

Inside The Hampton Court Clock

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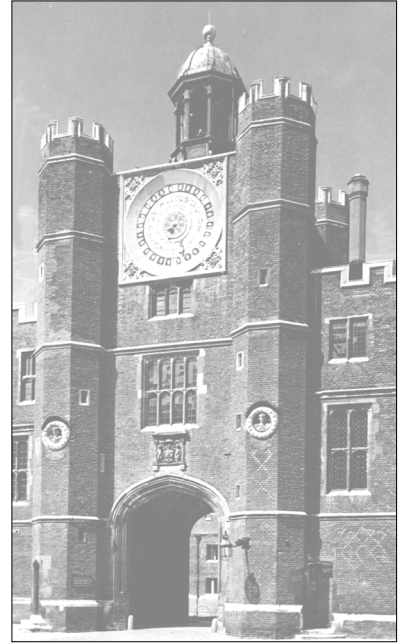
Inside the Hampton Court Clock

by Heather Hobden

The Astronomical Clock at Hampton Court Palace never worked well and was even scrapped for several years. The clock is famous because of its prominent central position in an historic royal palace which has become a tourist attraction and a national monument.

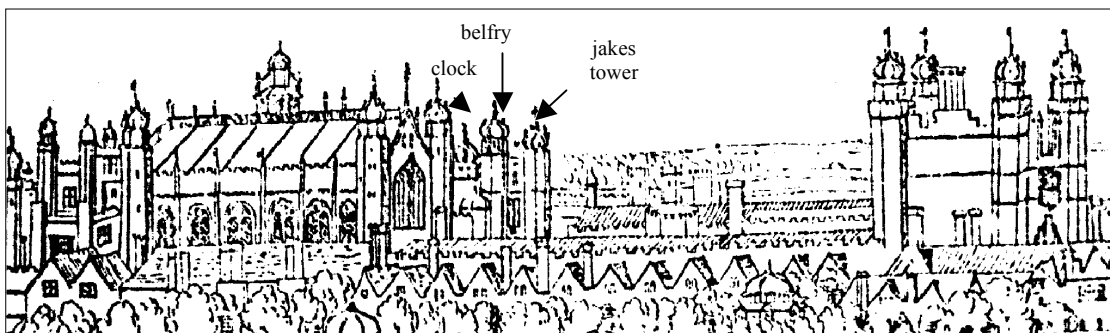
Where is this clock

Hampton Court is by the Thames on the west side of London, not far from Heathrow airport. Hampton Court Station, is reached from Waterloo. The station is just the other side of the bridge from the palace. Full details can be found on its website: <http://www.hrp.org.uk/HamptonCourtPalace/>.



There was no bridge across the River Thames until the mid 18th century. You can still go by boat up the Thames from London, as they did in the 16th century. The journey took five or six hours then, and it says much for the thoughtfulness of the original design that the first part of the palace that visitors reached after leaving the landing stage, was the "Great House of Easement". Horses were stabled opposite the Palace entrance in Hampton Green. Before they could enter the palace gates, visitors had to book in to the offices on the other side of the gate. This was the Lord Chamberlain's Office, which was in charge of staff, maintenance and the running of the palace.

Crossing the bridge over the moat and entering the gateway, you arrive in the first courtyard. This was surrounded by the lodgings for visitors with suites of rooms, jakes (the 16th century word for toilets) and lavatories (the 16th century word for washrooms). At the far end of this courtyard a second gateway leads through to the Great Hall and another courtyard leading to the State Apartments. This gateway is the clock tower. The contemporary illustration (originally engraved 1558) shows Hampton Court – looking across from the side where the offices were, towards the river

