Re-imagining the Ed Muirhead Physics Museum

Joe Pascoe, with contributions from Jude Prezens

Relativity

I like relativity and quantum
theories
because I don't understand
them
and they make me feel as if
space shifted about like a
swan that can't settle,
refusing to sit still and be
measured;
and as if the atom were an
impulsive thing
always changing its mind.

D.H. Lawrence, 1929[1]

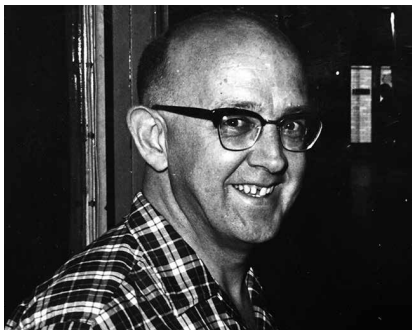
There is no such thing as Australian physics. Physics at the Department has always been international. Truly international.

Professor David Jamieson, 2017[2]

Since its inception in 1882 as the School of Natural Philosophy, the School of Physics at the University of Melbourne has surfed the biggest waves of physics research, from William Sutherland's extraordinary theoretical workings into the size of atoms[3]—prefiguring even some of Albert Einstein's theories[4]—to participating in global research into gravitational waves, essential to understanding the universe as a whole.

Stepping back in time some 2,400 years to ancient Greece, it is both interesting and beautiful to recall that it was Aristotle's student Theophrastus (c. 371–287 BC) who gave us the term 'natural philosophy'.[5] For Theophrastus, the close and measurable effects of changes in nature unlocked truths about reality, and complemented the more abstract discourse of Greece's legendary intellectual philosophers. Thus the discipline of physics, with its emphasis on scientific methodology, emerged from humankind's need to discuss reality in terms of truths. Where physics differs from, say, religion or art, is that physics is neither a cosmology nor an aesthetic metaphor; indeed, it has the virtue of nearly always asking a new question once an old question has been interrogated. It is this process that lies at the heart of the Ed Muirhead Physics Museum. The orrery—a clockwork model of the solar system—is an exemplar of an artefact created from such interrogation.

Nevertheless, divinity has not been lost to the school. Associate Professor Ed Muirhead (23 April 1927 – 1 February 2016), after whom the museum is named, was a practising Christian. As his daughter Anne remarked on the occasion of the official naming of the Ed Muirhead Physics Museum in 2017:

