

A fourteenth-century Italian turret clock

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A turret clock in Chioggia near Venice, decommissioned in the 1970s, can be traced back to 1386 on the basis of a systematic exploration of the local archives. This article presents the documentary evidence for the history of the clock and offers a 3D reconstruction.¹



Figs 1 and 2. Chioggia seen from the air, and a view of a canal in this enchanting ancient city in the Lagoon of Venice.

Introduction

Chioggia is a lovely city with about 50,000 inhabitants, built on an island in the Lagoon of Venice, some 15 miles south of the city of St Mark's which it predates. Mentioned by Pliny the Elder in the first century AD, it was especially important for the salt trade. Belonging to the Republic of Venice since 1380, it can be considered a sort of miniature version of that more famous city. Its canals, churches and palazzi are well worth a visit (Figs 1 and 2).

In the heart of the historical city stands St Andrew's church, a seventeenth-century building. Its bell tower, formerly a watch tower, is older and probably dates from the

eleventh century (Fig. 3). It shows a wonderful 24-hour dial, designed in the old Italian style of *hora italica*, the ancient time reckoning method in Italy which counted 24 hours, starting from sunset. It has a ring of 24 white stone hour plates made of *pietra d'Istria*,² and in its centre a rotating sun in gilt metal, with one longer ray acting as the hour hand (Fig. 4).

The single hand and the bells are driven by an electric timekeeper, installed in the 1970s. The old big birdcage wrought-iron movement that had been used until then was placed in a corner of the upper room on the fourth floor. In September 2004 this old clock came to my

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1. This is an updated version of Marisa Addomine, Aldo Bullo & Ettore Pennestrì, 'La scoperta a Chioggia di un orologio da torre del 1386', *La Voce di Hora* 21 (December 2006), 19-34. In 2012, Dr Addomine gave a talk about the Chioggia clock to the AHS Turret Clock Group at the BHI in Upton Hall. We first reported on this clock as a Horological News item in *Antiquarian Horology* September 2013, 329-30.

2. A white stone from Istria, a region that is now part of Croatia but used to be part of the Republic of Venice, widely used by ancient Venetian architects.



Fig. 3. St. Andrew's church and its bell tower, formerly an 11th-century watch tower.

attention thanks to Maestro Aldo Bullo and my friend Professor Ettore Pennestrì,³ and I arranged an inspection. The movement, its frame coated with red paint (Figs 6 and 8), was in generally good condition. It had been modified with a pendulum and the present escapement, a pinwheel, was certainly not part of the original design. No signatures or marks were visible. The clock is quite impressive for its size, its height is about 150 cm. When I gently pushed the pendulum bob, it started ticking again.

Tracing the history of the clock

The nineteenth-century city chronicles tell us that the clock used to be installed on the façade of the city hall, the *Palazzo Pretorio* (Fig. 5). This medieval building was partially



Fig. 4. The dial of the clock, with the central gilt sun and the 24 horary tiles, according to the *hora italica* tradition.

3. The clock was 'discovered' by Aldo Bullo, a retired school teacher living in Chioggia, who is a passionate lover of the history of his hometown, interested in mechanical clocks and a maker of a working replica of Dondi's Astrarium. Struck by its resemblance to the clock in Salisbury, he sent some text and pictures to Prof. Ettore Pennestrì, who holds the Chair of Mechanics Applied to Machines at the University of Tor Vergata in Rome, and is an internationally renowned expert in kinematics with an interest in the history of geared devices. As we share a passion for ancient turret clocks, he forwarded Maestro Bullo's email to me.



Fig. 5. The medieval *Palazzo Pretorio* with the clock, before the Neoclassical rebuilding by the Austrian rulers in the nineteenth century.

damaged by fire in 1817, and in 1842 the Austrian rulers decided to demolish it, because the revolutionary patriots looked on it as a symbol of the former independence and glory of Chioggia and Venice. Already in 1822, the clock and its dial had been transferred to St Andrew's church and placed on the tall bell tower, once again serving as the main timekeeper of the city.

