Article:
Murphy, P orcid.org/0000-0001-9660-7840 and Kabrna, P (Cover date: January/February 2023) It is not boring in Barnoldswick! The case of the Barnoldswick water supply borehole in northern England, and what should, could, and has been done to celebrate the borehole core. Geology Today, 39 (1). pp. 27-30. ISSN 0266-6979

https://doi.org/10.1111/gto.12418

It is not Boring in Barnoldswick!

The case of the Barnoldswick water supply borehole and what should, could and has been done to celebrate the borehole core.

Phil Murphy and Paul Kabrna

The importance of borehole cores and the geological insights which they provide are often underappreciated. Here the problems of seeking a water supply for an industrial town in Northern England has resulted in a very rare opportunity to view a core in the public domain. As we need to raise the profile of the geosciences and ensure a public understanding of geologies importance in underpinning our society we should seek other opportunities to highlight history and importance of borehole drilling and the cores recovered.

Barnoldswick is a small market town in the eastern part in the county of Lancashire, northern England with a population of approximately 11,000. The town is surrounded by the Pennine hills and sits astride the national watershed between the Ribble (draining westward) and Aire (draining eastward) valleys. Barnoldswick is the highest town on the cross country Leeds and Liverpool Canal. It was historically in Yorkshire until becoming part of the Pendle district of Lancashire following local government reorganisations in 1974. For hundreds of years it remained a small village. However the arrival of the Leeds and Liverpool Canal followed by the (now closed) railway, encouraged the development of an existing woollen industry and helped it to develop into a major cotton town. Prior to 1895 there was no adequate water supply – people relied on town wells or bought water from local carriers. Some houses had rain tanks in the cellar which stored water off the roof and a pump in the kitchen. A reliable source was need but the underlying geology was not conducive to groundwater abstraction.

The town is sited on rocks of the Carboniferous (Mississippian) Chatburn Limestone Formation. These are exposed in the centre of the North east - South west oriented Thornton anticline which forms part of the Ribblesdale Fold Belt. Younger strata of the Hodder Mudstone Formation are exposed on either side of the anticlinal core. Northern industrial towns at the time often relied on borehole abstraction form the sandstones of the younger Namurian age (Mississippian/Pennsylvanian) Millstone Grit Group, the nearest outcrop of which, the Pendle Grit Member, forms the high ground of Weets Hill to the south east of the town. Land was purchased at Whitemoor on the flanks of Weets Hill in 1890 and work began (Fig.1). At first a 10 foot diameter well was dig to a depth of 105 feet. The yield from this well proved disappointing so in 1898 a 10 inch diameter borehole was drilled from the base of the well to a depth of 504 feet. Pumping tests proved a better yield than from the well even though there was a drought ongoing at the time.

The waterworks were official opened in 1892 but demand soon outstripped supply and a further borehole was commissioned.

The new borehole was drilled to a depth of 922 feet with a diameter of 18 inches at the top and a diameter of 14 inches at the base. The borehole was cased to a depth of 396ft. The new deeper borehole was only 20 m to the west of the original borehole site and its yield proved disappointing. The additional deeper strata penetrated proved to be mainly mudrocks, probably the Upper Bowland Shale Formation, and what little sandstone was cut had low permeability. The gritstone strata in the higher parts of the well also proved to be poorly fissured. That a further borehole was commissioned so close to the original site, which had already proved unable to supply the town's requirements, is rather surprising. An investigation was undertaken into the geological controls on water supply by Professor Percy Kendall of Leeds University who was a leading figure in the development of geology in the north of England. Work on the detailed properties of the strata was undertaken by Albert Gilligan, a renowned expert on the Millstone Grit. The results of Professor Kendall's investigations were that little further resource would be gained from further engineering works at the site due to unfavourable geological conditions. These conclusions were presented to parliament in support of a bill seeking approval to construct a surface water reservoir to supplement the borehole supplies. This was a major undertaking requiring an act of parliament to enable the work. The Barnoldswick Urban District Council water bill was debated Thursday 4th February 1915 in the House of Commons. A surface water reservoir was built at Elslack along with the necessary piped infrastructure. This project had its own share of problems which included leaking when first filled and cost overruns. It was not fully opened until 1932

Borehole Drilling

The development of drilling technology both greatly enhanced our ability to exploit geological resources and revolutionised our understanding of the sub-surface. Drilling boreholes to exploit brine and natural gas was being undertaken in the Sichuan province of China from the 3rd century AD where boreholes up to 140 m were being drilled using iron bits and bamboo poles. A complex industry developed utilising the incredible strength and resilience of bamboo enabling depths of up to 400m being reached by the 1700s and the first 1000m deep well being drilled 1835. At this time in Euro-North American western cultures, while borehole drilling was an established industry for water and other resources, the maximum depths achieved were around 500m. By the 1850s rotary drilling was becoming more common in North America and Europe for oil, gas and water. Prior to this boreholes were drilled using either percussive techniques or variations on auger designs for shallower depths. John Vivian was given the first U.S. patent for a diamond drill in 1876. This development enabled the recovery of an intact core so was very valuable for prospectors and their successors – geologists.

The recovery of a drill core is still the best way to directly sample the rock units being penetrated. Today a whole suite of geophysical measurement tools can

be used to measure properties of the borehole walls but recovering a drill core remains the only way to get direct measurements of a range of rock properties. While in modern geoscience other techniques have gone some way to reducing the value, and have certainly reduced the frequency, of cutting core the study of recovered and preserved cores remains pivotal to modern geological and paleoclimate studies. In geoscience education core samples are still relatively rarely used in practical or field based education. In geoscience undergraduate education core samples are still relatively rarely studied which is in contradiction to professional practice where the vast majority of samples they will work on once they have graduated will be recovered cores. In the commercial world geological samples are nearly always cylindrical and of limited volume, not the impressive cliff or foreshore exposures studied while undertaking fieldwork.

