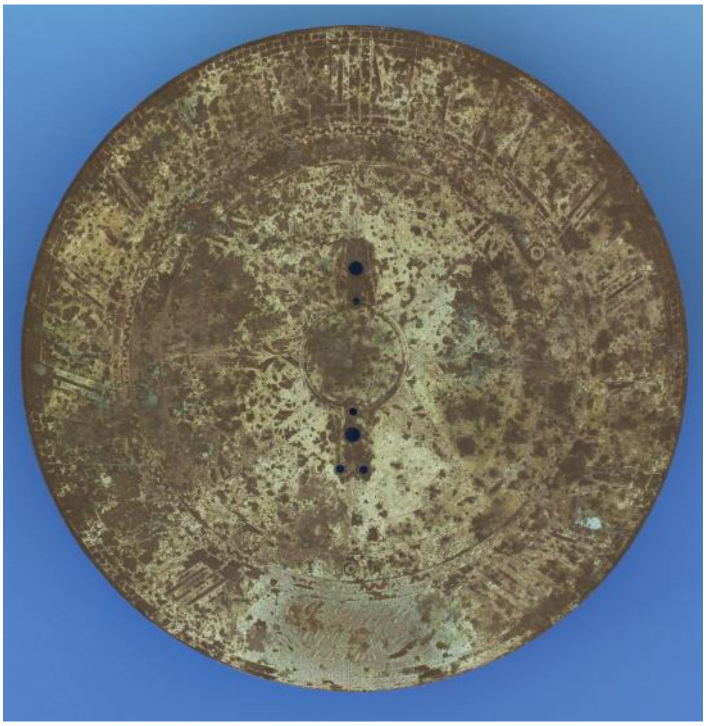
SUNDIALS BY THE DAVIS DYNASTY

JOHN DAVIS

'John Davis' is a fairly common name in Britain so it is not surprising that there have been a number of mathematical instrument makers with that name. Gloria Clifton's directory[1] of instrument makers over the period 1550 to 1851 lists thirteen John Davises though some of these may be duplicates: there are also numerous other Davises, some of whom may be related. Perhaps the most famous is the illustrious navigator and explorer Captain John Davis (c. 1550–1605), the inventor of the backstaff sometimes known as the Davis quadrant, though the clockmaker John Davis of Windsor (w. 1697–1709) who was apprenticed to Daniel Quare is also well-known. Naturally, I take an interest in any of my namesakes who made sundials!

The company Davis of Derby[2] and its predecessors and successors[3] (it still exists today) can trace its origins to Gabriel Davis (d. 1851) who, together with his two brothers, was a Jewish immigrant from Bavaria (where his grandfather was a rabbi in Pumbersfelton) to Britain.[4] Presumably they originally had an unpronounceable surname and adopted Davis as suiting their new home. The Davis clan set up instrument making businesses in several provincial centres: for example, David Davis became an optician in Glasgow and a branch in Dublin is also possible. Gabriel settled in the Mount Preston district of Leeds (now Mount Preston Street, on the Leeds University campus), as an optician and maker of surveying and mining equipment, where he eventually became the first leader of the local Jewish community, and it was he who signed the dial seen in Fig. 1. He married Ann Aaron from a Birmingham family and they had six children though most of them died young. His eldest, another David Davis, died in 1842, possibly of cholera, as did his eldest daughter Emma in the same year, with another son Henry having already died in 1830 as a baby. Another daughter, Sophie, survived to marry a Mark Marcus from Dublin but died a year later, in 1848. Only Abigail survived, marrying a James Cohan Pirani (who managed the Leeds branch of the Jewish-owned Leeds outfitters of Samuel Hyam & Co.) later emigrating to Australia where she lived into old age.[5]

With the loss of his sons, Gabriel took on his nephew Edward to work for him and who eventually become his partner and successor to the business when Gabriel died in 1851, being buried in the Gildersome cemetery (which he had himself helped to set up) alongside his son David.[6]