As the clock had belonged to Chioggia for a very long time, it was decided to make an attempt to trace its history in the old city accounts in the Historical Archive of the City of Chioggia. There are hundreds of volumes in perfect order dating all the way back to 1385, but there is no detailed index, so in practice one had to read all of them. A group of volunteers was assembled, and working backwards from a chosen date – we decided on the year 1600 – we carefully transcribed all references to the clock and its keepers.

The clock was sometimes referred to as 'very old' or 'the old clock'. All the notes we encountered were related to minor repairs. We found an important modification in 1557: the striking system was transformed from the original one, striking 24 hours in the Italian style, to 12 + 12, which was more modern and easier to decode for the common listener.

We found that in the year 1423 the clock had stopped and that a clockmaker from Venice named Paolo had come to inspect it. To the relief of the authorities, he reported that it was just a matter of repairing the *Ruota Magistra*, the great wheel, and that the clock was of very good quality and could go on working for another hundred years. He was



Fig. 6. The clock after cleaning work. For a full-page reproduction of this image, and another view, see *AH* Sept 2013, 329–330.



Fig. 7. The repair in the year 1423: a dovetail insertion of four teeth, performed by Maestro Paolo *ingeniero* (engineer) from Venice. In the wheel numbers are scratched from 5 to 60 in units of 5; their significance is unclear.

instructed to carry out the work, and after two independent clockmakers had approved of the result, he was duly paid. His unusual repair – four teeth with a dovetail insertion – can be seen in Fig. 7. Maestro Paolo from Venice knew his craft, and his prediction was correct – the clock went on working until the 1970s!



Fig. 8. Massimo Dolazza and Daniele Pons doing some preliminary cleaning of the clock.

At last, we hit upon the following in the City Council Book of the year 1386 (Fig. 9)

Die xxvi februari / Quod ponatur in exitu per massarios ad quod restat ad expensam orologi et quod teneatur in ordine et acconcio



Fig. 9. The calligraphic gothic style copy of the oldest document mentioning the keeper and the clock, dated 26 Februari 1386 (Consigli XXVI - f. 26r).

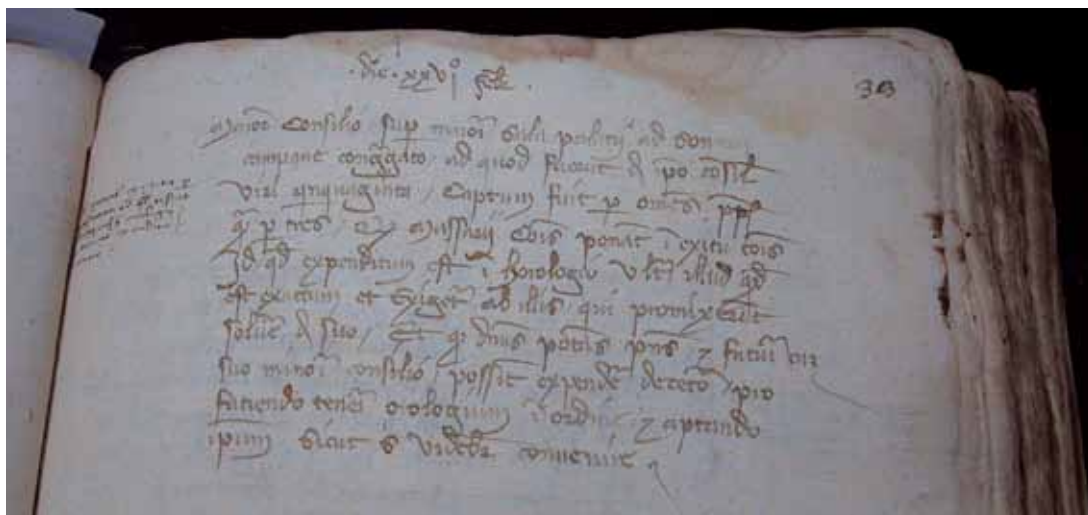


Fig. 10. The second, cursive hand copy of the oldest document mentioning the clock keeper and the clock, dated 26 Februari 1386 (Consigli XXV - f. 33r).

