The Jeety Starn

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Welcome to Issue 4 of *The Jeety Starn*, the quarterly newsletter of the Stirling Astronomical Society (SAS). This issue includes, *inter alia*, articles on the aurora and star formation, the third in a series on Royal Astronomers, which tells of the Astronomers Royal for Scotland, our regular quotes with astronomical overtones, and the final part of *The Sky in Scots*, which covers constellations 45 to 88.

Nova Watch: Impending Drama in Corona Borealis

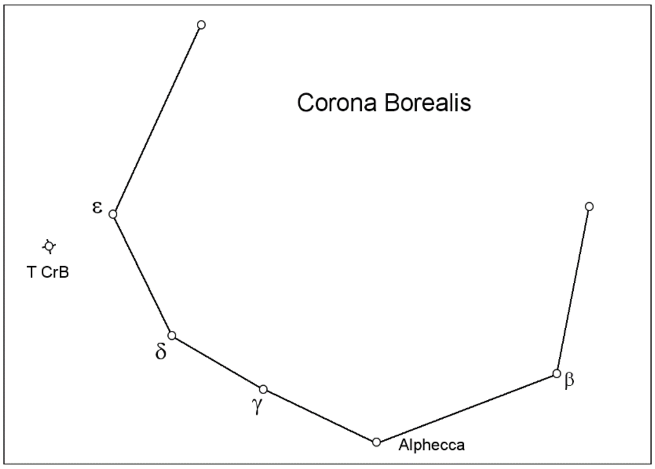
By Alan Cayless FRAS

Something dramatic is about to happen in our evening skies. A faint star in Corona Borealis is about to explode, brightening to naked eye visibility.

T Coronae Borealis (T CrB) is an example of an *accreting binary system*, consisting of two very different stars orbiting each other. The larger of these is a red giant with a very expanded outer atmosphere. Material from this giant star streams off and is transferred to the much smaller and denser companion, a white dwarf. Over the years, this material accumulates on the surface of the dwarf star, until eventually it reaches a critical amount, setting off a sudden burst of nuclear fusion. The star brightens rapidly, before dimming again over the next few days or weeks. This type of star with repeating outbursts is known as a *recurrent nova*.

In the case of T Coronae Borealis, previous nova events were seen in late 1866 and early 1946, suggesting a period of slightly less than 80 years between outbursts. This suggests that we are due another outburst very soon, possibly in the next few months. Variations in the star's light curve also appear to confirm that a new event is about to happen – on both previous occasions, the star's brightness dipped a few months before the main outburst. The last such dip in May 1945 was followed by a rapid brightening in February of 1946.

Another such dip has recently been reported by the American Association of Variable Star Observers (AAVSO), hinting that another eruption may be about to happen. When this occurs, T Coronae Borealis will brighten suddenly from magnitude +10 (too faint to see with the naked eye) to about +2, approximately the brightness of the pole star. It will remain visible for a few days or possibly weeks before fading again.



To find T Coronae Borealis look for the constellation Corona Borealis to the west, between Arcturus and Vega. T CrB is located close to epsilon CrB, on the western side of the constellation. Over the next few weeks, try taking a look at Corona Borealis from time to time, to familiarise yourself with the positions of the main stars as they normally appear. When the outburst occurs you should then be able to recognise T CrB as a new star. You can keep track of the light curve and predictions on the AAVSO and NASA websites, and we will of course also be reporting on our own Stirling Astronomical Society website.

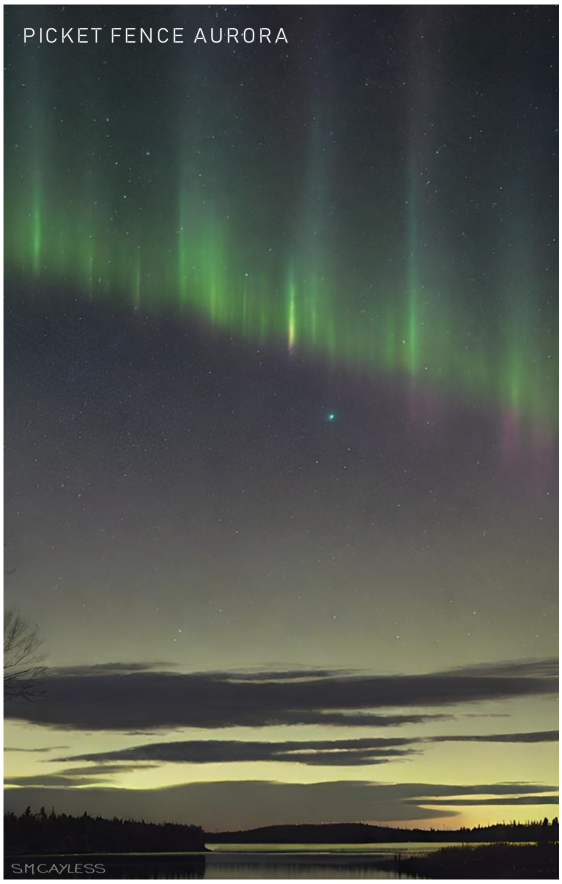
Aurora (1): Nature and Science

By Sandi Cayless

The name *Aurora Borealis*, or Northern Lights, means ‘red dawn of the north’ (Anon 2024). The aurora, visible at night in northern latitudes, originates from the earth’s magnetosphere. It appears when energy-rich particles (electrons, protons, helium nuclei – the solar wind) shot from the sun hit the earth’s upper atmosphere at up to 72 km per hour (Waldek & Dobrijevic 2024). Deflected by the Earth’s magnetic field, they hit air molecules, and between 100-300 km up, part of the collision energy is emitted as light. Earth’s magnetic field deflects the particles at oval-shaped areas (auroral ovals) around the poles. Aurorae do not occur below 80 km and rarely over 500 km (Anon 2024). The average range for a maximum intensity aurora is 110-200 km, although it varies from shape to shape. The sun constantly ejects the charged solar wind from its corona, but emissions go through a roughly 11-year cycle. At high activity (solar maximum), huge storms can hit the Earth in intense bursts to cause bright, more frequent aurorae, but an aurora is visible almost every clear, starry night in winter in high northern latitudes. It is rarely visible further south, unless solar activity is very high. Once or twice a century, an aurora can be seen on the Mediterranean coast.