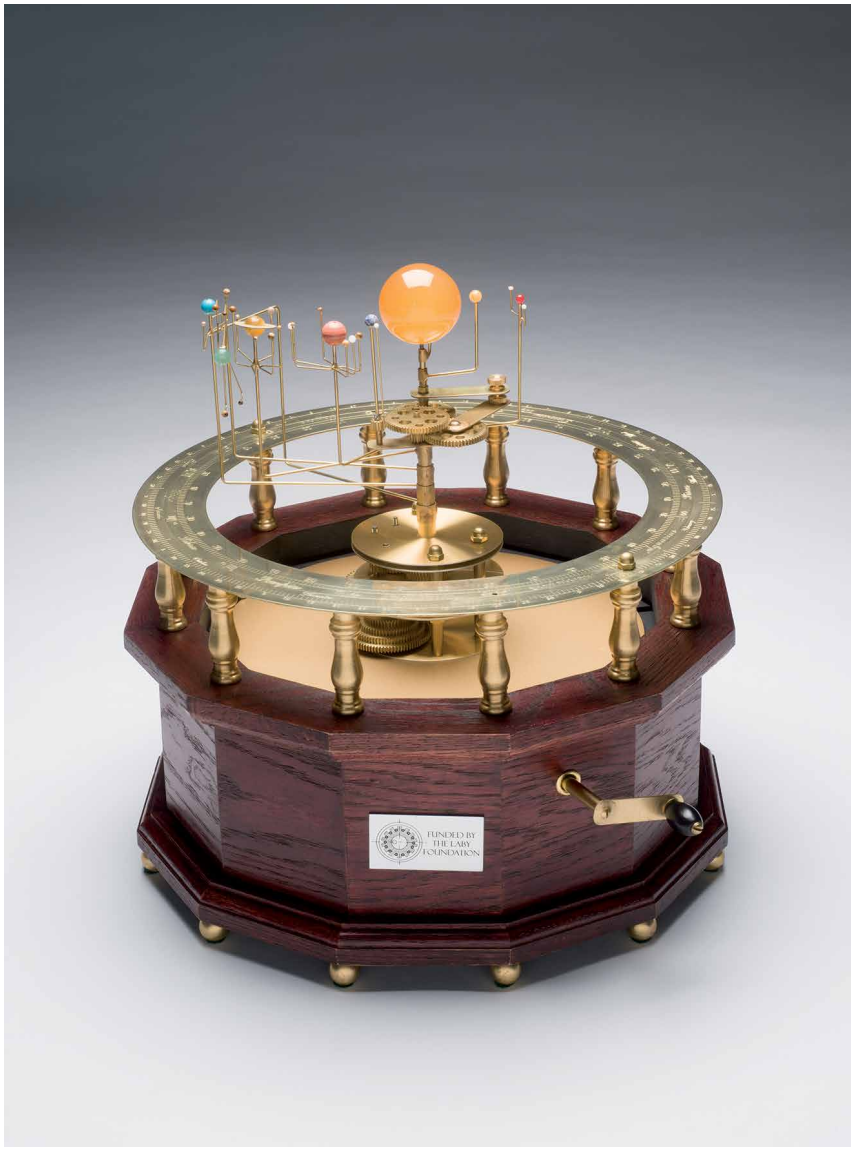


Dad was a Renaissance man who would have loved the Melbourne Model. He knew how important it was to explore different ways of knowing, learning and responding. Physics was held in creative tension with his strong Catholic faith, love of music and the arts and, of course, his passion for history.[6]

Ed Muirhead's love of music embraced both the artistic and scientific realms, and led to his building a harpsichord when he was in his sixties. In addition to his responsibilities at the School of Physics, he taught acoustics at the Conservatorium of Music, fashioning a French horn from a garden hose! On the keyboard, a favourite piece he liked to play was Handel's *Harmonious blacksmith*—a cheerful theme and variations—which is a bit like physics: an apparently simple

Previous page: Professor Ed Muirhead, c. 1995. Photograph courtesy the Muirhead family.

Below: Nova Art LLC (USA), *Grand orrery*, 2017 (replica of 19th-century orrery), wood, brass, wire, ceramic, with internal mechanism; approx. 25 cm diameter. Purchased 2017 with funds provided by the Laby Foundation, Ed Muirhead Physics Museum, University of Melbourne.



reality that, on closer examination, can lead to layers of intricacy, detail and mystery.[7] His broad gifts of perception and making artefacts came together in his efforts to preserve the museum's 'accidental' collection.

Ed Muirhead was an interesting leader. He established this museum from relics of the School of Physics. During his term as chair he instigated a comprehensive review of the school, the directions of its research and, most importantly, the staff needed to carry it into the future. This has happened within living memory and many of the present members of the academic staff were appointed under the strategy developed by the Muirhead review. Today, thanks to his foresight and the more recent introduction of the Melbourne Model curriculum across the university (a generalist bachelor's degree that includes 'breadth subjects' from different disciplines, followed by a more specialist postgraduate degree), the School of Physics is thriving, with a large complement of undergraduate and postgraduate students. The Melbourne Model has benefited the School of Physics, encouraging cross-overs with many other academic areas. Physics' founding in ancient Greece as natural philosophy is rightfully nurtured by this arrangement.

Sam Golding, *Winged Victory of the Muirhead*, 2017, pen and watercolour, 28.0 × 31.0 cm. Ed Muirhead Physics Museum, University of Melbourne.

Sam Golding's image combines elements from the museum collection to form an image of the goddess Nike, or the Winged Victory, part of the crest of the University of Melbourne.

Pagan passions also reside in the museum: in ancient Greece the muses gave inspiration to artists and philosophers, giving us the word 'museum'. Nike, the centrepiece of the University of Melbourne crest, while a goddess rather than a muse, epitomises speed and success, particularly victory in battle. In a university, the battle of words and ideas has replaced that of swords and chariots, with knowledge more important than national territory.