26 Feb 1386: Let the accountants of the city have the sum required to pay off the clock and to keep it in order and working well.

and (Fig. 10)

Die xxvi februari

Maiori consilio super maiori sala palatii ad sonum campanae congregato ad quod fuerunt de ipso consilio viri quinquaginta captum fuit per omnes pro quod per tres quod massari comunis ponant in exitu comunis id quod expensum est in horologio ultra illud quod est exactum et exigetur ab illis qui promixerant solvere de suo et quod dominus potestas presens et futurus cum suo minori consilio possit

expedere de cetero pro fatiando teneri orologium in ordine et aptando ipsum sicut sibi videbitur convenire.

26 February 1386. The major council, called by the sound of the bell in the great hall of the building, at the presence of 50 people and approval by all but for three, stated that the accountants must include in the city expenditures what has already been paid for the clock, beyond what has already been deposited by those who promised to finance the operation: that the present mayor and the future ones with their minor council will be allowed to spend at their discretion the money needed to keep the clock in order and working well.

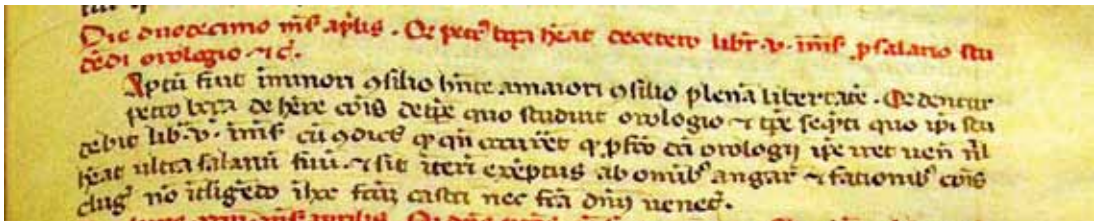


Fig. 11. The calligraphic gothic style copy of the second document mentioning the clock keeper and the clock, dated 12 April 1386 (Consigli XXVI - f. 27r).

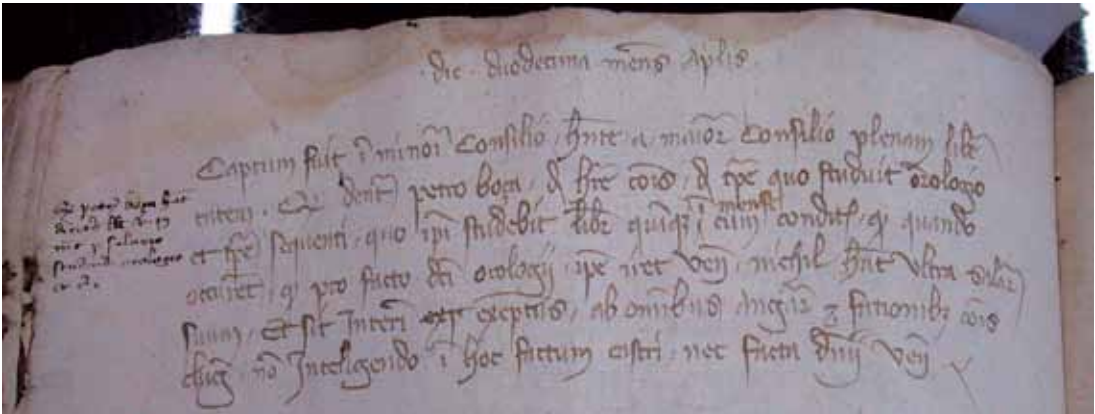


Fig. 12. The second, cursive hand copy of the document dated 12 April 1386, concerning the clock keeper and the clock (Consigli XXV - f. 34v).

A few pages further down was an instruction about the keeper and his salary (Fig. 11):

Die duodecimo mensis aprilis. Quod Petrus Boça habeat de cetero libras quinque in mense pro salario studendi orologio et cetero.

