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In Vivo

Lost and found: The Nooth apparatus

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ABSTRACT

John Mervin Nooth, military surgeon, correspondent of Joseph Priestly and Benjamin Franklin, and noted inventor and scientist has been lost and found several times, through his eponymous invention: the Nooth apparatus. A large glass apparatus superficially resembling a Kipp's gas generator was used originally for carbonating water during the "fizzy water" craze in the eighteenth century, only to be outdone by one Mr. Schweppes. The apparatus would later form part of the first anaesthetic equipment used in surgery, some twenty years after Nooth apparatus ceased to be made. The now part-Nooth apparatus / anaesthetiser would then, too, be forgotten again with the advent of the use of nitrous oxide. The Nooth apparatus in the Dublin City University Science Archive was found in a glassware dump in 2000 by the author, and subsequently cleaned, and restored in 2017. It is currently on display, but it is also used, with slight modification, as a gas generator for the undergraduate teaching of trainee teachers with the lesson: "never throw anything away."

Introduction

What makes science, and its analogue in schools, unique in its special state, if not status, is its setting—the laboratory—and its technology—materials and apparatus (Hofstein & Lunetta, 1982, 2004). In fact, in the author's experience, some children chose to do science under the preconceived notion that they would be doing experiments with complex glassware set-ups. How disappointing! Throughout the last few decades, the emphasis in science has shifted from the artefacts of science (in French, "technique") as a goal, to the scientific skills needed to solve a problem. That equipment might be required to solve the problem, and that very often the problem and its instrumentation had a history, escaped well-meaning promoters of the "skills" perspective. Science artefacts are worthy of investigation, and I include here those used in teaching as well as research. This paper offers a brief cultural history into the Nooth apparatus (manufactured 1775–1842) as an object of the material culture of science.

Holland (1999) outlined three categories of science materials used in teaching:

1) instruments with antecedents in science teaching going back to the eighteenth century;
2) instruments that represent simplified versions of precision instruments; and
3) authentic instruments currently in use in some technical fields.

We can see immediately that the Nooth apparatus belongs in category (1). Recent trends to disconnect science from these two special characteristics—its setting and technology—have not led to any significant improvement in attainment nor uptake in science. Greater attainment and participation in science are viewed as two cornerstones of contemporary government policy, therefore anything that detracts from stated goals requires closer attention. In fact, the loss of eye-catching apparatus has been unfortunate, as this can be an attractor for some to study science, if not its history (see, e.g., Bernhard, 2018). However, as McDonald, Le, Higgins, and Podmore (2005) point out, the technology of science is usually merely referred to, and rarely seriously studied, which is a peculiarity to say the least. However, one pedagogical approach which seeks to remediate this lacuna lies within the history and philosophy of science (HPS) domain, and perhaps cultural studies, i.e., employing the material culture of science.

Heering and Hottecke (2014) presented the "historical-investigative" approach used in science teaching laboratories at the high school and university levels, which is based on a broad perspective of HPS in the science teaching domain in science education. In Ireland, HPS has been an implicit strand running through primary and secondary education. In primary science education, where it does occur, HPS tends to exist as a discussion point in a learning sequence or a demonstration of former knowledge, whether seminal, obsolete, or contributory to present knowledge. In secondary (and university) science, HPS has been evident in

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Fig. 1. Nooth apparatus (Restored), unsigned but bearing the engraved code, 7779. Dublin City University Archive, SPD.001.001. Photograph by the author.

Fig. 2. Nooth's apparatus, late eighteenth to early nineteenth century. Science Museum Group Collection. ©The Board of Trustees of the Science Museum, licensed under CC BY-NC-SA 4.0.

textbooks where we see heavily edited recounts of discoveries from the ancient Greeks to the modern era, many of which would scandalise the past philosophers and scientists if they were around.[1] An undetermined number of teachers have been known to repeat classic experiments in the frame of HPS, but little is known as to their motivation or extent. It is assumed that such teachers are fewer than in previous years since they also tended to be "teacher-manufacturers," that is, teachers who manufactured their own equipment.