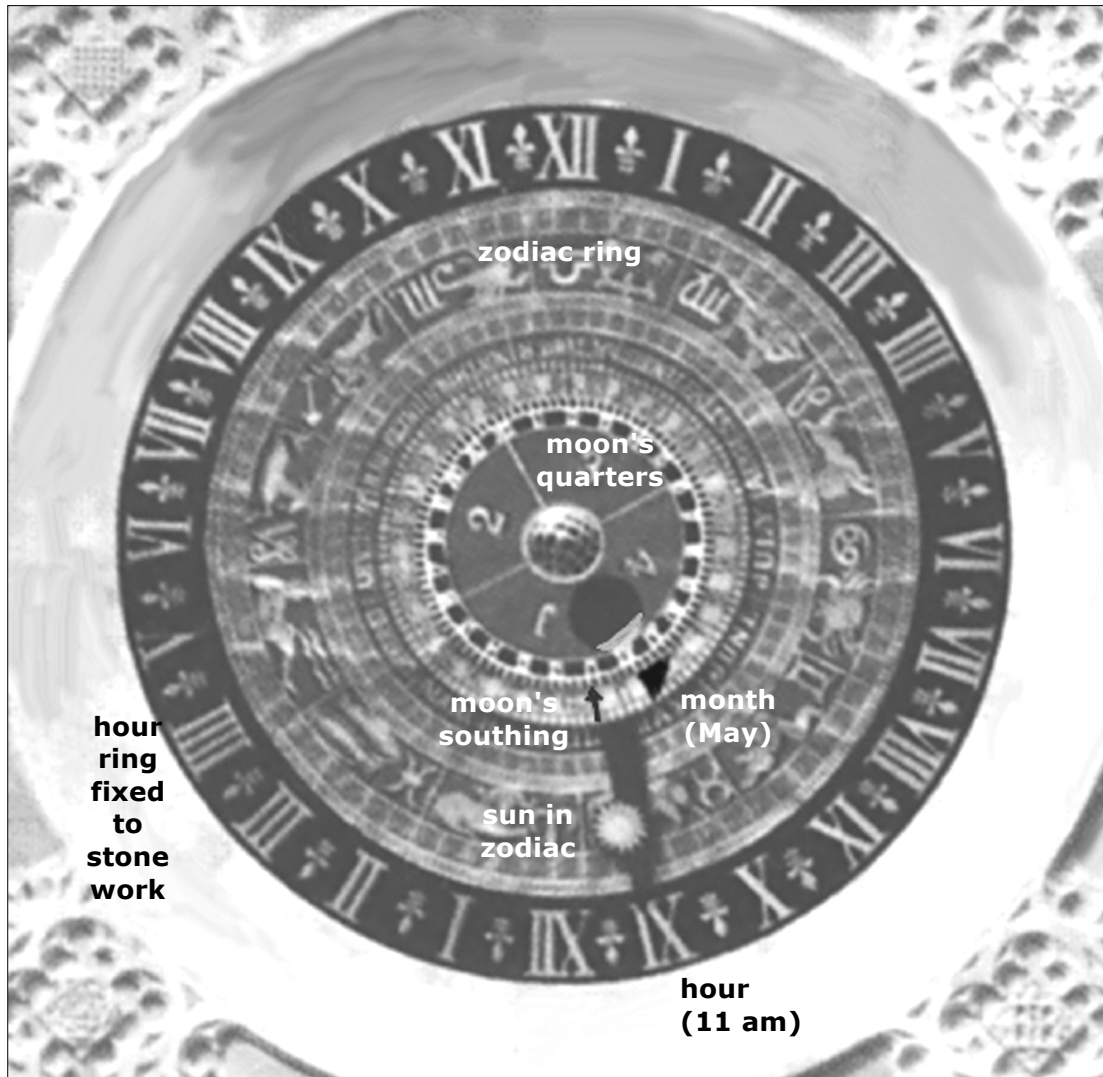


Reading the Clock Dial

The clock has two dials. The famous astronomical dial faces towards the second courtyard and state apartments.

The astronomical dial is 2.4 metres (about 5 feet) in diameter and is made from three copper discs each a different size, with gearing at the back (*see page 9*) which enables them to revolve around each other at fixed speeds. From the dial you can read the hour of the day, the day of the month, the month of the year, the phase of the Moon, the position of the Sun in the Zodiac for astrological predictions, and the time of the Moon's southing (when it is due south in the sky) to calculate the time of the tides on the Thames (at London Bridge). The Thames is tidal to just past Hampton Court. The time of the tides was useful to the officials at the palace as it enabled them to time the arrival of goods and passengers from London.

The pointer with the Sun painted on it indicates the month, the day of the month, the position of the Sun in the Zodiac (*for astrology which is not the same as astronomy – see page 5*), and against the outer fixed dial the hour of the day. The hours of the day are numbered in two sets of twelve. During the day the Sun hand should be pointing downwards. Another, smaller pointer indicates the day of the lunar month, (*not the day of the calendar month*) while the small red pointer facing inwards is indicating the time of the Moon's southing.



See the other side of this dial on page 10.

In the centre is the Earth. The dial was made when most astronomers held to the belief that the Earth was in the centre of the Universe. This astronomical dial was constructed according to the long established cosmological system first postulated nearly two thousand years before by Macedonian academic, Aristotle, tutor to Alexander the Great. The planets including the Sun and Moon, and the stars were all fixed to solid spheres, one inside the other, the Moon's sphere nearest the Earth, the Sun's between the planets Venus and Mars and the Stars on the outer of the spheres. This model of the universe when provided with gears and power is actually an astronomical clock of the kind which had been made in the Near East and China and other places for two millennia.

This type of astronomical dial is a flattened (planispheric) model of the universe (as in an astrolabe) with the heavenly bodies rotating about the Earth which is immobile in the centre.

About the Zodiac

The signs of the Zodiac which were used for horoscopes and mark out the apparent path of the Sun and Planets across the sky, were fixed in 127 BC. by the astronomer Hipparchos. He was from Nicea in what is now Turkey, and he worked in Rhodes. Since the conquests of Alexander the Great had extended the Greek Empire until it bordered the newly arising Chinese Empire and into India, Hipparchos and his contemporaries could compare and make use of different astronomical systems from many places. The Zodiac we use today, came from the system used by Babylonian astronomers in the country now called Iraq. But may have originated in India. The path of the Sun and Planets is called the ecliptic because eclipses may occur when the Moon crosses this line. It was divided into 360 degrees. The Chinese divided the sky into 365.25 degrees, the number of days in a year, but it is much easier to divide a circle into 360 equal divisions.

The ecliptic is also divided into 12 equal sections of 30 degrees each, each named after a constellation in that part of the sky. The twelve signs of the Zodiac are counted from Aries the Ram (the First Point of Aries), which in 127 BC when Hipparchos made his observations, marked the spring equinox (March 21st), when day and night are of equal length.

Although astrologers still used these signs with the same dates in the 16th century and even today, they are no longer correct due to precession. The position of the Sun gradually moves backwards in the ecliptic until it reaches nearly the same position again after almost 26,000 years. So at present the Spring Equinox is moving from Pisces the Fishes to Aquarius the Water Carrier. The other signs of the Zodiac are Capricorn the Goat, Sagittarius the Archer, Scorpio the Scorpion, Libra the Scales, Virgo the Girl, Leo the Lion, Cancer the Crab, Gemini the Twins and Taurus the Bull. You can see these all on the clock. The equal divisions of the Zodiac signs are no longer used by astronomers as the constellations are all different sizes and take up different numbers of degrees. For example the Sun passes forty four degrees through Virgo, seven degrees through the Scorpion and eighteen degrees through Ophiuchus which is not even a Zodiac sign. In an alternative system of the Zodiac which also comes from India and is still used in Chinese astrology, the names of the Zodiac signs mark twelve divisions around the equatorial line, rather than the ecliptic and do not now relate to constellations.

Wolsey's Bell



The clock tower in 1970 showing the excavations of the earlier gateway and bell tower.

In June 1514, Thomas Wolsey, Bishop of Lincoln and one of the King's most trusted and able statesman, rented Hampton Court from the Knights Hospitallers on a 99-year lease. He needed a residence from which he could run the affairs of state and entertain foreign envoys in a impressive manner. Hampton Court was within easy reach of Westminster, but had the benefit of fresh country air. Later that year, Wolsey became Archbishop of York, and had the use of York

Place, which went with the job and was conveniently close to the King's palace of Westminster. It was later called Whitehall.

King Henry VIII, who was 23 at this time depended

upon Wolsey as had his father Henry VII, for his skills and abilities, especially in foreign affairs. He was therefore keen to have Wolsey promoted as Cardinal. This happened in 1518, and Wolsey was also made a Papal Legate.

Wolsey now had a status equivalent to any European Prince. And Wolsey saw to it that his residences of Hampton Court and York Place should reflect that grandeur and be fit to be used, not only as centres of government but for the lavish entertainment, of King, Court and visiting dignitaries.