12 April 1386. Pietro Boça will get 5 pounds per month as a salary to keep the clock.

And a more extensive note (Fig. 12):

Die duodecimo mensis aprilis. Captum fuit in minore consilio habente a maiore plenam libertatem quod dentur Pietro Boça de habere comunis de tempore quo studuit horologio et tempore sequenti quo ipsi studebit, libras quinque in mense cum condicio quod quando occurrent quod pro facto dicti orologi ipse iret Venetia nichil habeat ultra salarium suum et sit interim exceptus ab omnibus angariis et fationibus comunis Clugiae, non intelligendo in hoc factum castri, nec facta domini Venetiae.

12 April 1386. The minor council, having full power to state this, given by the major council, orders that Pietro Boça will receive five pounds from the civic treasury for the time he worked and the time he will spend on the clock, with a condition that when he will need to go to Venice for the clock he will get no extra salary and that he will be exempt from all burdens and taxes of the city of Chioggia, not including war events or other facts imposed by the Venetian government.

So now we definitely knew the date of a payment (26 February 1386) but not the amount, and the name and salary of Pietro Boça, the clock keeper. We had explored the entire archive, from 1600 backward to 1385, and had found no reference to a replacement of the clock. We could not explore further back as there is a fifty year gap in the accounts. On 30 November 2005 the official presentation of the research findings was held in the city hall, followed by a special visit and blessing of the clock, performed by the Bishop of Chioggia.

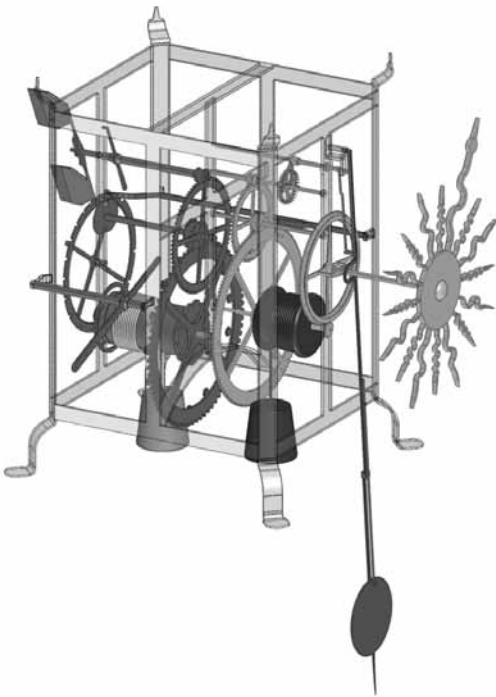


Fig. 13. A 3D virtual reconstruction of the Chioggia clock.

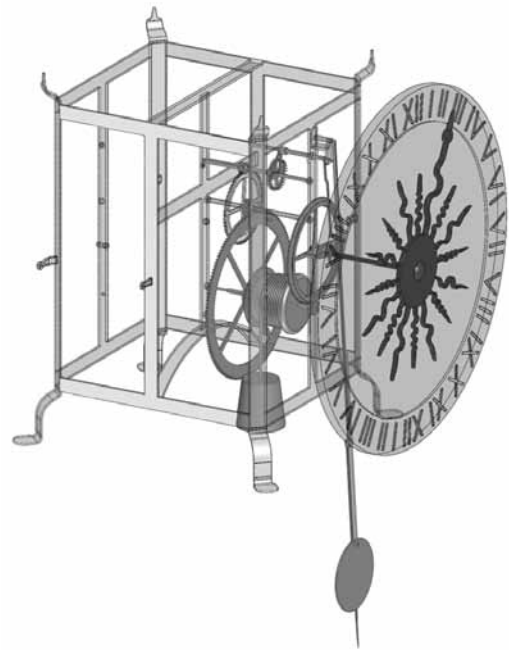


Fig. 14. The time train.

A 3D reconstruction

A complete 3D virtual reconstruction of the Chioggia clock has been carried out by the team of Prof. Pennestrì at the University of Tor Vergata, Rome (Fig. 13). This could in principle be used to build a replica of the original clock.

The time train (Figs 14 and 16) drives the motion of the single hand, performing one rotation in 24 hours. The striking train (Figs 15 and 17) has the traditional Northern Italian system, the so-called *ribotta*, where each hour is struck twice, at a short interval, in order to repeat the striking sequence for those who could not pay attention to the first occurrence.

