

# Art of Microtomy: A Slice of Historical Action

The means by which tissue is sectioned for microscopical examination has progressed stepwise from as early as the late 18th century. From cutting freehand with a knife or razor to tissue sectioning using various types of instrument, microtomy was, and largely remains, a skill born of considerable practice.

## Microtomy: A Time Line

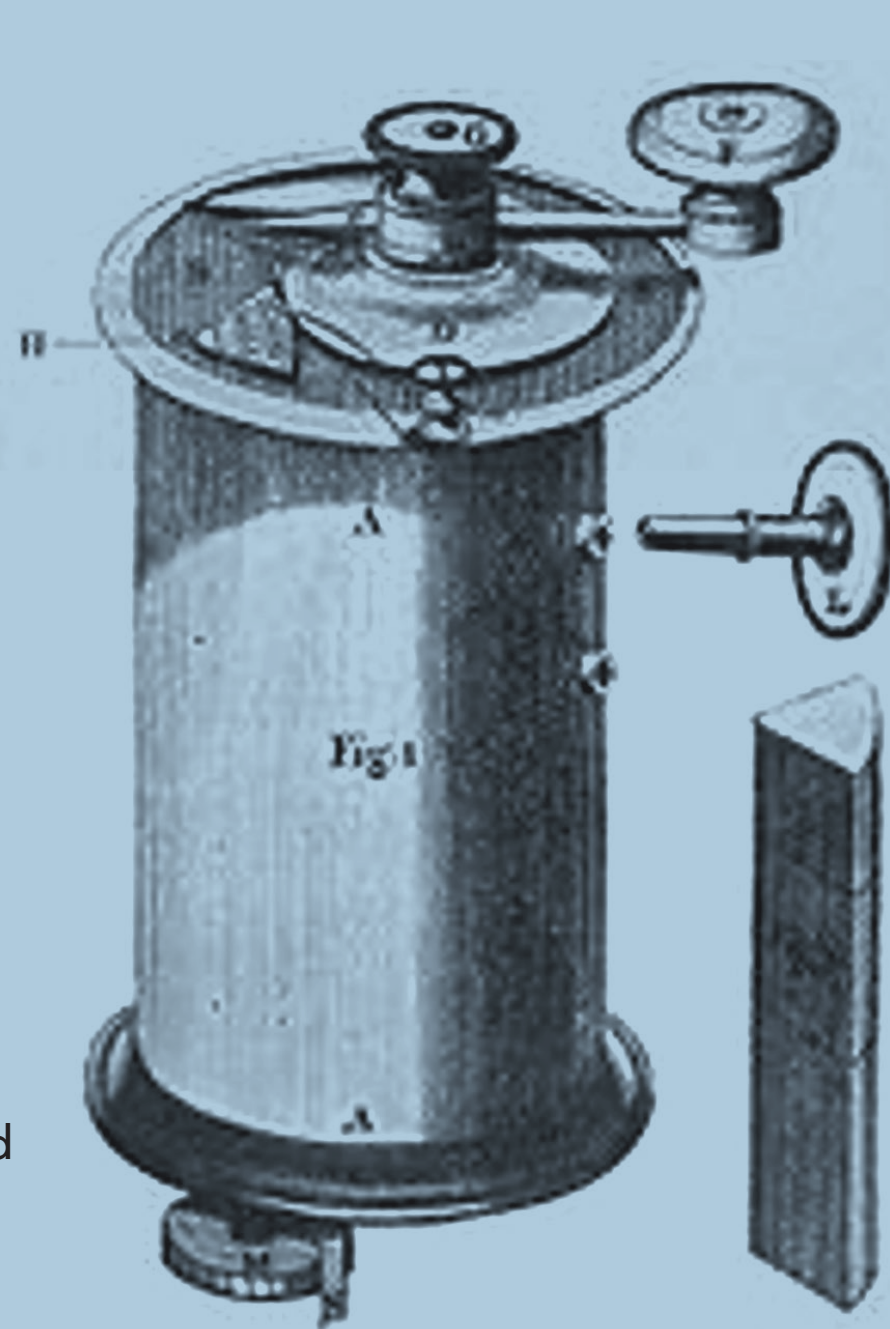
As the optical quality of microscopes improved so did the need to produce suitable material to allow the light to be transmitted through the section evenly to observe the structure of the specimen. In the beginnings of light microscope development, thin sections (approximately 100 µm thick) from plants and animals were manually prepared using a knife or razor, but the sections were not always of uniform thickness so various cutting devices began to appear that could give even thinner sections of the material.

