west and north of Jerusalem. Thus each High Day ends many hours earlier in Auckland than in San Jose.

In view of the variation in the moon's illumination from one geographical region to another, it is important to remember that the declaration of the day is based on the calculation of the full moon from only one point on earth—Jerusalem. The declaration of the full moons of Nisan 15 and Tishri 15, as calculated from Jerusalem, is applicable to God's people in every geographical region, whether or not the moon has yet reached the highest level of illumination visible to them.

Over the years, I have spent many long hours studying the Scriptures related to the Hebrew Calendar, those sections of the Talmud that discuss the calendar, astronomical calculations related to the calendar, and historical data concerning the calendar. In comparing the Scriptural documentation of

events with the dates that are recorded in the histories of men, I have not found one discrepancy between the Hebrew calendar dates and the historical and astronomical data.

Solar and lunar cycles from the period of the second temple until our day (a period of 2700 years) have been tracked by all knowledgeable cultures. These centuries include the life and ministry of Jesus, and the entire history of the church. Current calculations of the Hebrew Calendar, when compared with Scriptural and historical data back to the 700's BC, demonstrate that the calendar court of Ezra's time and forward had the same knowledge now used by astronomical physicists to calculate events of the heavens. This knowledge was used continuously down to New Testament times, and it is recorded in Scripture that Jesus and His apostles, and the believers in the early years of the Christian era, observed the dates of God's feasts as calculated by the Hebrew Calendar.

Since Jesus and the apostles placed their stamp of approval on the declarations of the Hebrew Calendar, it is not within our authority as Christians to pursue any other course in observing the holy days of God. Let us follow in the steps of the faithful believers of the New Testament era, and hold to the faith once delivered.

Appendix A

19-Year Cycle for Auckland 1997 to 2015 AD

Illumination Percentages at the Beginning of Nisan 15

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
1	1997	Tuesday, April 22	13.2 waxing	97.44%
2	1998	Saturday, April 11	13.2 waxing	97.45%
3	1999	Thursday, April 1	14.1 waxing	99.45%
4	2000	Thursday, April 20	15.3 waning	99.41%
5	2001	Sunday, April 8	13.8 waxing	98.74%
6	2002	Thursday, March 28	13.0 waxing	96.34%
7	2003	Thursday, April 17	14.1 waxing	99.41%
8	2004	Tuesday, April 6	14.5 waxing	99.88%
9	2005	Sunday, April 24	13.5 waxing	98.40%

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
10	2006	Thursday, April 13	13.4 waxing	98.07%
11	2007	Tuesday, April 3	14.3 waxing	99.82%
12	2008	Sunday, April 20	13.6 waxing	98.59%
13	2009	Thursday, April 9	13.3 waxing	97.72%
14	2010	Tuesday, March 30	13.8 waxing	98.88%
15	2011	Tuesday, April 19	14.9 waxing	99.88%
16	2012	Saturday, April 7	14.1 waxing	99.46%
17	2013	Tuesday, March 26	12.5 waxing	94.45%
18	2014	Tuesday, April 15	13.7 waxing	98.76%
19	2015	Saturday, April 4	13.6 waxing	98.63%

Appendix B

19-Year Cycle for Jerusalem 1997 to 2015 AD

Illumination Percentages at the Beginning of Nisan 15

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
1	1997	Tuesday, April 22	13.6 waxing	98.66%
2	1998	Saturday, April 11	13.6 waxing	98.62%
3	1999	Thursday, April 1	14.5 waxing	99.86%
4	2000	Thursday, April 20	15.7 waning	99.70%
5	2001	Sunday, April 8	14.2 waxing	99.58%
6	2002	Thursday, March 28	13.4 waxing	97.98%
7	2003	Thursday, April 17	14.6 waxing	99.93%
8	2004	Tuesday, April 6	15.0 waxing	99.86%
9	2005	Sunday, April 24	14.0 waxing	99.42%

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
10	2006	Thursday, April 13	13.8 waxing	99.08%
11	2007	Tuesday, April 3	14.7 waning	99.96%
12	2008	Sunday, April 20	14.0 waxing	99.39%
13	2009	Thursday, April 9	13.8 waxing	98.87%
14	2010	Tuesday, March 30	14.2 waxing	99.60%
15	2011	Tuesday, April 19	15.4 <i>waning</i>	99.23%
16	2012	Saturday, April 7	14.6 waxing	99.86%
17	2013	Tuesday, March 26	12.9 waxing	96.25%
18	2014	Tuesday, April 15	14.1 waxing	99.59%
19	2015	Saturday, April 4	14.0 waxing	99.43%

The lowest illumination for Nisan 15 for Jerusalem during the current 19-year cycle will 96.25% in 2013 AD and the highest will be 99.93% waxing in 2003 AD. The average for this cycle will be 99.20%.

