Current history

The Electrical and Electronic Engineering Collection

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In 1911, Edward Byam Brown was appointed as the first lecturer in electrical engineering at the University of Melbourne. That the university needed to be training students for the emerging field of electrical engineering had been recognised for some time: the Melbourne City Council had opened the Spencer Street power station in 1894, to provide electric lighting and power to the city; electric trams had begun regular operation in 1906; and industry was rapidly adopting electricity as an efficient and flexible source of lighting and power. Delayed by World War I, the first electric trains would run from 1919, and the State Electricity Commission was formed in 1921, to develop electricity generation and distribution throughout Victoria.

Some of the first instruments purchased by 'Eddy' Brown to support his teaching and research have survived in the heritage collection held by the Department of Electrical and Electronic Engineering. They are part of a larger collection of instruments that records significant aspects of teaching and research in electrical and electronic engineering at the university, and that also reflects major shifts in the field over the course of a century.

This article provides an initial survey of the collection and explores the history of some of its significant items. To understand what has survived in the collection (and what has disappeared), I will review the history of its development, and the way in which the collection has been shaped by the interests and dedication of a few individuals. Finally, the article considers how to develop the collection in the future, so that it can continue to document aspects of the department's teaching, research and innovation.

The Eddy Brown Era, 1911–46

Brown was the principal lecturer in electrical engineering from his appointment in 1911 until after World War II, shaping the course during those decades. All engineering students gained some general introduction to electrical engineering, but specialisation in the engineering degree was confined to the fourth year of the course, where students could focus on electrical, mechanical, civil or metallurgical engineering.

Brown had the requisite mix of research, professional and teaching experience to develop the electrical engineering subjects. He had graduated from the University of Melbourne with honours in physics and mathematics, studied further in London, worked with General Electric Co. in the United States, returned to Melbourne to conduct research for scientific instrument maker E.A. Machin, then in 1908 joined the Natural Philosophy (now Physics) Department as a lecturer.[1] A colourful character, who used his lectures to talk about his current research interest, Brown expected students to undertake their own reading and understanding of the textbook in order to pass the exams. Some of his more entertaining and arresting phrases were recorded by students as 'Eddy Currents' in the student journal *Cranks and Nuts*: 'My notes are a bit untidy. The silverfish have had a go too.' 'We dilute it (the voltage) down a bit for studes. We don't give them 400. It's not considered good for their health.' 'I've shown you how to get tangled up.' 'Most frequency meters are bits of liars.'[2]

The idea that meters might mislead reflected one of Brown's particular interests, evident in the collection. There are precision voltmeters and wattmeters made by the Weston Electrical Instrument Corporation of Newark, New Jersey, dating from 1912. These would not have been used directly by students, but to calibrate the student instruments. Precision instruments were

Left: Dr Edward Byam Brown (1880–1966) in the electrical laboratory, 1940s. Electrical and Electronic Engineering Collection, University of Melbourne.

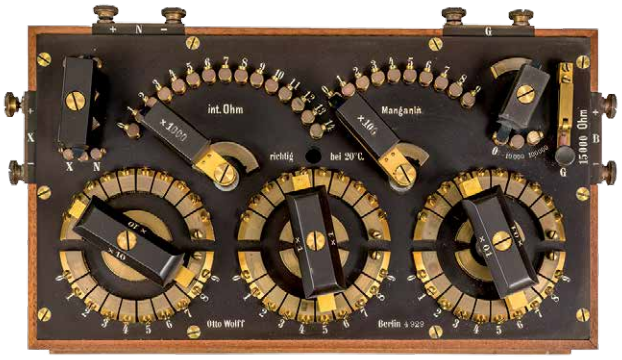
Below: Tuning-fork oscillator, probably made by Physics Department, University of Melbourne, to a design by Edward Byam Brown, 1924, 9 × 31 × 18 cm. EEE 015, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.

also important for Brown's research, or if he needed to provide measurements for external consultancies such as electricity suppliers or local manufacturers. One early surviving instrument is surprisingly makeshift, if effective. The load bank comprises a piece of timber with electric-bulb holders connected in parallel. In testing a transformer or generator, various electrical loads could be applied by screwing in Edison light bulbs; the Edison screw mounts and braided insulation suggest that this item was made early in Brown's tenure.