Further study

After we had found the date for the construction of the clock, all the more recent papers – that is: after 1600 – dealing with the clock have been explored. Part of them are still kept in the parish archive. We now have a full set of documents, from 1386 to 1970, with details on notes, payments or decisions about the clock – as well as for the belfry and the

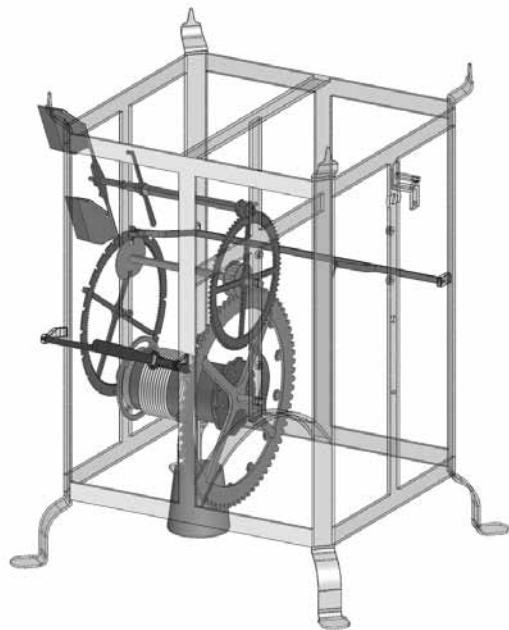


Fig. 15. The striking train.

