The Jeety Starn

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Welcome to Issue 5 of *The Jeety Starn*, the quarterly newsletter of the Stirling Astronomical Society (SAS). Included in this issue are articles on the myth and magic of the aurora, the fourth and last of the series on Royal Astronomers, which tells the story of the Royal Astronomers of Ireland, the origins of life on earth and the naming of Full Moons, as well as our regular quotes with astronomical overtones. We start with the story of the stars in T Tauri.

T Tauri stars – the early years

By Alan Cayless FRAS

Riding high above Orion throughout the winter months, the distinctive V shape of the Hyades in the constellation Taurus is one of the most familiar sights in the winter sky. At a distance of approximately 65 light years from Earth, the Hyades is an example of an *open cluster* – a loosely-bound system of bright, hot, young stars.

Based on models of stellar formation and evolution, the Hyades cluster is estimated to be approximately 625 million years old. While the stars making up the Hyades are relatively young compared to our own Sun, the wider constellation of Taurus contains an example of stars at an even earlier stage in their evolution and lifetime. Slightly to the north of the Hyades lies the *T Tauri nebula* (RA 04h 22m Dec +19° 32'), which is home to a triple system of stars collectively designated *T Tauri*. At approximately 470 light years from Earth, the T Tauri system is physically separate from the main Hyades cluster and is also separated in time, having been formed much more recently. All three of the stars in the T Tauri triple system are in the very earliest stages of their lives, having been formed from the collapse of gas from the surrounding nebula within the last million years (Cayless 2024).

The stars in T Tauri are still in the final stages of collapsing and have yet to settle down into the main equilibrium stage of their existence. At this early stage of a star's life nuclear fusion has not yet started in the core, and the stars are still powered by the energy of their initial collapse. T Tauri stars typically exhibit a significant amount of variability as they are still forming and not yet in an equilibrium state. Fusion will eventually take over as the core compresses and heats further, and the stars will eventually become more stable main sequence stars, like the ones in the Hyades. Since the discovery of T Tauri in 1852 by Nottingham-born astronomer John Russel Hind (RAS 1892a), many other examples of this type of star have been found (Joy 1945; Malatesta 2001; ULLYSES 2023). Stars of this type are now referred to as *T Tauri stars*, and this stage of a star's life cycle as the *T Tauri phase*.

Hubble image of the T Tauri triplet and surrounding nebula (NGC1555) (NASA 2024). **Image Credit**: NASA, ESA, G. Duchene (Universite de Grenoble I); Image Processing: Gladys Kober (NASA/Catholic University of America)

T Tauri stars are typically similar in mass to the Sun, with a range of up to three solar masses, and have spectra characterised by high ultraviolet and X-Ray emissions (Brooks et al. 2003). In addition to the variability that comes with not yet being in equilibrium, T Tauri stars tend to have a much higher overall luminosity than the Sun, with the radiation coming from outer layers of gas that have been

heated to high temperatures by energy from the gravitational collapse.

This phase is also characterised by outflows of gas and other material, driven by the outpouring of radiation. Material accreting onto the star from the surrounding nebula is then thrown outward along the axis of rotation, in a process of *bipolar outflow*. In our own solar system, much of the gas and dust from the original solar nebula was driven away from the inner parts of the system during this T Tauri phase. This meant that the inner planets including Earth and Mars formed from rocky cores with relatively little atmosphere, while the majority of the gas was driven further out to form the much larger gas giants.

The strong outflows of gas and radiation during the T Tauri stage of a star's life can also help to explain the mystery of the Sun's slow rotation. As an object collapses, conservation of angular momentum means that its rotation will speed up, but in spite of having collapsed from a much larger cloud of gas than the giant planets, the Sun rotates relatively slowly in comparison. The two largest gas giant planets, Jupiter and Saturn have rotation periods of 9.9 hours and 10.7 hours respectively (NSSDC 2024), while the Sun rotates much more slowly taking over 26 days at the equator. This suggests that much of the initial angular momentum in the solar nebula was transferred away from the Sun, resulting in its slower rotation. Some of this transfer is now understood to have happened during the T Tauri phase as material was driven outwards from the Sun towards the outer parts of the solar nebula.

Hind was awarded the Gold Medal of the Royal Astronomical Society in 1853 and also later became President (1880). While the medal was awarded primarily for his discoveries of asteroids including Fortuna, Kalliope and Thalia, the citation (RAS 1892b) also mentions discoveries of a number of variable stars, one of which was most likely T Tauri itself.

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From: Ulysses, by Alfred, Lord Tennyson

I cannot rest from travel: I will drink
Life to the lees: All times I have enjoy'd
Greatly, have suffer'd greatly, both with those
That loved me, and alone, on shore, and when
Thro' scudding drifts the rainy Hyades
Vext the dim sea:

From: Georgics, Book I, Star-Lore, by Virgil

When shining Taurus opens the year with his golden
Horns, and the Dog's averted star declines;
For greater harvests of your wheat and spelt,
Let first the Pleiades and Hyades be hid
And Ariadne's diadem go down.

Aurora (2): Myth and Magic

By Sandi Cayless

The *Aurora Borealis* has long been known as the Northern Lights, whilst its southern hemisphere counterpart, *Aurora Australis* are the Southern Lights. Humans have told tales and built legends around the aurora since time out of mind. Rock paintings by Cro-Magnon people over 30,000 years ago in caves in southern France are said to show the aurora, which would make them the first known recordings in history (Arctic Author 2014). Later rock carvings of so-called "Stickman" petroglyphs found across the globe from between 10,000 and 3,000 BCE have been linked to ancient periods of intense auroral activity (van der Sluis and Peratt 2010): the Los Alamos National Laboratory's *Roadrunner* computer was used to simulate auroral profiles under massive solar wind fluctuations, and image capture of different stages of the simulated aurora formation appeared to resemble these ancient petroglyphs.