In religion, the minute is as important as the huge. This is also true of physics, as suggested by this display label written by Professor David Jamieson:

> **Nuclear microprobe lens**
> A contemporary artefact from the School of Physics. Starting just six years after the particle accelerator was invented in Cambridge, the School installed its first machine in the basement of the Old Physics building in 1938. Since then successive generations of particle accelerators have had important roles in the research programs of the School. This continuous tradition is maintained with research programs in quantum materials science using the Pelletron accelerator in the basement of the David Caro building. Also, the School is deeply involved with the world's biggest particle accelerator at CERN on the French–Swiss border. This artefact represents this rich tradition. It is a prototype high-precision magnetic quadrupole lens designed and built in the School of Physics at the University of Melbourne. It is used to focus beams of high-energy particles to make images of quantum computer devices, new types of superconducting materials and other applications that exploit the unique attributes of high-energy ions. Production versions of this lens are now in use in many other particle accelerator laboratories around the world.

Jamieson's text focuses on one small but seminal object that underscores the exceptional importance of the museum's holdings. The collection contains some 400 original scientific instruments, which broadly span the period from 1882 to the late 1950s. It includes objects that were commissioned specifically for use by students and staff in the School of Physics. It is as though an institution such as the National Gallery Art School (later known as the Victorian College of the Arts and now part of the University of Melbourne) had each year kept a seminal artwork created by its most important staff member or student. It is a collection that was not designed to be a museum collection, helpfully and hopefully avoiding a single academic pedagogy through its latent definition as a formal museum collection.

Other aspects of the collection include significant archival material, such as research notebooks, reports, photographs and correspondence. As part of a recent update of the museum, a new acquisitions policy was developed. Its focus is on the School of Physics at the University of Melbourne, rather than on physics knowledge in its entirety. The breadth of vision of earlier policies reflected a very public announcement of the museum's establishment, in around the year 2000. But in 2017, returning the Sun to the centre of the universe was a more comfortable idea!

In 2017 a scoping study by Insect Arts Management[8] informed the upgrade of the Ed Muirhead Physics Museum.[9] It looked at five main areas: teaching, alumni, branding, physical development and museology. The process was guided by the university's Cultural Collections Unit. The purpose was to assess the status of the museum in relation to

E. Leybold's Nachfolger (Cologne and Berlin, 1870–1967), Konig's apparatus for the analysis of sound, c. 1920s. Reg. no. 352, Ed Muirhead Physics Museum, University of Melbourne.

The Konig's apparatus is used to analyse sound. This piece consists of several Helmholtz resonators tuned to the upper partials (harmonic frequencies) of the note C (the second-lowest resonator has been removed). Each resonator is isolated by a diaphragm which is connected to a flame. If a sound source contains a component equal to one of the frequencies in this range, the corresponding diaphragm will vibrate, in turn making its gas flame vibrate. By viewing the gas flames in the rotating mirror, the user can see which resonators have responded to the sound source, thereby determining which frequencies are present.

each of the five areas, discuss options for development based on likely resources, then tie it all together into a progressive strategy. This was set out in 30 recommendations grouped into sets—enough work to last another decade or so, when a new vision could be calibrated by those involved in the museum, in recognition of its specialist role as a study collection.

A new mission statement was also developed:

> The Ed Muirhead Physics Museum aims to celebrate the discipline of physics at the University of Melbourne. The museum also serves as an intellectual laboratory and a muse. The collection derives entirely from the School of Physics, which was established in 1882 as the School of Natural Philosophy.[10]

Thus the rationale was to deepen the character of the museum, in recognition of its twin exceptional qualities of originality and community relevance. Future acquisitions might include, for instance, a nano-satellite, in recognition of the school's likely involvement in a satellite launch program in the near future. On a more prosaic level, it is important to

Left: The occasion of the official naming of the Ed Muirhead Physics Museum, University of Melbourne, on 4 December 2017. From left to right: Professors David Jamieson, Anthony Klein and Stuart Wyithe, and Mrs Anita Muirhead.