As a former secondary science teacher and a "teacher-manufacturer," I was heavily influenced in the late 1970s to mid 1980s by my own teachers in Portora Royal School in Enniskillen, County Fermanagh, Northern Ireland, who were themselves in part influenced by the Nuffield Project,[2] and plainly committed to the use and role of apparatus within practical work in teaching science. Much of the equipment in physics was manufactured by the teacher who had a workshop in which to manufacture and repair equipment, and who used actual low-calibre weapons (e.g., pellet-guns) in experiments! In chemistry, we students were given rudimentary classes in glass bending if not blowing. I present a picture of the death-throes of a former age, with the teacher, on the one hand, operating in a space between the apparatus manufacturer and textbook as commercial interests, and, on the other hand, the government and curriculum writers as the power-holding stakeholders. Nowadays, teachers appear to hold less autonomy by having fewer manual skills, and HPS as a domain in science education, if not science itself, can alert the educator to the dangers of science becoming less practical and investigative, but rather more expositional and informational.

In the Bachelor of Education and Professional Masters in Education courses in Dublin City University (DCU), there are modules in science education where the opportunity exists for historical experiments to be repeated, particularly since DCU possesses the science equipment from the late nineteenth century until the 1960s as an archive—but intriguingly, it also holds one piece from before that time, and before the former constituent colleges existed. This work will provide an examination of the Nooth apparatus, focusing on who Nooth was, how the apparatus came to be—then how it was lost, then found and re-used, then lost again—and, finally, how we in DCU came to find our particular example and use it today.

Context

The Dublin City University is a relatively young university, officially dating from 1989, but owing its origins to its constituent independent parts from 1838 (Glasnevin, later Albert, Agricultural College) through to 1875 (St. Patrick's College of Education).[3] Through the vagaries of time and changes in government and their policies, a collection of scientific apparatus and

[1] Examples at the university level include the classic, Conant (1957), and, more recently, Greenwood (1983).

[2] In the case of biology, begun in 1962 and under the chairpersonship of Professor W. H. Dowdeswell (1914–1996): see Williams (1997).

[3] Albert Agricultural College was named in honour of Prince Albert following his visit in 1853 at the time of the Great (Irish) Industrial Exhibition in Dublin; see Anonymous (1954).

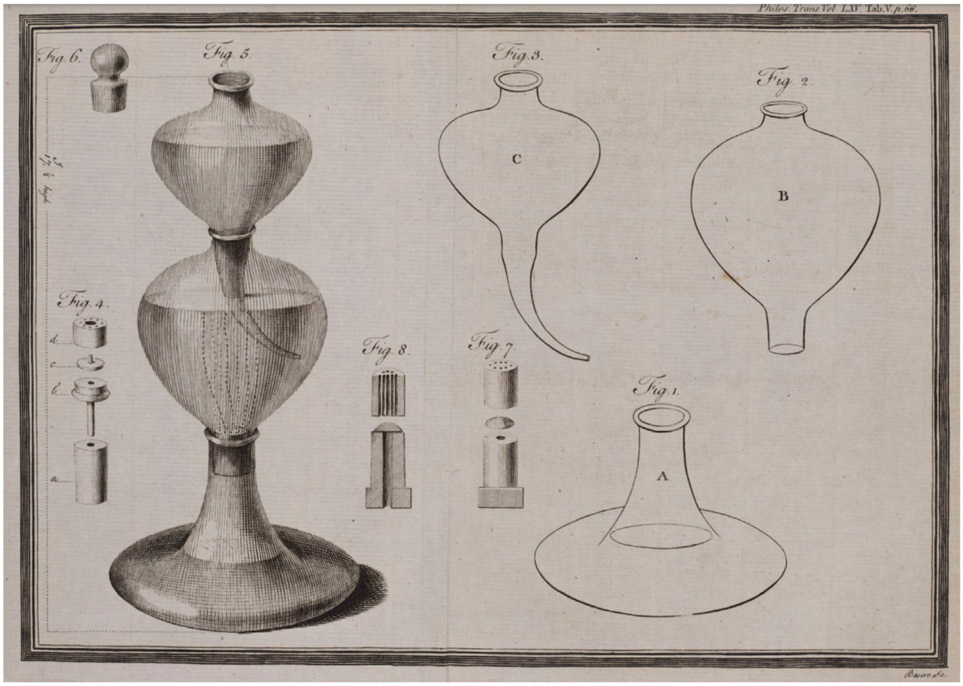

Fig. 3. Nooth's apparatus, showing the original specifications as illustrated in John Mervin Nooth, "The description of an apparatus for impregnating water with fixed air; and of the manner of conducting that process," *Philosophical Transactions of the Royal Society of London* 65 (1775), following p. 66.