While electrical power generation and distribution and its industrial and domestic applications remained the main focus of electrical engineering in the 1920s and 1930s—and where graduates would make their careers—Brown was alert to the rapid development of radio communication and commercial radio stations in the early 1920s, and he explored the implications in his teaching and research. The collection includes a tuning-fork–controlled oscillator (pictured below), described by Brown in the *Transactions of the Institution of Engineers, Australia* in 1925.[3] The tuning-fork oscillator was designed to calibrate wavemeters, to ensure that the new radio transmitters were accurately transmitting at their designated frequencies, thereby minimising interference between adjacent wavelengths: 'The author of this paper felt that it was very desirable for the University of Melbourne to be able to undertake accurate wave-length measurements'. The Physics Department had an extensive workshop, and it is likely that Brown had the instrument made there to his specifications, based on a report from the National Physical Laboratory in England.

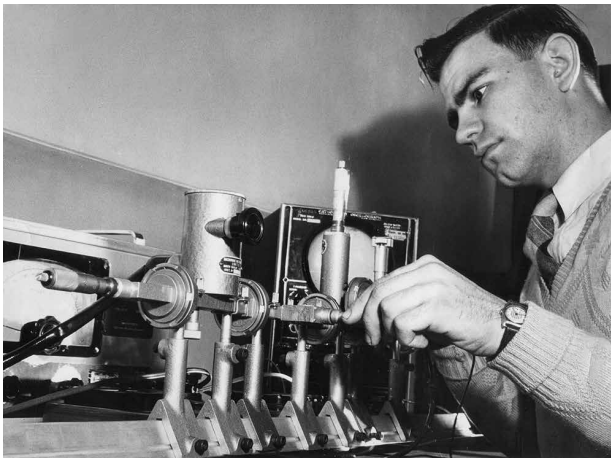
Right: Potentiometer or resistance bridge, no. 4929, made by Otto Wolff (Berlin), c. 1900, 21 × 45 × 25 cm. EEE 009, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.

Below: Signal generator, type 605-B, no. 811, made by General Radio Company (USA), 1940s, 40 × 58 × 27 cm. EEE 074, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.



Another set of instruments from the early 20th century is more puzzling. The collection includes several pieces of expensive laboratory equipment that would more typically be found in a physics laboratory than in an electrical engineering lab set up for teaching. The instruments include a Kelvin current balance, made by James White Ltd of Glasgow around 1910, and a precision resistance bridge, made by Otto Wolff of Berlin around the same period. Viewing these items, former electrical engineering and physics staff have proposed that the equipment must have originated in Physics, then gravitated to the Electrical Engineering Collection in recent decades. However, there is some evidence that the items were in Brown's lab in the 1930s: inside the lid of the resistance bridge are corrections annotated in 1938 by D.C.A.G. McLean, senior demonstrator in electrical

Don Hewitt at the microwave waveguide test bench, 1955. He is adjusting the waveguide attenuator depicted on page 27. Electrical and Electronic Engineering Collection, University of Melbourne.



engineering. On balance, it seems probable that Eddy Brown's physics background and longstanding interest in precision standards led him to acquire these items in the 1920s. Given the financial constraints of the university in the 1920s and 1930s, he either used personal funds or persuaded industry to pay for them (a recurring theme in the purchase of research equipment in the department).