Under the terms of the lease of Hampton Court, Wolsey not only acquired the use of all the existing buildings and surrounding land, and even the rabbit warrens, he was allowed to alter or rebuild the premises in any way he wished.

Part of the original buildings at Hampton Court are incorporated into the structure of the building next to the clock tower - the side opposite to the Great Hall. Foundations of the original building have also been found in excavations in the courtyard - what is now called the Clock Court, and these have been marked out in the paving. Within the building itself is the remains of the original bell tower, which may have also contained a clock, not necessarily with a dial, as many clocks just marked the time with bells.

The clock tower and gateway was the main entrance to the building at the time Wolsey acquired it. The Great Hall was on one side of the court as it still is – and other lodgings surrounded the court-yard with the chapel and kitchen beyond.

Wolsey built the new courtyard and main entrance in front, so the Clock tower then formed the entrance to the inner and less public part of what was now to be a palace fit not only for the Cardinal, but the King and Queen.

The palace was orientated parallel to the River Thames. On the north side was the kitchens. Wolsey added many more kitchens and offices with their own entrance. These were for the staff and visitors. The state apartments had their own kitchens.

The large bell still in use today to chime the hours, was presented to Wolsey in 1514 by the Prior of the Knights Hospitallers, Thomas Docwra.

The bell is huge – it weighs 915 kilograms. It was cast in 1478 or 1479 in the foundry of Thomas Harrys. The inscription on the bell reads:

I + STELLA MARIA MARIS SUCCERE PIISIMA + NOBIS + T. H. +

The Royal Apartments for the King and Queen faced the clock. Wolsey built new quarters for himself on the south side facing the river and catching the sun through big windows.

Wolsey planned to transform Hampton Court into a great Renaissance palace. The crenellated redbrick walls topped with many colourful and gilded minarets were similar in style to the Moscow Kremlin, rebuilt end 15th, early 16th century, and this is because both Wolsey and the Grand Duke of Moscovy Ivan III employed the same Italian architects. Italy was then at the leading edge of art and design. On their way back from Russia, many of these Italian workmen stopped off in England so Wolsey was able to employ to employ them on his new palaces. Unlike the Kremlin, Wolsey's palace, had spacious rooms and good sanitation - far better even than the palaces in France, which were short of conveniences in the grand parts of the palace although they were provided for staff. At Hampton Court there was a mains supply of clean fresh spring water and a system of sewers leading from the many indoor jakes (toilets) and lavatories (washrooms) on every floor of the palace, into the moat which was flushed by the Thames.

Henry VIII's Envy

Wolsey's modern and convenient palace was envied by King Henry VIII living in the unsanitary old palaces left to him by his predecessors. Especially when his former tutor, Skelton wrote:

*"Why come ye not to Court?
To whyche Court
To the Kynges Court
Or to Hampton Court
The Kynges Court
Should have the excellence
But Hampton Court
Hath the pre emynence."*

Wolsey felt impelled to hand over both his official residences, York Place and Hampton Court, to the King in 1525, but was allowed to continue to live in them - which meant he was still responsible for their maintenance.

Scandal and Sleaze

In 1529, Henry VIII seized all Wolsey's possessions, as he had failed to arrange his divorce from Queen Catherine so he could marry Anne Boleyn.

The clock tower was rebuilt by John Molton the King's Master Mason in 1528, at the time Anne Boleyn was the target of Henry VIII's love letters, and he was trying to find a way to divorce Queen Katherine. Molton also designed and built the gate house, with clock at St. James's Palace which looks very similar. Henry VIII intended this to accommodate his children. The clock tower at Hampton Court is called Anne Boleyn's gateway because it still has her AB badges and her falcon trampling red and white roses which was her emblem when Queen. These were missed when her badges and emblems were replaced with Jane Seymour's phoenix its wings sheltering the red and white roses.

Life at Hampton Court was rather interesting at this time. Before Henry VIII decided to make Anne Boleyn his second wife, he had a relationship for a number of years, with her sister Mary. She had been married to William Carey, a marriage sponsored by Henry, and her two children, Katherine and Henry were believed at the time to have been fathered by the King. Her husband had died in the 1528 epidemic of "the Sweat" so she was now widowed. And a rival to her sister Anne.

Also at the court was Lady Elizabeth Tailboys, originally Elizabeth Blount, who had not only been the King's mistress for some years but had given birth to the King's son. Later she was married off to Gilbert Tailboys, and lived in Lincolnshire. When her husband died in the Sweat epidemic, she was already back at the court along with her four children.

Elizabeth's eldest son, Henry Fitzroy, still Henry VIII's only acknowledged son, was given equal status with his daughter Princess Mary. In 1525, when Mary was created Princess of Wales, Henry Fitzroy was created Duke of Richmond and Somerset amongst other titles and sent to Yorkshire to rule the north of England. He was referred to as "the Prince". And now Henry VIII was planning to divorce Queen Katherine he had his son back at court and treated better than his daughter Mary. If the king was to marry again, what better than to marry the mother of his own son.

Anne had a coronation in May 1533 when she was pregnant. Henry VIII's son was staying in France out of the way, but even there he was it looks like Anne had sent her brother to try to poison him. (Luckily the poisoned wine was shared with his friend the Earl of Surrey – so both were ill but survived.)

Richmond returned to England when Anne had a girl (Elizabeth). He was still the King's only son. In 1534 Henry VIII and Elizabeth gave their son a joint New Years Gift with their initials H E engraved on it. Then Henry VIII found out that Queen Anne was plotting with her sister-in-law Jane to get rid of Elizabeth, the mother of the King's son. And also claiming to be pregnant again. Elizabeth left the court and later that year remarried. Her two sons remained with their brother at court.

Henry VIII extended his own accommodation on the south river facing side, with huge windows to catch the sun, gardens to look out on, private stairs for secret access when needed, and his own water gate attached to a water gallery, one of the features which included a banqueting house and little hill with a sort of gazebo, also for banqueting or more discrete entertaining. He had his state bedroom, and his real bedroom with ensuite circular bath with hot water on tap (supplied by a boiler in the next room), and velvet covered commode where he was attended by his Groom of the Stool. The King's main state rooms faced the clock tower – and as Henry VIII was keen on astronomy, and an amateur astronomer himself – it was probably his choice to have an astronomical clock.