materials has been saved from destruction and curated as a dedicated archive of science education as a particular subset of science per se.

The Dublin City University Science Archive consists of two main collections, mostly on display to the university community and to others by appointment. The first is classified with an emphasis on the era 1890–1920. These materials are catalogued in McCloughlin (2018). The second has an emphasis of materials introduced in the 1960s. These materials are catalogued in McCloughlin (2020).

Who was John Mervin Nooth (1737–1828)?

On December 15, 1774 a paper entitled "The Description of an Apparatus for Impregnating Water with Fixed Air" was read at the Royal Society by John Mervin Nooth, MD, FRS (Nooth, 1775). Nooth came to be recognised by his contemporaries as one of the most distinguished medical men of his day, and for a time his name was almost a (rich) household word, but largely because of his modesty and his self-effacing nature he is now almost completely forgotten (Zuck, 1978). Nooth originally designed this apparatus on foot of a suggestion by Joseph Priestley, to prepare water containing carbon dioxide (Roland, 2003); however, the two men fell out due to remarks made by Nooth concerning Priestly's (rather smelly) design (see Figs. 1–3).

The apparatus's bottom vessel contains chips of marble, to which dilute sulphuric acid was added. When combined carbon dioxide was given off and this passed into the middle vessel, which contained water in which some of the carbon dioxide dissolved. A valve arrangement allowed the gas to move upwards but did not allow the water to move downwards. When the water was needed, it was drawn off using the tap in the middle vessel.

The Nooth apparatus would continue to be manufactured, and sold commercially until 1831; however, it is difficult to estimate how many were made and how many are extant, for as we shall see, they were also recycled for a later use. One complete set resides in the Science Museum, London (Fig. 2), and another in the Wellcome Trust Collection (Fig. 4)—however it is listed as an anaesthetic equipment (Wellcome Collection, 2021). One is possibly extant in the Division of the History of Science and Technology Yale Peabody Museum of Natural History.[4] We are extremely fortunate to have a complete set in the DCU Science Archive (Fig. 1). Although it remained in catalogues and texts for some years—illustrated, for example, in Mitchell (1913) text on mineral and aerated waters (Fig. 5)—the apparatus was long out of manufacture by 1913.

The apparatus as a health fad

When considering the medical attitude to the use of carbonated waters in the past, we must try to see them in the light of the rapidly advancing chemical ideas of the times. For example, the physicians of the late eighteenth century did not regard them simply as the pleasant sparkling drinks as we regard them today, but as active chemical remedies with effects readily explainable on a chemical basis. The therapeutic applications can be considered broadly under three headings.

First, and perhaps rather surprisingly for the contemporary reader, they were used in the treatment of what were known as "putrid diseases," which we would now call infections, that were characterised by putrefaction of the tissues. Second, for the treatment of bladder stones, apparently a very common condition until the eighteenth century; and third, for all manner of other complaints such as gout, arthritis and gastro-"intestinal disturbances" for which mineral waters were thought to be effective.

According to (Zuck, 1978), the rationale for the use of carbonated water in infectious conditions related to an idea known as "MacBride's doctrine." This was a theory put forward in 1764 by David MacBride (1726–1778). MacBride published in book form a collection of experimental essays that embraced, in a

[4] Alexi Baker, Collections Manager of the History of Science and Technology at the Yale Peabody Museum (personal communication, September 18, 2020), but confirmed by Yale Peabody Museum staff as currently missing.