Appendix C

19-Year Cycle for Jerusalem 21 to 39 AD

Illumination Percentages at the Beginning of Nisan 15

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
1	21	Tuesday, April 15	13.3 waxing	97.87%
2	22	Sunday, April 5	13.8 waxing	99.04%
3	23	Thursday, March 25	13.4 waxing	98.15%
4	24	Thursday, April 13	13.4 waxing	98.02%
5	25	Tuesday, April 3	15.5 <i>waning</i>	99.18%
6	26	Saturday, March 23	15.5 <i>waning</i>	99.19%
7	27	Thursday, April 10	13.0 waxing	96.96%
8	28	Tuesday, March 30	15.4 waxing	99.32%
9	29	Sunday, April 17	14.1 waxing	99.46%

Year of Cycle	Year AD	Day/Date Nisan 15	Moon Age	Disc Illumination
10	30	Thursday, April 6	13.3 waxing	97.84%
11	31	Tuesday, March 27	13.9 waxing	99.13%
12	32	Tuesday, April 15	15.1 waning	99.84%
13	33	Saturday, April 4	14.8 <i>waning</i> lunar eclipse	99.98%
14	34	Tuesday, March 23	13.8 waxing	99.19%
15	35	Tuesday, April 12	15.1 <i>waning</i>	99.71%
16	36	Saturday, March 31	14.8 <i>waning</i>	99.82%
17	37	Thursday, March 21	15.4 waning	99.24%
18	38	Tuesday, April 8	14.2 waxing	99.54%
19	39	Saturday, March 28	14.2 waxing	99.54%

Appendix D

A Comparison of Illumination at the Beginning of Tishri 15 and Tishri 16

Tishri 15
Saturday, October 11, 2003
99.78% *waning*

Tishri 16
Sunday, October 12, 2003
98.13% *waning*

Tishri 15
Thursday, September 30, 2004
98.42% *waning*

Tishri 16
Friday, October 1, 2004
94.75% *waning*

Tishri 15
Tuesday, October 18, 2005
99.96% *waning*

Tishri 16
Wednesday, October 19, 2005
98.19% *waning*

Tishri 15
Saturday, October 7, 2006
99.66% *waxing*

Tishri 16
Sunday, October 8, 2006
99.52% *waning*

Tishri 15
Thursday, September 27, 2007
99.96% *waxing*

Tishri 16
Friday, September 28, 2007
98.82% *waning*

Tishri 15
Tuesday, October 14, 2008
98.02% *waxing*

Tishri 16
Wednesday, October 15, 2008
99.85% *waxing*

Tishri 15
Saturday, October 3, 2009
97.20% *waxing*

Tishri 16
Sunday, October 4, 2009
99.51% *waxing*

Tishri 15
Thursday, September 23, 2010
99.41% *waxing*

Tishri 16
Friday, September 24, 2010
99.78% *waning*

Tishri 15
Thursday, October 13, 2011
99.61% *waning*

Tishri 16
Friday, October 14, 2011
97.64% *waning*

Tishri 15
Monday, October 1, 2012
99.64% *waning*

Tishri 16
Tuesday, October 2, 2012
97.57% *waning*

Tishri 15
Thursday, September 19, 2013
99.09% *waxing*

Tishri 16
Friday, September 20, 2013
99.89% *waning*

Tishri 15
Thursday, October 9, 2014
99.92% *waning*

Tishri 16
Friday, October 10, 2014
97.83% *waning*

Tishri 15
Monday, September 28, 2015
99.69% *waxing*

Tishri 16
Tuesday, September 29, 2015
99.45% *waning*

Appendix E

Let us look at a scenario in which the High Sabbath full moons of Nisan 15 and Tishri 15, 2002 are declared two days later for Auckland than declared by the Hebrew Calendar.

Auckland Nisan 17, 2002

If we were to shift Nisan 15 forward from Thursday, March 28, to Saturday, March 30, viewing from Auckland, New Zealand, the moon would have risen at 6:56 PM (06:56 UT) the night of Friday, March 29, beginning the High Sabbath at 15.4 days of age and a disc illumination of 99.30% *waning*. When the moon set Saturday morning, March 30, at 7:41 AM (19:41 UT) Auckland time, it would have advanced to an age of 16.0 days and a disc illumination of 98.37% *waning*. When the moon rose at 7:30 PM Auckland time, Saturday evening, March 30, it would have advanced to an age of 16.6 days and a disc illumination of 96.07% *waning*.