Records of aurorae abound in eastern Asian cultures – reports appeared in China over 2,000 years ago and lists of auroral observations start in 687 BCE. The Chinese described them using fire and animals such as dragons (NASA 2002). The oldest written document dates from about 2,600 BCE and says: "Fu-Pao, the mother of the Yellow Emperor Shuan-Yuan, saw strong lightning moving around the star Su, which belongs to the constellation of Bei-Dou, and the light illuminated the whole area." Stars were thus visible, the aurora was observed to the north and the landscape was illuminated. Norwegian Vikings called the aurora the sky bridge between the gods and the earth (Bifrost) and took it to be light reflecting off the armour of the Valkyrie; in Norse mythology, Heimdall is the god of the northern lights (Arctic Author 2014, Anon 2024). The Scandinavian peoples have also linked northern lights to dead virgin souls, and some Norwegians recall that as children, they waved white clothing at the aurora as they believed that their waving increased the movements of the lights. To the Sami people, the northern lights had supernatural power. The Sami have symbols for them on their drums, and give them several names, including Guovssahas (lights that can be heard). To the Hebridean Scots, the *Na Fir Chlis* (merry dancers) fought the Everlasting Battle, where the blood of the wounded fell to earth and congealed into blood stones, known in the Hebrides as *fuil siochaire* (fairy blood). There are also tales of the *merry dancers* taking part in clan fights over custody of a fairy lady by rival chiefs (Mackenzie 1935). The red auroral light below vivid streamers is called the pool of blood.

The Siberian Chuvash believed that the Suratan-Tura (birth-giving heaven) gave birth to a son during an aurora, and reduced the agonies of a woman in childbirth. The Chukchee of northeast Asia saw the aurora as an abode for those who had died a violent death, whereas the Baltic Estonians viewed it as a heavenly war (Holmberg 1964). An Alaskan Inuit legend says that the northern lights are spirits playing ball with a walrus head, whilst to Hudson Strait Inuit people, the aurorae were the torches of spirits leading recently-dead souls to paradise; the Copper Inuit of the Coronation Gulf thought the aurora brought good weather (NASA 2002). Native American peoples had other myths, and Holzworth (1974) gives many examples, such as: to the Onondaga, the aurora is an advisor to Chief He-Holds-the-Earth; to the Ottawa people of the Canadian Manitoulin Islands, the aurora was a sign from Nanahboozho, creator of the world; the Fox believed the aurora to be a bad omen, the ghosts of their slain enemies trying to rise; the Dog-Rib tribe of the Chipewya envisaged the aurora as the fingers of Ithenhiela beckoning them to his home in the sky, which he had been given as a reward for retrieving the medicine belt that allows the sun to shine.

The indigenous Aboriginal and Māori people of the southern hemisphere also have their own traditions of the aurora, and associated the spectacle variously as connected to fire, evil spirits and messages from ancestors. As no habited land lies under the areas of highest auroral activity in Australia, the aurorae visible to the indigenous people tend to be high altitude and low to the horizon, and are dominated by the red of oxygen. They thus tend to be associated with blood, fire and death, and according to Hamacher (2013), only interpretable by initiated male tribal elders. Among the Māori people, the *Aurora Australis* is called the Tahunui-a-rangi, or *great torches in the sky* (Best 1922). The Māori believed it to be a huge fire lit by ancestors whose canoes had drifted into the Antarctic sea.

Greek philosopher Anaximenes (c. 586–525 BCE) mentions an aurora seen in 593 BCE, whilst Xenophanes (c. 570–478 BCE) wrote of "the accumulation of moving and burning clouds" (Arctic Author 2014). A Babylonian astronomer at the court of Nebuchadnezzar II recorded the aurora on a tablet dated to 567 BCE. Hippocrates (c. 460–370

BCE) believed the aurora to be reflected sunlight, but according to Aristotle (384–322 BCE), the sun's heat raised steam from the ground which hit the fire element of the air, which ignited. Around 360 BCE, Philip of Macedonia, about to attack Byzantium, had his army dig tunnels under the city walls, but as his soldiers opened the far end of the tunnels for the night-time assault, they saw a sudden bright light shaped like a crescent moon lighting up the landscape. This portent was enough to save Byzantium, and a coin bearing a crescent was struck to commemorate the event. The crescent was probably an auroral arc, as the crescent moon would not have been bright enough to light the landscape. This crescent appears on many flags and is usually taken to be the moon, but it is oriented the wrong way. An auroral display that allowed people to see cavalry and infantry soldiers occurred in 44 BCE, before the death of Julius Caesar, and it was said that the aurora lit the sky of Palestine when Titus destroyed Jerusalem, but when the Roman Empire ended, few records of the aurora appear for almost a thousand years.

The first written mentions of the aurora in Great Britain appeared in 555. A detailed description of the most intense one of the century, in 585, exists and other examples of aurorae between 500 and 1100 can be found in the Chronicle of Scotland (Arctic Author 2014). An early realistic description of the aurora is in the Norwegian book *Kongespeilet* (King's Mirror) from the 1200s, which describes the aurora (or Norðrljós) as a natural phenomenon (Anon 2024). The first printed document about the northern lights was produced in 1490 (Arctic Author 2014). French mathematician Gassend has been credited with devising the term *Aurora Borealis* (from the Roman goddess of dawn, Aurora, and the Greek god of the north wind, Boreas) in 1621, but Galileo was already using it in 1619. After the auroral display of 1621, aurorae were missing almost totally during the next hundred years, when no sunspots were observed in the sun (the Maunder minimum). That was ended vividly by the massive aurora of the 17th of March, 1716.

Perhaps the most famous song ever written about the *Aurora Borealis*, *The Northern Lights of Old Aberdeen*, was penned in 1952 by a woman from Leamington Spa who had never seen the Granite City, or an aurora (Britton 2023). Mary Webb was then working in a London hospital kitchen with her friend Winnie Forgie, from Aberdeen. Winnie was so very homesick that Mary, with her husband William (known as Mel), sat down at Mary's piano to create a melody to cheer her friend. Mary was originally a concert pianist but little did she and Mel realise that they would produce an enduring Scottish song that would premiere in the Albert Hall, as Mary had sent the song to Scots tenor Robert Wilson. Mel by then had sadly passed away, and never heard it sung when Mary and Robert stepped onto the stage in 1953 at the Tivoli Theatre in Aberdeen. Mary herself died at age 88 in Charing Cross hospital, London. The piano on which Mary wrote *The Northern Lights of Old Aberdeen* is now on display at the Mary Garden room of the Aberdeen Music Hall.