Below: Jane Sutherland, Portrait of William Sutherland, 1911, pastel on paper, 44.0 × 32.5 cm (sight). H27928, State Library Victoria.

remember that the museum is often experienced in fleeting glimpses by students rushing to lectures with only seconds to spare, or at greater length by retired professors recalling the past. Both ends of the physics ecosystem have importance, and are united by the existence of the displays, which act as reminders of the scientific method. The modern 'algorithm' of museum management also factors in the implicit financial value of the School of Physics 'brand', and the very real opportunities the collection offers for digital communications, both of which are noted in the scoping study.

As part of the upgrade, an orrery (illustrated on page 30) was purchased for display in the foyer of University House, the university's staff club.[11] This will serve as a symbol of the accessibility of physics to visitors to University House, where a superb exhibition of collection-related photographs has been installed in the main dining room.[12] These dramatic images by Lee McRae (see example on page 36) depict a selection of objects from the collection, along with portraits of four significant people associated with the School of Physics: William Sutherland (1859–1911), Professor Thomas Howell Laby (1880–1942), professor and former vice-chancellor David Caro (1922–2011), and atmospheric physicist Dr Jean Laby (1915–2008).

The Ed Muirhead Physics Museum is located on Levels 1 and 2 of the David Caro Building, which in turn houses two lecture theatres, named in honour of Professor Thomas Laby and Professor Eric Hercus (1891–1962). The museum is configured around the lecture halls in free-flowing foyers. In this sense it is a museum without walls, as the walls that are present serve another purpose: to communicate scientific knowledge through the spoken word. The collection is displayed mainly in stand-alone cabinets, with its audience comprising mostly students—passing through like gravitational waves.

The research for new display content brought to light some touching stories, which are worth recounting as they dispel the clichéd ideas many people hold about physicists. One such story was the tender circumstances surrounding a portrait of William Sutherland by his sister Jane Sutherland (1853–1928), completed in around 1911, the year of William's slightly premature death. The two siblings had achieved considerable distinction and fame in the Australian nation, which was then barely a decade old: William for his international success as a theoretical physicist, and Jane as a prominent member of the Heidelberg School of artists, painting in the company of such luminaries as Tom Roberts.

Both William and Jane Sutherland were discovering a new reality, albeit in different ways. William himself was a modest watercolourist, not unusual for a gentleman of his times. He helped his sister to paint in various locations after she suffered a stroke in 1905. Following his death, Jane mostly ceased painting. Her portrait of William (below), now in the collection of State Library Victoria, is a private vision of a brother she loved.

Mechanical equivalent of heat apparatus, made in the Natural Philosophy Workshop, University of Melbourne, c. 1918–29. Reg. no. 33, Ed Muirhead Physics Museum, University of Melbourne.

By the end of the 19th century, the concept of energy was firmly established. In 1859, the English physicist, mathematician and brewer James Prescott Joule had demonstrated the equivalence between mechanical energy and heat. The temperature rise of a known quantity of water due to a specific amount of work done on that water led to the concept of 'J': the mechanical equivalent of heat.

