MUSEUM OF FINE ARTS, BOSTON

Recent decades have seen widespread popular embrace of the idea that when a calendar month contains two full Moons, the second one is called a "Blue Moon." The unusual pattern of lunar phases in early 1999 — two full Moons each in January and March, and none at all in February — has triggered a groundswell of public interest. Countless newspapers and radio and TV stations have run stories about Blue Moons.

In *Sky & Telescope*'s March issue (page 52), folklorist Philip Hiscock traced the calendrical meaning of the term "Blue Moon" to the *Maine Farmers' Almanac* for 1937. But a page from that almanac, displayed in Hiscock's article, belies the second-full-Moon-in-a-month interpretation, as Donald Olson and Roger Sinnott pointed out in a companion article that called for further research.

With help from Margaret Vaverek (Southwest Texas State University) and several other librarians, we have now obtained more than 40 editions of the *Maine Farmers' Almanac* from the period 1819 to 1962. These refer to more than a dozen Blue Moons, and not one of them is the second full Moon in a month. What's going on here?

What's a

Blue Moons and the Seasons

Several clues point to a strong connection between the almanac's Blue Moons and the four seasons of the year. All of the listed Blue Moons fall on the 20th, 21st, 22nd, or 23rd day of November, May, February, or August. These dates fall about a month before the Northern Hemisphere winter and summer solstices, and spring and fall equinoxes, respectively, which occur on similar day numbers.

Although the idea of a seasonal pattern suggested itself to us immediately (as well as to many other *S&T* readers; see the box on page 38), verifying the details required a lot of detective work. We found that the Blue-Moon definition employed in the *Maine Farmers' Almanac* is indeed based on the seasons, but with some subtle twists.

Instead of the calendar year running from January 1st through December 31st, the almanac relies on the tropical year, defined as extending from one winter solstice ("Yule") to the next. Most tropical years contain 12 full Moons — three each in winter, spring, summer, and fall — and each is named for an activity appropriate to the time of year (such as the Harvest Moon in autumn). But occasionally a tropical year contains 13 full Moons, such that one season has four rather than the usual three.

Today we usually mark the beginning of the seasons when the Sun's celestial longitude passes 0° (spring), 90° (summer), 180° (autumn), and 270° (winter). The Sun appears to move along the ecliptic at a variable rate because of the Earth's not-quite-circular orbit, so the seasons defined this way are not equal in

A rising full Moon lights the scene in *The Fishing Party,* painted by Fitz Hugh Lane after a visit to the coast of Maine in August 1850. That month contained a Fruit Moon, according to the Maine almanac's rules.

duration. Another approach uses the dynamical mean Sun or fictitious mean Sun — imaginary bodies that move along the ecliptic and the celestial equator, respectively, at a constant rate — and produces seasons of equal length. The Maine almanac defines the seasons using this alternative method.

The almanac also follows certain rules laid down as part of the Gregorian calendar reform in 1582. The ecclesiastical vernal (spring) equinox always falls on March 21st, regardless of the position of the Sun. Lent begins on Ash Wednesday, 46 days before Easter, and must contain the Lenten Moon, considered to be the last full Moon of winter. The first full Moon of spring is called the Egg Moon (or Easter Moon, or Paschal Moon) and must fall within the week before Easter.

At last we have the "Maine rule" for Blue Moons: Seasonal Moon names are assigned near the spring equinox in accordance with the ecclesiastical rules for determining the dates of Easter and Lent. The beginnings of summer, fall, and winter are determined by the dynamical mean Sun. When a season contains four full Moons, the third is called a Blue Moon.

Our computations reproduce the pattern of Blue Moons in the box at right only when we use this idiosyncratic approach!

Why is the third full Moon identified as the extra one in a season with four? Because only then will the names of the other full Moons, such as the Moon Before Yule and the Moon After Yule, fall at the proper times relative to the solstices and equinoxes.

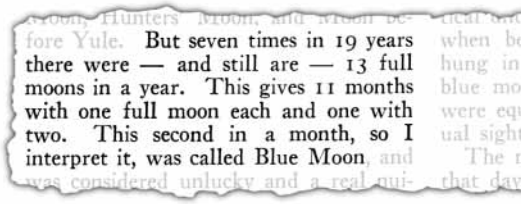
Dates of Some Early Blue Moons

These Blue Moons are not listed in the *Maine Farmers' Almanac* from 1915 to 1951 but are identified as such in the "Farmers' Calendar" commentaries of the 1937 to 1948 editions.	These Blue Moons are listed explicitly in the "Aspects, Holydays, Weather, Etc." section of the *Maine Farmers' Almanac* from 1937 to 1956. (All dates in both columns are Universal Time.)
1915 November 21	1937 August 22
1918 August 22	1940 May 21
1921 May 21	1943 February 20
1924 February 20	1945 August 23**
1926 summer	1948 May 23
1929 spring	1951 May 21*
1932 winter*	1953 November 20
1934 November 21	1956 August 21
1951 winter*	

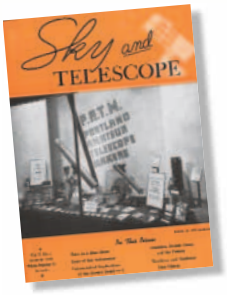
*The "Farmers' Calendar" for May 1948 gave the seasons of several past and future Blue Moons, including winter of 1932 and winter of 1951, both of which are probably errors. When the 1951 almanac was actually printed, the Blue Moon was listed on May 21, 1951. Our calculations give Blue Moons on May 20, 1932, and May 21, 1951.

