

# THE VALLEY SKYWATCHER

Volume 47

Number 3

Summer 2010

The Valley Skywatcher is the official publication of the Chagrin Valley Astronomical Society, founded 1963. Our mailing address is PO Box 11, Chagrin Falls, OH 44022  
More information can be found on our web site: [www.chagrinvalleyastronomy.org](http://www.chagrinvalleyastronomy.org)

**Editor: Dan Rothstein**

## Table of Contents:

A Few Summer Double Stars

Constellation Quiz

Discovery History and Recent Light Curves for 1700 Zvezdara

Astronomical Alignments in Ireland

George Gliba

Dan Rothstein

Ron Baker

Dan Rothstein

A Few Summer Double Stars - by G.W. Gliba

There are many fine double stars available in the Summer sky that can be split in a small refractor or medium size reflector this time of the year. One of my favorite is Xi Bootids, because it was originally thought to be the radiant to a solo minor meteorite shower, which is now known to be a complex of several radiants, now recognized by the IAU as the Bootid-Corona Borealis Complex. It can be split with a good 2.4-inch refractor. The components consists of a 4.8 magnitude primary star that is a G8V with a 7th magnitude companion of K5V spec. type, which appears yellow and orange respectively to an observer. This star system is 22 light years distant. The G8V component is also a variable star of low amplitude know as a BY Draconis type star, which varies from 4.52 to 4.67 over 10.137 days. However, this variability can't be noticed visually.

Much easier and more colorful is the nice pair Epsilon Bootis nearby, also known as Izar. It consists of a K0 and A2 type stars that are 2.5 and 4.9 magnitude respectively, and are 2.8 arcseconds separation. The colors are beautiful in a my 4-inch f9 refractor with a Jaegers objective. Being brighter, it activates the cones in the eye better, but I have found that too much light from too large of an aperture telescope will dull the colors somewhat. So, that is why certain double stars are actually better in a smaller telescope. Too much light can over saturate, while too little aperture may not not be enough light to show the colors optimally.

Over in Hercules are some fine double stars. My favorite is Alpha Herculis. It consists of M5 giant and G5 suns that are 4.6 arc-seconds separation. The primary is a semi-regular variable star that varies from 3.0 to 4.0 magnitude, while the secondary star is 5.4 magnitude. A good 2.4-inch glass will split the pair nicely, but a 3-inch or larger scope would be better. My 4-inch refractor shows the pair easily. The variability of Alpha Hercules was discovered by the famous astronomer Sir William Herschel in England over 215 years ago. It was included in one of his research projects, looking for the Solar Parallax. I'm sure that this variability caused him some problems.

Herschel made the assumption, which was only partly correct, that closer stars were brighter than farther ones. So, by looking at double stars with different magnitudes, one could discover the stellar parallax when the Earth was on the opposite side of its orbit around the Sun. He never did find this parallax. This had to wait until 1938 when the German astronomer Friedrich W. Bessel finally found the long sought stellar parallax. However, William Herschel did instead discover the true nature of the physical binary stars, when he found that the components of the double star Castor, and a few others, were in orbit around each other. This turned out to be one of William Herschel's greatest discoveries, and it was serendipitous!

Another nice double in Hercules is Kappa Herculis, which consists of a G8 and K1 star with 27.5 arc-seconds separation, that are 5.0 and 6.3 magnitudes. This is a nice low power double sun located near the head of Serpens Caput that can be split using hand held binoculars held steady, or on a tripod. However, it is much easier to split in a small telescope using a low power eyepiece.

Over in Cygnus is the star 61 Cygni, which is another nice low power double star that also has historic interest as mentioned. It is located a few degrees north of Epsilon Cygni, the most eastern star in the Northern Cross. In 1838 Bessel became the first person to measure the distance to another star using stellar parallax. He found the distance to 61 Cygni to be about 11 light years, which was correct. The components consists of K5 and K7 suns separated by 29.7 arc-seconds, of 5.2 and 6.0 magnitudes brightness respectively, which are easy to split in a small telescope with low power. This also provides a beautiful star field, as it is right in plane of the Milky Way.