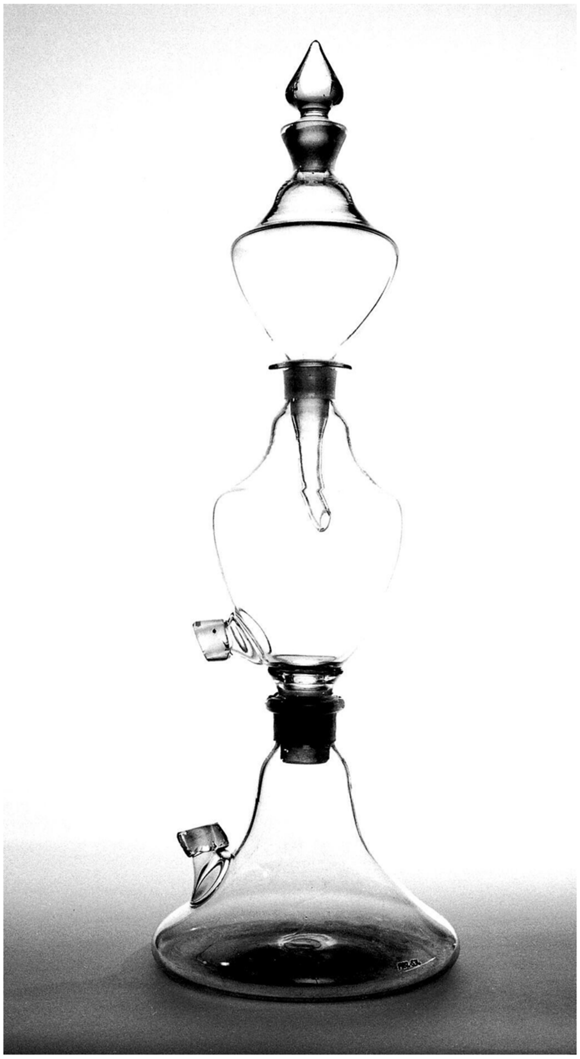

Fig. 4. Nooth's apparatus. Wellcome Collection, licensed under CC BY 4.0.

comprehensive hypothesis, the physiological work of Stephen Hales, to whom he pays frequent tribute (Zuck, 1978). Hales had conducted many experiments on the production of gases from solids by the action of heat or acids, and from his studies produced the theory that the tiny particles that make up all solid substances (regardless whether animal, vegetable or mineral) are held together by the Newtonian attractive forces of the fixed gas or "air" that they contain. The term "fixed" was used in the sense that it is in combination with something else and no longer free to expand and escape, but not the specific "fixed air" of Joseph Black, because Hales did not distinguish between different types of air. If this fixed air is liberated, either by heat or by acid, the solid will crumble to a powder. This observation was the basis of his attempts to dissolve bladder stones.

MacBride, however, when he took up Hales's ideas, applied them in exactly the opposite sense, with the emphasis not on solution but on "conservation," and with a particular application to medicine (Scott, 1970). If dissolution of substances, including vegetable and animal matter, was due to the loss of a gas, which he was able experimentally to identify specifically as Black's "fixed air," or carbon dioxide, then putrefaction could be arrested, or even reversed, by exposure of the diseased tissues to that same gas. In the eighteenth century, a number of diseases were regarded as putrefactive including typhus, so-called "putrid sore throat," various external ulcers, and, because of the rotting gums and leg