Colours, heights, intensity: Auroral light contains specific colours as it is created by the light emitted by atoms and ions in the atmosphere struck by solar particles (Anon 2024). As the atmosphere consists mostly of nitrogen and oxygen, these govern the main colours. The colours also vary with height. A strong green appears around 120-180 km, above which is red; blue and violet chiefly occur below 120 km. At times of strong solar activity, red appears between 90-100 km. A completely red aurora can sometimes be seen at low latitudes. The dominant red is due to nitrogen, whilst green is the product of oxygen. A weak aurora will appear as bright as the Milky Way, medium aurorae will match starlight in intensity, and a strong aurora parallels moonlight.

North, South and STEVE: The southern counterpart of the *Aurora Borealis* is the *Aurora Australis*, or Southern Lights. They are physically alike but during a solar storm the arrival of one often trails the other (Waldek & Dobrijevic 2024). Some aurorae occur in both hemispheres at the same magnetic local time whilst others develop around the two polar regions at different times, e.g. pre-midnight in the north and post-midnight in the south. This irregularity is partly due to interference between the sun’s and the Earth’s magnetic fields, but research is ongoing. A different atmospheric optical event is the Strong Thermal Emission Velocity Enhancement, or STEVE, observations of which go back to the 1700s (Bailey et al. 2018). STEVE emissions show as narrow, distinct arcs aligned east-west, usually purple-mauve and often with a green ‘picket-fence’ aurora, and can extend thousands of kilometres. STEVE is visible from lower latitudes, closer to the equator, than aurorae. Nishimura and colleagues (2019) reported that STEVE is linked to fast plasma flows, sharp plasma boundaries, and intense waves at an altitude of 25,000 km; the mauve arcs result from the plasma heating of charged particles by the fast flows and waves, while the picket-fence structure results from electrons falling into the atmosphere.



The science: Edmund Halley (1656-1742) lived during the Maunder minimum occurring after the 1621 display, during which no sunspots were seen in the sun for a hundred years and very few aurorae appeared, until the minimum was broken by the vivid aurora of 1716. He explained it thus: “Auroral rays are due to the particles, which are affected by the magnetic field; the rays are parallel to Earth’s magnetic field, and the vault-like shape is due to perspective phenomena.” This scientific finding was accepted and still is. Numerous theories were then advanced, many of which considered burning gas as crucial (Arctic Author 2014). In 1741 Celsius reported a link between the aurora and magnetic activity, but he stole the result (and the honour) from his student Hjorter. This was the second scientific finding to be accepted since its proposal. Henry Cavendish in Britain accurately estimated the altitude of the aurora in 1790, but for over a hundred years this was not fully accepted. In the 1700s M. V. Lomonosov in Russia believed the Aurora Borealis to mark an unfrozen sea in the Arctic Ocean and spent much of his life looking for it. An explanation for auroral light emission was still lacking in the early 19th century despite the advance of spectroscopy, but Ångström finally proved in 1866-67 that light emission was due to a gas. Systematic auroral research began in 1882-83, during the first International Polar Year, when simultaneous measurements were made at sites around the polar region. Before this, Danish teacher, astrophysicist and photographer Sophus Tromholt had published descriptions of the global behaviour of the aurora, and during 1882-83 he established a scientific northern lights centre in Kautokeino, pioneering modern auroral science. Other records exist in descriptions by the Swede Carlheim- Gyllensköld and the Finn Nordenskiöld: *he* carried out research in northern Siberia in 1878-79, when his ship was stuck in winter pack ice, and described the auroral zone as a halo above the polar region. Norwegians Kristian Birkeland and Carl Störmer developed auroral science into the 20th century. Birkeland associated the aurora with a system of electrical currents that covers the whole of near-earth space. These currents exist horizontally in the regions of aurorae and vertically along magnetic field lines. Those appearing parallel to the magnetic field are known as Birkeland currents and were measured in the 1970s by satellites. Birkeland had created artificial aurorae in a laboratory and had published a theory in 1896 that electrically charged particles stream out of sunspots at such a speed that they penetrate the polar atmosphere deeply, led by Earth's magnetic field, to collide with gases in the denser layers, causing the gases to ignite and glow as arches and beams (Anon 2024). Störmer had calculated the trajectories of electrically charged particles in 1907. Understanding creation of auroral light evolved through the 20th century and in the late 1950s it was shown that electrons are mainly responsible for exciting atoms and molecules.

Why aurora science is important: Changes in the solar wind cause reactions in the Earth's upper

KRISTIAN BIRKELAND

atmosphere, which, linked with planetary rotation and the activity of particles in near-Earth space, cause diverse auroral shifts and shapes. From these, the physics along the Earth's magnetic field lines can be deduced. Aurorae can provide data on the density, composition, flow speeds and electrical current strength of the upper atmosphere, which in turn explain dynamic changes in Earth's magnetic field and how it extends into space. These and data on other space weather events are important for safeguarding ground and orbital technologies from the dangers of aurorae and other space weather (NASA 2002, 2024). The strongest geomagnetic storm recorded was the Carrington Event (caused by a solar flare) of 1 September 1859: telegraph systems were hit globally, spark discharges shocked operators and telegraph paper was set alight. Near dawn next day, skies worldwide flared in red, green, and purple aurorae, so brilliant that newspapers could be read. And a solar flare on 13 March 1989 disrupted transmission from Canada's Hydro Québec generating station, leaving 6 million people cut off for 9 hours, and triggered surges in New Jersey that melted power transformers.

Aurorae on other planets: The presence of aurorae indicates planets with magnetic fields and atmospheres, although not necessarily Earth-like. Most planets in our solar system, a few satellites, brown dwarfs and comets also have aurorae (Galand et al 2020, Waldek & Dobrijevic 2024, NASA 2024b). All the gas giants have strong magnetic fields and are strong sources, but aurorae have been detected on Venus and Mars, both of which have weak magnetic fields.