No summer evening splitting double stars in Cygnus can be complete unless Beta Cygni is looked at. Also known as Albiero, this is probably the most colorful double star in the Summer sky. It consists of K3 and B8 stars, that are 3.1 and 5.1 magnitudes in brightness, with only 34.5 arc-seconds separation. It can also be seen in binoculars on a tripod.

The pair have a beautiful color contrast in a low power field. The view of Albiero in a rich Milky Way star field makes it a favorite of many observers. Use the lowest power you have that will just split them, to get the best effect.

Sources - <http://www.solstation.com/stars/xibootis.htm>  
[http://en.wikipedia.org/wiki/Xi\\_Bo%C3%B6tis](http://en.wikipedia.org/wiki/Xi_Bo%C3%B6tis)  
[http://www.starobserver.eu/multiplestars/xi\\_bootis.html](http://www.starobserver.eu/multiplestars/xi_bootis.html)  
The Observer's Sky Atlas - by E. Karkoschka 1990  
Burnham's Celestial Handbook - by Robert Burnham Jr. 1978

Constellation Quiz                      conducted by the editor

1. This star is known as “the rider on his horse”.
2. At various times this asterism has been called: the seven wise men of Greece; the seven sleepers of Ephesus; the seven champions of Christendom; the triones (or oxen); and the seven little Indians.
3. This circumpolar constellation was called by some Greeks the Laconian Key.
4. What was referred to as Mohammed’s Star? When Vega becomes the pole star for the northern hemisphere, this star will be the pole star for the southern hemisphere.

Answers to last issues’ quiz questions

1. In the time of the early Greek civilization, this very bright evening star was known as Hesperus. The very bright morning star was known as Phosphorus. Later the Greeks realized that these two were actually the same object, that we know as the planet Venus.
2. The two stars known as the Guardians of the pole are the two brightest stars of the Little Dipper’s bowl,
3. The “Ell and Yard” are the three stars of Orion’s belt: Alnitak, Alnilan, and Mintaka.
4. Aries was considered the first house of the zodiac because the Vernal Equinox (called the First Point of Aries) occurred there in the time of the Greeks. Later, precession carried the Equinox out of Aries, but modern astrologers don’t seem to have gotten the message.

DISCOVERY HISTORY AND RECENT LIGHTCURVES FOR 1700 ZVEZDARA

By Ron Baker

The main belt asteroid 1700 Zvezdara was discovered 1940 Aug 26 by Pero Djurkovich at the Belgrade Astronomical Observatory (BAO), in the former Yugoslavia. In those days, moving objects were found by physically comparing photographic plates covering similar sections of sky but recorded at different times. 1700 Zvezdara was discovered on plates covering a full 12 X 8 degrees in area. Due to the limited sensitivity of the photographic medium, objects dimmer than roughly 14<sup>th</sup> magnitude were difficult to capture with exposures of reasonable length. By comparison, the field of view of a typical CCD image is several thousand times smaller in area, and the limiting magnitude is much fainter.

Since the time of its discovery, many astrometric observations of 1700 Zvezdara have been submitted to the Minor Planet Center from observatories throughout the world. As a result, accurate orbital elements are well known for this asteroid. An ephemeris based on the elements indicates several important parameters, including the asteroid’s celestial coordinates, estimated magnitude, sun-distance, earth-distance, phase angle, and apparent sky motion. Light-curve analysis would not be possible without the knowledge of these parameters. Vladimir Benishek, from the Belgrade Astronomical Observatory in present day Serbia, has provided historical photographs of the BAO facilities and instruments, some of which are reproduced here.