As you approach the clock tower from the first courtyard which is surrounded by Wolsey's visitors lodgings, you can see two corner turrets. The turret on the right hand side is the jakes tower. It contained - and until recently was still used for this purpose - a loo – Tudor word – jakes- on each floor. The turret to your left by the entrance to the Great Hall, was the weights tower. The clock weights hang down here and there was sand at the bottom in case they broke off and fell. By the stairs to the Great Hall is a door giving access to the bottom of the weights tower, so that anything or anyone who falls down can be rescued. On the side facing the royal apartments are the staircases.



In the 16th century the clock was lower in the tower than it is now. The roof was flat with a crenellated parapet. Each turret was topped by a minaret with a gilded weather vane. At the top of the jakes tower, a door led to the loo for the convenience of the security guards who patrolled the walkways on the roof. The two turrets on the other side contained the stone spiral staircases which wound their way up to each floor and out through doors accessing the roof. On top of the weights tower was a larger minaret than the others for this was the belfry which contained the large hour bell, the oldest surviving part of the clock. The clock tower is called the Anne Boleyn gateway as her initials survive on the ceiling as it was rebuilt when she was Queen.



Fitzwater's Clock

There are no surviving records of a turret clock at Hampton Court before 1528 when the present gateway clock tower was built although there appears to have been a clock tower previously.

Vincent Quesnay, a French clockmaker from Rouen, was employed in 1530 at Hampton Court. On the 5th December 1530 he was paid £19.16s.8d. for eleven clocks and dials. On the 14th December he was paid 14s. for installing these clocks and putting them in order. Two years later, on the 18th May 1532, he was paid £11. 8s. 8d. for "*suche stuf as he solde to the King*". In 1540 he returned to Rouen to be Keeper of the Cathedral Clock. His son Jean took over when he died in 1553. He does not seem to have any direct involvement with the Hampton Court Clock.

John Fitzwater is first mentioned as the Keeper of the Clock at Hampton Court on 14th February, 1532 when he was paid his salary of 27s. 8d.

John Fitzwater became clockmaker to Henry VIII from 1530. Fitzwater came from a clockmaking family in Devon who had been responsible for many generations for the Exeter Cathedral clock, a famous astronomical clock, unlike Hampton Court, the dial is inside the building.

Fitzwater was an experienced turret clock maker who made clocks for a number of Henry VIII's palaces. Installing an astronomical clock at Hampton Court would have been the King's idea, as Henry VIII was very interested in astronomy and had a number of scientific instruments specially made for his own use. He had another large astronomical clock installed in his newly built palace of Nonesuch in 1538.

No description survives of the original clock and its dials. It would have had a verge escapement which needed regular setting and winding and maintenance. This type of movement had been used for large turret clocks since the twelfth century and large public clocks more complicated and entertaining than this, with astronomical data and moving figures and musical tunes, were common in Europe.



Fitzwater's clock at Hampton Court though, does not appear to have been a success. Other clockmakers, and the King's astronomer (paid 100s. a quarter), Nicolaus Kratzer, were repeatedly called in for consultation on adjusting the mechanism and to make repairs. The problems could have been caused by the clock having to run two dials. And also by the gearing at the back of the astronomical dial making it off balance.

Kratzer, born 1487 in Munich, made sundials and taught astronomy at Oxford. He was also responsible for the King's clocks, sundials, astronomical and navigational instruments and the King's horoscope, and sent to prospect for calamine and copper mines (needed for brass used for scientific instruments). Also to expected to forecast the weather and calculate the tides. He was paid

40s.(£2) in 1531 for mending a clock for the King, but there is no evidence this was the Hampton Court clock. He was a friend of Holbein and they often worked together. Holbein painted his friend surrounded by his instruments – this is a copy of part of that portrait.

King Henry VIII is not noted for tolerating failure. In 1538 John Fitzwater was moved from his position at Hampton Court and made Keeper of the Clock at the palace of Newhall Boreham in Essex. This was demotion for Fitzwater, for not only was the job much less important, Newhall was no longer used by the King who gave the palace to his daughter Mary, but the pay was less too. Fitzwater now received a salary of 13s. 4d. every three months, which compares unfavourably with the salary of his successor as Keeper of the Hampton Court Clock, Nicolas Oursian, who received 20s. 8d every three months.

Nicolas Oursian and the Clock

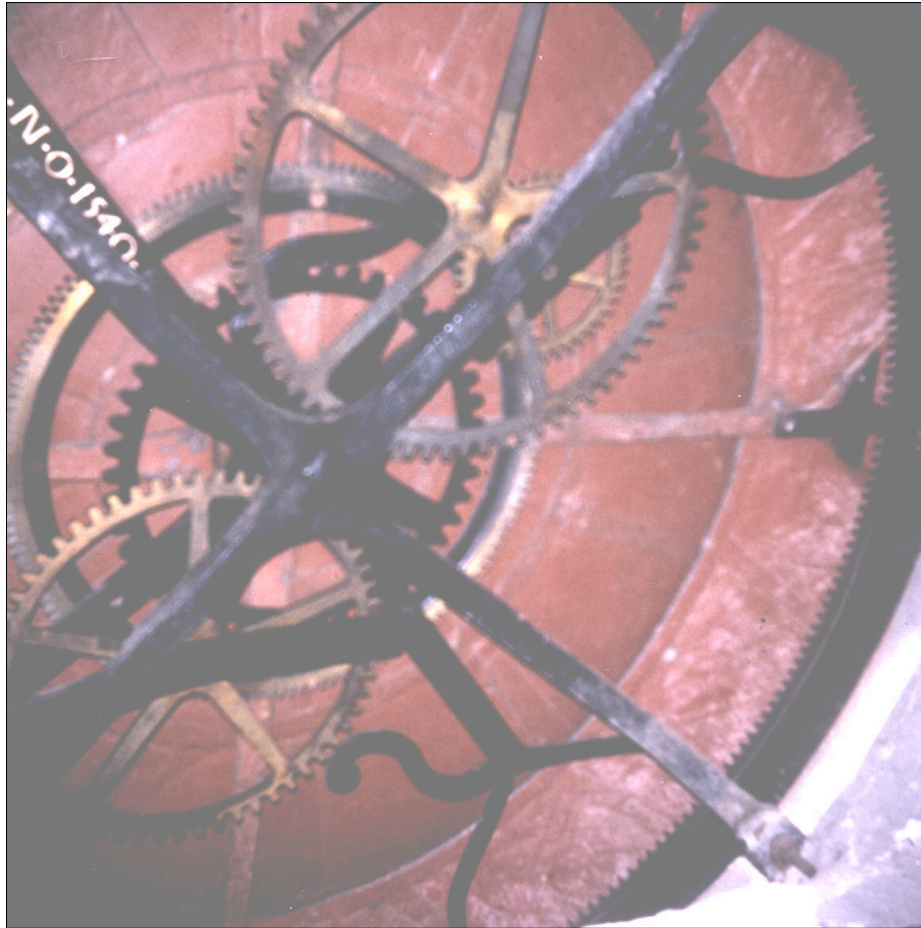
Nicolas Oursian, a French clockmaker, who had been frequently called in to repair Fitzwater's clock at Hampton Court, was commissioned to make a new clock mechanism.