"She called them the heavenly dancers,
Merry dancers in the sky,
I'll never forget that wonderful sight,
They made the heavens bright."

Aurorae exist on other planets and satellites, around brown stars, and comets (Callingham et al. 2021; Galand et al. 2020, Lillis et al. 2022, NASA 2024): perhaps other civilisations have their own legends, myths and songs.

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Aurora Borealis (Herman Melville, 1865)
What power disbands the Northern Lights
After their steely play?
The lonely watcher feels an awe
Of Nature's sway…

Poetic Licence

Meredith, William: Starlight
Going abruptly into a starry night
It is ignorance we blink from, dark, unhoused;
There is a gaze of animal delight
Before the human vision. Then, aroused
To nebulous danger, we may look for easy stars,
Orion and the Dipper; but they are not ours

Södergran, Edith: On Foot I Had to Cross the Solar System
On foot – I had to cross the solar system
before I found the first thread of my red dress.
I sense myself already.
Somewhere in space hangs my heart,
shaking in the void, from it stream sparks
into other intemperate hearts.

Tagore, Rabindranath: The Lost Star
Where the lost star had gone.
Everybody said,
'It was the star which brightened the heavens most
It was the biggest and the best.'

Tappan, William B.: To the North Star
Bright Star, while thou thy lonely way
Pursu'st in yon expanse of blue,
Thy gem-like form and steady ray
Attract the heedless peasant's view

Whitman, Walt: When I Heard the Learn'd Astronomer
When I heard the learn'd astronomer,
When the proofs, the figures, were ranged in columns before me,
When I was shown the charts and diagrams, to add, divide, and measure them,
When I sitting heard the astronomer where he lectured with much applause in the lecture-room,
How soon unaccountable I became tired and sick,
Till rising and gliding out I wander'd off by myself,
In the mystical moist night-air, and from time to time,
Look'd up in perfect silence at the stars.

How on Earth did Life originate?

By Chris Davis

Life is everywhere, from Arctic ice to equatorial hot springs. In the last century, Life's astonishing chemistry was discovered to be based on a self-replicating molecule, DNA (deoxyribonucleic acid), which is also an information-carrying polymer.

The chemistry of DNA and its protein products are so intimately interwoven that their spontaneous origin together is on the impossible side of not very likely, and there is no fossil record of how it happened four and a half billion years ago.

Fossil signs of bacterial life have been found dating from when the Earth was only one third of a billion years old. This quick appearance of life on Earth hints that it came from somewhere else, where it could have had billions of years to evolve into complete bacterial cells.

There are extremophile bacteria that live deep inside porous rock. Such bacteria could have been blasted off their home planet in meteorites which eventually seeded our planet with life. Other water-bearing solar system bodies like the moons Europa and Enceladus may well be found to have been also seeded by DNA- based microorganisms.

The question remains, however, "How did life originate, albeit not on Earth?". The answer is we do not know, and we can only speculate on how something as complex as our DNA chemistry originated in the Universe.

I had the privilege of spending some time with the Origin of Life authority Dr A. G. Cairns-Smith of Glasgow University. He was famous in the 1970s for his book "The Life Puzzle". He was interviewed on both radio and television. His theme was that the sophisticated and complex DNA system had to evolve from a simpler, more likely self-replicating, material. He pointed out that the primitive Earth may well have had an abundance of lamina clay particles, growing layer by layer in mineral-rich water washing off the rocks of new continents. The crystalline silicate clay layers would flake apart under certain conditions and seed new clay particles.

The silicate crystal structure would contain faults which could be replicated in the flaked-off daughter crystals. What is more, the faults would be the centres of any catalytic activity. The clays could catalyse the synthesis of organic molecules and polymers. In turn these organic molecules could enhance the growth and replication of clays with the most favourable catalytic fault patterns. Clays could therefore have evolved as self-replicating information-carrying systems.

Further, they could have hosted the evolution of a more efficient, organic replicating molecule, DNA, for its precise protein-making ability, which created membranes and eventually the cells of life with which we are familiar today.

But it has to be said, no such system has been synthesised and demonstrated in a laboratory, so we do not know exactly how Life originated.

"…the first alien visitor to their… planet would take one look at the inhabitants and immediately want to lodge a complaint with the management…"
Linen Lyrican, in *Sub Martis: Dome Lowell* (ISBN 10: 1492327476)

The Astronomers Royal (Part 4)

By Mark Butterworth FRS

In the last of a 4-part series by our late, dear friend, Mark Butterworth, reprinted from SAS Mercury newsletters 2005-2006 by kind permission of Mrs Pat Butterworth, Mark tells us of the Royal Astronomers of Ireland. Illustrations have been amended as appropriate.

The Royal Astronomers of Ireland

The first Royal Astronomer of Ireland was appointed in 1792. The post was combined with the position of Director of the Dunsink Observatory, Dublin, and the Andrew's Chair of Astronomy at Trinity College, Dublin. The post existed between 1792 and 1921; no replacement post was established by the Irish Free State in 1921.

The position was sometimes called "Astronomer Royal for Ireland", adopting the title as a parallel to that of the Astronomer Royal for Scotland. This alternative form was even used occasionally by holders of the post in formal contexts. For example, Franz Brünnow described himself in the Dunsink Observatory publications of 1870 as the Astronomer Royal for Ireland, rather than Royal Astronomer of Ireland. However, the title Royal Astronomer of Ireland is correct.

John Brinkley, 1792-1827


BRINKLEY

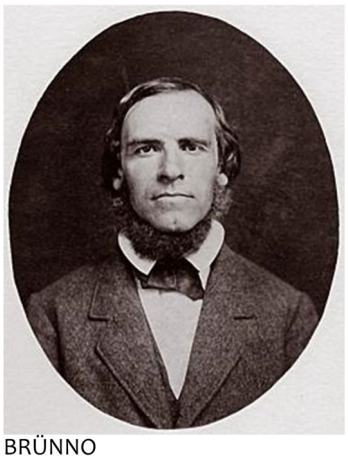
Brinkley was the first Royal Astronomer of Ireland and later became the Bishop of Cloyne. In 1792 he became the Andrew's Professor of Astronomy in the University of Dublin. His main work was on stellar astronomy and he published his *Elements of Plane Astronomy* in 1808. He was awarded the Copley Medal by the Royal Society in 1824. Brinkley's observations that several stars shifted their apparent place in the sky in the course of a year were disproved at Greenwich by the Astronomer Royal John Pond.