The European Mars Express mission observed discrete aurorae on Mars in 2004: remanent magnetism in the Martian crust generates local magnetic force fields that trap charged particles and create an auroral glow. There are three types of Martian aurorae – one occurs only on the day-side, another is an extensive night-side feature triggered by strong solar storms and the third is a sporadic night-time event (Lillis et al. 2022). The United Arab Emirates' Hope Mars orbiter caught the latter sporadic event in early 2021 (Al Matroushi 2022, Al Matroushi et al. 2022). And recently, NASA's MAVEN orbiter recorded the many Martian global ultraviolet aurorae of February 2024, using its Imaging Ultraviolet Spectrograph (IUVS) (Phillips 2024) and again between 14-20 May 2024, when the sunspots triggering Earth's May 10-11 aurora turned towards Mars. Indeed, the X12 solar flare that hit the planet on May 20 produced a staggering surface radiation dose of 8,100 micrograys, as measured by Curiosity's Radiation Assessment Detector (RAD) (JPL 2024). Martian aurorae can be global because Mars has virtually no protection from solar storms. Without a strong magnetic field, charged solar particles can enter the atmosphere anywhere. These amazing aurorae were caused by solar energetic particles (SEPs) accelerated by shock waves within approaching Coronal Mass Ejections striking the Martian atmosphere and causing the auroral glow.

Jupiter's magnetic field, at 20,000 times stronger than Earth's, gives rise to very bright aurorae, some of which are driven by particles shot into space by the close-orbiting and highly volcanic Jovian moon Io. Perceptible auroral activity in extra-solar systems has been reported. Studies (Callingham et al. 2021) detected radio waves emitted by many M dwarfs and associated these with a 'backward' aurora, i.e. one that flashes near stars and is driven by particles loosed by feeder planets in close orbits, where the planet, enclosed in the magnetic field of its star, feeds material into massive currents that power bright aurorae. Such feeder planets are currently hypothetical, as no planets were been discovered orbiting the red dwarfs studied, but aurorae are probably common in many exoplanets.

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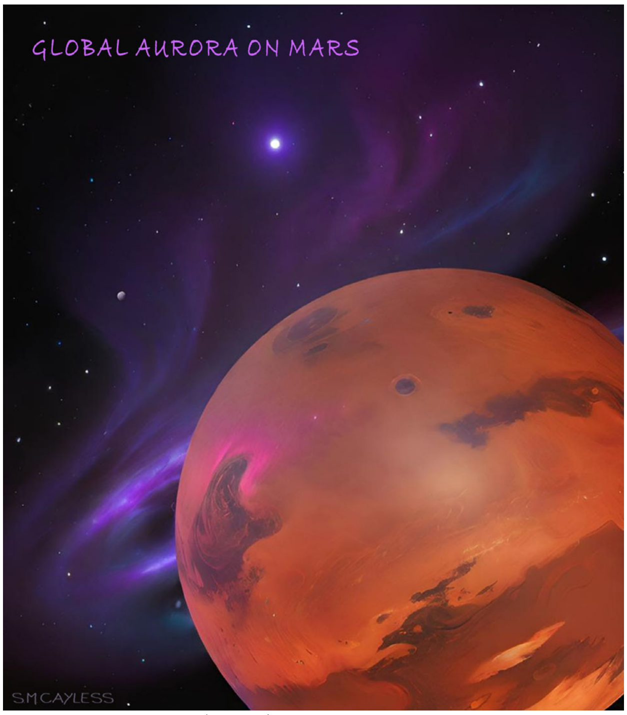

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Image: Kristian Birkeland (Kristian Olaf Bernhard Birkeland, 1867–1917): Portrait of Kristian Birkeland, Norwegian scientist and industrialist, 1900, by Asta Nørregaard [cropped]. The portrait belongs to Hydro company, Oslo. Public Domain.

Poetic Licence

Here we have more poetic and literary gems that could be read as having an astronomical bent.

Richard Aldington: Evening

The chimneys, rank on rank,
Cut the clear sky;
The moon,
With a rag of gauze about her loins
Poses among them, an awkward Venus —

And here am I looking wantonly at her
Over the kitchen sink.

Franklin, James Thomas: Astronomy

Oh science sequestered much,
And by wisdom's gentler touch,
          Accelerated more!
Did not thy voice give the command
That man must venture from his strand
In quest of other distant land,
          Or was it ancient lore?

For sure into his peaceful breast,
Thou breathed the spirit of unrest,
          And bade him search the skies:
Thou pictured earth a moving sphere
Whose revolutions make the year,
And whispered to his listening ear,
          "Search heaven and be wise."

Frost, Robert: But Outer Space

But outer Space,
At least this far,
For all the fuss
Of the populace
Stays more popular
Than populous

Hopkins, Gerard Manley: The Starlight Night

Look at the stars! look, look up at the skies!
O look at all the fire-folk sitting in the air!
The bright boroughs, the circle-citadels there!
Down in dim woods the diamond delves! the elves'-eyes!
The grey lawns cold where gold, where quickgold lies!
Wind-beat whitebeam! airy abeles set on a flare!
Flake-doves sent floating forth at a farmyard scare!
Ah well! it is all a purchase, all is a prize …

Keats, John: Bright Star, Would I Were Stedfast as Thou Art

Bright star, would I were stedfast as thou art—
Not in lone splendour hung aloft the night
And watching, with eternal lids apart,
Like nature's patient, sleepless Eremite

Longfellow, Henry Wadsworth: The Light of Stars

The night is come, but not too soon;
And sinking silently,
All silently, the little moon
Drops down behind the sky.

There is no light in earth or heaven
But the cold light of stars;
And the first watch of night is given
To the red planet Mars.

Collapsing Clouds and Star Formation - the Jeans Criterion

By Alan Cayless FRAS

From late October to the end of February, the Orion Nebula is one of the most familiar objects in our winter skies. Located in the sword below Orion's belt and easily visible in binoculars or a small telescope, the Nebula (designated M42 in Messier's catalogue) is a vast cloud of glowing gas and dust over 20 light years across and 1,500 light years from Earth. At its heart, the four bright stars of the trapezium shine brightly. Light and radiation from these and dozens of other recently-formed stars energise the surrounding gas, turning it into a spectacular glowing nebula.