- **1770:** Semi-automated microtome invented by George Adams Jr. and further developed by Alexander Cummings (1733–1814). The prototype, a metal cylinder that contained the specimen, usually a plant, was screwed by hand into the path of a knife to make a tissue slice.
- **1835:** Andrew Pritchard clamped a similar instrument to a table for greater stability. A section was then prepared with a two-handled plano-convex knife by drawing it across the specimen.
- **1838:** Professor Gabriel Valentin developed the double-bladed Valentin knife. The gap between the blades was adjusted to allow the production of thin slices of soft tissues for microscopic examination.
- **1841:** Jan Evangelista Purkyně was the first investigator to use a forerunner of the modern microtome, which was constructed by his assistant Adolph Oschatz
- **1868:** Swiss anatomist Wilhelm His Sr designed his own microtome for the free-hand sectioning of paraffin wax-embedded embryos. This allowed sections to be cut at a thickness of 50 µm
- **1872:** First microtome for mass production built by Rudolf Jung and Rudolf Thoma
- **1873:** Professor William Rutherford at King's College London developed a machine that used an integrated ice bath to freeze the tissue and also allow it to be sectioned. In 1881 the ice was replaced with an ether spray and in 1931 F L Dunn used 'dry ice'. R Holman described the use of an attachment that used compressed CO<sub>2</sub> gas as a freezing agent
- **1884:** William Caldwell and Richard Threlfall described an automatic microtome with a fixed horizontal knife that enable cutting ribbons

- **1885:** Horace Darwin patented a less complex rocking arm microtome with a fixed vertical knife. This became the forerunner of the 'Cambridge Rocker', that was widely used in laboratories across the world and is still in production today
- **1886:** An automatic microtome which used rotary motion to advance the block and move it across the knife was developed by Charles Minot
- **1910:** Both Jung and the Cambridge Scientific Instrument Company introduced 'Sledge' microtomes in which the specimen was slid along and across the knife. These were very substantial machines on which it was easier to cut hard materials.

Jan Evangelista Purkyně

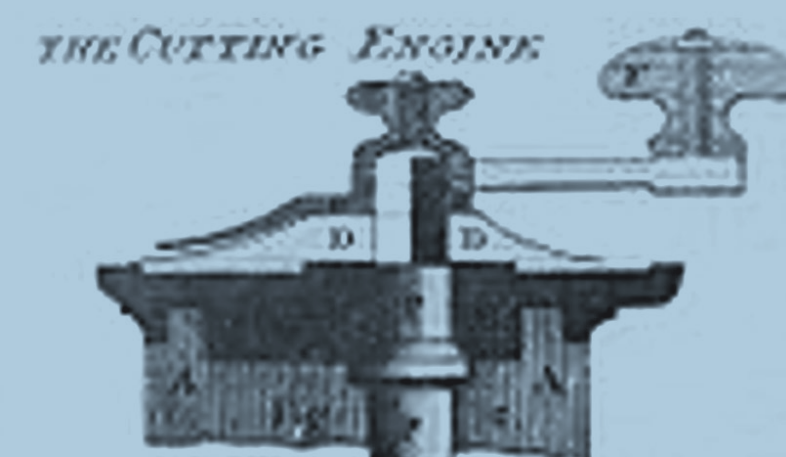
In the earliest microtome the thickness of the section was determined by how far the specimen was pushed up the tube, initially manually then by a screw-driven piston which was turned manually. Consistency of thickness wasn't obtained until the introduction of an automatic calibrated toothed wheel and pawl feed mechanism integrated with the operating mechanism in Rocker, Rotary and Sledge microtomes which advanced the block on each cycle.



The Cutting Engine, an early means of cutting thin sections.