Establishing and building the department

Brown retired in 1946, coinciding with a broader discussion about the need to establish additional chairs in engineering. Back in 1930, Henry Payne, professor of engineering, had lobbied the university council to create separate chairs in mechanical, civil and electrical engineering, but the idea met resistance, and there was a lack of funds. The Depression and World War II prevented any subsequent investment in engineering. It also didn't help that Payne's successor, Aubrey Burstall, actively resisted the idea of creating specialist undergraduate courses in each discipline, and suggested moving electrical engineering to the science faculty. By 1946, however, the university advertised for professors of civil, mechanical and electrical engineering. Emerging from the war, Australia was about to embark on large-scale investment in infrastructure, symbolised by the Snowy Mountains hydro-electric scheme. During the war, many secondary industries had emerged to meet military needs and to replace the lack of imported manufactured products; now was the moment for the university to train the new generation of engineers who could contribute directly to this industrial transformation.[4]

Charles Moorhouse, a former student of Brown, was appointed as senior lecturer in charge of the new Department of Electrical Engineering in early 1947; he would be confirmed as its professor in 1948. Having worked for the British Thompson Houston Company in the United Kingdom and the State Electricity Commission of Victoria (SEC), Moorhouse brought extensive experience in power engineering. To complement his own experience, he appointed Arthur Ferguson, who during the war had worked in electronics and communications for the Council for Scientific and Industrial Research. The wartime development and application of radar had shown the significance of microwaves, and opened up new fields in electronic communication.[5]

Moorhouse and Ferguson built a curriculum for the new department, based roughly on a 50/50 split between power systems and electronics, and new staff were recruited to teach in each of these fields. The department remained relatively small; at the end of its first decade there were only five full-time teaching staff. Finding funds for equipment was a continuing difficulty: 'By the late 1950s the laboratories were in a poor state. Much of the equipment had been purchased by Eddy Brown as early as 1911 and the financial stringencies of the depression and World War II had severely limited the scope of any replacements'.[6] To find suitable electronic teaching equipment, staff would visit a military surplus store in Flinders Street, or head out to Point Cook airfield, where workers were ripping apart military aircraft with axes and salvaging electrical equipment.[7] The power laboratories were upgraded with disposal items from the SEC, retrieved from country towns that were being converted from local direct-current supply to the statewide grid.

Some new equipment from the 1950s has survived in the collection, notably items made for the department by local scientific instrument makers J.L. and A.J. William. The William brothers had studied at the Working Men's College (now RMIT University) and set up instrument-making businesses in the 1930s; during the

Below: Wattmeter, type P.W.6, made by A.J. William (Melbourne), 1950s, 28 × 16 × 33 cm. EEE 242, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.

Microwave waveguide attenuator, made by Microwave Instruments Ltd (North Shields, England), c. 1960, 3 × 10 × 8 cm. EEE 313, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.

war they joined forces to produce some 100,000 electrical instruments at their small factory off Little Bourke Street in Melbourne. After the war, A.J. (Austin) William specialised in making standard equipment for industry and teaching labs, selling his instruments to universities and colleges throughout Australia. L.J. (Les) William developed a separate business making specialist research equipment, developing a close relationship with the Physics Department as well as Electrical Engineering at Melbourne.[8] An A.J. William wattmeter in the collection (pictured opposite) reveals the trials that some equipment could be put through by students. Although the department staff did fit special fuses to many wattmeters to try to save them from accidental overload, this particular wattmeter has been marked 'O.C.' for open circuit, to indicate that it has been burnt out with excess voltage.

Under Arthur Ferguson's guidance, students explored the expanding field of electronics. Don Hewitt was one of Ferguson's early students, graduating in 1955, then working as a demonstrator in the department before heading to the United Kingdom for experience at the GEC research labs. Among the items in the collection is a small group that set Hewitt on his career in microwaves:

> That, from my point of view, that instrument and that box is the reason that I moved into microwaves … That was the reason why I went to England to GEC Research, and the reason I came back to Telstra Research, and then back into the department was probably all because Arthur Ferguson bought that when I was an undergraduate student … There was a whole experimental system where we could make measurements at 10 GHz. At that particular stage, 10 GHz was a very high frequency. The wave length was 3 centimetres, and the students were attracted to this in terms of research because it was novel and new. At that time all the wave-guide communication systems were being developed around the country.[9]

Hewitt (pictured on page 25) returned to the department in 1961 to continue his research and teaching on microwaves; retiring in 1995, he has retained research and honorary positions in the university.