Oursian is first mentioned in the King's accounts in May 1532:

"Itm, the xx daye paied to nycolas Ourcean a Clockemaker for stuf made for the Kings Grace. vii. iijs." (£7. 3s. 0d.= £7.15p.) (from BM.Addit.20,080, f.110).

His name appears in the King's accounts variously spelled as: Ourseau, Ursian, Oursian, Wourstan, Worston, Orshawe, Ourceau, Urseau, etc...

Oursian's initials "N.O." and the date "1540" can be seen inscribed and painted gold on a bar on the back of the astronomical dial.



But is this inscription original? The bar of the dial with the inscription has a counterweight at one end, and originally had a similar weight at the other end, which was fixed by a large bolt. This fastening would have obliterated the beginning of the inscription, so if the inscription was of the same age as the bar it would have been placed a little further along. The bar is wrought iron and looks as though it could be 16th century, but did it always have this inscription, now so clear.

William Derham who examined the clock just before the clock tower was rebuilt by Wren, mentions "And at this very day there is a Stately Clock in his Majesties Palace at Hampton-Court, whose Inscription shews it to have been made in King Henry VIII's time by one N.O. in the year 1540" (*see page 13*). But he does not say where he found this information, nor does he mention it when he describes the dial. When Dr. Pearson visited the clock in 1802, (*see page 15*) for his article on horology in Rees Cyclopaedia, he looked for the inscription "N.O. 1540" mentioned by Derham, but could not find it anywhere. As Pearson examined the clock thoroughly, and counted all the cogs in the gearing, he would not have missed the inscription as it now appears on the bar on the back of the dial. This seems to indicate that the inscription was somewhere that was replaced by Langley Bradley. When Derham saw the clock in 1714, Oursian's clock had recently been restored by Herbert. It is probable that Herbert updated the original verge escapement with a new escapement with pendulum as this was done to most turret clocks at about this time. Since metal was then very expensive, he may not have replaced the whole movement and frame. Unfortunately Derham does not describe the clock works at all, only the dial.

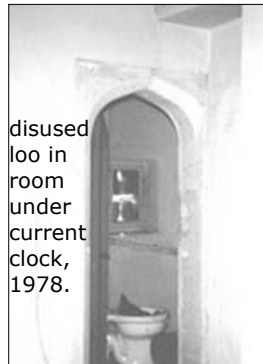
In 2007, when the Cumbria Clock company restored the clock, they had samples of the metal tested. This showed that the bar with N.O. 1540 on it was very probably a 19th replacement. More on this later.

The Clockmaker's Workshop

It is not clear whether Oursian installed just the clock mechanism or one or both of the dials. After the installation of the clock, Oursian was appointed as King's Clockmaker and as Keeper of the Clock in place of John Fitzwater. This meant that Oursian was responsible for the clock's daily maintenance and repair. He received wages of 4d. (2p.) a day. This was the same as the wages paid to the King's musicians.

Now he was the King's Clockmaker, Oursian had to become a British citizen. He was granted denisation (Pat.p.8.m.9) and the papers were delivered to his home in Westminster on the 12th March 1541.

The two clock faces were lower than you see them today. They would have been about where the windows are that are now below the clock faces. The dome was added later as we shall see. As you can just see in the picture taken from an engraving of the palace published in 1558 (*on page 3*), above the clock face was the crenellated parapet surrounding a flat roof where the guards patrolled. Although the rooftops over the palace buildings were mostly pitched, there were walkways along them for the guards to patrol. The two spiral staircases on either side of the astronomical



disused
loo in
room
under
current
clock,
1978.

dial went up to the roof tops and ended in minarets, coloured and gilded. The belfry was over the weights tower, and the jakes tower had a loo on each floor including the roof.

So there was a toilet provided for the use of the clockmaker and his assistants in the clock room which was behind the dials. Here there was a window (later blocked up) on the side next to the fireplace. (*Since the windows now there are in the spaces originally occupied by the clock faces*). The clock maker was provided with everything he needed for an overnight stay while working on the clock.



blocked
window
by
fireplace

The Queen's Clock

Oursian continued as clockmaker to the Crown after the death of Henry VIII, through the reigns of Edward VI, Mary I, and Elizabeth I. In 1556, Oursian presented Queen Mary I with *"a fair clocke, in a case, cover with blak vellat."* This is what we would now call a watch. Mary collected watches – then an expensive fashion statement. She wore her watch at the end of a long chain attached to her waist. This was fashionable, but probably why her watches needed frequent repair.

Oursian was mentioned as living in Westminster in 1568 with two assistants, Lawrence Daunton who was French, and Peter Doute who was Dutch. They were both Protestant refugees. By this time, Oursian, as Clockmaker to Queen Elizabeth I, was looking after the clocks at the palaces of Oatlands and Westminster, as well as Hampton Court.

In 1572, Bartholomew Newsam, Clockmaker, in the Strand, persuaded the Earl of Leicester, who as Queen Elizabeth's lover had considerable influence with the Queen, to allow him to take over the office of Clockmaker to the Queen on Oursian's death or retirement.

Perhaps it was this threat to his position which prompted Oursian to have the Hampton Court Clock repainted by George Gower, the Queen's Serjeant Painter. He had no intention of retiring and he did not die until 1590, leaving Newsam only three years to enjoy the appointment before his own funeral.