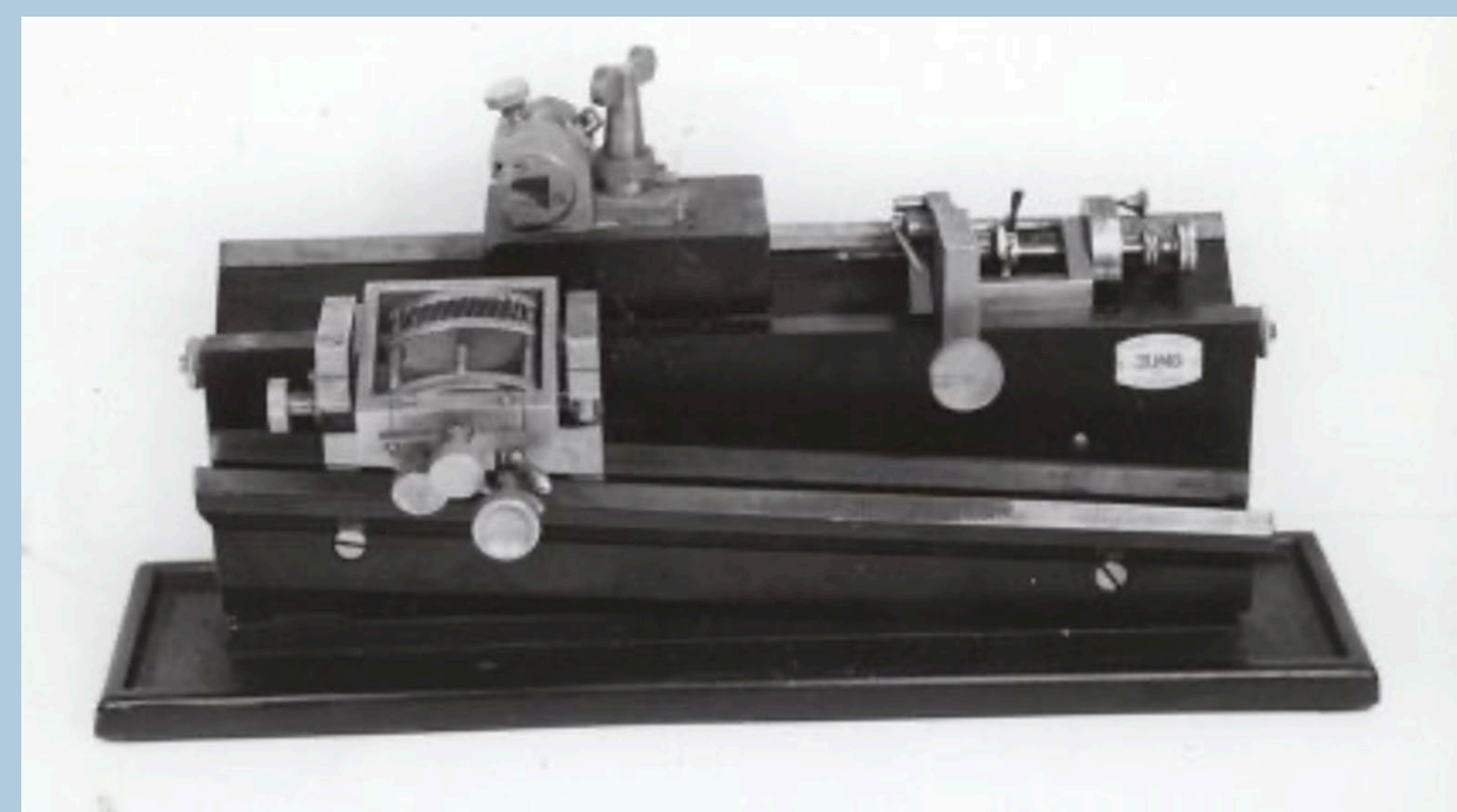
The name microtome comes from Greek *mikros* (small), and *temnein* (to cut) – a device that enables thin slices of a specimen to be cut and prepared for microscopical examination.

- **1839:** Charles Chevalier, a French microscopist, was the first to use the name microtome.
- **1884:** J A Ryder was the first to use microtomy to describe the art of cutting sections.