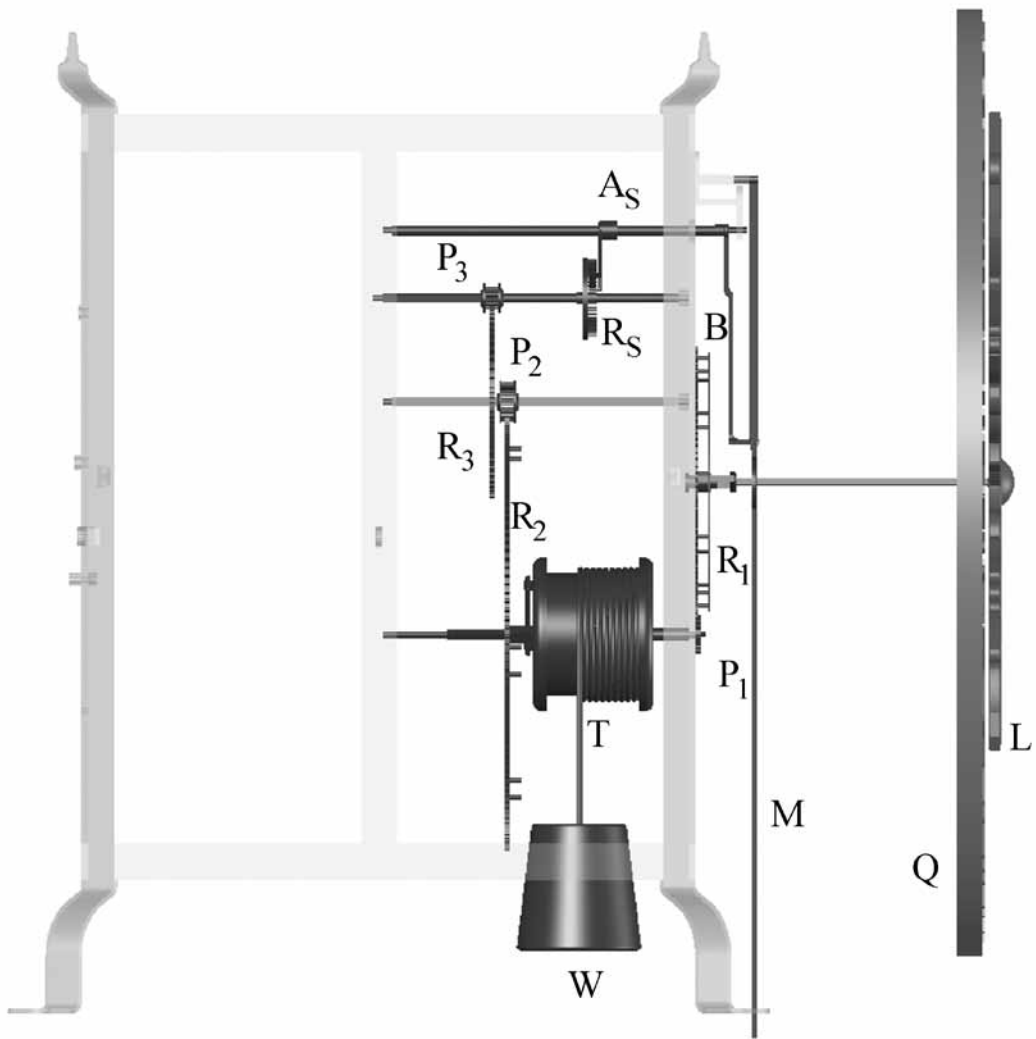


Fig. 16. The time train. Four wheels P1, R1, R2 and R3, two lantern pinions P2 and P3, a wooden barrel T, the escapement wheel Rs, the anchor As, the crutch B, the pendulum M, the dial Q, the hand L, the weight W.

The barrel T rotates integral with pinion P1 and wheel R2. Pinion P1 meshes with wheel R1; wheel R2 meshes with pinion P2, which shares the same axis with wheel R3 and is integral with Rs, the escapement wheel. The present pinwheel escapement, most probably originally a verge and foliot one, is composed of wheel Rs, anchor As and crutch B. The crutch drives the pendulum.

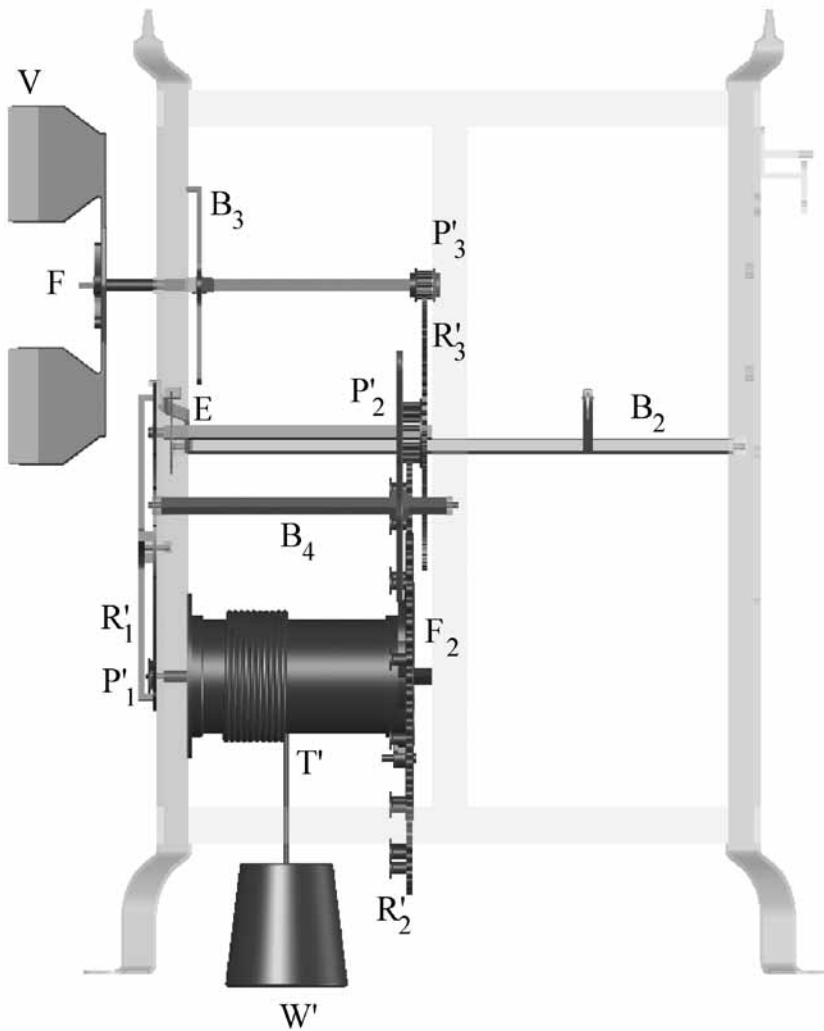


Fig. 17. The striking train. The countwheel R'1, three wheels P'1, R'2 and R'3, two lantern pinions P'2 and P'3, the hammer lifting arm for the bell B4, the rod acted by the clock B2, a rod R3, the cam E, the fly V, a wooden barrel T', two ratchets F and F2, the weight W'.