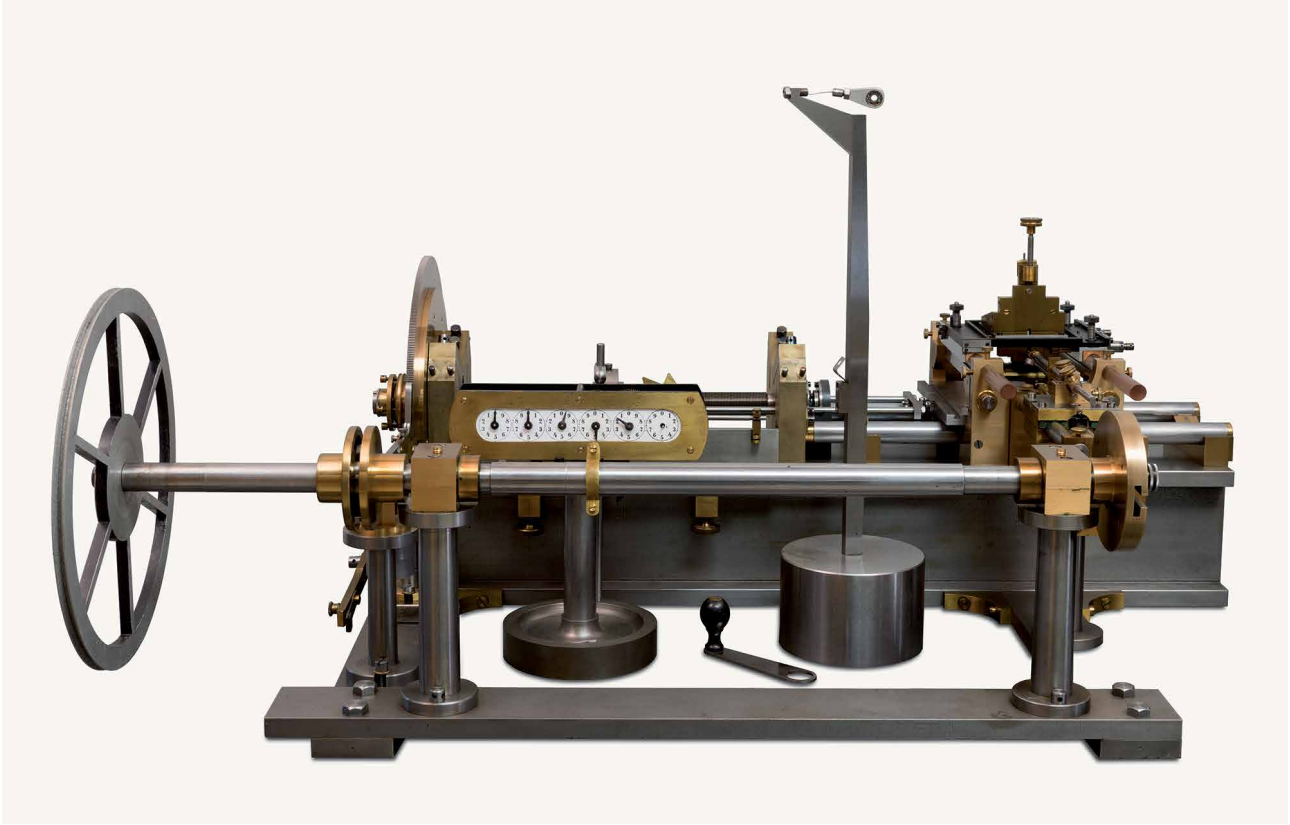
In Melbourne, Professor Thomas Laby and Professor Eric Hercus used this apparatus to reduce systematic errors, and it helped them calculate a value for J that contributed significantly to the final accepted value of J. This apparatus worked via a purely mechanical technique, and was not dependent on the value of electrical units and conversions, which were not accurate at the time. The outer electromagnet was rotated at constant speed, creating a rotating magnetic field that would tend to produce rotation in a stator. This stator was kept stationary by application of an external torque. The resulting eddy currents induced in the stator raised the temperature of water flowing in a calorimeter (a device used to measure energy) surrounding the stator.

Henry Joseph Grayson and William Stone, Diffraction grating ruling engine, built in Melbourne, c. 1910–12; modified 1912–30; used c. 1912–30. Reg. no. 35, Ed Muirhead Physics Museum, University of Melbourne.

A diffraction grating is a reflective or transparent plate engraved with an extremely large number of fine parallel lines. It is used in the analysis of light (spectroscopy), splitting a beam of light into its component wavelengths (spectrum)—similarly to how a prism splits light into its component colours. This ruling engine was built by Henry Joseph Grayson (1856–1918) with the help of a friend, the engineer and amateur physicist William Stone (1858–1949). The machine was used by Professor Thomas Lyle from 1917 to 1930 in the School of Natural Philosophy (now the School of Physics). It was originally designed to rule lines (of the order of 10,000–15,000 per inch) on glass, and was then modified to rule on speculum metal.

Grayson trained as a nurseryman and gardener, and then took up botany. This led him into the field of microscopy, at which he excelled. He was employed as a laboratory assistant in the School of Physiology, and then in Geology.