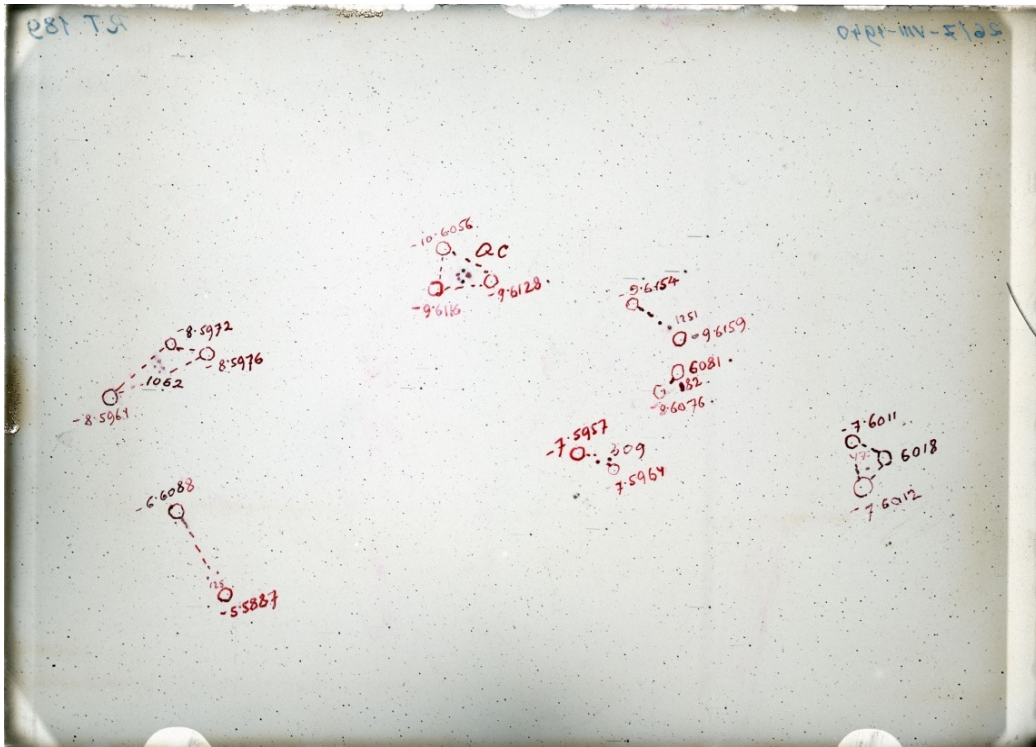
A small asteroid the size of 1700 Zvezdara does not look very impressive in a CCD image. But subtle changes in the object’s apparent brightness can be measured, and those changes reveal various characteristics. In the composite image below, 1700 Zvezdara is roughly 2 AU from the sun (just outside the orbit of Mars). But even at that great distance, the stars in the image are 10 million times more distant.