Sir William Rowan Hamilton, 1827-1865


HAMILTON

A child prodigy, he had mastered thirteen languages by the age of 13 and was still an undergraduate when he became Professor of Astronomy at the University of Dublin. Hamilton was one of the most original and creative mathematicians of his time. In his *Theory of Systems of Rays* he predicted the existence of conical refraction (later confirmed experimentally). He unified the field of optics under the principle of varying action, which he later extended to dynamics and which has become of fundamental importance in modern physics, particularly quantum theory. His later years were largely devoted to the invention and development of his theory of quaternions – complex numbers with four components. Although he believed this work to be his most important, quaternions have been superseded in many applications by the methods of vector and tensor analysis. However, they opened the way for the discovery and development of numerous types of abstract algebras by later mathematicians and are commonly used in 3D computer graphics.

Franz Friedrich Ernst Brünnow, 1865-1874


BRÜNNO

Brünnow was born in Berlin and attended the University of Berlin, where he studied mathematics, astronomy and physics as well as chemistry, philosophy and philology. After graduating he took an active part in astronomical work at the Berlin Observatory under the direction of Encke, and he contributed numerous important papers on the orbits of comets and minor planets to the *Astronomische Nachrichten*. In 1854 he accepted the post of director of the new observatory at Ann Arbor, Michigan, in the United States. In 1865 he

became Royal Astronomer of Ireland, with his first undertaking being the erection of an equatorial telescope to carry the fine object-glass presented to the University by Sir James South. On its completion he began an important series of researches on stellar parallax. He retired in 1874 with failing eyesight.

Sir Robert Stawell Ball, 1874-1892


BALL

Ball worked for Lord Rosse at Birr before being appointed Astronomer Royal. He established a regular programme of observing stars for parallax. He hoped quickly to establish the most appropriate types of star by observing hundreds in prolonged sessions at the telescope, but his researches were unsuccessful. In 1892 he was appointed Lowndean Professor of Astronomy and Geometry at Cambridge University. His lectures, articles and books (e.g. *Starland* and *The Story of the Heavens*) were popular and simple in style, and made him the most famous astronomer in the UK at the time. His main interest was mathematics and he devoted much of his spare time to the theory of screws, a follow-on from Hamilton's quaternions. He presented the Christmas Lectures at the Royal Institution three times and his popular lectures attracted huge crowds. He lectured at the Albert Hall, Stirling in 1885, where he presented "An Hour with the Modern Telescope".

Arthur Alcock Rambaut, 1892-1897

Rambaut [no image available] was educated at Trinity College, Dublin, and came first in his year in mathematics. After studying experimental physics with Helmholtz in Berlin he became Andrew's Professor of Astronomy and Royal Astronomer of Ireland. He enlarged a new edition of the Elements of Quaternions by Sir William Rowan Hamilton, and published a Manual of Quaternions. As well as directing observational work at Dunsink, he was a member of the Royal Irish Academy-Royal Dublin Society's expedition to Plasencia, Spain for the total eclipse of 1900.

Edmund Taylor Whittaker, 1906-1912


WHITTAKER

Whittaker was educated at Manchester Grammar School and Trinity College, Cambridge, where he graduated as Second Wrangler. Between 1906 and 1911 he was Royal Astronomer of Ireland and taught mathematical physics at Trinity College, Dublin. He became Professor at Edinburgh University in 1911, where he served out his academic career. He had a particular interest in numerical analysis, but also worked on celestial mechanics and the history of physics. As the author of *A Course of Modern Analysis* he developed the Whittaker's function or Whittaker integral and his book became one of the indispensable mathematics texts of the time.

Henry Crozier Keating Plummer, 1912-1921


PLUMMER

Plummer studied physics and was appointed Lecturer in Mathematics at Owen's College, Manchester. In 1900 he was appointed Assistant at the Oxford University Observatory, with one year out as a Research Fellow at Lick Observatory in the USA. His research interest was in the rapidly expanding discipline of spectroscopy and developments of the science at American observatories. In 1912 he was appointed Royal Astronomer of Ireland and Andrew's Professor of Astronomy at Trinity College, Dublin. Working at the Dunsink Observatory with the 15" reflector, he began a long programme of photometric observations of short-period variable stars and the analysis of their light curves. He also studied radial pulsations of Cepheid stars. In 1921 he moved to be Mathematics Professor at the Military College of Science at Woolwich.

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A Quote or Two...

Coleridge, Samuel Taylor (1772-1834)
The stars hang bright above, silent, as if they watched the sleeping earth.

Columbus, Christopher (1451-1506)
Following the light of the sun, we left the Old World.

Crisp, Quentin (1908-1999)
In an expanding universe, time is on the side of the outcast. Those who once inhabited the suburbs of human contempt find that without changing their address they eventually live in the metropolis.

Copernicus, Nicolaus (1473-1543)
So far as hypotheses are concerned, let no one expect anything certain from astronomy, which cannot furnish it, lest he accept as the truth ideas conceived for another purpose, and depart from this study a greater fool than when he entered it.

Every light has its shadow, and every shadow hath its succeeding morning.

To know that we know what we know, and to know that we do not know what we do not know, that is true knowledge.

For I am not so enamoured of my own opinions that I disregard what others may think of them.

Finally we shall place the Sun himself at the centre of the Universe.

Mathematics is written for mathematicians.

Curtis, Helena (1924-2005)
You and I are flesh and blood, but we are also stardust.

Dawkins, Richard
Scientific truth is too beautiful to be sacrificed for the sake of light entertainment or money. Astrology is an aesthetic affront. It cheapens astronomy, like using Beethoven for commercial jingles.

De Vries, Peter (1910-1993)
The universe is like a safe to which there is a combination. But the combination is locked up in the safe.

Descartes, Rene
The only thing we have power over in the universe is our own thoughts.

The only thing that I know, is that I know nothing.

Reason is nothing without imagination.