In addition to microwaves, the second major research strand in the department in the 1960s and 1970s was in electronic devices and circuits. The main items in the collection are teaching instrumentation that was constructed in the department to teach students the basics of logic circuits. Students would be given the task of designing a logic circuit for a particular task, then checking that it worked by building the circuit with interconnectors and measuring the response. Several of the students would go on to distinguished careers in semiconductor and integrated-circuit design in the United States.

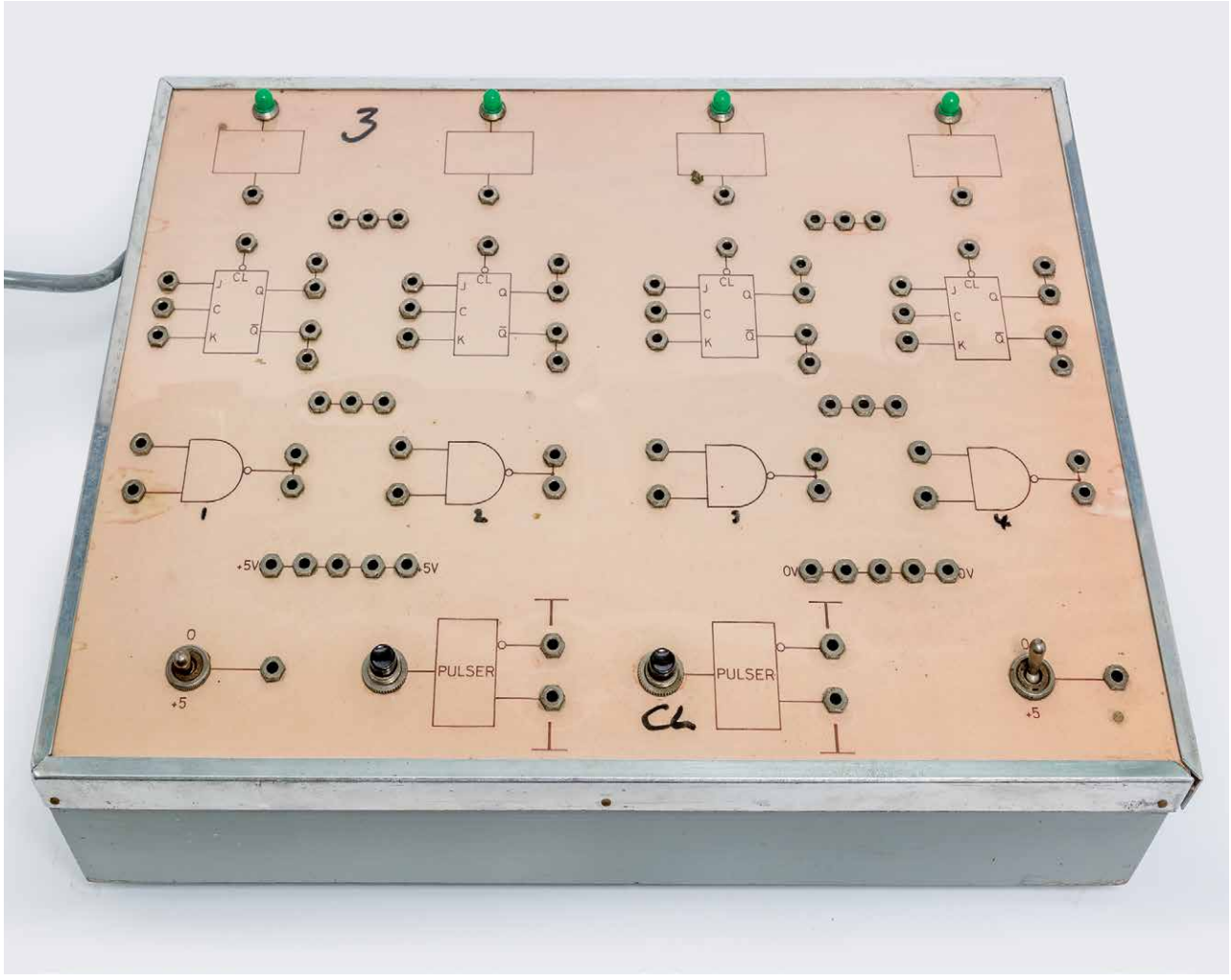
Contemporary collecting and use

Although there are many rich stories in the existing collection, the past four decades of teaching and research in the department are not well represented. This seems to be a characteristic of several of the science and engineering collections at the university, and it is worthwhile considering why this has occurred. I will focus on the Electrical and Electronic Engineering Collection, but similar themes are evident in other collections.