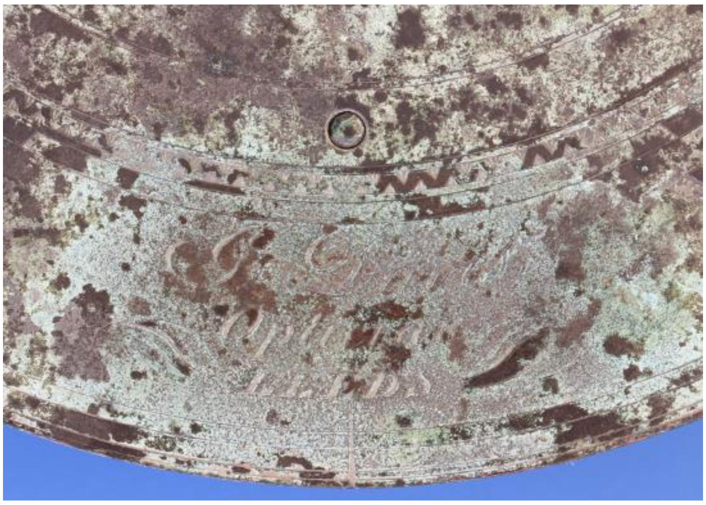


Fig. 1. Top: A horizontal dial plate by Gabriel Davis; bottom: the signature – note also the zig-zag border and the end of the pedestal-fixing screw.

Another of Gabriel Davis's nephews, John (1810–73, Fig. 2) brother of Edward, was born in Thame, Oxfordshire, and was apprenticed to Jacob Abrahams, from another Jewish family.[7] Abrahams styled himself Mathematical Instrument Maker to the Duke of Wellington and the Duke of Gloucester.[8] His main premises were at 7 Bartlett Street in Bath but he also had a shop in Cheltenham, which is where John Davis undertook his

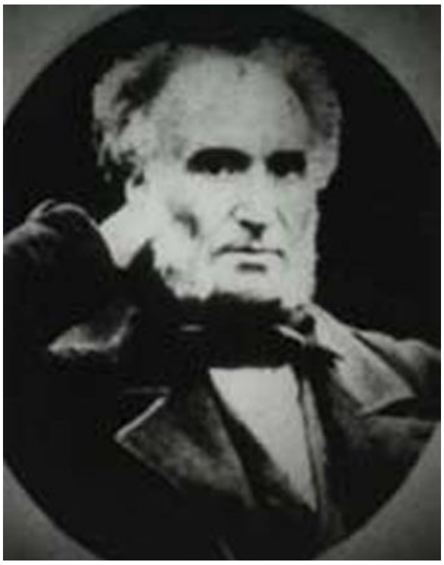


Fig. 2. Portrait of John Davis (1810–73) of Derby. Courtesy D. Johnson, note 3.

Fig. 4. A painting of 1868 by A.J. Keene, now held by the Derby Art Galley, of the All Saints Works on the corner of Amen Alley and Full Street to which Davis later moved (now demolished).

Fig. 3. Above: A recent photograph of John Davis's early house, with workshops behind, originally Meynell House and now no. 22 Irongate in the old part of Derby near the cathedral. Below: The space behind the Irongate buildings (22 on the left and 24A on the right) with a view of the cathedral and a jumble of buildings where John Davis had his workshops, probably the ones earlier occupied by John Whitehurst.
Photos: Irene Brightmer.

apprenticeship. After gaining his freedom in 1830, John went to work for his uncle Gabriel but although based in Leeds he regularly moved around the Midlands taking orders and setting up local shops in places such as Liverpool, Derby and Cheltenham, using the expanding railway services to move around every few months. By 1833 he had set up business on his own account but with a range of instruments very similar to those of Gabriel. By 1843 he decided to settle down in Derby with his wife and their two young sons. He bought the freehold of the 16th-century Meynell town house (Fig. 3) which is now the oldest surviving premises in Iron Gate, Derby, and where there was a workshop at the back to produce his products for the two decades before moving to the nearby All Saints Works (Fig. 4). Meynell House had previously been associated with John Whitehurst, a famous clockmaker and instrument maker, who had his workshops there and who has a blue plaque on the next-door building, no. 24.[9] There has previously been some confusion amongst several sources[10] as to exactly which numbers in Irongate Whitehurst and Davis occupied. A commercial directory of 1850 by S. Glover lists Davis as a 'Burgess and Freeholder' of Irongate.