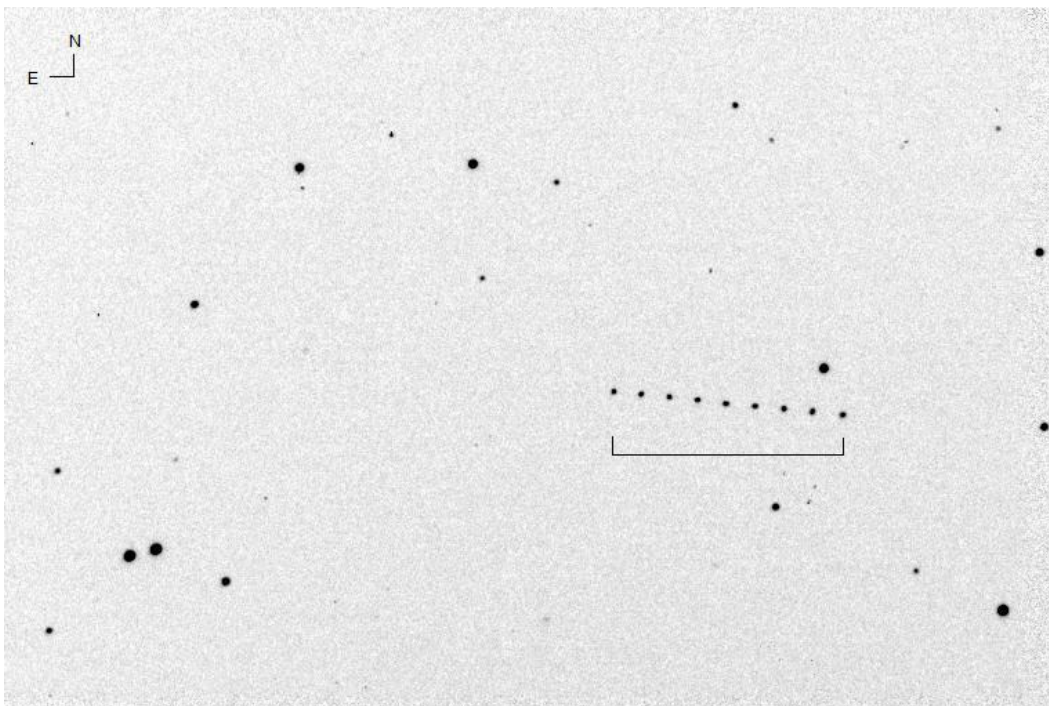
The Belgrade Astronomical Observatory under construction in 1932 on Zvezdara hill.



Photo-visual Zeiss refractor used in the discovery of 1700 Zvezdara. The photograph shows the telescope after it had been set up for use with a spectrophotometer in the early 1970s.



The original discovery plate from 1940 Aug 26 (including Pero Djurkovich's notations). 1700 Zvezdara is located inside the triangle labeled "AC" in the top center. FOV 12 X 8 degrees



Asteroid 1700 Zvezdara, 2009 Sep 18, sky motion 3 arcmins during 5 hour period 03:00-08:00 UT, FOV 12 X 8 arcmins, field center: RA 23 58 52 Dec -00 05 03, Indian Hill Observatory, R. Baker.

During the period Aug to Nov 2009, 1700 Zvezdara was observed with the 12" SCT at Indian Hill Observatory, and with telescopes at 3 other observatories (located in Serbia, New Mexico, and Australia). Opposition occurred 2009 Sep 21, just one month before the asteroid reached perihelion. It brightened to 14<sup>th</sup> magnitude (similar in brightness to the dwarf planet Pluto), and will not appear as bright again for 30 years. This favorable apparition provided a good opportunity for making photometric CCD observations.

The software programs *MPO Canopus* and *Astrometrica* were used to measure the images, analyze the data, and construct various lightcurves and plots. Our combined data reveals the asteroid's previously unknown synodic rotational period (P) and amplitude (A), as well as new values for its absolute magnitude (H), phase slope parameter (G), and diameter (D). The following values were found: P =  $9.114 \pm 0.001$  h; A =  $0.10 \pm 0.02$  mag; H =  $12.447 \pm 0.019$  mag; G =  $0.072 \pm 0.019$ ; and D = 20.89 km.

Our project is described in an article published in the *Minor Planet Bulletin* (MPB), Vol. 37, No. 3, on-line at this address: <http://www.minorplanetobserver.com/mpb/default.htm>

The MPB is the quarterly journal of the Minor Planets Section of the Association of Lunar and Planetary Observers – ALPO, and is edited by Dr. Richard P. Binzel, Senior Professor of Planetary Studies at MIT.

## Astronomical Alignments at Megalithic Sites in Ireland

Dan Rothstein

My sister went on vacation to Ireland in May and bought me the book *Island of the Setting Sun, In Search of Ireland's Ancient Astronomers* by Anthony Murphy and Richard Moore. This book describes some of the iron-age monuments around the valley of the Boyne River (which drains into the Irish Sea north of Dublin.) Quoting from the dust jacket, "Ireland is home to some of the world's oldest astronomically-aligned structures, giant stone monuments erected over 5000 years ago. Despite their apparent simplicity, these megalithic edifices were crafted by a scientifically knowledgeable community of farmers who endeavored to enshrine their belief in a stellar afterlife within the very fabric of their cleverly designed stone temples."