We have a description of the clock in 1575 when Queen Elizabeth's Serjeant Painter, George Gower was paid for:

"painting the great dial at Hampton court, containing the howres of the day and night, the course of the sonne and mone, the xij signs with the characters of vij planets, environed into a circle, the sea, shippes, and territories; and on the other side certain badges of the croune, all wrought in oil colours, as vermillion, etc. and gilded with fine goulde; for cleansinge the seconde diall cong. the howres of the daie, half-howres and quarters, and in divers places her mats trio of name, and sondrie her mats badges, wrought likewise in oyle colours and gilded with fine goulde".

The dial was clearly, much more colourful and pictorial, than we see it today. Although the 19th century restorers intended to restore the dial to its "original colours and appearance", it is likely that the traces of colour they used for guidance dated from the clock's alterations by Wren in the 18th century, when the exuberance of the 16th century palace seemed dated and the astrological significance of the dial was no longer of interest.

The courtyard overlooked by the astronomical dial is today paved and called the Clock Court. In the time of Queen Elizabeth I this was a garden laid out with paving, flowerbeds and grass. It was then called the Fountain Court as it featured a monumental but trick fountain that could shoot a surprise jet of water up your farthingale. This was a place of recreation for people staggering out of a state banquet or theatrical show, in the Great Hall to get some air and the clock would have been part of the entertainment.

The Clock in the 17th Century

The clock stopped at four in the morning on March 2nd 1619, at the very same time that Queen Anne, wife of James I, breathed her last at Hampton Court. This coincidence gave rise to the belief that the clock stops when any resident at Hampton Court dies. Since hundreds of people have lived there, many of them elderly, and since the clock has never worked well and has often stopped, this myth has endured.

Oliver Cromwell had Hampton Court surveyed in 1649, before it was made his official residence as Lord Protector. In the survey the clock is described as having **"one large bell, and a clock under it, very useful for the whole house, having a fair dial or finger upon the end of the said Great Hall facing into the Great Court".**

When Charles II moved back to Hampton Court the palace was redecorated and the clock repainted. In 1664, the King's Serjeant Painter, Robert Streeter, was paid £11. 7s. 0d. for

"gilding & painting the Great Diall in the fountain court and shadowing of all the Letters, Ciphers and Characters and painting the clock diall that is over the other side of the gate house."

On Charles II's death, his brother James II moved into Hampton Court. James II was ousted by his daughter Mary and her husband William of Orange and fled with wife, baby son and wet nurse, abroad into exile pausing only to throw the Great Seal of England into the Thames.

Wren in

When William and Mary came from Holland to take over the English throne jointly, they had to leave behind their new, still barely finished palace of Het Loo. Theirs was a marriage of convenience. Mary spent most of her time in her office or with her woman friends. William spent most of his time hunting with his buddies. At Het Loo, the old castle was left as William's hunting lodge, and the new modern palace was designed as a semi-detached with his and her sides of equal status.

They were dismayed at the traditional Renaissance charm of Hampton Court, and Mary particularly wanted to modernise the palace and have accommodation of equal status and separate from her husband.

They called in the astronomer Christopher Wren (who became more famous as an architect) to redesign and rebuild the whole palace to make it similar to Het Loo. Work began immediately on rebuilding the state apartments.

The early death of Queen Mary in 1694 halted the work for a while. Mary never had a chance to live in the palace and had spent her reign camped out in the water gallery which had previously been adapted to house Charles II's mistress Barbara Castlemaine. Later, William III managed to get some building finished but as he did not pay his bills to the workmen he left massive debts when he died in 1702. As a result the project was curtailed by Mary's successor, her sister Queen Anne. So fortunately some of the original Tudor palace survives.

The rebuilding had started at the back of the palace with the state apartments and had reached halfway. The clock tower might have escaped, but Queen Anne's husband, Prince George of Denmark, Lord Admiral, was interested in astronomy and horology, and in the problems of finding longitude. (Which was to lead by 1714, to the establishment of the Board of Longitude and the offer of a prize). He was keen to see the astronomical clock updated.

In 1707, Wren, then aged 75, presented his designs for a new top to the clock tower to Queen Anne and Prince George. Prince George died the following year but the project was to go ahead. The picture from a small part in an engraving of Hampton Court about 1710 shows the clock as it looked before the changes we see today.



Langley Bradley's Clock

Queen Anne's Clockmaker William Herbert had given the Hampton Court clock a complete overhaul and restoration in 1702. But Sir Christopher Wren had plans for the clock tower which did not include working with Herbert.

Wren, wanted Langley Bradley, a clockmaker in Fenchurch Street, London, to make a completely new clock to run the existing astronomical dial, which would be refurbished to tone in with the new baroque decor. In fact Wren wanted to replace Herbert by Bradley as official clockmaker to Queen Anne.

Wren promoted his friend Bradley in a letter to the Lord Chamberlain's Office in 1711, as

"a very able artist, very reasonable in his prices"

Herbert he claimed as unfit for the job as he had become bankrupt. This was a very unfair comment since Herbert's sad financial condition was caused by the royal accounts remaining unpaid. Anyway the Lord Chamberlain's Office replied:

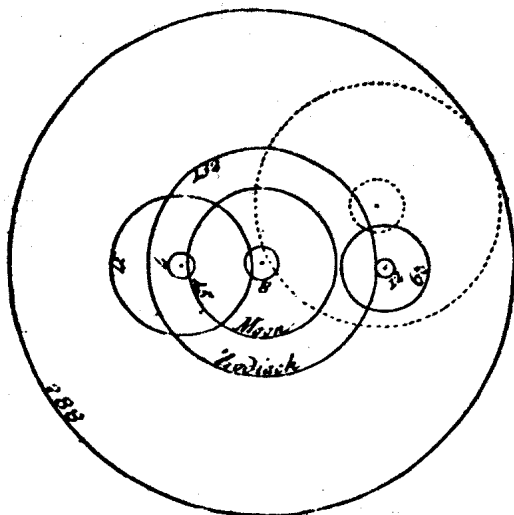
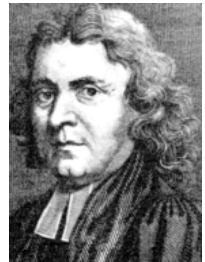
"this is certain can confer no right to the works on Sir Christopher's part."