John Davis traded as J. Davis, Derby, and a number of variants before it took on the name of 'Davis Derby' and, later, J Davis & Son. A dial with the Davis Derby signature is shown in Fig. 5.

With the expansion of the coal-mining business, John Davis was able to develop a line of mathematical instruments for the industry, for example anemometers, mining ('Hedley') dials and safety lamps, which quickly became standards, allowing the business to prosper. When he died in 1873, his son Henry was appointed to run the business which continued to expand, moving into new premises in the 1870s at All Saints Works, Amen Alley, Derby. Although the product line at this time included

Fig. 5. A small dial signed "Davis Derby".

items such as turret clocks and weather vanes, it was mining equipment and, increasingly, electrical instrumentation and telemetry which gave the company a strong footing into the 20th century. Although a catalogue from 1877 exists, disappointingly, it does not show any sundials – clearly, they were not a significant item by this time.

Dials by Gabriel and John Davis

The two dials illustrated here are probably less than 50 years apart in manufacture and thus present an interesting comparison. They are quite different in size and also show that technology in the early 19th century was progressing rapidly. Whilst it is possible that the Gabriel Davis dial was actually engraved by Gabriel, it is highly probable that the 'Davis Derby' one was engraved by an employee of John Davis.

The Gabriel Davis dial plate (Fig. 1 – the gnomon is unfortunately lost) is 228 mm in diameter (9″ nominal), around an eighth of an inch thick and is the earlier of the two dials, probably from around 1820. The signature is "*G. Davis Optician LEEDS*". It is nicely engraved and the engraved pattern is absent where it would have been hidden underneath the gnomon, which would probably have had a hemispherical supporter or foot. The two holes which define the origins of delineation are, at about 2 mm diameter, rather larger than average. The gnomon would have been attached by handmade screws rather than tenons. There are four holes: two for the screws and another smaller pair which would have been for tightly-fitting alignment pins.

The engraving features Roman numerals which are outward-facing – standard by this time for London-made dials – delineation to 5-minute intervals with diamond (rather than the earlier fleur-de-lys) half-hour marks, with a narrow zig-zag border inside the chapter ring. The infill on the broad strokes of the numerals has been achieved by perpendicular strokes of the burin and the narrow strokes are elegantly tapered. Generally, a simplification of the engraving from the more florid 18th-century style is evident.

The dial plate still retains a set of three specially-made fixings of a 'mushroom' shape for attaching the dial to a pedestal (Fig. 6). These are screwed into the plate and individually marked with one, two or no punched dots to ensure they go in the matching holes.

The later (c. 1850) dial by John Davis (Fig. 5) is simply signed "Davis Derby" and is just 128 mm (5″ nominal) in diameter. It is unclear whether it was intended for an outdoor pedestal or for a windowsill. The engraving is simple but very sharp and neat. There are two zig-zag borders but the 'feathered' infill of the compass points on the Gabriel Davis dial has been further simplified to a set of parallel lines. The gnomon is attached with a pair of almost modern-looking screws. The numerals remain outward-facing and have their narrow strokes neatly flared into the

Fig. 6. Back of the Gabriel Davis dial, showing the three 'mushroom' fixings with tapered shafts. Inset: the 'one-dot' pedestal fixing. The marks in the patina show that at one time the dial was mounted on a square capital. The shiny spot is the area cleaned for XRF.

Dial Maker	Location	Cu	Zn	Sn	Pb	Fe	As	Others, comments
Gabriel Davis	Back, cleaned	78.9	17.7	1.0	1.8	0.4	0.1	Bi 0.12%
	Back, uncleaned	83.2	14.1	tr	2.4	0.1	nd	
	Front, uncleaned	78.4	4.6	2.7	9.5	2.1	1.1	Bi 0.45%; dark patina
John Davis	Back, cleaned	79.3	18.2	nd	2.4	0.1	nd	
	Back, uncleaned	79.7	17.3	nd	3.0	0.1	nd	
	Front, uncleaned	78.5	17.6	nd	3.2	0.6	nd	
	Gnomon, East	81.5	13.1	1.0	3.8	0.4	0.1	Bi 0.17%
	Gnomon, West	81.5	13.2	1.0	3.5	0.5	0.2	Bi 0.19%