Democritus (460-370 BCE)
Nothing exists except atoms and empty space; everything else is opinion.

Dirac, Paul (1902-1984)
God used beautiful mathematics in creating the world.

Pick a flower on Earth and you move the farthest star.

Full Moons and Their Names

By Sandi Cayless

A full moon occurs when the earth is aligned precisely between the sun and the moon, allowing the complete side of the moon facing earth to be sunlit. Myriad names have been used to identify types or timings of full moons and most relate to cultural, agricultural and natural observations that helped humans to recognise seasonal shifts and track time. Some months share the same moon names (e.g. *Harvest Moon*) as, depending on latitude and climate variability, natural events may occur earlier or later in the season. A great many names have come via the native tribes of America, as lunar cycles were critical in their culture (RMG 2024), and there is strong consistency across the names, although they do differ in specifics (Farmers' Almanac 2023), but some names are Celtic, Anglo-Saxon, Medieval English and Neo-Pagan (Buckle et al. 2024). Here are some examples by month.

January This full moon is often called *Wolf Moon*, as

the cries of hungry wolves when food was scarce could be heard. Many believe this name to be Celtic or Old English in origin, and brought to North America by European settlers, as the distinctive howl of the Grey Wolf was heard everywhere (Farmers' Almanac 2023). Other Celtic names are *Stay Home Moon* and *Quiet Moon* (Buckle et al. 2024), and an Anglo-Saxon rendering is *Moon After Yule*, indicative of the Yule, or winter solstice, celebration. In Native American culture, the Sioux call the January full moon *The Time When Wolves Run Together*, the Potawatomi of the Great Lakes call it *Bear Moon*, the Alaskan Haida call it *Bear Hunting Moon*, and to the Tlingit of the Pacific Northwest it is *Goose Moon* (Higgins 2024a). The *Sun Has Not Strength To Thaw Moon* is Algonquin, whilst *When Snow Blows Like Spirits In The Wind Moon* is Arapaho; to the Cherokee it is *Cold Moon*, to the Cheyenne it is *Moon Of The Strong Cold*, and to the Omaha it is *Moon When Snow Drifts Into Tipis*. *Severe Moon* and *Center Moon* are also of Native American derivation, and the names *Ice Moon* and *Old Moon* are also found (Rao 2024).

February A common name for this full moon is *Snow Moon*, marking a time of often heavy snowfall, but it is known to the Mahican of north-east USA as *Deep Snow Moon*, whilst to the Oneida tribe of upstate New York and the Great Lakes it is *Midwinter Moon* (Mayntz 2024a). Further south, on the Great Plains, the Arapaho call it *Frost Sparkling in the Sun Moon*, whereas the Comanche tribe of the warmer southern plains name it *Sleet Moon*, hinting of spring. Further south still, the February full moon is *First Flower Moon* to the Catawba of South Carolina. This full moon also has names indicative of hunger or scarcity (Mayntz 2024a, Peters 1988, Rao 2024): *Hunger Moon*, *Hungry Moon*, *Bone Moon* or *Bony Moon* (Cherokee of North Carolina); *Moon of Big Famine* (Choctaw of south-east USA); and, *Out of Food Moon* (Kalapuya of the Pacific Northwest). Animals also appear in the nomenclature: it is *Goose Moon* to the Haida of Alaska, and *Moon When Geese Come Home* to the Omaha, as geese start to return north to their nesting grounds. *Black Bear Moon* (Tlingit) suggest the stirring of black bears, as does *When the Bear Cubs Are Born Moon* (Ojibwe of southern Canada). *Sucker Moon*, used by the Chippewa, signifies the return of suckers (carp) under the ice at a time of near-starvation (Peters 1988). Other names include *Storm Moon* and *Ice Moon*. But February may not have a full Moon… As the lunar cycle is 29.5 days, a full moon at the very end of January means no full moon in February. This makes February the ***Black Moon*** month. There are several definitions of a Black Moon (Spanner 2022) but this particular February type occurs about every 19 years (the last was 2018, the next will be in 2037). However February, that month of eccentricity, may also have a *Leap Day* full moon, a very rare full moon that occurs on 29 February (Mayntz 2024a). The current millennium sees only four Leap Day full moons: 2048, 2132, 2216 and 2376.

March *Worm Moon*, when earthworm trails appear as heralds of thawing ground, is a common name for the March full moon. With winter ending and spring beginning, nature stirs, and as a result this full moon has many names (Mayntz 2024b). Northern winter-end names such as *Snow Crust Moon* or *Hard Crust on the Snow Moon* (Ojibwe and Chippewa tribes by the Great Lakes) are found. In areas such as the Great Plains, northern plains and Dakotas the bright late winter/early spring sunlight reflects off residual

snow to cause snow blindness or eye soreness, giving rise to *Sore Eye Moon* (Sioux, Lakota and Assiniboine). Strong winds are common during this time, and the moon at full is *Wind Moon* to the Choctaw, Cherokee and Catawba. In Celtic culture, this becomes *Moon of Winds*. In south-west US desert areas, the names *Moon of the Whispering Wind* (Hopi) and *Little Sand Storm Moon* (Zuni) occur. The generic term *Spring Moon* is found among the Inupiat (Alaska) and the Passamaquoddy (NE USA), while the southeastern Creek use *Little Spring Moon*. The southwest Pueblo peoples use the name *Moon When the Leaves Break Forth*. A major food activity at this time of year is the collection of sap, when it is actively rising in maple trees, to make maple syrup and maple sugar. To the Ojibwe of southern Canada the March full moon is thus *Sugar-Making Moon*, whilst the Shawnee (Ohio and Pennsylvania) call it *Sap Moon*. For a very clear description of how maple trees were traditionally tapped, sap extracted and maple syrup made, see Ingalls Wilder (1932). Animal names such as *Crow Moon* (Ojibwe) denote crows cawing as they seek mates and define territories. To the Arapaho, whose livelihood depended on the buffalo, this moon is *Buffalo Dropping Their Calves Moon*, whereas the fishing Algonquin tribe of the Great Lakes call it *Catching Fish Moon*. *Chaste Moon* occurs in Old English and *Death Moon*, *Crust Moon*, *Lenten Moon*, *Wind Moon* and *Plough Moon* have also been used (Buckle et al. 2024).