Another rather beautiful story that emerges from the shadows of the museum's past as a working collection relates to the association of the Laby family with the School of Physics. It's a story that could be told in many ways, but a recurring theme would have to be the love and support—and professional confidence—that Professor Thomas Laby showed his daughters Betty and Jean, resulting in something like 100 years of involvement by the Laby family in physics at the University of Melbourne, from 1915 onwards. A Jean Laby Facebook page, created posthumously in 2015, contains an excellent video interview with Jean,[13] in which she demonstrates an extraordinary sense of purpose, even in her later years. The Laby family's combined century of contribution to the School of Physics will be extended even further, thanks to an outstandingly generous bequest to establish the new T.H. Laby Professorial Chair, dedicated to advancing new areas of physics

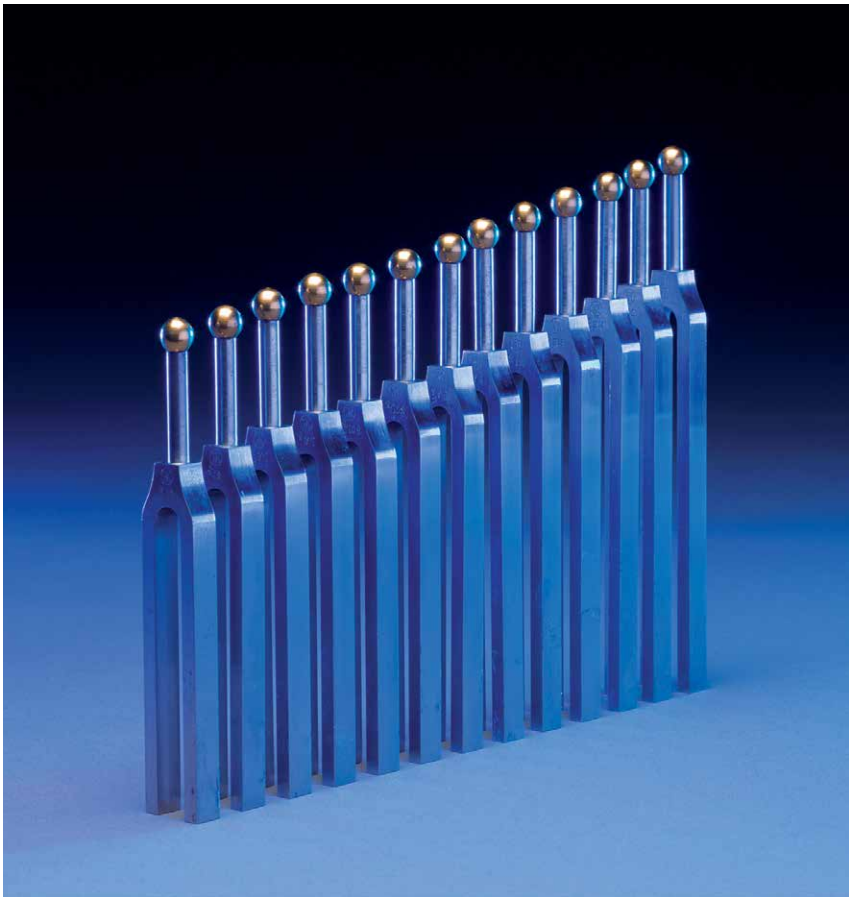


Set of 13 'Diapason Normal' tuning forks, c. 1905, made by Max Kohl AG (Chemnitz, Germany, est. 1876). Reg. no. 53, Ed Muirhead Physics Museum, University of Melbourne. This photograph is one of a series taken in 2017 by Lee McRae for display in University House.

In the early 1900s there was intense debate in Melbourne, and elsewhere, about the adoption of a standard pitch for use in musical performances—whether by orchestras, choirs or soloists. The great Melbourne-born soprano Dame Nellie Melba (1861–1931) was at the forefront of a push to adopt 'Low' or 'French' pitch, and purchased a complete set of brass and woodwind instruments tuned to this pitch, for use in Melbourne. The Victorian Minister for Education was sympathetic to the cause of standardisation and intended to order tuning forks for all Victorian schools; he provided this set to the university in early 1908 and it was placed in the care of Professor Lyle in the School of Natural Philosophy. The forks are tuned to the scale based on A4 = 435 Hz (435 cycles per second) or 'Diapason Normal', also called Low Pitch or French Pitch.[14] Today, standard concert pitch is slightly higher, at A4 = 440 Hz.

research. Also, the Laby Foundation generously supported the 2017 upgrade of the Ed Muirhead Physics Museum.