Table 1. Alloy compositions of the components of the two dials (in wt.%, rounded to one place of decimals) as measured by XRF by the author using an Olympus Innov-X Alpha 2000 analyser with a 60-second sampling time and used in its 'Analytical' mode. The instrument was cross-calibrated against a set of CHARM (Cultural Heritage Alloy Reference Materials) test specimens with a representative range of trace elements in a copper-alloy matrix.[13] nd = not detected; tr = trace.

serifs, and the delineation is still to 5-minute intervals, with quarter-hour divisions on an inner ring.

Metallurgy

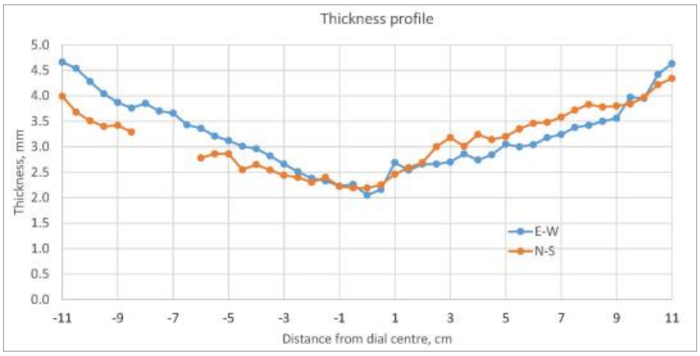
The metallurgy of the two dials was studied by X-ray fluorescence (XRF) and also by the simple but revealing method of profiling the thickness of the plates across their diameters.

The alloy compositions are shown in Table 1. The Gabriel Davis dial-plate can be seen to be a leaded gunmetal (in modern terms) with a medium level of zinc, Zn, and a quite high level of lead, Pb. The two analyses of the back of the dial (cleaned and uncleaned) show the effect of the thin patination and can be compared to the reading from the front, which has been exposed to weathering and developed a much thicker, mottled patina. The lead concentration differs between the back and the front of the plate in a similar manner to that seen on the much thicker 'Hughes of Bryngola' (1775) dial described in an earlier article.[11] Thus it is fairly certain that the plate is a casting and the lead in the molten alloy has been swept to the last surface to solidify.

The Davis Derby dial plate, in contrast, is a simple leaded brass, with no tin, Sn, detected. Also, the level of the iron, Fe, impurities has been reduced, indicating a more modern smelting process. The general impression is that the material is from a more developed source. The gnomon of this dial, though, has a composition much more similar to the Gabriel Davis plate, even down to the trace amounts of arsenic, As, and bismuth, Bi. There is a good probability that the gnomon came from the same foundry that Gabriel had used.

The thicknesses of the two dial plates were measured at half-centimetre intervals across their diameters, nominally in the N–S and E–W directions, using a mechanical digital thickness gauge with a 0.01 mm resolution. The anvil of the gauge which was in contact with the dial face was fitted with a 2 mm diameter disc of hard plastic, spanning the narrow engraved lines and also protecting the dial face from scratches.

The thickness profiles of the two dials are shown in Fig. 7. The Gabriel Davis dial shows dramatic variations – it is over twice as thick at the rim as in the centre, although this was not readily apparent when handling it. Although the profile is circularly-symmetric, there are no marks to suggest that the disc has been turned on a lathe; rather, it appears that it is the result of the casting process, as is supported by the lead concentration profile. The working front face of the plate is completely flat with the thickness profile resulting from a deep dishing on the back. With this