April *Pink Moon* is a common name for the April full moon in Native American tribes living in areas where the pink phlox wildflowers bloom (Buckle et al. 2024, Mayntz 2024c, Rao 2024). Other Native American peoples call this moon variously *Moon of the Red Grass Appearing* (Oglala), *Budding Moon of Plants and Shrubs* (Tlingit), *Moon of Blackberry* (Choctaw), *Flower Moon* (Cherokee), *Moon of the Big Leaves* (SW Apache) and *Sprouting Grass Moon* (several tribes). The most common name imported from Europe to the Americas is *Planter's Moon*, and the Winnebago of the Great Lakes region use similar, *Planting Corn Moon*. Another colonial name for April's full moon is *Sugar Maker Moon*, where collecting sap to make maple sugar and syrup still occurs (Mayntz 2024c, Peters 1988). Nature-related names include *Egg Moon* (many tribes, to indicate nesting), Fish *Moon* (many fisher tribes, to signify salmon or shad spawning) and *Sucker Moon* (Anishinaabe, for the return of suckerfish). To the northern tribes, where such nature signs do not appear so early, the April full moon is *Ice Breaking in the River Moon* (Arapaho), *Breaking Ice Moon* (Algonquin) or *Moon When the Streams are Navigable Again* (Dakota tribes). Food scarcity is still an issue for some, and the Lakota (Teton) Sioux know it as *Moon When Wives Crack Bones for Marrow Fat*. Names found in European cultures include *Budding Moon*, *New Shoots Moon*, *Seed Moon* and *Growing Moon* (Celtic), and *Awakening Moon* (Neo-Pagan). If it is the first full moon after spring equinox, it is *Paschal Moon*, as the date for Easter is set after it. In Jewish tradition, it is *Passover Moon*. In China, this moon is named *Peony Moon*, to signify when native peonies flourish.

May In many cultures, May's full moon is known as *Flower Moon*, signalling the blooming of numerous diverse flowers. To the Creek and Choctaw of south-east USA, however, it is *Mulberry Moon*, as this is when the highly useful red mulberry tree (dried fruit, water additive, cornbread flavouring, dyes, archery bows) blooms (Higgins 2024b). The Kalapuya of the Pacific Northwest call this moon *Camas Blooming Time*. The blue-flowered camas (*Camassia* species) are meadow flowers flourishing across Oregon, eastern Washington and northern Idaho, and their nutrient-rich roots are a key food source (Carney et al. 2021, Turner & Kuhnlein 1983) when little else is available. Leaf growth also figures largely in names such as: *The Season When The Leaves Are Green* (Apache), *Moon Of The Green Leaves* (Lakota) and *The Time Of Big Leaf* (Mohawk) (Higgins 2024b). With the danger of hard frost passing, farmers can begin planting, and this moon is also known as *Field Maker Moon* (Abenaki), *Corn Moon* (Winnebago), *When Women Weed Corn Moon* (Algonquin) and the wonderfully-named *Putting It In A Hole Moon* (East Cherokee). Animal names for May's full moon include *Alewife Moon* (used by the Passamaquoddy – alewives are river herring) and *Frog Moon* (Cree). In medieval Europe, *Milk Moon* signified the time when cows were moved onto summer pasture. Celtic and other names include *Hare Moon*, *Mothers' Moon*, *Bright Moon* and *Grass Moon*.

June The name of *Strawberry Moon* marks the main strawberry harvest in Native American culture (Algonquin, Ojibwe, Dakota, Lakota, Chippewa, Oneida, and Sioux), as the wild strawberry plant (*Fragaria virginiana*) is ripe and ready to harvest in June, and being early-ripening and widespread, it is an important food staple (Mayntz 2024d). Other berry names for June's full moon are used and relate to the main berry crop of the region. These include *Blackberry Moon* (southeastern Creek), *Raspberry Moon* (Shawnee), and *Berries Ripen Moon* (Haida). The names *Flowering Moon* and *Garden Moon* are also used by the Ojibwe. Seasonal names include *Plants in Garden Are Sprouting Moon* (Cherokee), *Green Corn Moon* (various tribes) and *Moon When Leaves Come Out* (northern Cree), though the Choctaw of the southern Great Plains call the June full moon *Windy Moon*, in reference to spring storms. In Anglo-Saxon Europe, *Honey Moon* or *Mead Moon*, the latter referring to mowing of meads (meadows), was used. Elsewhere, it is known as *Rose Moon*, for the time when roses bloom, or in China, *Lotus Moon*. The name *Hot Moon* for the start of summer heat is also used (RMG 2024) – but the same moon in the same month in south Africa is *Cold Moon*, heralding the approach of the winter solstice (Mayntz 2024d). Animal names are also used to represent June's full moon, and the Inupiat and Tlingit peoples (Alaska) call it *Moon of Birthing*, when many northern animals give birth, whereas it is *Moon When the Buffalo Bellows* to the Great Plains Arapaho, in reference to the mating calls of these important animals, or *Moon When the Buffalo Bulls Hunt the Cows* (the Omaha of Nebraska). All these are ancient names, but there is one modern name for the full moon of June: in 2024, to commemorate the first white bison calf born in Yellowstone National Park, the Farmers' Almanac (USA) named this moon the *White Buffalo Moon* (Farmers' Almanac 2024).

July *Buck Moon* is a common name to mark the time when new antlers grow on male deer (RMG 2024). Alternative names include *Salmon Moon* (Haida and Tlingit tribes) and *Salmon Go Up Rivers In A Group Moon* (Wishram), to signify the start of salmon migration (Higgins 2024c). Other names are plant-related: *Time Of Much Ripening Moon* (Mohawk); *Blackberry Moon* (Shawnee); *When The Chokecherries Are Black Moon* (Lakota); *When the Squash Are Ripe Moon* (Algonquin); *Limbs Are Broken By Fruit Moon* (Zuni); *Blueberry Moon* (Ojibwe); *String Bean Moon* (Oneida); *Ripe Corn Moon* (Cherokee); and, *Moon Of The Young Corn* (Potawatomi). This moon is also known as *Thunder Moon*, marking summer storms, and *Hay Moon*, for July hay harvesting (RMG 2024). To the Celts, the July full moon was alternately *Wyrt Moon*, *Herb Moon* and/or *Mead Moon* (Higgins 2024c), all indicating gardening, herbalism or brewing. A wyrtyard was an herb garden, and wyrt is now spelt wort, a word familiar to brewers everywhere; mead is a honey-based drink.