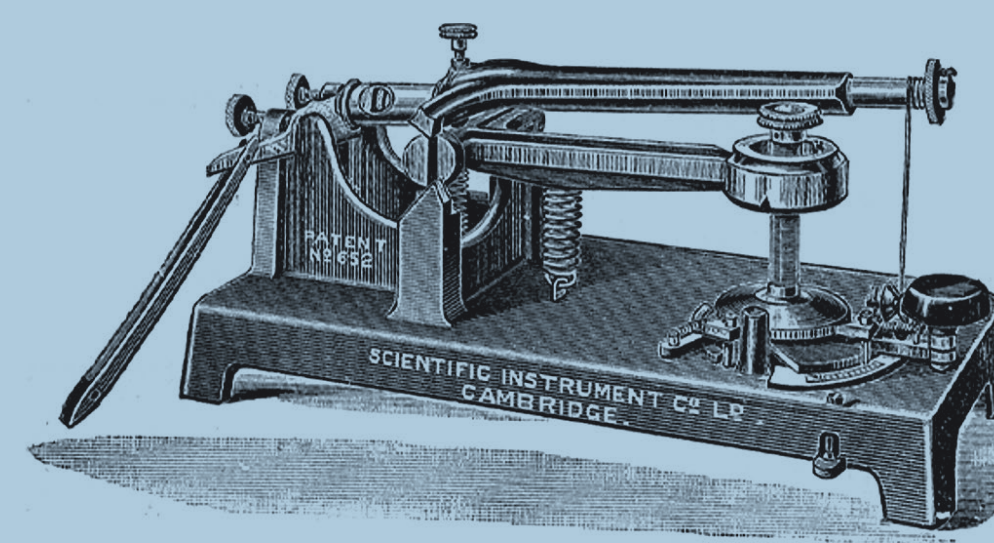


## Life on the edge

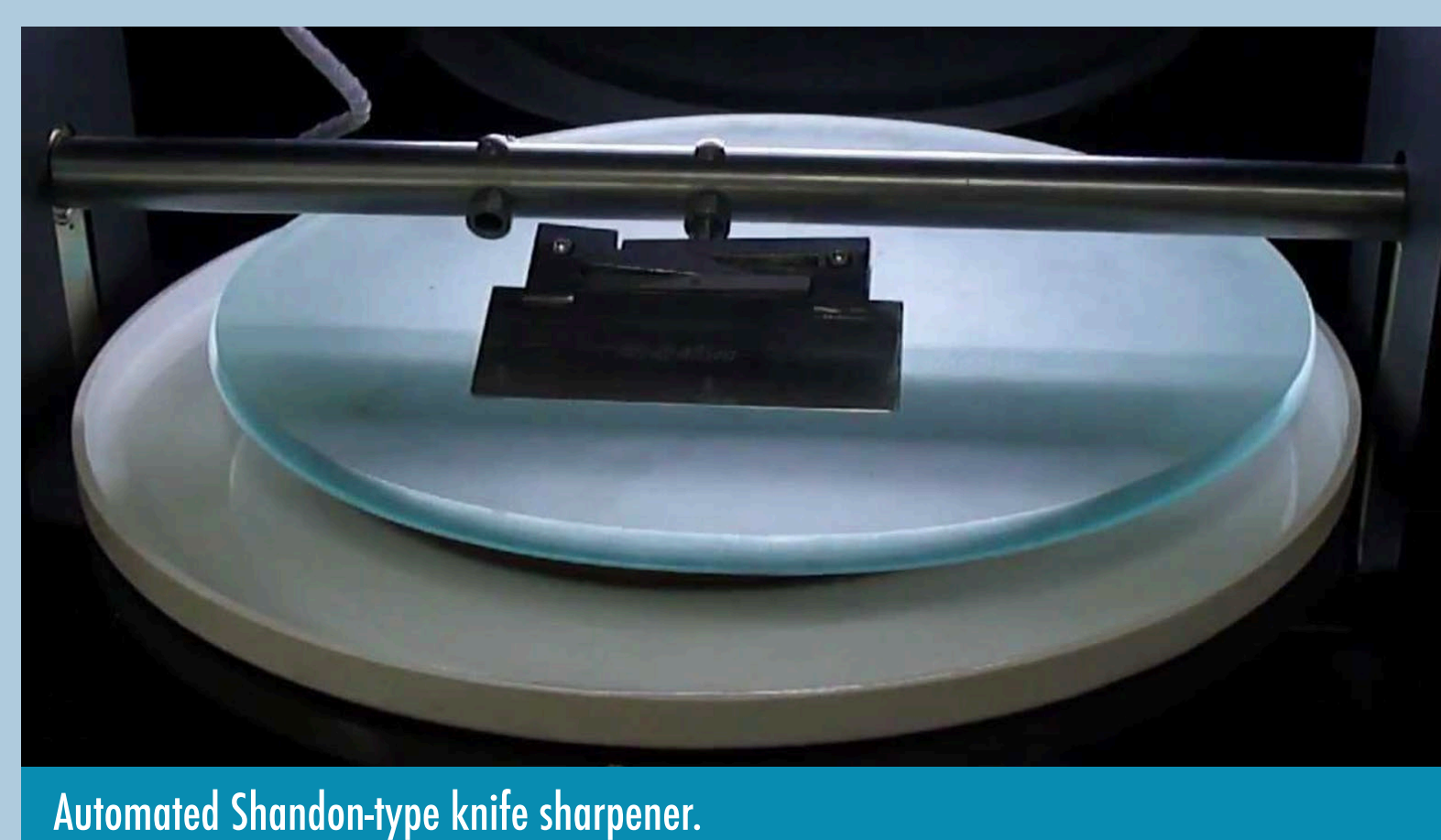
With the widespread adoption of the automatic microtome came knives designed to be used with them. The Rocker used the biconvex Heiffor, the Rotary and Sledge used the Riechart/Jung wedge knife. These were sharpened manually using stone hones, or glass plates dressed with oil and increasingly fine grades of aluminium oxide powder. Then finished on a leather strop dressed with oil and Jeweller's Rouge (ferric oxide powder). By the early to mid-1960s manual sharpening was largely superseded by the Shandon automatic knife sharpener, itself being overtaken by the introduction of disposable knives.