**Our calculations based on the apparent Sun give August 23, 1945, while computations based on the mean Sun give November 19, 1945. The August 1945 Blue Moon appears to be another almanac error.

Blue Moon?


fore Yule. But seven times in 19 years there were — and still are — 13 full moons in a year. This gives 11 months with one full moon each and one with two. This second in a month, so I interpret it, was called Blue Moon

***Sky & Telescope,* March 1946**



A 53-year-old mistake in Sky & Telescope *(above) changed pop culture and the English language in unexpected ways.*

By Donald W. Olson, Richard Tresch Fienberg, and Roger W. Sinnott

Questions and Answers

During the period 1932 to1957, under the editorship of Henry Porter Trefethen (1887–1957), the *Maine Farmers' Almanac* consistently listed Blue Moons derived from the convoluted seasonal rule just described. So where did the modern convention — that a Blue Moon is the second full Moon in a calendar month — come from? *Sky & Telescope* has, and is, the answer!

Laurence J. Lafleur (1907–1966) of Antioch College, Ohio, discussed Blue Moons in a question-and-answer column in this magazine's July 1943 issue (page 17), citing the 1937 *Maine Farmers' Almanac* as his source. It is clear that Lafleur had a copy of the almanac at his side as he wrote, since he quoted word for word the commentary on the August 1937 calendar page. This commentary notes that the Moon occasionally "comes full thirteen times in a year," but Lafleur did not judge whether this referred to a tropical year or a calendar year. More important, he did not mention the specific dates of any Blue Moons and never said anything about two full Moons in one calendar month.

Oops!

Some three years later, in March 1946, an article entitled "Once in a Blue Moon" appeared in *Sky & Telescope* (page 3). Its author, James Hugh Pruett (1886–1955), was an amateur astronomer living in Eugene, Oregon, and a frequent contributor to *Sky & Telescope*. Pruett wrote on a variety of topics, especially fireball meteors. In his article on Blue Moons, he mentioned the 1937 Maine almanac and repeated some of Lafleur's earlier comments. Then, unfortunately, he went on to say, "Seven times in 19 years there were — and still are — 13 full moons in a year. This gives 11 months with one full moon each and one with two. This second in a month, so I interpret it, was called Blue Moon."

Pruett must not have had the 1937 almanac handy, or he would have noticed that the Blue Moon fell on August 21st (obviously not the second full Moon that month) and that 1937 had only 12 full Moons. But only in retrospect is his error so obvious.

Modern Folklore

Sky & Telescope adopted Pruett's new definition, using it in a note entitled "'Blue' Moons in May" on page 176 of the May 1950 issue. In a bizarre twist, the data on lunar phases for this note came from none other than H. Porter Trefethen of Winthrop, Maine, editor of the very almanac Pruett misread four years

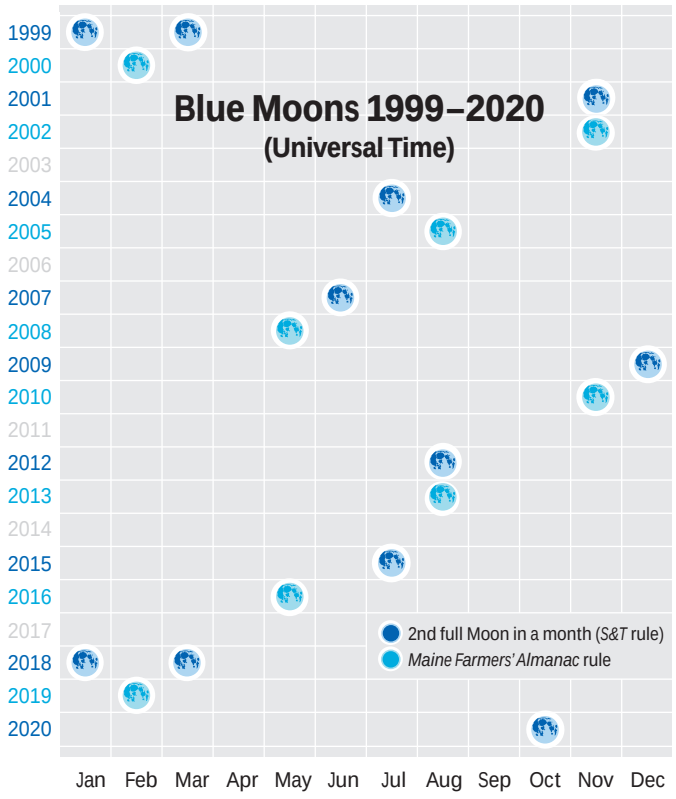
The Seasons—Cardinal Points of the Year
Int. Date Line Time Meridian Zero

R.A.M.S. 18h. Winter begins, 1938, Dec. 22 Th. 2h. 44m. eve.
R.A.M.S. 0h. Spring begins, 1939, Mar. 23 Th. 10h. 11m. eve
R.A.M.S. 6h. Summer begins, 1939, June 23 F. 5h. 38m. morn.
R.A.M.S. 12h Autumn begins, 1939 Sept. 22 F. 1h. 5m. eve.
R.A.M.S. 18h. Winter begins, 1939, Dec. 22 F. 8h. 32m. eve.
Length of the year 365d. 5h. 48.7628m.