August This month heralds a *Sturgeon Moon*, when the sturgeon (the lake sturgeon, *Acipenser fulvescens*) is recognised to be most abundant by Native American fishing tribes (Mayntz 2024e, RMG 2024), but as the full moon often indicates crops, harvests and growing seasons, there are many other names, such as *Grain Moon* (Anglo-Saxon), *Harvest Moon* (Dakota tribe, and in China), *Moon of the Ripening* (Lakota), *Green Corn Moon/ Corn Moon* (Algonquin and Ojibwe; Medieval English) and *Corn Is in the Silk Moon* (Ponca) (Mayntz 2024e). Other crops are also recognised, and to the Sioux and Assiniboine tribes, this moon is *Black Cherries Moon* (chokecherries), whilst to the Shawnee it is *Plum Moon*. As temperatures rise, water sources may dry up, and these phenomena are recognised in names such as *Dry Moon* (Catawba), *Drying Up Moon* (Cherokee) and *Hot Moon* (Tunica and Shoshone). The August full moon is also known as *Red Moon*, as early evening summer haze often appears to give the moon a reddish tint, and in European and Neo-Pagan cultures, *Lightning Moon* is found where lightning is common in late summer. In the far north,

August's full moon has different connotations, and *Mountain Shadows Moon* (Tlingit) reflects the Earth's angle and its impact on the rugged Alaskan mountain scenery. Very different conditions occur in the Southern Hemisphere, and to other cultures, this moon may be *Snow Moon*, *Storm Moon* or *Hunger Moon*.

September A *Full Corn Moon* marks the time of the corn harvest and the end of summer, and this full moon is also called *Barley Moon* (RMG 2024), but as it is usually the nearest full moon to the autumn equinox, appearing very bright and rising early, it is also called by its very familiar name, *Harvest Moon*, because it allows farmers to carry on harvesting into the night (Higgins 2024d). China's Moon Festival, a national holiday, relates to the full moon of the autumn equinox and a time of seasonal change. The September full moon is also called *Middle Between Harvest And Eating Corn Moon* by the Algonquin, *Moon Of Full Harvest* by the Hopi, *Autumn Moon* by the Passamaquoddy and *After Harvest Moon* by the Kalapuya. *Corn Maker Moon* (Abenaki), *Moon When The Corn Is Taken In* (Pueblo) and *Corn Is Harvested Moon* (Zuni) are alternative names, but other crops are represented in the names *Rice Moon* (Chippewa and Ojibwe) (Peters, 1988), *Nut Moon* (Cherokee) and *Little Chestnut Moon* (Creek).

October The familiar *Hunter's Moon* marks when the pre-winter hunting season occurs. Summer-fattened deer and fox are unable to hide in bare fields, and like a Harvest Moon, a Hunter's Moon is particularly bright and stays long in the sky, allowing hunters to stalk at night, although chillier conditions give rise to the name of *Dying Grass Moon* (RMG 2024). To the Chippewa, it is *Moon of Trout*, when trout come close to shore to spawn and can be caught (Peters 1988). But cooler weather has advantages that simplify the storage and preservation of meat for winter, hence the Ponca tribe's name of *When They Store Food in Caches Moon* and the Oneida tribe's *Someone Stores Food Moon* (Mayntz 2024f). The alternative *Hunting Moon* (Stockbridge-Munsee and Tunica tribes) refers to the action, not the person. If the October full moon is early it can also be called *Harvest Moon*, and the names *Big Chestnut Moon* (Creek), *Moon When Corn Is Taken In* (Apache) and *Seed Moon* (Celtic) also occur. Seasonal changes that bring cold, frost and dropping leaves are represented by the names *Falling Leaves Moon* (Ojibwe, Abenaki, and Arapaho), *Moon When The Wind Shakes Off Leaves* (Lakota), *Wilted Moon* (Shawnee), *White Frost on Grass Moon* (Algonquin), *Moon of the First Frost* (Potawatomi) and *Freeze Begins on Stream's Edge Moon* (Cheyenne). Animal behaviour is embodied in *Moon the Birds Fly South* (Cree) and *Bears Hibernate Moon* (Haida). The October full moon is also known as *Travel Moon* (Iroquois, Algonquin) or *Travel in Canoes Moon* (Wishram), as travelling by night is made easier; and other post-harvest tasks done are reflected in the Dakota tribe's *Moon When Quilling and Beading Is Done* (Mayntz 2024f). The Southern Hemisphere's reversed seasons have spring-related names instead of autumn, and these include *Egg Moon*, *Fish Moon*, *Pink Moon*, *Seed Moon* and *Waking Moon*.

November: This month brings a *Beaver Moon*; there is argument as to whether the name refers to the time when beavers build their winter dams, or the time when Native Americans set beaver traps. [N.B. Currently, beaver trapping is permitted by licence in the United States between 01 November and 07 April (NYSDEC 2024)]. Still, *Beaver Moon* is a prevalent name, and a tribute to these remarkable animals, as however frustrating their lodges or dams are to landowners, who sometimes seek to destroy them, "most colonies will rebuild a dam faster than most people can attempt to destroy it" (Laramie & Knowles 2016). Other animals are also represented in the name of the November full moon: the Chippewa call it *Whitefish Moon* (Peters 1988), to the Cheyenne it is *Deer Rutting Moon*, and to the Choctaw, *Panther Moon*; the Hopi call it *Fledgling Hawk Moon* and the Potawatomi *Turkey Moon*

(Higgins 2024e). November's full moon, when frost really begins to bite, is also *Moon of Much White Frost On Grass* (Algonquin) or simply *Frost Moon* (Assiniboine), *Moon When The Rivers Begin To Freeze* (Abenaki, Arapaho and Cree), *Freezing Moon* (Chippewa and Ojibwe Anishnaabe, Passamaquoddy) and *Heading To Winter Moon* (Comanche). Further south in the USA, it is *Moon When All Is Gathered In* (Pueblo), whereas the northern Kalapuya call it, appropriately, *Moon Of Moving Inside For Winter*.