The development of the collection has relied on the enthusiasm of individual staff members, often retired staff who appreciate the historical significance of the equipment. After his retirement, Eddy Brown continued to undertake research in the department. On one occasion, thinking that Eddy was on holiday, the staff loaded some old equipment onto a truck to be quietly sent for scrap:

Below: Digital trainer, made by University of Melbourne, 1970s, 10 × 42 × 31 cm. EEE 104, Electrical and Electronic Engineering Collection, University of Melbourne. Photograph by Russell Winnell.

Opposite: Programmable sweep generator, model 6660A, made by Wiltron (USA), c. 1980, 15 × 43 × 49 cm. EEE 306, Electrical and Electronic Engineering Collection, University of Melbourne. This instrument was used by Rod Tucker at Bell Labs in the United States, and brought back as part of the establishment of the Photonics Laboratory in 1990. Photograph by Russell Winnell.



'As luck would have it, Eddy turned up unexpectedly just as the truck was leaving and is said to have run after it desperately pulling items off as it headed for the gates'.[10] Some of these items were found decades later, secreted in the roof of the Engineering Library, and are now part of the collection. Similarly, John McCutchan, who joined the electrical power systems group in 1958, rescued many items when they were about to be discarded, and stashed them in the power labs; when he retired, he built an extension to his garage to store them, until a museum could take them. Due to his foresight, many have now returned to become part of the collection.

The speed of change has resulted in a faster turnover of equipment and laboratories. Staff have to clear laboratories for renovation, or move labs to new buildings, often retaining only those items that will be useful in the future, rather than those that record the past. Significant items can easily disappear in the process. Biomedical engineer David Dewhurst purchased the first PDP-8 minicomputer in Australia in 1966, bringing it with him when he moved from Physiology to Electrical and Electronic Engineering. Dewhurst's students would go on to work with Graeme Clark to develop the electronic circuits for the bionic ear in the mid-1970s.[11] The PDP-8 computer survived a departmental move to Bouverie Street in 2002, but has not resurfaced in the past decade and is presumed to have been discarded. Larger and heavier items such as the PDP-8 and electric motors and switchboards from the power labs have been too difficult to retain and store (although some bulkier items from Engineering are currently stored offsite).

While documenting the collection over the past few months, I have tried to locate potential additions. The temporary relocation of the photonics laboratory at the end of 2018 created an opportunity to assess with staff the older equipment, and rescue significant items and documentation that were no longer needed. The department's research in photonics began in 1990 with the arrival of Rod Tucker to a newly created chair. With the support of vice-chancellor David Penington, the university invested substantial funds, with additional support from Telstra, to facilitate research and training in the rapidly advancing field of optical fibre communication systems (the basis of today's National Broadband Network). Tucker returned from his position at Bell Labs in the United States with equipment and a briefcase of small but precious semiconductor lasers that would be the basis of the team's experiments for several years. Several of the lasers are now in the collection, along with early equipment from the photonics lab. In 1997, Tucker would share the Australia Prize in science for his contribution to telecommunications.[12]

Other projects over the past three decades await the location and documentation of objects; how many objects and stories are tucked away in labs and storerooms? For example, there is little relating to the extensive research and training programs in information and communications technologies undertaken by the Victorian Research Laboratory of NICTA (National Information and Communication Technology Australia Ltd), based in the department and funded by the Commonwealth and Victorian governments from 2004 to 2014.[13]

If a collection is to survive, it must have a purpose. While collection items remain personal historical curios, primarily of interest to staff who worked with them, they will lead a perilous existence. The present impetus for developing the engineering collections is the Melbourne School of Engineering's MSE 2025 initiative, which will see the school based at the Melbourne Connect precinct across Swanston Street, a new campus at Fishermans Bend, and redevelopment at Parkville. Opening in late 2020, Melbourne Connect will highlight the

school's tradition of innovation and collaboration with external partners, showcasing items and stories from the collections. Researchers and industry partners will be encouraged to present current research projects; where appropriate, these can form the basis of a contemporary collecting program.