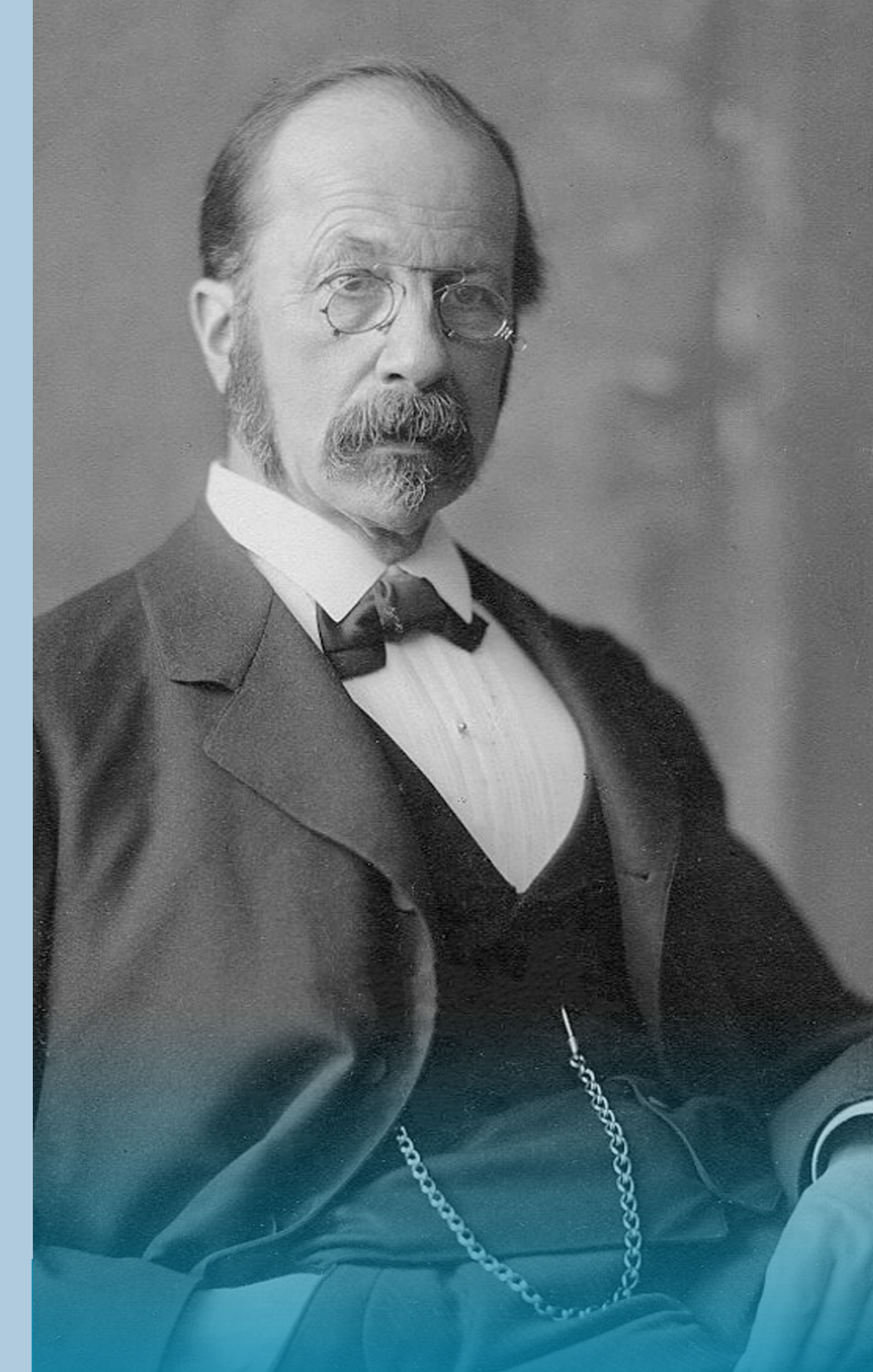
The Thoma microtome, developed by Rudolf Jung with Heidelberg pathologist Rudolf Thoma.