December: Predictably, this is named *Cold Moon*, its

title echoed in the Chinese *Bitter Moon* (Mayntz & Thomas 2024), and it is the signal for winter's chill in the Northern Hemisphere. This last full moon of the year (usually) is also known as *Long Night Moon*, or *Full Long Nights Moon* (Mahican, Oneida tribes, neo-pagan cultures). December means winter, and *Winter Moon* is a common epithet (Shoshone and others). Other descriptive terms are *Dead of Winter Moon* (Alaskan Inupiat), and *Snow Moon* (Cherokee and Haida). As December nights are at their longest at this time of year, the moon lights the sky for longer, and the Sun is much less in evidence; this has led the Zuni tribe to call this December sight *Sun Has Travelled Home to Rest Moon*. The Arapaho and Oglala title this moon *Popping Trees Moon*, as popping or snapping sounds can be heard if sap freezes and ruptures trees' bark. Other plant names include *Oak Moon*, when the white berries of the mistletoe from oak trees were harvested (Medieval/Druid), or *Evergreen Moon* (Comanche), while animals are represented by *When Deer Shed Their Antlers Moon* (Dakota, Lakota and Sioux). The dark December nights foster reflection, tale-telling and spirituality with names such as *Little Spirit Moon* (Ojibwe and Chippewa) (Peters 1988), *Moon of Respect* (Hopi), *Storytelling Moon* (Catawba) and *Christmas Moon* or *Moon Before Yule* (American Colonial). For the peoples of the Southern Hemisphere, where spring and summer are in full swing, the names *Strawberry Moon*, *Rose Moon*, *Honey Moon* or *Fruit Moon* occur. Whatever the month's name, a Full Moon (clouds permitting) will illuminate the bowl of the night sky and everything that is following the cycle of the seasons below it.

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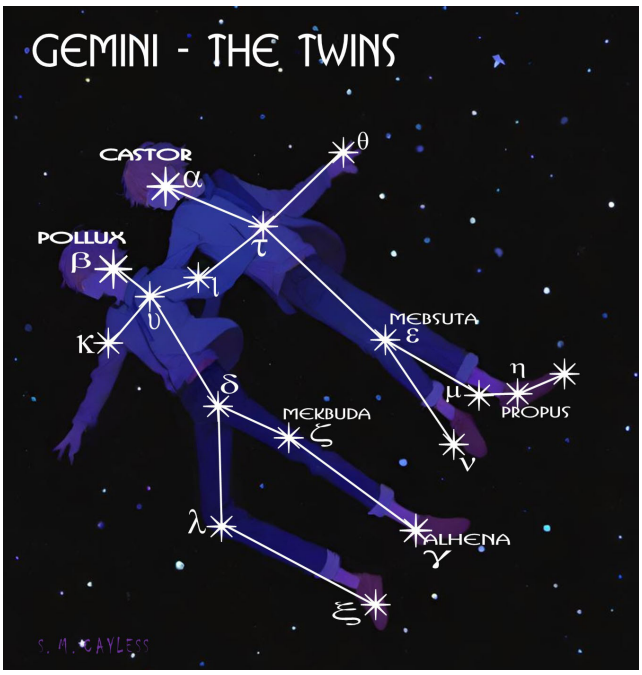
Happy Observing!

From December onwards, there is plenty to look at above us! Jupiter is at Opposition on December 7, and the 2024 Geminid meteor shower will be active between 4-20 December, reaching its maximum on December 14-15. One of the best annual displays (usually!), you may see up to 150 meteors an hour, but as the peak occurs close to full moon on the 15th (the *Cold Moon*), its light may inhibit your view. The radiant is near Castor, in Gemini.



Unlike most meteor showers, the Geminids do not originate from a comet but are residual fragments of asteroid 3200 Phaethon, though there is debate as to whether Phaethon *is* an asteroid; its structure is asteroidal, but its orbit is strongly elliptical, hence comet-like. Phaethon may be a *rock comet*, an entirely new class of celestial object (Quanzhi Ye et al. 2021 Planet. Sci. J. 2 23 DOI 10.3847/PSJ/abcc71). The best chance to see the Geminids will be in the early hours, near the peak, but several should be seen during the active period from just after sunset. Geminids are very bright, quite fast, and atypically, some may be coloured: yellow, green, red, and blue. The colours are in part caused by trace metals such as sodium and calcium, in meteoric particles.

At the solstice of December 21-22 is the peak of the Ursids meteor shower (5-10 meteors per hour), produced by dust grains from comet 8P/Tuttle, but the waning gibbous moon may hinder viewing. Meteors radiate from Ursa Minor, but can appear anywhere in the sky. On December 25, Mercury reaches its Greatest Western Elongation (22° from the Sun). Look low in the eastern sky just before sunrise.

January 1-5 brings us the Quadrantids, peaking at 40 meteors per hour on January 3-4. The Quadrantids are thought to be dust grains left over by the extinct comet 2003 EH1. The crescent moon sets early evening, so the best view will be after midnight. Meteors radiate from Boötes, but can appear anywhere in the sky. Venus is at Greatest Eastern Elongation (47.2 ° from the Sun) on January 10, and Mars is at Opposition on January 16, and visible all night. The new moon of January 29 will provide a good opportunity to observe faint objects such as galaxies and star clusters.

February 1 sees a close approach of the 3-day old moon to both Venus and Saturn, in Aquarius, and on February 3, there is a conjunction of Venus and Neptune. The moon and M45 (Pleiades) make a close approach on February 6, and the following evening, the moon and Jupiter are close.

Mars and the moon come close on February 9, and Venus reaches its greatest brightness on February 16. A close conjunction between the moon and Antares will occur on February 21, and the new moon of the 28th gives us another opportunity to spot fainter celestial objects.

Many thanks to all our contributors over the first year of *The Jeety Starn*. Members, please hand over submissions to the editor, or send them via the Society's contact email address. Illustrations also welcome!

A very happy Holiday Season to all our members and readers. Here's hoping for clear starry nights and plenty of observing… S.C.

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