A weaving narrative can be told through the collection. There are connections with early X-ray research, wartime optics, nascent particle physics, climatology, astrophysics, and many other areas of enquiry—all of which have had profound consequences for society. The museum collection has an unusual integrity, as each object has a direct connection with an individual who worked at the School of Physics. This is a rare quality, not seen in many museum collections of such international significance. Many museum collections are based on collecting from afar, a method that, although valid, assumes a staged curatorial position. The Ed Muirhead Physics Museum is instead a four-leafed clover at the front door. May its cherishing bring great luck to the School of Physics at the University of Melbourne.



Joe Pascoe has a degree in art history from La Trobe University and is a founding graduate in museum studies, gaining a Graduate Diploma in 1979 from Prahran College of Advanced Education. He has held leadership roles at Geelong Art Gallery, Victorian Ministry for the Arts, Shepparton Art Gallery, Australia Council for the Arts, and Craft Victoria, and in 2013 established Insect Arts Management. In 2017 he was a visitor to the School of Physics at the University of Melbourne.

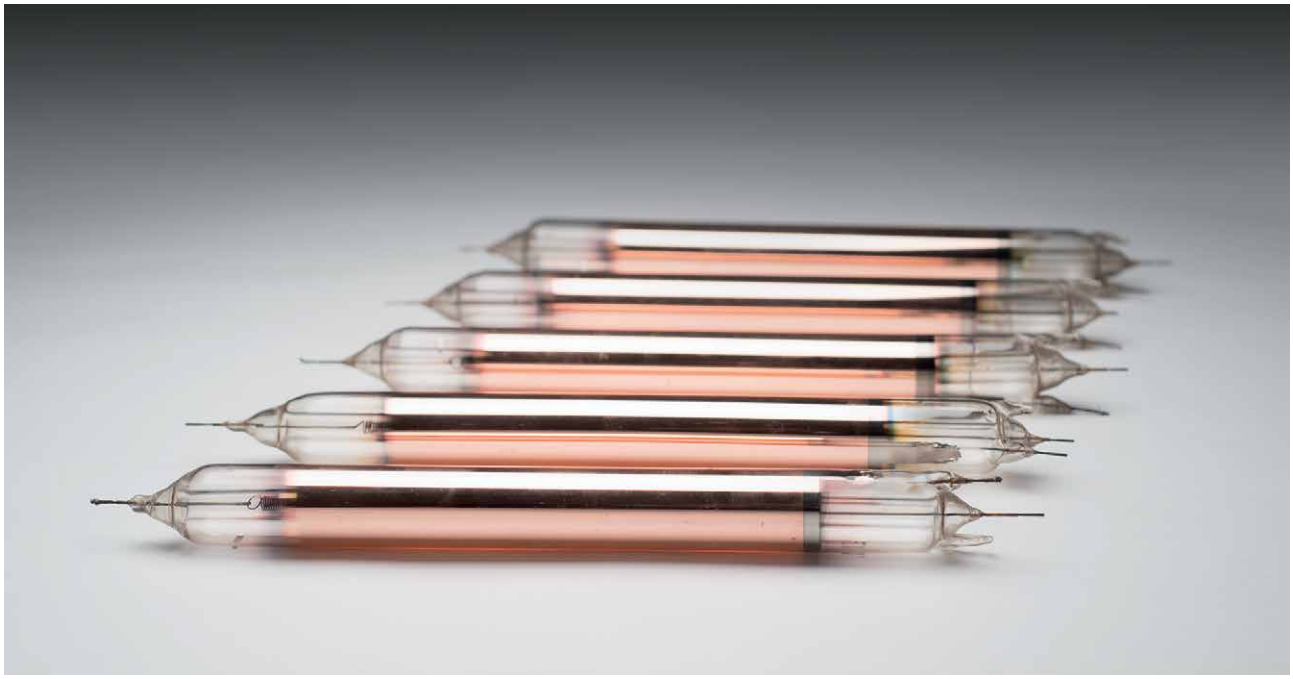
Jude Prezens is collections manager of the Ed Muirhead Physics Museum.