They pointed out that the Queen's clockmaker was appointed by warrant to deal with her Majesty's clocks, and that the Office of Works was not entitled to consider that turret clocks came under their provenance merely because they happened to be part of a building.

Wren wanted to employ Langley Bradley at Hampton Court because he had worked with him on numerous other projects, the most famous of which was the clock in the new St. Paul's Cathedral. Official opposition to Bradley was justified by the fact that Bradley's clock at St. Paul's had been a costly failure, resulting in years of acrimonious dispute, pamphlets, accusations of fraud, and a government commission under the chairmanship of Sir Isaac Newton.

Langley Bradley's clock at St. Paul's Cathedral, was so inadequate as well as unsafe, it could not even be effectively altered. The whole expensive machinery had to be scrapped and a new clock was commissioned from Wright and Street. This much sturdier machine lasted until 1892. It was replaced by the huge nineteen foot, six inches long clock mechanism, designed by Lord Grimthorpe and made by John Smith and Sons of Derby, still working today.

Before the Clock Tower at Hampton Court was rebuilt by Wren and the new clock was installed by Langley Bradley, Bradley's friend William Derham went up the tower to get a description of the clock for the 1714 edition of his book **"The Artificial Clockmaker"**. (It was not mentioned in the 1696 and 1700 editions). In Chapter 6 pages 91-92 Derham states:

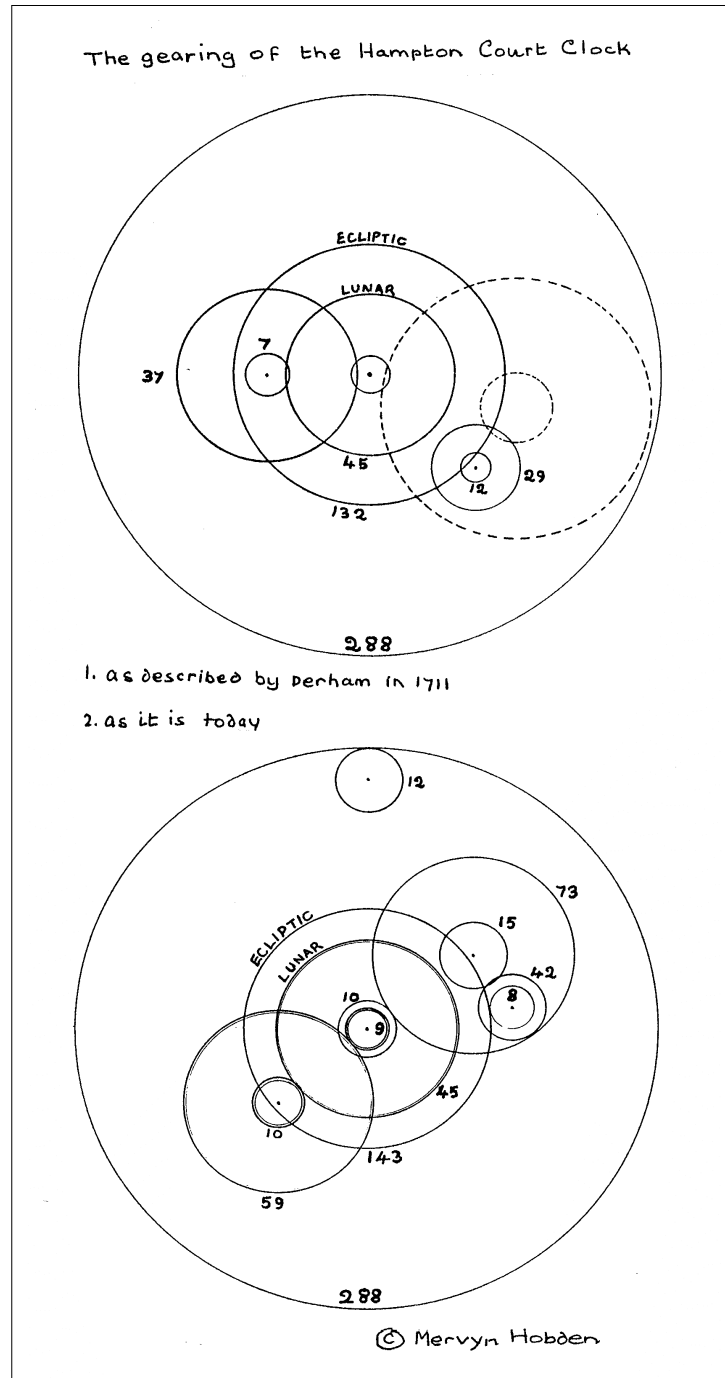


"And at this very day there is a Stately Clock in his Majesties Palace at Hampton-Court, whose Inscription shews it to have been made in King Henry VIII's time by one N.O. in the year 1540; which for its antiquity and good contrivance I have given the Calliper of in fig.4 and shall say more of in Chapter 10.

In Chapter 10 pages 120-122, "I shall, for the rarity thereof, present the Reader with a short account of the Hampton-Court Clock before mentioned, made A.D.1540; which shews the Time of the Day and the Motion of the sun and Moon through all the Degrees of the

Zodiack, together with the matters depending thereon, as the Day of the Month, the sun and Moon's place in the Zodiack, Moon's Southing, etc.

To shew how compleatly (for that age) the Wheel-work is laid under the Moving-part of the dial-plate I have given the Callibre thereof...(see diagram) which represents the several Wheels and Pinions only, which lye under the dial-plate, and drive the several Motions in this manner. In the Center of all, both the Dial-plate and its Wheelwork is placed on a fixed Arbor, which hath a Pinion of 8 on the end of it, which drives both the solar and Lunar Motions, by means of a large Wheel of 288 Teeth turning round upon it once in 24 hours; which large Wheel is driven round by a Pinion of 12 fixed on the Arbor of the great-Wheel within the Clock, which turneth round once in an hour. The Wheel 288 thus turning round in 24 hours, carries about with it the Wheel 37 and its Pinion of 7 Leves, as also the other prickt Wheel, and its Pinion, on the other side. The Pinion 7 of the wheel 37 drives another Wheel of 45 Teeth, which carries round the Moon's Ring or circle. On the opposite side



the aforesaid Pinion 8 drives round the Prickt Wheel, whose Pinion drives a Wheel of 29 Teeth, whose Pinion of 12 Levels drives round the Wheel 132 that carries the sun round, and the Zodiacal matters. These were the numbers of the Wheel-work remaining in the year 1711. But the Prick'd Wheel and Pinion was taken out formerly, I suppose by some ignorant Workman that was not able otherwise to amend the Clock: (could be a jibe at Herbert) but were supplied, and the whole Movement repaired lately by that skilfull Artist Mr. Lang. Bradley in Fenchurch-Street, London."