Many megalithic sites have been excavated in and around the Boyne River. These standing stones and mounds show alignments with the equinoxes, solstices, cross-quarter days (half-way between equinoxes and solstices), major and minor standstills (extremes north or south) of the moon, and rising and setting points of Venus and major constellations. These show that they were good surveyors and could create perfect alignments between mutually invisible points. These monuments were positioned, and their interior passages aligned to point to the horizons (and to other mounds or mountain tops) on astronomically significant days, not only yearly ones, but significant times in the lunar cycle and the 8-year cycle of Venus' motions. There is also evidence from the alignments that they understood the precession of the equinoxes and the Metonic cycle of eclipses, and included both in the alignments. Their mythical poetry can be interpreted in terms of historical events, both on the ground and in the sky, around the time that all these monuments were being created. Their kings and gods were associated with figures in the sky, notable Orion and Cygnus. The Boyne valley was associated with the Milky Way, one of many heavenly alignments that were associated with physical alignments on the ground.

There are five major mound sites around the Boyne Valley: Newgrange (See Figure 1), Tara, Knoth, Dowth, and Millmount. Four are referred to as passage-mounds, since they have tunnels built into them. The fifth, Millmount, in the city of Drogheda, has a military tower built over it.



**Figure 1 Newgrange Megalithic**

The high mound it was built on (63 m across at its base, surrounded by bank and ditch) cannot be excavated without destroying the historical tower, a historical landmark and tourist attraction. Whether a passage exists is uncertain, but annals of Irish history, and the military history of the tower say there were underground chambers. The four passage mounds all had ritual funerary purposes. In Irish mythology the mounds were portals from which the souls of the people buried within were transported out into the sky along the beam from whatever heavenly body it aligned with (such as the sun) to the afterlife in the land of eternal youth.

I will concentrate on the site of Newgrange, since it combines most of the alignment phenomena seen at the other passage-mounds, but I will mention some of the alignments at the others which show their use as a combined lunar-solar calendar. The passage at Tara aligns to the sunrise on the cross-quarter days in November and February. The southwest passage at Dowth, being quite wide, admits light at sunset for over 5 months, however it aligns very well with sunset at lunar major standstill. The western passage targets the sunset at lunar minor standstill, which also points to Newgrange. Knoth has 2 passages, on the eastern and on the western sides, but they are not aligned to the equinoxes, being 5 degrees north (6 days) and 11 degrees south (18 days from the equinox), respectively. The day on which the sunrise penetrated the eastern passage was exactly 3 synodic (same place among the stars) lunar months before summer solstice, 6 before Autumnal equinox, and 9 before winter solstice. So, counting lunar months predicted the solar cycle. If the moon was at 1<sup>st</sup> quarter then, one counted 1<sup>st</sup> quarters. If full, one counted full moons. Only around 3300 BCE did this work. The west passage at Knoth functions in a similar way. The sun shines into the western passage 18 days before vernal equinox, which is exactly 13 synodic months before the following vernal equinox, independent of the phase. Knoth could also be used to observe the major and minor lunar standstills.

There are also alignments between the various sites. A line from Millmount to Tara passes over Carbury, the source of the Boyne, toward the winter solstice sunset. At Millmount, at the equinoxes, the sun sets over the Hill of Slane, 8 miles away, then 24 miles farther away it aligns with dozens of mounds built on a mountain top. The full moon would have set over the Hill of Slane while the sun was rising due east toward the Pleiades. The Hill of Slane is now associated with St. Patrick, who arrived 3500 years later, adding another layer of legends. The southwest chamber at Dowth points to Tara, which is also the direction of the winter solstice sunset. A stone at Dowth points to the heliacal rising of Sirius at vernal equinox. It is obvious that these monuments were located precisely relative to each other, to produce many multiple alignments at the critical times in the solar and lunar cycles.