The Ed Muirhead Physics Museum is located on Levels 1 and 2 of the School of Physics, David Caro (South) Building, corner of Swanston and Elgin Streets, Parkville campus, University of Melbourne. It is open from 9 am to 5 pm Monday to Friday, and visitors are most welcome. See physics.unimelb.edu.au/engage/ed-muirhead-physics-museum.

Photograph by Lee McRae of Geiger-Müller tubes for Geiger counter, made in England, c. 1955, glass and metal, 56.0 × 3.0 cm (diameter). Reg. no. 16, Ed Muirhead Physics Museum, University of Melbourne.

Geiger-Müller tubes are lined tubes that have an electrode at each end and contain various gases in a semi-vacuum state, making them a highly responsive system to ionising radiation (in this case, cosmic rays). The radiation particle would interact with the gas, liberating electrons from the gas. The electrons would be attracted to the positive electrode in the tube, thus completing the circuit and producing the famous clicking sound produced by Geiger counters.

Geiger-Müller tubes were named after German physicists Hans Geiger (1882–1945), who invented the principle in 1908, and Walther Müller (1905–1979), who collaborated with Geiger in 1928 to produce a practical tube that could detect a number of different radiation types. The tubes, used by researchers around the world to collect radiation data, were sometimes attached to balloons and sent aloft to measure various behaviours of ionising cosmic radiation. These tubes were used by Dr Jean Laby in around 1972, during her research on aerosols in the atmosphere for the Climate Impact Assessment Program of the United States Department of Transportation.



1 D.H. Lawrence, 'Relativity', in *Pansies*, London: Privately printed by P.R. Stephensen, 1929, p. 89.
2 Professor David Jamieson, interviewed by Joe Pascoe, University of Melbourne, 12 April 2017.
3 William Sutherland, 'A dynamical theory of diffusion for non-electrolytes and the molecular mass of albumin', *London, Edinburgh, and Dublin Philosophical Magazine and Journal of Science*, vol. 9, no. 54, 1 June 1905, pp. 781–5.
4 R.W. Home, *Speculating about atoms in early 20th-century Melbourne: William Sutherland and the 'Sutherland-Einstein' diffusion relation*, Sutherland Lecture, 16th National Congress, Australian Institute of Physics, Canberra, January 2005.
5 'Theophrastus', in *Encyclopedia of classical philosophy*, Westport, Conn.: Greenwood Press, 1997, p. 55.
6 The Ed Muirhead Physics Museum was officially named on 4 December 2017 in a ceremony addressed by Emeritus Professor Roderick W. Home AM (the University of Melbourne's inaugural professor of history and philosophy and science), Professor Stuart Wyithe (head of the School of Physics) and Ms Anne Muirhead.
7 Anne Muirhead, notes, 5 January 2018.
8 Insect Arts Management is owned by the author.
9 Joe Pascoe (Insect Arts Management, Melbourne), 'Ed Muirhead Physics Museum, School of Physics, Faculty of Science, University of Melbourne—scoping study', unpublished report, 2017.
10 Pascoe, 'Ed Muirhead Physics Museum'.
11 The orrery is also to be used as an inspirational object in the School of Physics' forthcoming Telescopes in Schools program, involving secondary schools in Victoria.
12 Project managed by Susie Shears, cultural collections coordinator, and Susannah Britt, graduating Master's student.
13 Australian Academy of Science, 'Jean Laby—in her own words', 2016, Facebook, www.facebook.com/Jean-Laby-In-Her-Own-Words-1740530592891085, viewed 31 January 2018.
14 Simon Purtell, *The 'Melba Gift': Issues of pitch in Melbourne in the early twentieth century*, BMus thesis, University of Melbourne, 2006.