M42, the Orion Nebula

The Orion Nebula is part of a much larger complex of gas clouds in the constellation of Orion which contains glowing regions such as the Flame Nebula and M42 itself, and darker regions such as the Horsehead Nebula where cooler gas absorbs the light from behind. Such giant molecular clouds like the Orion complex form a significant part of the interstellar medium – the material that fills space between the stars.

Under the influence of gravity, the gas in the Nebula is collapsing and fragmenting to form many new stars, including those in the Trapezium. Images from the Hubble space telescope show that many of these new stars are surrounded by disks of gas and dust that will eventually condense further to form solar systems with planets, some of which may even have conditions suitable for life many millions of years from now.

Not all molecular clouds in the interstellar medium will collapse in this way. For a cloud to collapse, the force of gravity must overcome the outward pressure of the gas itself. The precise conditions required for collapse were worked out by Sir James Jeans – one of the most talented and mathematically-minded astronomers of the early twentieth century.

Jeans (1877 – 1946) studied mathematics at Trinity College Cambridge, and subsequently made major contributions in physics, mathematics and astronomy, specifically in the field of cosmology. While he always considered himself primarily a mathematician, he is perhaps most well known for his astronomical work. Following a spell at Princeton University, Jeans lectured in applied mathematics at Cambridge until 1912 when he withdrew from teaching to concentrate on his mathematical and astronomical research.

Jeans applied his mathematical approach to a number of problems in cosmology, including the expansion of the Universe, which was also being worked on by Eddington and others, but perhaps his most important contribution was in his analysis of the processes by which clouds of interstellar gas contract and collapse to form new stars.

While gravity is the driving force, Jeans realised that other conditions were necessary for a cloud of interstellar gas to start contracting and eventually to initialise the process of star formation. Jeans started with Sir Isaac Newton's Law of Universal Gravitation, which was published by Newton almost two and a half centuries earlier, in 1687.

Based anecdotally on his encounter with a falling apple, Newton's Law of Gravitation states that the force of attraction between two objects depends on the masses of the objects, and on the distance between them. This relationship is expressed in the familiar equation:

$$F = \frac{GMm}{r^2}$$

In this equation, *M* and *m* are the masses of the two objects, and *r* the distance between them. The force *F* between the objects is proportional to the masses multiplied together, and falls off according to the square of the distance between them. This means that the force becomes weaker as objects become further apart, and stronger as objects approach closer together.

G is the gravitational constant – a very small number that can nevertheless result in a substantial gravitational pull when multiplied by very large masses such as the mass of the Earth or the Sun. Gravity is the force that causes apples to fall, keeps the Moon in orbit around the Earth, and is ultimately responsible for the collapse of molecular clouds of interstellar gas like the Orion Nebula.

Although Newton's description of gravity was immensely successful, leading, among other things, to Kepler's Laws of planetary motion and enabling us to land spacecraft on Mars, it is limited in the sense that it only allows us to calculate forces between two individual objects such as the Earth and the Moon, or Mars and a landing spacecraft. A cloud of gas and dust contains vast numbers of molecules, all of which are attracting each other and it would not be possible to calculate the individual forces between them all. Jeans took a different approach, based on averages. He reasoned that for a cloud to collapse, the inward force of gravity had to overcome the outward pressure of the gas, which would depend on the density of molecules and their temperature. Rather than calculating individual forces, Jeans compared the energy in the gravitational field with the thermal energy of the gas.

Jeans came up with a criterion for collapse that can be expressed in different ways. Perhaps the easiest to understand is the *Jeans Mass* – for a cloud of a given radius and temperature to collapse, its total mass must be large enough for the combined gravitational attraction of the molecules to overcome their pressure. The total mass depends on the number of molecules within that radius, meaning that a denser cloud will be more likely to collapse than a less dense one of the same size.

Jeans' criterion can also be expressed in terms of a *length* – this is the smallest size for a cloud of a given temperature and density that would lead to the cloud collapsing. This *Jeans Length* (*R*) depends on the temperature (*T*) of the gas, the density of molecules (ρ) and the average mass of the molecules (*m*):

$$R = \sqrt{\frac{15\, k_B\, T}{4\, \pi\, G\, \rho\, m}}$$

In this equation, k_B is Boltzmann's gas constant from thermodynamics, and *G*, Newton's gravitational constant.

Expressed simply, the Jeans criterion tells us that if a large enough mass of material accumulates into a small enough region of space, then it will begin to collapse under its own gravity.

The Jeans length form of the criterion also helps us to understand what happens next and how a cloud will condense and separate into individual stars and planets. As the cloud contracts, its density increases because the molecules are packed more closely together. The gas will also heat up as gravitational energy is converted to thermal energy – but some of this energy is radiated away as infrared, meaning that the temperature does not increase as much as it would otherwise do. This combination of increasing density with a lesser increase in temperature means that the Jeans length becomes smaller and smaller compared to the radius of the cloud as the collapse continues. Eventually, the Jeans length is sufficiently small that individual clumps within the cloud will start to collapse in their own right, and the cloud fragments to form individual stars and eventually solar systems.

Towards the end of his career, Jeans published a number of popular astronomy books, including *The Universe Around Us* (1929) and *The Stars in Their Courses* (1931). Copies of these can sometimes still be found in second-hand bookshops. Jeans was awarded the Gold Medal of the Royal Astronomical Society in 1922, later becoming President of the Society from 1925 to 1927. He was knighted in 1928.

James Jeans helped us to understand how the interstellar medium is recycled to form new stellar systems. We know from spectroscopy that the Orion Nebula contains both hydrogen and oxygen, along with other elements crucial to life. Although it will take millions of years, the solar systems now forming there may one day be capable of supporting life of their own.

"The human race, whose intelligence dates back only a single tick of the astronomical clock, could hardly hope to understand so soon what it all means."