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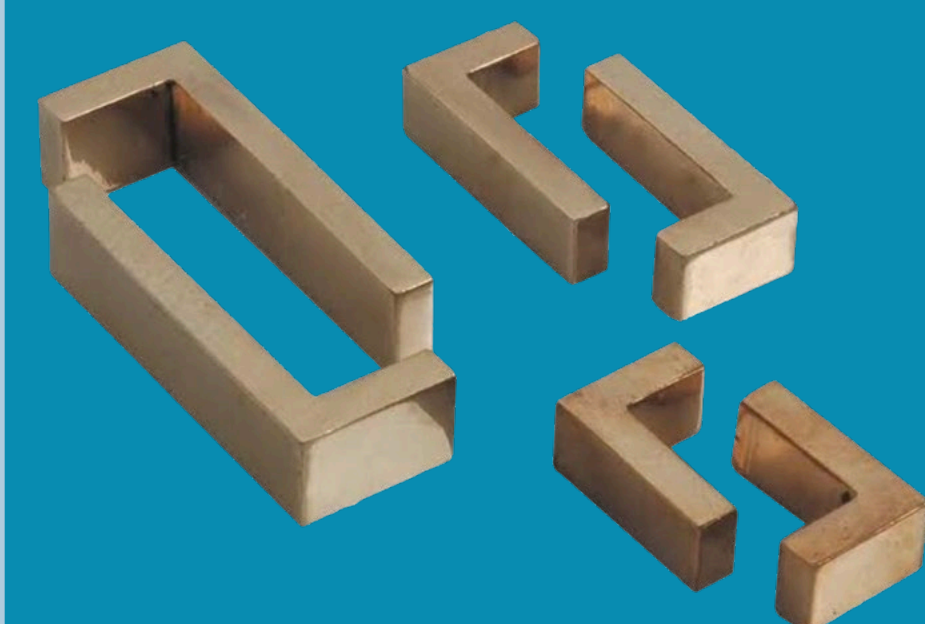
William His Sr

## Early embedding

- Early workers used made-up paper boxes for embedding specimens in wax. In 1881, Leuckhart introduced the use of two L-shaped pieces of brass placed on a glass sheet as 'containers' to hold the molten paraffin wax
- By the beginning of the 20th century the basic techniques and equipment for producing sections from wax-embedded specimens were well established. These continued to be developed and refined over subsequent decades, mainly by the introduction of mechanisation.
- Embedding media other than paraffin wax were introduced, including celloidin, gelatine and methacrylate, as were waxes of different melting points as well as water soluble waxes to support specialised applications

## Two important developments in the 1950s

- **1952:** Humberto Fernandez Moran invented the ultramicrotome for preparing sections for electron microscopy.
- **1954:** Professor A G E Pearce and Kenneth Slee (CEO of South London Electrical Equipment [SLEE]) develop the first cryostat. They placed a Cambridge Rocker inside a refrigerated chamber and all the controls externalised to help maintain the chamber at a constant temperature of -20°C. The prototype cryostat, affectionately known as 'Wheezy', was later commercialised as the Pearce-SLEE cryostat.



Leuckhart's brass mould pieces

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Produced by the IBMS History Committee for Congress 2025