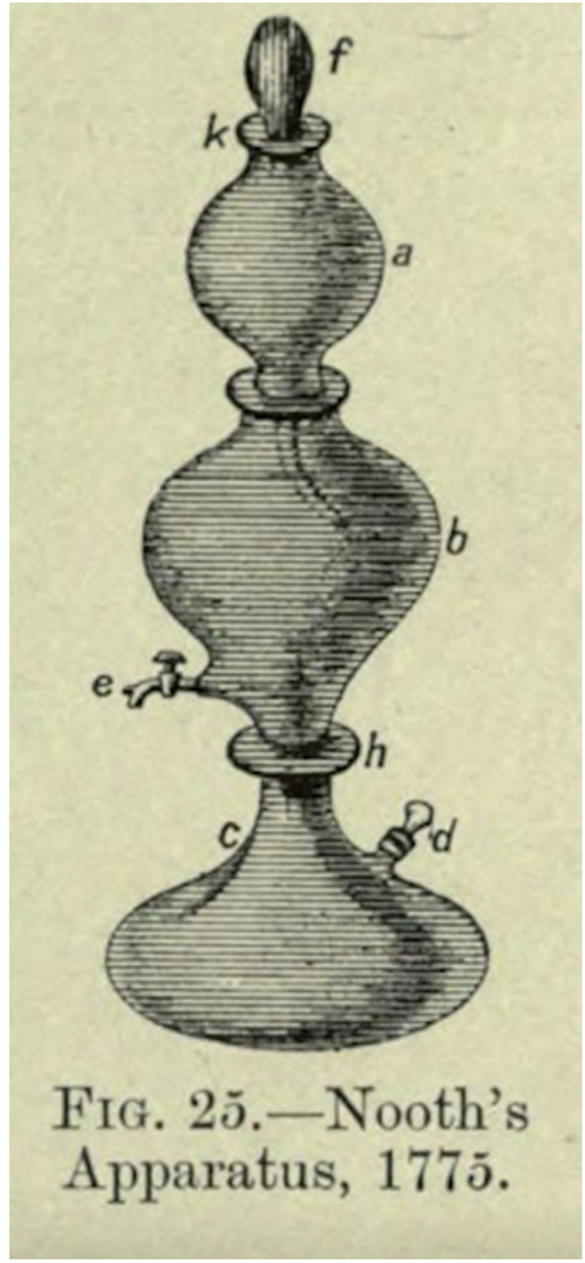

Fig. 5. The Nooth apparatus from C. Ainsworth Mitchell, *Mineral and Aerated Waters* (London: Constable), p. 89.

ulcers, scurvy; and there are accounts of the use of carbonated water in all these conditions. In addition to treating disease, a correspondent of Priestley, Sir William Lee, reported that fruit and meat had been preserved from putrefaction in carbonated water in the middle vessel of a Nooth's apparatus.

The apparatus as a medical device

Thus, Nooth's heyday in the late eighteenth and early nineteenth centuries rested in the success of his apparatus to produce carbonated water—so long as this health fad lasted, and no simpler or more economic technique arose. In both conditions, alas, time ran out on Nooth. The craze for carbonated or "impregnated" water for health benefits dwindled in the nineteenth century, as it became more important in everyday soft drink production. In particular, the well-known drinks manufacturer

Fig. 6. Squire's inhaler, nineteenth century. Surgeons' Hall Museums Collections. Reproduced by permission of Surgeons' Hall Museums.

Schweppe was able to ramp up production to an industrial scale, which alleviated the need to purchase a relatively expensive apparatus and its constituent ingredient (dilute sulphuric acid) (Simmons, 1983). The apparatus may have lingered on the shelves of scientific suppliers or pharmacies for a number of years, and its last known location "in stock" was by Cripps (1927), who noted that it was in a photograph of the premises of Allen & Hanburys of Plough Court, London "some time before 1868" (p. 100).

However, it so happened that in 1846 Robert Liston, senior surgeon at University College Hospital, London, visited Peter Squire, Chemist to the Queen; they contrived to reproduce the *etheriser* as reported in a letter from Boston in the United States. It was something of a "rush-job" since the former needed it for a pending leg amputation. Liston hobbled together a contrivance from a Nooth's apparatus—into which he placed sponges to absorb the ether and assist in vaporisation—and he added a glass funnel, a valve to control the direction of airflow, a breathing tube, a ferrule for regulating the admixture of air, a mouthpiece and a nose clip, and an inhaler (Fig. 6). The resulting apparatus was then used by William Squire (Peter Squire's nephew, and medical student) to administer the first general anaesthetic (Zuck, 1978).