Sir James Jeans

The Sky in Scots 2 (2): Constellations 45 to 88

By Sandi Cayless

(Thanks to the Dictionaries of the Scots Language (*Dictionars o the Scots Leid*, www.dsl.ac.uk/) for terms/words, although again I admit to some latitude (and much longitude) in borrowing these for descriptive terms… SC)

No	Constellation	English Name	Scots Name
45	Lacerta	Lizard	Heather-Esk
46	Leo	Lion	Lioun
47	Leo Minor	Smaller Lion	Peerie Lioun
48	Lepus	Hare	Maukin
49	Libra	Balance	Wey-Bauks
50	Lupus	Wolf	Wouff
51	Lynx	Lynx	Lucerve (Spottit Linkis)
52	Lyra	Lyre	Harp
53	Mensa	Table	Tabill
54	Microscopium	Microscope	Keeker
55	Monoceros	Unicorn	Ane-Horned Cuddy
56	Musca	Fly	Flee
57	Norma	Square	Squar’
58	Octans	Octant	Aucht Meesure Graith
59	Ophiucus	Serpent Holder	Sarpent Hauder
60	Orion	Orion	Michty Hunter
61	Pavo	Peacock	Peajock
62	Pegasus	Winged Horse	Wingit Cuddy
63	Perseus	Perseus	Loon wi Magik Sheen
64	Phoenix	Phoenix	Phenix (Fire-Birdie)
65	Pictor	Easel	Airtist’s Staund
66	Pisces	Fishes	Twa Fush
67	Pisces Austrinus	Southern Fish	Soothren Fush
68	Puppis	Stern	Starn
69	Pyxis	Compass	Airt-Finder
70	Reticulum	Reticle	Wee Net
71	Sagitta	Arrow	Flane
72	Sagittarius	Archer	Schutar
73	Scorpius	Scorpion	Stang-tail Beastie
74	Sculptor	Sculptor	Gravar (Steen-Shaper Airtist)
75	Scutum	Shield	Targe
76	Serpens	Serpent	Sarpent
77	Sextans	Sextant	Saxt Meesure Graith
78	Taurus	Bull	Buill
79	Telescopium	Telescope	Far-Keeker
80	Triangulum	Triangle	Three-Neukit Graith
81	Triangulum Australe	Southern Triangle	Soothren Three-Neukit Graith
82	Tucana	Toucan	Big-Nebbit Birdie
83	Ursa Major	Great Bear	Charlewain (Peter’s Pleuch, Muckle Bier)
84	Ursa Minor	Little Bear	Horn (Peerie Bier)
85	Vela	Sails	Sailles
86	Virgo	Virgin	Vergine
87	Volans	Flying Fish	Fleein’ Fishie
88	Vulpecula	Fox	Tod Lowrie

The Astronomers Royal (Part 3)

By Mark Butterworth FRS

In Part 3 of a 4-part series by our late, much-missed member, Mark Butterworth, reprinted from SAS Mercury newsletters 2005-2006 by kind permission of Mrs Pat Butterworth, Mark tells us the story of the Astronomers Royal for Scotland. Illustrations have been amended as appropriate; amendments to the original text are in square brackets.

The Astronomers Royal for Scotland

The title of Astronomer Royal for Scotland was created in 1834 and was formally linked with the post of Regius Professor of Astronomy at the University of Edinburgh until 1991.

Thomas Henderson, 1834-1844


HENDERSON

Henderson trained as a lawyer but worked at the Cape of Good Hope Observatory, where he developed a new method for using lunar occultations to measure longitude. He retired due to ill health but in 1834 was then appointed Astronomer Royal for Scotland. He spent years analysing his measurements from South Africa and eventually came to the conclusion that Alpha Centauri was just slightly less than 3.25 light years away. This figure is about 33% too small. Doubts about the accuracy of his instruments kept him from publishing until 1839, by which time Bessel had been credited as the first to calculate an accurate stellar parallax.


PIAZZI SMYTH

Charles Piazzi Smyth, 1845-1888

At the age of sixteen Smyth went out as an assistant at the Cape Observatory. As Astronomer Royal for Scotland he continued the parallax observations made by his predecessor. In 1856 he made experimental observations on the Peak of Tenerife, testing the astronomical advantages of a mountain observatory. He investigated the spectra of the aurora and zodiacal light, and in 1877-1878 he constructed a map of the solar spectrum. Smyth also researched infrared astronomy, and was notable for advancing the theory that the Great Pyramid of Giza was based on the size of the Earth, revealed by measurements of the structure.

Ralph Copeland, 1889-1905

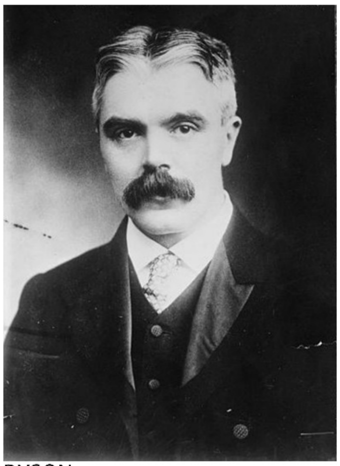

COPELAND

In the 1870s Copeland worked with Lord Rosse at Birr and for Sir Robert Ball at Trinity College in Dublin, followed by a period at Dun Echt Observatory in Aberdeenshire. During this time he made expeditions to Mauritius and Chile to view the 1874 and 1882 transits of Venus. In addition he travelled to Greenland and Lake Titicaca to investigate high altitude astronomy. When appointed Astronomer Royal for Scotland, he selected a site for a new Observatory at Blackford Hill, Edinburgh as being least affected by the wind blowing smoke from the city ("Auld Reekie"). The telescopes and instruments from the Dun Echt Observatory were donated by Lord Crawford and the new Observatory was opened in 1896. Copeland spent most of his time with the administrative work of the Observatory and the development and delivery of courses for astronomy students.

The Royal Observatory Edinburgh

"A Light to Lead the Way"

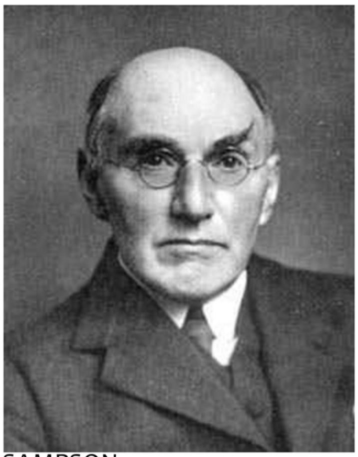
Sir Frank Watson Dyson, 1905-1910



DYSON

Dyson was Astronomer Royal for Scotland, and later Astronomer Royal in England. In Edinburgh he studied the solar corona and stellar parallax. In 1928 he introduced a new free-pendulum clock in the Greenwich Observatory. This wireless transmission meant that Greenwich Mean Time was more accurate. He also invented the "six pips" in 1924. Dyson crater on the Moon is named after him, as is the asteroid 1241 Dysona.