Newgrange is the largest of the passage-mounds, being over 80 m in diameter, and is surrounded by monoliths. It has a quartz façade, which shines from afar in the moonlight. It is a UNESCO World Heritage Site and a patriotic symbol in Ireland, the zenith of megalithic achievement. Its passage is 18 m long and aligns with the winter solstice sunrise. When built, the passage was only 40 cm wide, so the sun shown down the passage for only 3 days before and after solstice, and for only 17 minutes each of these day. The rest of the year the passage is dark. At the rear of the passage the sunbeam struck a triple spiral, see Figure 2, (a popular artistic motif in Ireland and the symbol for Newgrange), progressing across it on those days when the sun could penetrate the recess, centered exactly on the solstice. In 2006, over 27,000 people entered the lottery, which chooses the 50 who are allowed to watch this alignment from inside the passage.



**Figure 2 Triple Spiral at Newgrange**

The shape and proportions of the passage (See Figure 3) mimics the shape of Cygnus, as do many other tombs nearby. This has long been a wintering site for whooper swans, and the swan has a prominent place in Irish mythology. It is possible that some of the constellations were invented on the periphery of Europe and later migrated into the classic world, rather than the reverse direction. The shapes of Cygnus, Lyra, and Aquilla are represented in paintings at the Lascaux caves in France, which date back over 16000 years. The cross-shaped passage of another nearby mound called Fourknocks (out of sight 15 km away) points to the spot on the horizon where, 5000 years ago, Deneb would have risen above the horizon after just barely dipping below it (the only time in the precession cycle for which Deneb is not circumpolar when Thuban was the pole star.) The cross was a potent symbol, possibly inspiring construction not only of the four Boyne passage-mounds, but at sites such as Avebury in England (which also is a wintering site for swans), and Callanish in the outer Hebrides of Scotland.