Auckland Tishri 17, 2002

If we were to shift Tishri 15 two days forward from Saturday, September 21, to Monday, September 23, viewing from Auckland, New Zealand, the moon would rise at 6:46 PM (06:46 UT) Auckland time, Sunday evening, September 22, beginning the first High Sabbath at 15.4 days of age and a disc illumination of 99.31% *waning*. At moon set 7:03 AM (19:03 UT), Auckland time, Monday morning, September 23, the moon would advance in age to 15.8 days with a disc illumination of 98.68% *waning*. At moonrise 7:42 PM (07:42 UT), Auckland time, Monday evening, September 23, the moon would advance in age to 16.3 days with a disc illumination of 96.96% *waning*.

Daylight Savings Time ended on Sunday, March 17, 2002, at 3:00:00 AM local daylight time. Daylight Savings Time starts on Sunday, October 6, 2002, at 2:00:00 AM local standard time.

As these scenarios show, a two-day postponement of Nisan 15 and corresponding postponement of Tishri 15 would place these two High Days after the occurrence of the full moon at Auckland. Thus the moon, although appearing to be full, would actually be in the *waning* phase. A one-day postponement of the two High Days would avoid this problem for brethren in New Zealand, but would pose a major problem for brethren in other parts of the world. However, the effect on brethren in New Zealand or in any other area is not the determining factor. The decision rests on the calculation of the full moon at Jerusalem.

When we examine the astronomical data, we find that postponing the High Day of Tishri 15 at Jerusalem would move its observance past the full moon of the seventh month.

Jerusalem Tishri 16, 2002

When the moon rises at 6:56 PM (15:56 UT) Jerusalem time, Saturday night, September 21, it will have advanced to an age of 14.8 days with a disc illumination of 99.75% *waning*. When the moon sets at 6:55 AM (03:55 UT) Jerusalem time, Sunday morning, September 22, it will have advanced in age to 15.3 days with a disc illumination of 99.61% *waning*. When the moon rises at 7:23 PM (16:23 UT) Sunday evening, September 22, it will have advanced to an age of 15.7 days with a disc illumination of 98.63% *waning*.

An analysis of the above data reveals the following regarding the length of disc illumination at or above 99%:

Moonrise	6:56 PM	September 21	99.75% <i>waning</i>
Moonset	6:55 AM	September 22	99.61% <i>waning</i>
Moonrise	7:23 PM	September 22	98.63% <i>waning</i>

These astronomical facts illustrate the inaccuracy in postponing the observance of the High Day of Tishri 15 for even one day. The declaration of the Hebrew Calendar for the full moon of Tishri 15, 2002, at Jerusalem is right on target.

Appendix F

Nisan 15, 2002 Moon Rise and Moon Set Illumination Percentages

	Auckland	Jerusalem	San Jose
Moon Rise Wednesday Evening March 27	96.34% waxing	97.98% waxing	99.20% waxing
Moon Set Thursday Morning March 28	97.85% waxing	99.19% waxing	99.81% waxing
Moon Rise Thursday Evening March 28	99.40% waxing	99.83% waxing	99.59% <i>waning</i>

Nisan 17, 2002
Moon Rise and Moon Set
Illumination Percentages

	Auckland	Jerusalem	San Jose
Moon Rise Friday Evening March 29	99.30% <i>waning</i>	98.32% <i>waning</i>	96.66% <i>waning</i>
Moon Set Saturday Morning March 30	98.37% <i>waning</i>	97.03% <i>waning</i>	94.94% <i>waning</i>
Moon Rise Saturday Evening March 30	96.07% <i>waning</i>	93.70% <i>waning</i>	90.81% <i>waning</i>

Tishri 15, 2002
Moon Rise and Moon Set
Illumination Percentages

	Auckland	Jerusalem	San Jose
Moon Rise Friday Evening September 20	98.29% waxing	99.03% waxing	99.57% waxing
Moon Set Saturday Morning September 21	99.19% waxing	99.54% waxing	99.80% waxing
Moon Rise Saturday Evening September 21	99.77% waxing	99.75% <i>waning</i>	99.49% <i>waning</i>

Tishri 17, 2002
Moon Rise and Moon Set
Illumination Percentages

	Auckland	Jerusalem	San Jose
Moon Rise Sunday Evening September 22	99.31% <i>waning</i>	98.63% <i>waning</i>	97.58% <i>waning</i>
Moon Set Monday Morning September 23	98.68% <i>waning</i>	97.76% <i>waning</i>	96.36% <i>waning</i>
Moon Rise Monday Evening September 23	96.96% <i>waning</i>	95.70% <i>waning</i>	93.93% <i>waning</i>

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Christian Biblical Church of God
P.O. Box 1442
Hollister, California 95024-1442 USA
E-mail: FredCoulter@cbcg.org
Phone: 1-831-637-1875
Fax: 1-831-637-9616