Ralph Allen Sampson, 1910-1937



SAMPSON

Sampson graduated from St. John's College, Cambridge in 1888 and in 1895 became Professor of Mathematics at Durham College in Newcastle-on-Tyne. He had been a student of John Couch Adams and helped to edit and publish the second volume of Adams' papers in 1909. As Astronomer Royal for Scotland he did pioneering work in measuring the colour temperature of stars, and he carried out important research into the theory of the motions of Jupiter's four Galilean satellites, for which he was awarded the Gold Medal of the Royal Astronomical Society in 1928.

(William) Michael (Herbert) Greaves, 1938-1955

GREAVES

From 1924 until 1938 Greaves was the Chief Assistant at the Royal Astronomical Society. In 1938 he became Astronomer Royal for Scotland, and in 1939 he was elected a Fellow of the Royal Society of Edinburgh. He remained Astronomer Royal for Scotland until 1955 and was also Regius Professor of Astronomy at Edinburgh University for the same period. He is most noted for his work on stellar spectrophotometry.

Hermann Alexander Brück, 1957-1975

BRÜCK

Born in Berlin in 1905, Brück began his astronomical career at the Potsdam Astrophysical Observatory. Persecuted, in 1936 he left Germany, and obtained a temporary Research Assistantship at the Vatican Observatory. From there he went to Cambridge and then moved to Dublin where he re-established the Dunsink Observatory. He moved from Dublin to the Royal Observatory Edinburgh in 1957. He wrote the histories of the Royal Observatory Edinburgh and of the earlier Dun Echt Observatory in Aberdeenshire. He also wrote (with his wife Mary) a biography of Charles Piazzi Smyth, an earlier Astronomer Royal for Scotland.

Vincent Cartledge Reddish, 1975-1980

Reddish [no image available] was born in Leigh, Lancashire in 1926. He published books and papers on stellar formation and evolution, galactic evolution and stellar interiors. [Prior to his appointment as Astronomer Royal for Scotland, (1960s and 1970s) Reddish co-led the creation of an automated plate measuring machine (the GALAXY), led the development of the UK Schmidt Telescope in Australia and led the early development of the four metre (UKIRT) infrared telescope in Hawaii.] Asteroid 2884 Reddish, discovered in 1981, was named after him.

LONGAIR

Malcolm Sim Longair, 1975-1980

After completing his PhD in the Radio Astronomy Group of the Cavendish Laboratory, Cambridge, Longair was a Royal Society Exchange Visitor to the Lebedev Institute of the USSR Academy of Sciences.

He has held visiting professorships at the California Institute of Technology (1972), the Princeton Institute for Advanced Study (1978), the Harvard-Smithsonian Center of Astrophysics (1990), and the Space Telescope Science Institute (1997). In December 1990 he delivered the series of Royal Institution Christmas Lectures for Young People on television on the topic 'The Origins of Our Universe'. His primary research interests are in the fields of high energy astrophysics and astrophysical cosmology.

1991-1995
The position was unoccupied for these years, and the post was separated from the Regius Professor of Astronomy and Director of the Royal Observatory, Edinburgh. The first Astronomer Royal for Scotland under this new system [was] the [previous] Professor of Astrophysics at the University of Glasgow.

John Campbell Brown, 1995-2019


BROWN

As Regius Professor of Astronomy [University of Glasgow], Brown [was] Leader of the Astronomy and Astrophysics Research Group with main research interests in solar and stellar plasmas, solar space missions, stellar mass loss and polarimetry. His teaching [covered] Exploring the Sky, Stellar Physics/Compact Objects, Relativity, Theoretical Astrophysics, X-Ray Astrophysics and Cosmology. He [gave] frequent planetarium shows and talks to schools, the public and amateur societies, including our own. [In 2012 Brown was awarded the Gold Medal of the Royal Astronomical Society for his work on solar energetic particles and contributions to astrophysical research and public outreach; in further recognition of his services to the promotion of astronomy and science education, Brown was awarded an OBE (Officer of the Order of the British Empire) in 2016.]

[Catherine Heymans (2021 – Present)
In May 2021, Catherine Heymans was appointed as the 11th Astronomer Royal for Scotland, and is the first woman to hold the post. Dr Heymans is Professor of Astrophysics at the Institute for Astronomy, University of Edinburgh, and is based at the Royal Observatory, Edinburgh (ROE). She is also

the Director of the German Centre for Cosmological Lensing at the Ruhr-University Bochum, Germany, she co-leads the Canada-France-Hawaii Telescope Lensing Survey (CFHTLenS) and the European Southern Observatory (ESO) Kilo-Degree Survey (KiDS) and she teaches on the Massive Open Online Course (MOOC) at Coursera on *AstroTech: The Science and Technology behind Astronomical Discovery*.

In 2022 she became the youngest person to receive the Royal Astronomical Society's prestigious William Herschel medal for outstanding merit in observational astrophysics. She is a fellow of both the Royal Society of Edinburgh, and the Leopoldina, the National Academies of Scotland and Germany. Catherine is a regular contributor to BBC Radio and TV, providing expert comment for a wide range of physics and space stories. She also co-leads the Scottish Youth Telescope Network, installing telescopes across Scotland's outdoor education centres. Her main area of research focusses on making detailed observations of the Dark Universe using weak gravitational lensing.]

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Malcolm Longair: Taken at a meeting of the James Webb Space Telescope Advisory Committee at the Space Telescope Science Institute, Baltimore, May 8-9, 2013. Author: Mark McCaughrean; originally posted to Flickr at https://flickr.com/photos/72642321@N03/8750955675. File licensed under the Creative Commons Attribution-Share Alike 2.0 Generic license (https://creativecommons.org/licenses/by-sa/2.0/deed.en).
John Brown: From visit of Astronomers Royal Professor Sir Arnold Wolfendale (England) and Professor John Brown (Scotland) to the Old High School Observatory and Telescope in 1995; © Stirling Astronomical Society.
Catherine Heymans: Image and additional text courtesy of Professor Catherine Heymans.

