

“The test tube has this metaphorical meaning that has gone far beyond its physical form”

THE TEST TUBE: A SYMBOLIC STORY

While the test tube is hardly the most imposing item of glassware on a scientist's workbench, its symbolic power is second to none.

The test tube is possibly the most unobtrusive piece of equipment in the lab: its workaday function and sheer ubiquity render it more or less invisible. Scratch beneath the surface, though, and you'll find... well, not a whole lot.

It has little in the way of an arresting origin story – indeed, the inception of the test tube is as opaque and colourless as many of the solutions it holds. The materials that go into manufacturing test tubes are generally unexceptional (mostly plastic or glass, though Pyrex is mildly diverting), and otherwise there is little to differentiate one test tube from another, apart from the size, which, roughly

speaking, varies from 10 to 20mm wide, 50 to 200mm in diameter, and 100 to 150mm long. We could talk about test tube racks and brushes, but they're not about to set the imagination on fire, are they?

Yet despite this lack of any real defining character or compelling backstory, if one piece of lab equipment has come to symbolise chemistry, and in some ways the whole of modern science, it is the test tube. How on earth did that happen?

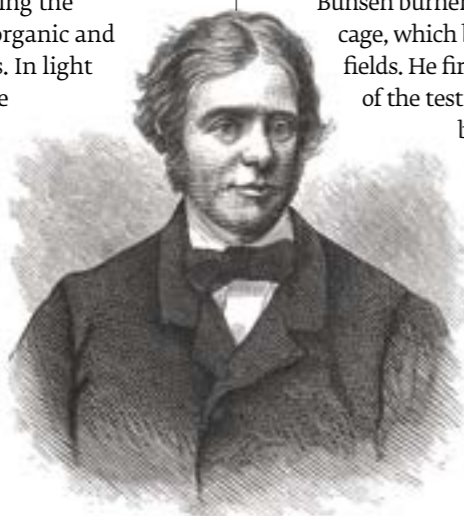
Historic origin

Of all the many basic shapes and sizes of equipment that populate the average chemistry lab, the test tube appears to be a relatively new addition: no mention of it, or anything like it,



appears before the 19th century.

One version has it that the test tube sprang from the imagination of the Swede Jöns Jacob Berzelius (1779-1848). Considered one of the fathers of modern chemistry, Berzelius has more than enough achievements to his name, not least discovering silicon, selenium and thorium, devising the chemical notation system, and establishing the differences between organic and inorganic compounds. In light of that, conceiving the test tube could have been something he tossed off in an idle moment one rainy afternoon. According to the evidence he described something very similar to what we know as the test tube in an article he



wrote in 1814 – though this was more likely the genesis of the tall form beaker that carries Berzelius' name to this day.

Another version contends that the test tube was the brainchild of Michael Faraday (1791-1867). He is, of course, famous for his pioneering work in chemistry and electromagnetism, and for inventing an early version of what was to become the

Bunsen burner, plus the Faraday cage, which blocks electromagnetic fields. He first mentions the idea of the test tube in his 1827

book *Chemical Manipulation*, suggesting that small glass tubes would be useful for testing reactions. They would be a purpose-built replacement for the wine glasses that Faraday and other chemists would

normally reach for when they needed to store or mix small amounts of liquids. In an article for *Chemistry World*, the science writer Philip Ball also points out that Faraday's letters were littered with descriptions and drawings of test tubes: "He sketches one, for example, in a letter to the German-Swiss chemist Christian Friedrich Schönbein in 1854."

Perhaps Faraday picked up on Berzelius' idea, scaled it down so that it would fulfill a specific practical purpose, and in that way made it his own? We'll likely never know, but whatever the truth it's fairly certain that Faraday, Berzelius or anybody else who might have "invented" the test tube could not possibly have imagined the extent to which this simple container has since populated labs all over the world.

Heat resistance

Arguably, the key moment for the test tube was not actually its inception but rather when the German chemist and glass expert Otto Schott (the founder

of the global glass manufacturing corporation Schott AG) created borosilicate glass for the first time in 1893.

Borosilicate glass is made with boric oxide, silica sand and soda ash, and has the vital property of a low thermal expansion coefficient – in other words, it can withstand very high temperatures without stressing its shape, area or volume. This meant that test tubes could be applied directly to a heat source, such as a Bunsen burner, which would raise the temperature of the liquid or solid inside but leave the tube itself intact and unchanged.

While the actual heat resistance will vary depending on the properties of the specific type of borosilicate glass, it can typically withstand temperatures of up to several hundred degrees celsius. It's also resistant to chemicals and has excellent optical clarity, so it quickly became the ideal material for the test tube and other pieces of glassware.

Schott called his glass Duran, but the most well-known trade name for

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borosilicate glass is undoubtedly Pyrex, which was developed by Eugene Sullivan in the US in 1908 after he had encountered borosilicate glass as a student in Germany. In one form or another, Pyrex soon found its way into countless labs and kitchens, where its fracture-proof powers have prevented many a scorching casserole dish from shattering upon impact with cold water.

Even today, most of the glassware to be found within the reach of a chemist – including test tubes, flasks, jugs, bottles and beakers – will have been manufactured from borosilicate glass under one brand name or another.