Barrel T' rotates together with pinion P'1 and wheel R'2, this one driven by ratchet F2. Pinion P'1 meshes internally with countwheel R'1, which has the typical slots - of different lengths - on the external rim. These slots are engaged by one of the two pins placed at one extremity of arm B2, when the striking is silent.

Wheel R'2 meshes with pinion P'2, integral with both cam E and wheel R'3.

Cam E has two large hollow areas, on the opposite longer sides of the cam. This hollow space houses the second peg of arm B2 when the striking is silent.

Striking is activated by arm B2, which is in turn acted by one of three pairs of pins placed on the face of wheel R'2. Arm B4, acting on the hammer of the bell, is operated by the 15 pins of wheel R'2. Finally, wheel R'3 meshes with pinion P'3, acting through arm B3 and ratchet F, to the fly, V.

bells after the removal to St Andrew's church.⁴

From a historical point of view, it is perhaps not surprising to find such an old clock in Chioggia. The city was the birthplace of both Jacopo and Giovanni Dondi, so one can put forward the hypothesis that their presence led to the development of mechanical and horological skills at a local level. The Dondis also owned an important estate near Chioggia, at Le Bebe. In that area they conducted experiments for new mechanical mills, like Richard of Wallingford did in St Albans fifty years earlier.

A study group, the Chioggia–St Albans Committee, established in 2005, is working on the parallel aspects of the two cities. Both are minor cities but close to major capitals (London, Venice) and in the intellectual milieu of renowned scientific universities (Oxford, Padua) and both are places where the best horological minds of the times worked and studied (Richard of Wallingford, Jacopo and Giovanni Dondi).

To conclude

In recent years, the tower has been transformed into a museum, where hundreds of visitors come from many countries every year. What they can see there is a clock whose long history has come to light through a combination of happy circumstances: a retired school teacher fond of medieval clockmaking, some friends sharing a passion, an extraordinary archive, and wonderful people volunteering. And, last but not least, the fact that the movement has always been

in the city. Had it been found on the antiquarian market, it would have been impossible to reconstruct its long life, and Chioggia would never have been given the honour of being the proud possessor of this horological treasure.

For centuries the Cinderella of the Lagoon, Chioggia now can show something that Venice does not have: a medieval clock.

Acknowledgements

Many people contributed to this discovery. Maestro Aldo Bullo, a passionate lover of his city, with an extraordinary interest in medieval science. All the people in Chioggia: the former parish priest, Monsignor Cinzio Zennaro and the present one, Monsignor Vincenzo Tosello, but also the staff at the Archives, the Mayor, the Municipality. Padri Cavanis offered fantastic meals when we were in the field. Prof. Ettore Pennestrì of the University of Tor Vergata in Rome gave full support for the mechanical analysis and the 3D drawings. Senator Massimo Dolazza from Bergamo helped with the cleaning campaign, in person. Last but not least, Daniele Pons, my partner, who shared this research with me day after day, always helping with his technical and historical competence.

Picture credits

Figs 1, 2 and 4 Chioggia Tourist Office; Fig. 3 Daniele Pons; Figs 5 and 9–12 Courtesy Historical Archive of the City of Chioggia; Fig. 6 Chris McKay; Fig. 7 Aldo Bullo; Fig. 8 Marisa Addomine; Figs 13–17: Courtesy Prof. Ettore Pennestrì.

4. A list of the archival findings related to the clock during its presence on the *Palazzo Pretorio* over the years 1386 to 1822 is printed as appendix to the article in *La Voce di Hora* mentioned in note 1.