The Sun, Turns and Crosses for 1939
Eastern Standard Time Meridian 17h. west from Int. Date Line

Mar. 21 Tu. 7h. 29m. morn. Sun on equator ♋, crosses the line
June 22 Th. 2h. 40m. m'n. Runs high, northern tropic (turn)
Sept. 23 Sa. 5h. 50m. eve. Sun on equator ♈, crosses the line
Dec. 22 F. 1h. 6m. eve. Sun runs low, southern tropic (turn).

Above: **These tables appeared in the 1939 *Maine Farmers' Almanac* and show that the beginnings of the seasons were fixed by the "R.A.M.S." (right ascension of the mean Sun). The almanac lists separately the "Turns and Crosses" of the apparent Sun, which executes a "turn" from northward motion in declination to southward (or vice versa) at the solstices and "crosses the line" (the celestial equator) at the equinoxes.**



Right: **When is the Moon "blue," in a calendrical sense? According to the Maine almanac, a Blue Moon occurs when a season has four full Moons, rather than the usual three. This type of Blue Moon is found only in February, May, August, and November, one month before the next equinox or solstice. According to modern folklore, a Blue Moon is the second full Moon in a calendar month. This type of Blue Moon can occur in any month but February, which is always shorter than the time between successive full Moons. *Sky & Telescope* diagram.**

earlier! But Trefethen himself never called the second full Moon in a month a Blue Moon. The "'Blue' Moons" headline was likely added by *Sky & Telescope*'s founding editor, Charles A. Federer Jr. Contacted at his Florida home, Federer, now 90 years old, agrees that he probably wrote that headline with Pruett's then-recent article in mind and without consulting Trefethen.

As Hiscock explained in the March issue, widespread adoption of the second-full-Moon-in-a-month definition followed its use on the popular radio program *StarDate* on January 31, 1980. We examined this show's script, authored by Deborah Byrd, and found that it contains a footnote not read on the air that cites Pruett's 1946 article as the source for the information. Byrd now writes for the radio program *Earth & Sky*, whose Web site (www.earthsky.com) contains a note giving her perspective on this modern contribution to lunar folklore.

The Next Blue Moon

According to the rule in the *Maine Farmers' Almanac*, none of the full Moons in 1999 are "blue." Instead, our calculations place four full Moons between the winter solstice of 1999 (determined by the mean Sun) and the Easter Moon of April 2000. So the next Blue Moon falls on February 19, 2000.

With two decades of popular usage behind it, the second-full-Moon-in-a-month (mis)interpretation is like a genie that can't be forced back into its bottle. But that's not necessarily a bad thing. Rather than argue over whether to celebrate the dawn of the new millennium on January 1st in 2000 or 2001, those with the sunniest outlooks will celebrate twice. Why not treat Blue Moons the same way, marking both the second full Moon in a calendar month and the third full Moon in a season with four? "Even if the calendrical meaning is new," says Federer, "I don't see any harm in it. It's something fun to talk about, and it helps attract people to astronomy."

Don Olson *works on historical applications of astronomy at Southwest Texas State University.* Rick Fienberg *joined* Sky & Telescope *after earning his Ph.D. in astronomy and now serves as the magazine's publisher. Associate editor* Roger Sinnott *edits* S&T*'s Celestial Calendar.*

BLUE-MOON FEVER

The Blue-Moon articles in our March issue struck a chord with readers. We received dozens of letters from astronomy enthusiasts who, like us, felt compelled to try and figure out the *Maine Farmers' Almanac*'s rule for Blue Moons.

From the August 1937 almanac page reproduced in *Sky & Telescope,* many readers correctly deduced that the Blue-Moon rule involves the seasons. Those who realized that a Blue Moon is the third of four full Moons in a season include Charlie Kluepfel, Silvio Marazzi, Bruce McCurdy, Jean Meeus, Ted Molczan, Joe Orman, Jay Respler, and Dan Tilque.

Others suggested that a Blue Moon might be the second full Moon under a given astrological sign. But we found no mention of astrology in any of the almanacs we examined. With some trepidation we acknowledge John Blaisdell, Joseph L. Gerver, Willi Kratzer, Jan N. Pedersen Jr., and Kelley L. Ross for suggesting this other way to determine Blue Moons — a way we hope will not be adopted!

Two correspondents correctly predicted the date of the next Blue Moon. But Larry Molnar and Bill Petry used the apparent Sun to define the beginnings of the seasons. By coincidence, the Maine rule gives a Blue Moon on February 19, 2000, using either the mean Sun or the apparent Sun.