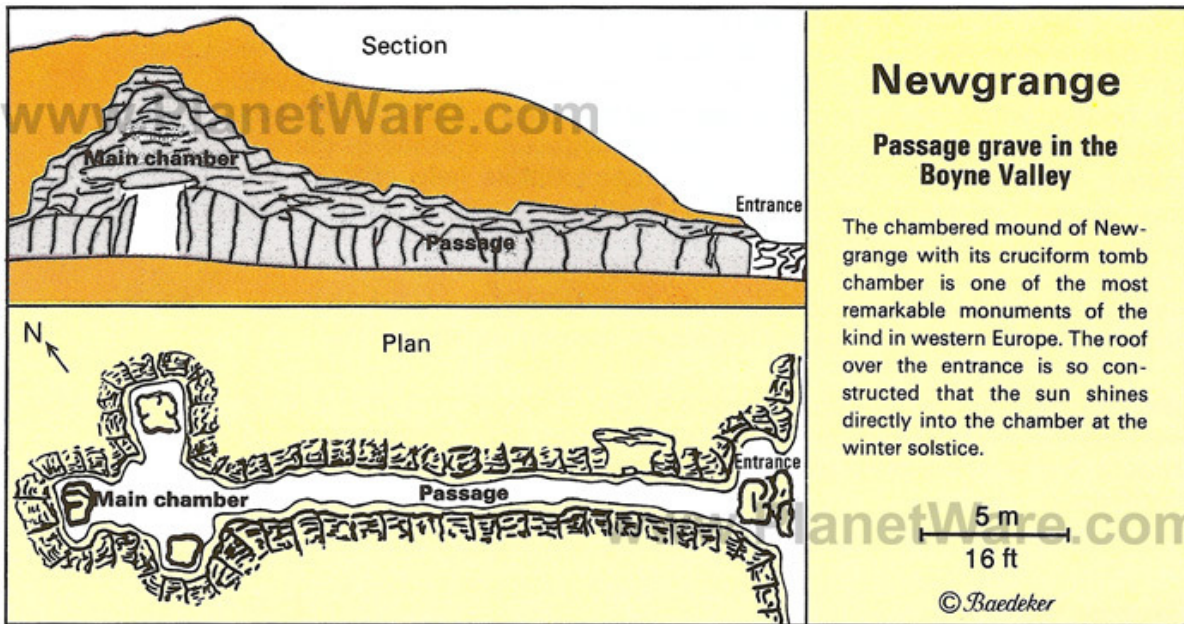


Figure 3 Passage Chamber at Newgrange

These also have cruciform shapes pointing north built into them. At winter solstice, the wings of Cygnus point downward toward the horizon, roughly toward the sun, announcing sunrise. Unlike today, when a third of the Milky Way lies permanently below our horizon, at this time in the precession cycle in Ireland the entire Milky Way could be seen, forming a complete ring stretching entirely around the horizon for part of the night. The quartz ring around the mound may have been its terrestrial counterpart. The Boyne, which nearly encircles Newgrange, also mirrors the Milky Way, just as the Ganges in India and the Nile in Egypt represented the celestial river. Thus, Newgrange immortalizes an unique time in human history. At certain times the moon aligns with the winter solstice sun. At this time the moon rises over the same hill that the sun does. This pinpoints when the moon is at a node of its orbit, allowing the prediction of eclipses. Newgrange and many other sites are egg-shaped, some being split along the solstice line. The solar shaft pierces the mound which conceals the womb-shaped cave, indicating possible use of these sites in fertility rituals. All of these sites appear to be built with multiple astronomical and religious purposes in mind. Newgrange also has a Venus connection. Venus would shine into the passage just before sunrise at various times, but only once in its 8 year cycle would this occur at winter solstice ( $\pm 2$  days). In the passage is a lintel forming a window, an opening through which Venus would have risen in twilight in 3147 BC, pinpointing the era of Newgrange's use. In 3107 BC, the sun, moon, and Venus all shone into the passage at winter solstice.

Newgrange, Dowth, and Kesh all have what are called kerb stones around their bases. Venus requires 584 days to go from morning to evening and back to morning star. Five of these periods is almost exactly equal to 99 lunar months. There are 97 at Newgrange, with two that are considered double, so counting lunar months allowed the prediction of triple conjunctions. At Kesh, the count is 127. Counting months around the kerbstones once is 9.5 years, half the Metonic cycle. Dowth has 115 kerbstones. Twice around the stones is the number of synodic months (full to full) in the 19.6 year lunar swing (rising point on the horizon) cycle.

There was one other significant object in the sky which transited the Newgrange “sky window”- Sirius. The Dog Star shared the same rising point as the winter solstice sun back in the Neolithic. Precession would have eliminated this alignment by 2950 BC. Dog skeletons were found in the recesses at Newgrange. It seems unlikely these features were coincidence. “Deneb, Sirius and the Milky Way held a unique precessional importance at the time that Newgrange was built.... There can be no doubt that the competence of the astronomical engineers allowed them to make an accurate estimation of the precessional time scale, the largest sky cycle of them all” (p. 179)

Various gods, heroes, and kings have been personified in Irish mythology (and in other societies) as Orion. From Millmount, Orion seemed to walk along the horizon, setting over Tara. The sun, moon, and Venus cross the Milky Way twice in their motions along the ecliptic. One of these crossings is in the upraised hand of Orion, between Gemini, Auriga, and Taurus. The hand of Orion could be imagined as grasping the sun. In the early Neolithic it was at the vernal equinox. In the Bronze Age it occurred at Beltaine (around May Day, marking the Irish New Year), and now at the summer solstice. Where the path of the sun crossed the Milky Way were important, considered portals to the afterlife.

There is an enormous amount of additional connections between the geography, mythology, religion, and astronomy in Ireland, only a small part I was able to include here. Anyone can borrow this book from me if they would like.