A Quote or Two…

Bruno, Giordano (1548-1600)
Innumerable suns exist; innumerable earths revolve around these suns…. Living beings inhabit these worlds.

The physical world of things is embedded in the infinite, embedded in a space filled with all the other possible worlds…

An atom, beyond which we cannot in fact go, although to thought it may be still further divisible; so there is in every figure, in every kind of thing, a definite number of atoms.

This entire globe, this star, not being subject to death – dissolution and annihilation being impossible anywhere in Nature – from time to time renews itself by changing and altering all its parts. There is no absolute up or down, as Aristotle taught; no absolute position in space; but the position of a body is relative to that of other bodies.

Everywhere there is incessant relative change in position throughout the universe, and the observer is always at the centre of things.

Burroughs: William S. (1914-1997)
Man is an artefact designed for space travel. He is not designed to remain in his present biologic state any more than a tadpole is designed to remain a tadpole.

Language is a virus from outer space.

Byron, Lord (1788-1824)
Ye stars! Which are the poetry of heaven!

Churchill, Winston (1874-1965)
Do not let spacious plans for a new world divert your energies from saving what is left of the old.

Cicero, Marcus Tullius (106-43 BCE)
The contemplation of celestial things will make a man both speak and think more sublimely and magnificently when he descends to human affairs.

Clarke, Arthur C. (1917-2008)
Perhaps, as some wit remarked, the best proof that there is Intelligent Life in Outer Space is the fact it hasn't come here. Well, it can't hide forever – one day we will overhear it.

Astronomy, as nothing else can do, teaches men humility.

When the Sun shrinks to a dull red dwarf, it will not be dying. It will just be starting to live and everything that has gone before will merely be a prelude to its real history.

Interesting Asteroids (3)

By Sandi Cayless

The third of an occasional series on asteroids of interest, the following deals with the astronomer who inspired the naming of asteroid 4809 Robertball (1928 RB). A main belt object, asteroid 4809 was discovered at Heidelberg on the 5th of September 1928 by German astronomer and astrophotography pioneer M. F. Wolf (JPL 2024). The body's interest to members of Stirling Astronomical Society is of course that our late, sadly-missed friend, Mark Butterworth (1954-2014), was instrumental in having the asteroid named for Robert Stawell Ball, for whom Mark had great affection. Older members will recall Mark, dressed as Sir Robert Ball, presenting one of Ball's lectures in the way that the great Irish astronomer, author and public speaker would have, using Victorian magic lantern slides. Mark was a member of the Magic Lantern Society, an expert in these slides and had a great collection.

Ball was born on 1 July 1840 in Dublin, and died on 25 November 1913 in Cambridge. He is buried in the Ascension Parish Burial Ground (formerly the burial ground for the parish of St Giles and St Peter's). According to Mark (Butterworth 2004), Robert Ball, Lowndean Professor of Astronomy at Cambridge, was among the leading popular lecturers of his time, travelling throughout the UK and Ireland as well as touring in Canada and America, fitting these activities in with his professional duties. He lectured several times at the Royal Institution, as well as in almost every main town in the UK and Ireland, and usually with a lantern. Mark tells us that in one of his notebooks, Ball wrote himself a brief reminder: '… beware when lecturing in Manchester. They get bored after 75 minutes'.

Robert Stawell Ball was born at number 3, Granby Row, Dublin, in a typical 4-storey Georgian townhouse that still stands (NIAH 2011). He was the second of the seven children of Robert and Amelia Ball. Robert Ball Sr was a keen scientist – he later became Director of the Trinity College museum – and the children were brought up in scientific environs. All three Ball sons would go on to hold chairs at Trinity College, Dublin (Herries Davies 1985). Robert Ball entered Trinity as an undergraduate in October 1857, and though uncertain about his path, went on to become a double Senior Moderator, winning gold medals in Experimental and Natural Science and Mathematics. His future was sealed when in November 1865 he was asked to tutor the Earl of Rosse's three youngest sons at Parsontown (Birr Castle). Ball agreed – on condition that his Lordship would allow him to use the Leviathan. This mighty telescope was erected by the third Earl Rosse and towered above the castle lawns. It was constructed in 1845, had a 72 inch speculum and would remain the world's largest telescope until 1917, when the Hooker reflector on Mount Wilson, California, overtook it. During his short time at Birr, Ball used the telescope to discover six previously unknown spiral nebulae (O'Connor & Robertson 2005). He also witnessed the great Leonids display of 13/14 November 1866, when thousands of bright meteors were seen (and reported on via the Royal Astronomical Society by Charles Piazzi Smythe, Astronomer Royal for Scotland – see ref Piazzi Smythe, 1866), which made a great impression on him. Of his three young students, Charles Parsons would go on to become an engineer and invent a multi-stage steam turbine to revolutionise marine propulsion.

Asteroid 4809 Robertball	
Argument of Perihelion (°)	173.68719
Ascending Node (°)	169.19607
Orbital Inclination (°)	13.65734
Orbital Eccentricity	0.2476241
Perihelion Distance (AU)	1.9318814
ΔV w.r.t. Earth (km/sec)	9.6
Semi-Major Axis (AU)	2.5677076
Mean Anomaly (°)	80.90368
Mean Daily Motion (°/day)	0.23954410
Aphelion Distance (AU)	3.204
Period (years)	4.11
Absolute Magnitude	13.05
Diameter (km)	6.446
Geometric Albedo	0.354
Phase Slope	0.15
	Data: IAU/JPL