While the importance of drill cores is appreciated across the scientific community, and their industry and governmental sponsors, there is little understanding of this amongst the general public. This is perhaps something the geoscience community needs to address. There are significant costs associated with the preservation of these vital sources of information and as public budgets come under increased scrutiny ensuring people are aware of how valuable cores are may help justify the costs involved. The example described here is of a borehole which was important in the historical development of a northern industrial town and the preservation of its core on the local recreation ground is the only known example of the display of a core in the public domain. Its continued existence provides an opportunity to bring the importance of core samples to public attention.

The Barnoldswick Core

While the Barnoldswick water borehole proved less than fully successful as a water supply part of the recovered core has been preserved in Letcliffe Country Park, a recreation area established by Barnoldswick Urban District Council in 1902. The core is in pieces which are scattered around the formalised garden section of the park. The longest section forms a 7 m long path edge (Fig.2)and all are of 16 ½ inch diameter so consistent with an 18 inch borehole diameter. Other pieces are scattered through the park forming gateway edges and wall tops amongst other things. The various segments are not in any order or consistent orientation but four segments have depths carved into them – 630, 669, 702 and 780 feet (Fig.3). The orientation of the carvings show section are not in order and at least one piece is inverted. The outer surface of the core shows a concentrically grooved pattern – this is a results of the use of the ‘shot drilling’ technique whereby hardened steel shot is used as a cutting medium. All the four recorded depths are assigned to units named ‘Grit’ or ‘Grit with shale joints’ on the borehole log. A piece is incorporated into the sensory garden which is a recent (2018) addition to the Barnoldswick Forces Memorial garden on Kelbrook Road (Fig.4). The presence of the core in Letcliffe Country Park is not mentioned on the on-site noticeboards giving a history of the park and no explanatory material has been located. This is a real a shame as an

opportunity to bring the importance of geological cores to the public's attention is being missed.

The presence of the core in Letcliffe Country Park is the only example so far found of a core being on public display. The lack of a reliable water supply was a big issue for Barnoldswick so maybe the core was considered too valuable to simply dispose of at the time. There are various museums and memorials to boreholes such as the Dukes Wood Oil Museum in Nottinghamshire, and the site of the first successful oil well in the UK at Hardstoft in Derbyshire which is now a garden centre. There is a memorial statue named the Oil Patch Warrior to the American drillers who ran a secret oil drilling campaign in the Nottinghamshire oil fields during the Second World War at Rufford Abbey Country Park near Newark but no other example of core being on public display is known. Looking further afield the geoscience and environmental education centre in Windeschesenschenbach, Bavaria, has the core samples from the German Continental Deep Drilling project for educational use. This is widely known as the KTB borehole which was drilled to a depth of 9,101 m between 1987 and 1995 as a cold war rival to the Kola superdeep borehole, still the world's deepest borehole, drilled by the Soviet Union.

Considering the importance of borehole cores to our understanding of the sub-surface and the need to raise the profile of the geosciences in underpinning our society perhaps it is time we did more than just preserve them in a core store. We need to come up with innovative ways of bringing their existence and both scientific and economic importance to public attention.

Further Reading.

Barnoldswick history and geology:

Carthy D and Lancaster M 1990. *West Craven Patchwork*. Privately published, Barnoldswick.

Earp, J.R., Magraw, D., Poole, E.G., Land, D.H. & Whiteman, A.J., 1961. The geology of the country around Clitheroe and Nelson. *Memoirs of the Geological Survey of Great Britain*, sheet 68 (England and Wales).

Graham S C 1988. *Barnoldswick the story of a Pennine town*. Privately published, Barnoldswick.

Professors Kendall and Versey:

https://www.ypsyork.org/resources/yorkshire-scientists-and-innovators/kendall/

Versey H C 1937. In memoriam: Percy Fry Kendall. *Proceedings of the Yorkshire Geological Society* 23(4) 196-198

Gilligan A 1920. The petrography of the Millstone Grit of Yorkshire. *Quarterly Journal of the Geological Society of London* **75**, 251 - 94.

Hudson R G S 1939. In memoriam: Albert Gilligan. *Proceedings of the Yorkshire Geological Society* 24(3) 177-179

Cores and coring:

Zigong Salt History Museum, Sichuan (travelchinaguide.com)

https://csegrecorder.com/articles/view/ancient-chinese-drilling

https://www.thedriller.com/drilling-history

https://geoscientist.online/sections/unearthed/have-we-passed-peak-core/

https://www.bgs.ac.uk/geological-data/national-geological-repository/

https://www.iodp.org/resources/core-repositories

Dukes Wood (dukeswoodoilmuseum.com)

https://www.oilwellnursery.co.uk/

https://www.atlasobscura.com/places/the-oil-patch-warrior

https://www.geozentrum-ktb.de/

Figure Captions

Fig.1 The opening commemoration plaque on the external wall of the Barnoldswick Water Works. The buildings have now been converted into private residences.

Fig.2 The core being utilised as a path edge in Letcliffe Country Park

Fig.3 One of the core depth carvings still visible. The numbers are 3 cm high.

Fig.4 A section of core incorporated into the Barnoldssick Sensory Garden along with other geological materials from the local area.