Symbolic power

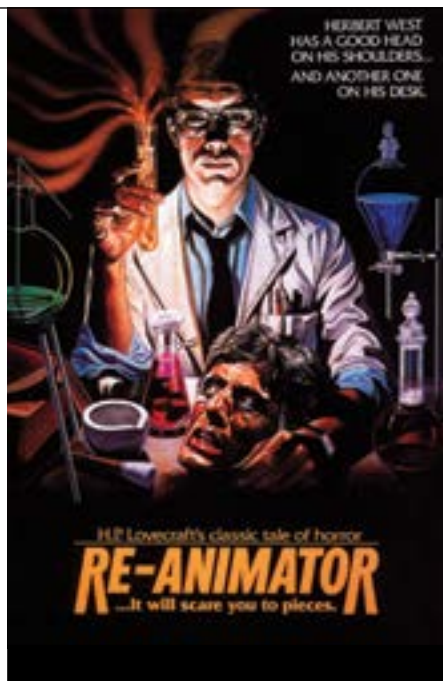
Never mind the history or physical properties of the test tube, what truly matters is that it has come to signify something much bigger. As Andrea Sella, Professor of Chemistry at University College London, says: "The

test tube has this metaphorical meaning that has gone far beyond its physical form. It is the incubator of ideas, the thing to which you turn to carry out experiments. It is extraordinary how that resonance has built up, and I think that comes from the fact that most people encounter test tubes in school. It's one of the fundamental, iconic bits of equipment that nobody escapes using."

This is a telling point. Children encounter the test tube early on in their school careers, usually long before they have the chance to lose interest in science, and at some point will have picked up a test tube, perhaps poured something inside it, held it over the flame of a Bunsen burner, and observed what happened. And even if they never handle another piece of lab equipment, they will always have that experience of using a test tube. For Andrea this "summarises the idea of 'doing science'. And it is part of what has made the test tube a universal symbol for science".

He also argues that the test tube established its strong presence in the lab towards the end of the 19th century, when chemical analysis became a big business: "This is one of the reasons why so many chemists were trained up in serried ranks, and the point when the layout of the lab itself became codified, with rows of benches, the raised sections where the reagents go, the fume hoods in the middle, and the test tube becomes part of that scene."

Now add the chemists' fevered work to that scene, and the full image comes into focus. "We have all sorts of qualitative testing going on," says Andrea, "to identify whether sugar or flour is contaminated with salt or even arsenic, and we have simple precipitation tests where the chemists add a reagent and do an immediate observation. The test



IN POPULAR CULTURE

The test tube is possibly the only piece of lab equipment with a punk band named after it – Peter and the Test Tube Babies. They formed in 1978, the same year the original test-tube baby Louise Brown was born, and are still playing today.

Gothic literature is littered with test tubes and their sinister contents secreted in dark, labs – think *Frankenstein* and *Dr Jekyll and Mr Hyde*. But the best example is probably HP Lovecraft, whose stories ooze horror. Take 1922's *Herbert West-Reanimator*, where the narrator finds himself "pouring something from one test tube to another... when from the pitch-black room we had left there burst the most appalling and daemonic succession of cries that either of us had ever heard". This story was the basis for gory 1985 movie *Re-animator*, which featured more flasks, beakers and test tubes than you could shake an oversized syringe at.

Any Hollywood movie with a vaguely scientific theme is bound to have a test tube pop up. For example, the *Planet of the Apes* reboot, *Jurassic Park* and its endless sequels, and the Marvel films all use test tubes as a sort of shorthand for science gone wrong and occasionally as the containers of a serum that can save the protagonists' lives.

Video games have also adopted the test tube and other lab equipment as props to their stories and game play. For example, the *Resident Evil* games are littered with lab detritus from the Umbrella Corporation's ongoing experiments to create zombies.



tube really lent itself to that sort of work. From that point on, we find that the term 'test tube' slips into common parlance".

Future role

Today, the idea of the test tube as a symbol for science is possibly best encapsulated by the term "test-tube baby". Since the birth in 1978 of Louis Brown, the world's first baby conceived using *in vitro* fertilisation (IVF), this has become the universal term for any and all children who have been born as a result of IVF. Anybody with a passing knowledge of the process will know that the IVF is more likely to happen in a petri dish than an actual test tube, but "pertri-dish baby" has neither the alliterative ring or the simple symbolic power of "test-tube baby" – while the average citizen might struggle to point out a petri dish in a glassware line-up, they'd have no such trouble with the test tube.

For the same reason, most chemical and corrosive substance warnings depict a liquid dripping on to a hand from a test tube and not from another piece of lab equipment. Confronted with such a warning, nobody needs to dwell a moment longer on deciphering its meaning.

But despite its prominent position in the public imagination, could the age of the test tube be coming to an end? Advances in all fields of science mean that traditional equipment is increasingly taking a backseat to more advanced technology. "My work doesn't often call for test tubes," says Andrea Sella, "and in some ways there isn't that much call for test tubes. The spot tests that were universal during the 19th and 20th centuries have largely disappeared. Spectroscopy has taken over so much, though there are areas where the test tube persists, such as chromatography."

Whether this new technology can wield the same power in the popular imagination remains to be seen, so while we wait for that, the self-effacing test tube will just have to continue its duties as the symbol for science that nobody could mistake. 