In 1867, Robert Ball was appointed to the chair of Applied Mathematics and Mechanism in the new Royal College of Science for Ireland, and in 1868 he married Miss Frances Elizabeth Steele (his impish sense of humour led him to name his first son Robert Steele Ball). His mathematical research was in dynamics, especially screw theory. His work, *The Theory of Screws: A Study in the Dynamics of a Rigid Body*, published in 1876, was awarded the Cunningham medal of the Royal Irish Academy in 1879. It was at the Royal College that Ball began to make a name as an author and public lecturer. He was elected a Fellow of the Royal Society in June 1873 and in 1874, with urging from Trinity College's Professor Samuel Haughton and on the advice of his own former professor Richard Townsend, he applied for and gained the chair of Andrews Professor of Astronomy at Trinity. This brought with it the role of Royal Astronomer of Ireland and Director of Trinity's Dunsink observatory, posts he held for 18 years (Whyte 2002; O'Connor & Robertson 2005). He set up a regular programme of observing red stars for parallax, but his research was ultimately unsuccessful. By 1884, he was reported to have given over 700 public lectures, and in 1884, he lectured at the British Association Meeting in Montreal, Canada. He was later to make acclaimed lecture tours of the United States in 1887 and 1901/2. His most successful book, *The Story of the Heavens*, was published in 1885. In January 1886, Ball was knighted at Dublin Castle. He gained further honours, being elected President of the Mathematics Section of the British Association for the Advancement of Science from 1886 to 1887, and President of the Zoological Society of Ireland from 1890 to 1892.

Following the death in 1892 of John Couch Adams, Lowndean Professor of Astronomy and Geometry at Cambridge and director of the Cambridge Observatory, Ball applied for the position and to his great delight was appointed (Jones 2005), deeming it "the highest scientific chair in England, if not in Europe, the Solar System, no! The Milky Way, indeed the highest in the whole Universe" (Ball, 1915). In Cambridge, he continued giving popular lectures on astronomy and working on mathematics. He was elected President of the Royal Astronomical Society from 1897 to 1899, and of the Mathematical Association of London from 1899 to 1900 (O'Connor & Robertson 2005). During his 1901 lecture tour in the USA, he gave 24 lectures in 29 days, stayed with Percival Lowell, and met many famous people, including Professors Hale, Barnard and Burnham at Yerkes, Simon Newcomb of the US Naval Observatory, and Mark Twain (Jones 2005). Ball gave his last public lecture in 1910 at the Caxton Hall in London, in aid of the National Society for the Prevention of Cruelty to Children. He was by then suffering from diabetes, but still played golf until 1912. His death in 1913 was a great loss, and he is remembered as one of the greatest communicators on, and popularisers of, astronomy, as well as a mathematician and a master of practical astronomy (MacPherson 1905).

From Stirling, asteroid 4809 Robertball is not easily to observe, being very close to the Sun (separation of 18°), but it is presently in the constellation of Cancer (Ford 2024).

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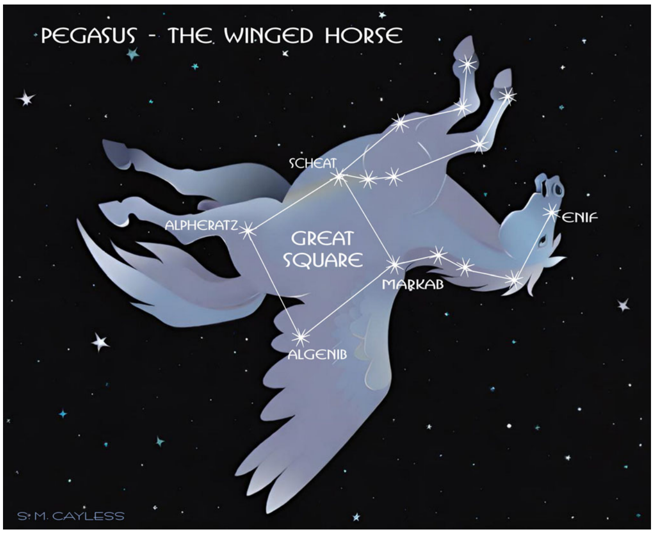
Happy Observing!

The sky from September on gives us plenty to look at, clear skies permitting! Pegasus begins to stand out and is easily recognisable by the four stars of its slightly warped Great Square, an asterism, or group of stars that make a pattern. These are Markab, Scheat and Algenib (α, β and γ Pegasi respectively) and Alpheratz (α Andromedae). The four stars that lead out from Markab imply the head and neck of the Winged Horse, while his front legs sprout from Scheat. Alpheratz is shared between Pegasus and Andromeda; and the New Moon of 3 September will help with viewing a more distant object, the Andromeda galaxy. Follow the peaks of the W of Cassiopeia in the north-east to find a fuzzy patch – binoculars will help.

Mercury is at its greatest elongation west on 5 September, which makes it a good time to spot in the morning sky. On 8 September, Saturn is at opposition, and will present a great time to view. The 17/18 of the month brings us a partial lunar eclipse of the Harvest Moon, which will be visible from the Americas, Europe, Africa and parts of Asia. This Harvest Moon (or Full Corn Moon) is also a Supermoon, and heralds the autumnal equinox on September 22. Neptune is at opposition on 21st September.

The first of the two New Moons in October is a Micromoon, i.e. it coincides with apogee, the point in the Moon's orbit farthest from Earth – this is also the reason that the solar eclipse of 2 October (alas not visible in Europe) is annular, when the Sun's outer edges form a visible annulus, or ring of fire. October 8/9 brings the Draconid meteor shower, best seen just after nightfall. The October 17 Full Moon (Hunter's Moon) is the third Supermoon of the year. The second of October's meteor showers are the Orionids (from Halley's Comet); they peak around 20-21 October, but with the Moon at waning gibbous, conditions may not be favourable.

The New Moon of November 1 gives a good chance to explore the night sky. The luminous blue stars of the Pleiades cluster are worth viewing during November. There are over 1,000 of these young stars in the cluster, but usually only six or seven are visible to the naked eye. November's Full Moon, on the 15th, is known as the Beaver Moon, as beavers build their dams during this time of year. It is the last of the four Supermoons of 2024. Mercury is at its greatest elongation east on 16 November, and may be spotted in the evening sky. The Leonid meteor



shower is around between 6-30 November, and peaks on 17/18 November, when there may be up to 15 meteors per hour. Uranus moves into opposition on 17 November, providing our astrophotographers with a great opportunity to catch a shot.

Thank you to our contributors. Members, please hand over submissions to the editor at any Society lecture or Members' Evening, or send them via the Society's contact email address.

S.C.

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Contact us at:
contactstirlingastronomy@gmail.com

www.stirlingastronomicalsociety.org.uk