Conclusion

When a glassware dump was investigated in a locked, dark plant room in 2000, no one could imagine the riches it would produce, not merely in artefacts such as the Nooth apparatus, but in surfacing the alternative thinking and conceptions surrounding them from centuries past. Such artefacts are not merely relics of a former era, nor merely quaint to look at, particularly given the modern person's view of digital technology as *de rigeur* today. Rather, in the HPS domain, they can be used to teach science AND history of science, the formation of ideas by reenacting how they were used, in simulations, or by replicating the experiments authentically. The Nooth apparatus is a physical link to the world of Priestly, Franklin, Black, and Hales, as well as the *oeuvre* of the many unknown glassblowers who were rarely, if ever, recognized, and yet their work crafted objects with beauty and things of curiosity—as perhaps befits museums today. That time of speculation concerning gases, their structure, and their behaviour had moved on from the time of Jan Baptist van Helmont, but a great deal of counter-theories still circulated, including the healing powers of carbonated waters and how they worked. The Nooth apparatus is somewhat unique in the study of the material culture of science in that it was later reincarnated as part of an anaesthetic apparatus. Thus, the Nooth apparatus must have had a status that outlasted its initial use—only to be reenlisted anew.

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References

Anonymous (1954). Albert Agricultural College. *University Review*, *1*(1), 69–71.
Bernhard, J. (2018). What matters for students' learning in the laboratory. Do not neglect the role of experimental equipment!. *Instructional Science*, *46*, 819–846.
Conant, J. B. (1957). *Harvard case histories in experimental science*, *1-2*Cambridge, MA: Harvard University Press.
Cripps, E. C. (1927). *Plough court: The story of a notable pharmacy*. London: Allen & Unwin.
Greenwood, M. S. (1983). *Physics, the excitement of discovery*. Belmont, CA: Wadsworth Publishing.
Heering, P., & Hottecke, D. (2014). Historical-investigative approaches in science teaching. In M. R. Matthews (Ed.), *International handbook of research in history, philosophy and science teaching* (pp. 1473–1502). Dordrecht: Springer Verlag.
Hofstein, A., & Lunetta, V. N. (1982). The role of the laboratory in science teaching: Neglected aspects of research. *Review of Educational Research*, *52*(2), 201–217.
Hofstein, A., & Lunetta, V. N. (2004). The laboratory in science education: Foundations for the 21st century. *Science Education*, *88*(1), 28–54.
Holland, J. (1999). Historic scientific instruments and the teaching of science: A guide to resources. In M. R. Matthews (Ed.), *Proceedings of the history, philosophy and New South Wales science teaching second annual Conference* (pp. 121–129). Sydney: University of New South Wales.
McCloughlin, T. J. J. (2018). *Catalogue of the DCU science archive*. Volume 1: Pre-1800s to 1960. Dublin: Graphikon..
McCloughlin, T. J. J. (2020). *Catalogue of the DCU science archive*. Volume 2: 1960 to 2010. Dublin: Graphikon..
McDonald, G., Le, H., Higgins, J., & Podmore, V. (2005). Artifacts, tools, and classrooms. *Mind Culture and Activity*, *12*(2), 113–127.
Mitchell, C. A. (1913). *Mineral and aerated water*. London: Constable.
Nooth, J. M. (1775). The description of an apparatus for impregnating water with fixed air; and of the manner of conducting that process. *Philosophical Transactions of the Royal Society of London*, *65*, 59–66. http://dx.doi.org/10.1098/rstl.1775.0005.
Roland, C. G. (2003). *"NOOTH, JOHN MERVIN." Dictionary of Canadian biography vol. 6*University of Toronto/Université Laval. (Accessed October 21, 2020) http://www.biographi.ca/en/bio/nooth_john_mervin_6E.html.
Scott, E. L. (1970). The Macbridean doctrine of air. *Ambix*, *17*, 43.
Simmons, D. A. (1983). *Schweppes, the first 200 years*. London: Springwood Books.
Wellcome Collection. (n.d.). *Nooth's apparatus*, https://wellcomecollection.org/works/fd5rcn6q (accessed October 21, 2020).
Williams, G. (1997). Professor W. H. Dowdeswell 1914–1996. *Journal of Biological Education*, *31*(2), 86.
Zuck, D. (1978). Dr. Nooth and his apparatus: The role of carbon dioxide in medicine in the late eighteenth century. *British Journal of Anaesthesia*, *50*, 393–405.