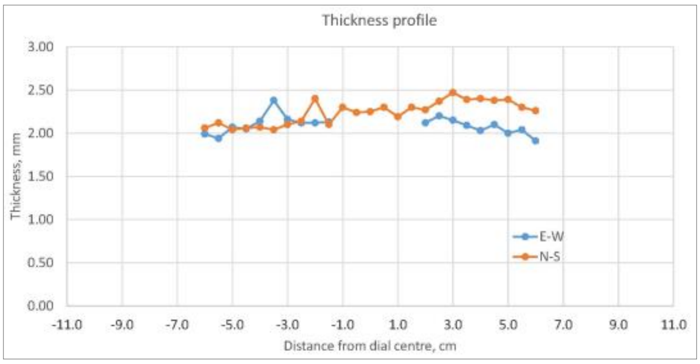


Fig. 7. Thickness profiles of the two dials, measured by a mechanical gauge. The gaps in the profiles are due to interference from the gnomon and from the pedestal fixings. Upper: Gabriel Davis, lower: John Davis.

feature, it is important that the dial is not screwed down tightly to the flat surface of a pedestal or distortion will occur.

The thickness profile of the Davis Derby dial indicates not just that the material is much thinner but also that it is far more uniform. Indeed, other than a slight thinning near the rim – possibly wear – it is nearly as good as modern stock brass and better than would be expected for hammered or 'battery' brass. The likely explanation is that this material has been produced by a rolling mill rather than a battery one. We know that the brass works in the Bath–Bristol region did begin to employ rolling mills in 1840, still powered by watermills,[12] although they were beginning to lose the competition with the brass suppliers of Birmingham who took over as the biggest brass works in the country. At present, the source of materials used by Davis Derby is unknown but it is to be hoped that further studies may reveal this and it may also help to give a more accurate dating of the dial.

ACKOWLEDGEMENTS

I am very grateful to Irene Brightmer for the photographs of modern Derby and for many stimulating communications.

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2. Davis Derby Ltd is at Chequers Lane, Derby DE21 6AW; *www.davisderby.co.uk*. They feature in A.D. Morrison-Low: *Making Scientific Instruments in the Industrial Revolution*, Ashgate, Aldershot (2007), p. 126 and elsewhere.
3. Dave Johnson: The Davis Derby Story, 1779–2009, available online at *www.trucklog.com/uploads/files/ThehistoryofDavisDerby.pdf*
4. Murray Freedman: 'Deciphering an old gravestone in Leeds', *Shemot* (J. Jewish Genealogical Soc. of G.B), 2(4), 7–8 (October 1994). Online at *www.jewishgen.org/jcr-uk/Community/Leeds/articles/Deciphering_Old_Gravestone.htm*
5. Details and a photograph of Abigail are at *http://artsearch.nga.gov.au/Detail.cfm?IRN=198262*
6. Freedman (note 4).
7. Maxwell Craven: *John Whitehurst: Innovator, scientist, geologist and clockmaker,* Fonthill (2015) records (pp. 205 & 254) that a John Davis, with brothers David and William, attended the preparatory school from June 1798 to June 1799, run by liberal schoolmaster Matthew Spencer in Derby from. Although Craven states (p. 205) that this was the founder of the Derby scientific instrument manufacturing firm, the date is too early and this John Davis was actually an uncle of the scientific instrument maker (Craven: personal communication). The school was supported by John Whitehurst I and Erasmus Darwin, members of the Lunar Society, and indicates the tradition of scientific development in Derby.
8. For information on Abrahams, including a whole-body silhouette, see Cecil Roth: 'The rise of provincial Jewry', The Susser Archive, Jewish Communities & Records UK (1950), online at *www.jewishgen.org/jcr-uk/susser/provincialjewry/bathcamb.htm*. Several copies of his tradecard exist, e.g. at *www.jewishmuseum.org.uk/?unique_name=search-our-collections-new&adlibid=6319*.
9. I. Brightmer: 'Blue Plaques in Derby', *BSS Bull*., Reader's Letter, 26(ii), 15 (June 2014).
10. Craven (note 7) pp. 28–29 states that John Whitehurst I originally lived in 24 Irongate, next door to Meynell House (no. 22) behind which were his workshops.
11. J. Davis: 'A Mystery Welsh Horizontal Dial', *BSS Bull.*, 28(ii), pp. 2–6 (June 2016).
12. Joan Day and Tony Coverdale: 'The Avon Valley Copper and Brass Industry', *J. Bristol Industrial Archaeology Society*, 46 (2013). Obtainable online at *www.brassmill.com/saltford_brass_mill_002.htm*
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