A collection such as this one matters. It provides a material, tactile sense of the history of the field, and the university's place in teaching and research. The collection can show how the university has built collaborative partnerships, and how these have always been an integral part of the university's work, especially in sciences and engineering. Contemporary collecting allows us to showcase recent achievements and current research projects; objects and their associated interpretation can convey the physical, lived character of the research, which can otherwise seem abstract and impersonal.

Finally, objects are what we touch, manipulate and remember; they are the interface between the physical world and the ideas that motivate and challenge. I have been struck by how reuniting staff with objects that mattered to them sparks a different kind of conversation: the tactile nature of the objects triggers different memories and an affective response, compared to traditional oral histories. The last word should go to Don Hewitt, on encountering the Gunn diode, the first generation of semiconductor microwave sources, which was used in his laboratory for many years to undertake research in microwave communications and train a generation of students: 'Aah, you little beauty!'[14]

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Dr Richard Gillespie is an honorary principal fellow in the School of Historical and Philosophical Studies at the University of Melbourne, and formerly head of the Humanities Department at Museums Victoria. He is currently curating the collections of the Melbourne School of Engineering, to facilitate their display at Melbourne Connect and Fishermans Bend.

For further information and access to the **Electrical and Electronic Engineering Collection**, please contact Dr Richard Gillespie on gillespie.r@unimelb.edu.au. Part of the collection is on display on Level 2 of the Electrical and Electronic Engineering Building (Building 193, facing Wilson Avenue).

1 'School and M.U.E.S. notes', *Varsity Engineer*, vol. 3, June 1911, p. 43.
2 Quoted in Carolyn Rasmussen, *Increasing momentum: Engineering at the University of Melbourne, 1861–2004*, Melbourne University Press, 2004, p. 97.
3 Edward Byam Brown, 'The calibration of wavemeters by means of a tuning-fork controlled valve oscillator', *Transactions of the Institution of Engineers, Australia*, vol. 6, 1925, pp. 176–93.
4 John Packer, *The first fifty years: The Department of Electrical and Electronic Engineering, University of Melbourne, 1947–1997*, University of Melbourne, 1997, pp. 5–7; on engineering during World War II and the post-war expansion, see Rasmussen, *Increasing momentum*, pp. 107–31, and Charles E. Moorhouse, *A century of degrees: The Melbourne University Engineering School*, Faculty of Engineering, University of Melbourne, 1989, part 2.
5 Packer, *The first fifty years*, pp. 7–8
6 Packer, *The first fifty years*, p. 9.
7 John McCutchan, interviewed by Richard Gillespie, 16 November 2018.
8 Bert Bolton, 'The William brothers of Melbourne: Makers of electrical scientific instruments', *Australian and New Zealand Physicist*, vol. 32, 1995, pp. 134–7.
9 Don Hewitt, interviewed by Richard Gillespie, 6 February 2019.
10 Packer, *The first fifty years*, p. 9.
11 Richard Gillespie, 'Collecting computers—and computer users', *University of Melbourne Collections*, issue 22, June 2018, pp. 12–22; on Dewhurst, see Richard L.G. Kirsner and John S. McKenzie, 'Biophysics and biomedical engineering at the University of Melbourne: David Dewhurst's seminal role', paper presented at EPSM-ABEC Australian Biomedical Engineering Conference, Melbourne, December 2010.
12 Packer, *The first fifty years*, pp. 41–50.
13 *Research that matters, NICTA Victoria Research Laboratory, 2004–2009*, Melbourne: NICTA Victoria Research Laboratory, [2009].
14 Don Hewitt, interview.