The Long Route to the Invention of the Telescope

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Through his insightful and breathtakingly meticulous analysis in the first seven chapters, Willach dramatically reconstructs the history of optical craft in the centuries preceding the invention of the telescope. Simply put, by casting the development of optics in terms of the technological and craft-based elements in making glass objects, he has produced without any doubt the most important new writing on the subject in decades. However, in chapters eight to eleven, his obvious eagerness to build on his main findings to retell the history of the telescope leads him to make what seem to me to be terribly, terribly weak inferences. Yet if that were to cause historians to look askance at his whole work, it would be a terrible shame, for there is a huge amount to be proud of here.

Willach is an independent scholar with his very own tightly-focused research programme: applying quantitative scientific testing methodologies to old lens-like objects to try to understand the ways in which they were made. Over many years in dogged pursuit of this quest, he has examined the Nimrud Lens, the Lothar crystal, lapides ad legendum (reading stones) embedded in liturgical art, curved glass covers in reliquaries, spectacle lenses embedded in a bookcase, rivet spectacles found beneath a nuns' choir, spectacles in private collections, early telescope lenses etc. Furthermore, there seems to be no end to the range of physical and optical tests he has at his disposal: and he has even built and used his own a replica lens grinding machine. He has also delved deeply into the practical chemistry, physics and craft of glassmaking and glassblowing. In short, in a world where many self-professed experts are content to simply talk a good talk, it is wonderfully refreshing to find someone who has really, really walked the walk.

For Willach, the physical evidence strongly indicates that spectacle lenses developed not out of reading stones (pieces of rock crystal hand-turned on a wheel but progressively more curved towards the edges), but from the large number of reliquary covers needed to accommodate the tidal wave of martyrs' relics that washed back into Europe after the Crusades. Just as with the reading stones, these were formed from pieces of rock crystal, and individually ground and polished on some kind of wheel, just as similar items had been turned since antiquity.

At some stage, glass began (quite understandably) to replace the far more expensive rock crystal. But when? Willach translates (pp.33-37) "cristallum" in the 1284 Venetian trade regulations as if it referred to the innovative Murano cristallo glass invented in the mid-Quattrocento by Angelo Barovier (and which is first documented in the context of a salt cellar in 24th May 1453, according to Gianfranco Toso's "Murano: A history of glass", p.46). Here, Willach has got the technological sequence right, but the timeline plain wrong. And so it seems highly likely to me that early glass spectacles were tinted or coloured (as indeed all other glass-made items were at that time), until 1450 at the earliest.

The first mass-manufactured glass lenses were made in a devastatingly simple way: by blowing a pear-shaped bubble of glass (contrary to popular myth, these bubbles were never spherical), stamping out circular blanks from it, and then subsequently grinding down the concave side of the blanks until flat. Used up until around 1500, this approach produced plano-convex lenses with a distinctive unground curved side and a ground flat side – though occasionally reasonably good near the centre, they were simply not optically good enough to be used in telescopes.

The next technological change came from Nuremburg, where from around 1478 a small group of spectacle-makers

began to produce plano-convex lenses using moulds. For a while, these were ground only on the curved side with the planar side left unground: but it was only about 1500-1510 when both sides began to be ground that the quality of these lenses leapt ahead. This was arguably the first point when telescopes began to become optically possible (but not initially in Italy, for the Nuremberg spectacle-makers managed to keep their secret intact for a long time).

Yet the hunger of the European mass-market for cheap spectacles meant that, before very long, the quality of mould-made lenses began to go downhill. Ultimately, lens moulds ended up (as Girolamo Sirtori lamented in 1612) simply being hammered roughly into shape rather than measured against a perfect curve. By 1600 or so, all the subtle craft skills required for making good lenses had (apparently) long been forgotten.

All of which forms the moving technological and craft canvas upon which the history of optical devices (such as telescopes, microscopes, and camera obscuras) was painted: and, thanks to Willach's sustained efforts, it is now very much better-defined than it has ever been. But… what of the telescope, then?

As far as the prehistory of the telescope itself goes, there used to be one big open question: despite the fact that convex and concave glasses were produced in large quantity from around 1450, why was the telescope not invented until circa 1600? I think it is a measure of Willach's massive redefinition of the entire field of study that this now seems hugely simplistic, if not actually naïve. Yet this is essentially the question that he sets out to answer in his final chapters.

As an example: the writing of Girolamo Fracastoro has long been a curious anomaly in the telescope's prehistory: in 1538, Fracastoro unambiguously described a twin lens telescopic arrangement – but this apparently was not picked up by anybody. Yet within the framework of optical history as rendered by Willach, I think we can get a glimpse of the reason why that should have been the case: in Fracastoro's time, the craft of lens making was on the way down – that is, Fracastoro just happened to be living in the brief period early in the 16th century when moulded lenses were still made with a bit of craft in Venice – there was (I conjecture) only a brief window around that time when off-the-shelf lenses would have been good enough to be used in a telescope.

But why is Willach so certain that things had recovered by 1608? If, as Girolamo Sirtori wrote in 1612 (which Willach approvingly quotes), the craft of spectacle-making had indeed been lost, from where did the craft of telescopes emerge? As I wrote in my September 2008 History Today article, the notion that three Dutchmen all dreamt the same hi-tech dream at the same time (and then went away and executed it independently of each other) is extraordinarily suspect – and, I would now add, the kind of mass-produced, low-quality glass spectacle market that seems to have been in existence circa 1600 makes this even more unlikely.

But all of this begs a large question about one of Willach's assumptions. Albert van Helden baldly expresses the assumption in his introduction to Willach's book, when he notes that the telescope's "origins clearly lie in eyeglasses". I would say that, actually, the first half of Willach's book does an excellent job in undermining that basic presumption: and that we are now at the point where we can start to glimpse what was really going on – and I now believe it wasn't anything to do with eyeglasses.

There was a quite different class of glass-made lens-based optical artefact made at the time, which (thanks to David Hockney) has recently received a significant amount of academic attention and debate (particularly in "Inside the Camera Obscura – Optics and Art under the Spell of the Projected Image", edited by Wolfgang Lefevre) – the camera obscura. The connection between this and the telescope is a big story yet to be properly grasped and retold: but one strand I would like to flag straightaway comes from Sven Dupré's fascinating article (in Lefevre's book), "Playing with Images in a Dark Room: Kepler's Ludi Inside the Camera Obscura".

Kepler mentioned in his 1604 book Paralipomena "an experimentum [...] which I saw at Dresden in the elector's theater of artifices [...] A disk thicker in the middle, or a crystalline lens, a foot in diameter, was standing at the entrance of a closed chamber against a little window, which was the only thing that was open, slanted a little to the right. [...] But the walls were also particularly conspicuous through the lens, because they were in deep darkness." But hold on a moment… who made this camera obscura lens, so obviously predating the Dutch telescope? Perhaps it is to letters in a Dresden-linked archive that telescope historians should now be looking…

Of course, it would be a curious irony if Willach's scintillating research actually had the effect of severing his presumed link between spectacles and telescopes. And my conclusion (that this is so) will doubtless be no more than one voice amongst many in the field. Regardless: whatever your own angle, I strongly urge you to buy a copy of Willach's excellent book and make up your own mind. This truly is history in the making – exciting times.

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