Wren had the top of the clock tower rebuilt to accommodate the incongruous Baroque belfry we see today. The belfry housed the original hour bell and two smaller bells for striking the half and quarter hours. These had been cast in the 1530s by William Culverden and moved here from another part of the palace.



To allow space for the two-second, fourteen foot long, pendulum of the new clock works by Bradley, the clock movement was inserted on an extra floor squeezed in over the original clock room on the roof under the new belfry. The pendulum came down into the original clock room on one side. It is just possible to see the marks on the plaster where the niche made for the pendulum in the wall was covered up in the 19th century. The



original window on the opposite side of the room next to the fireplace, was blocked up. The window frame is still visible in the room, and the position of the window can be discerned in the brickwork outside. New windows were placed where the original clock dials had been. Later, when "Gothic" and "Renaissance" styles became fashionable they were replaced with windows matching the Tudor building. The dials were moved higher where we see them today.



facing clock court



facing base court

Access to the clock was now by way of the staircase in the tower on the side nearest the Great Hall. The door of the other staircase was blocked up by the rebuilding, as was another door, the one for the loo used by the guards on the roof.



Fascinating Discovery

Naturally we were curious to see what lay behind these doors blocked up since the early 18th century. Clock towers are not usually tidy. Debris is left around, along with the dust, dead mice and birds etc. accumulated so we had hoped to find bits from the earlier clock.

The Director of Works arranged for holes to be made in the doors, so on our next visit we could look in. There was nothing of interest at the top of the blocked up staircase. But the other door was much more interesting.

On the two lower floors, the loos had continued in use with updated sanitary ware. One was just off the kitchen of the flat below. The one off the previous clockroom, now under the clock, was provided ensuite facilities for the main bedroom of this flat. The bedroom was fitted out in repro Tudor style oak. There was a wardrobe with mirrored doors across the front of the great gap of the weights tower. We could see that in the ensuite, great lead pipes continued up.

Looking through the door to the loo, we saw the remains of the original brick jakes, almost intact, although it had been filled with junk left by Wren's workmen and the seat was missing.



Sad Decline

Bradley's clock at Hampton Court was not very much more successful than his clock at St. Paul's Cathedral. In fact he did not even always get the credit for this clock as an account of the clock in 1742 shows.

"Over the portal of the second quadrangle is a beautiful astronomical clock the workmanship and contrivance of the late celebrated Tompion on which are curiously represented the rising and setting of the sun, his gradual progression through the twelve signs of the zodiac, the various phases of the moon, and other such emblematical amusements as justly make it the object of universal admirations."

In fact Tompion had no involvement with the turret clock at Hampton Court. Langley Bradley's clock though had to be repaired not long after its installation and the escapement was changed.

The alterations made by Wren to the clock tower made access extremely difficult.

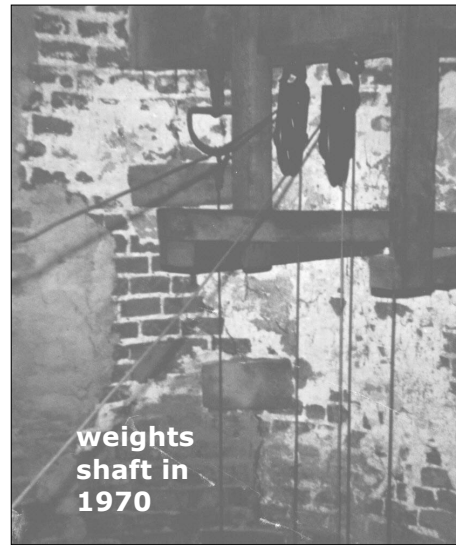
There are dark shadows despite the two windows that were put in the new clock room, and the lighting system has been for some time a bulb at the end of a wire. It is impossible to stand up without clouting



your head on a beam. Cables stretch across to trip you up and the weight shaft lies open and unprotected for you to fall down if not already caught up in the moving machinery. The place is



filthy with the dust of ages, the debris dumped by clock winders and maintenance, dead birds and mice and other horrors. Going up on the roof you find a low parapet just high enough to trip you over the edge, and barely room to edge round the dome.



When Dr. Pearson visited the clock in 1802 for his article in Rees Cyclopaedia, he complained

"the enterprise was attended with some personal danger".



Using Derham's book as reference, Pearson discovered that the clock had been altered since Bradley had installed it. The escapement had been changed from Bradley's anchor escapement to a pin wheel dead beat escapement. Evidence that Bradley's clock at Hampton Court had been fitted with an updated escapement when repaired, in an attempt to improve it. Pearson also found -

"on minute and careful examination, that the whole of both the annual and lunar movements are different from the original ones recorded by Dr. Derham".



This means that little or nothing remained of the original gearing at the back of the dial.

Pearson also noted that during the course of the day the clock was sometimes five minutes fast and sometimes five minutes slow.

Picture shows 18th century clock dial on the opposite side to the astronomical clock with second minutes dial above.

Stopped

After George II died on the toilet in 1760, Hampton Court was no longer used as a royal residence. His grandson, George III hated the place and preferred to live at Kew. The palace was not left empty, since the staff permanently in residence remained with their families who continued to squat there long after the official tenants had passed on. They were joined by friends and relatives and new squatters, fleeing the law, since arrests could not be made inside a royal palace. The people living there made an income by showing tourists round the palace.



As the palace was no longer in use by the King and his family, maintenance backslided. One day the clock stopped and no one was sent to fix it

To the Clock Without Hands at Hampton Court by G. P. R. James

Memento of the gone-by hours,

Dost thou recall alone the past?
Why stand'st thou silent 'midst these
towers,

When time still flies so fast?

Where are the hands in moments fled,
That marked those moments as
they flew,
To generations of the dead,
Who turned on thee their view.

To watch and greet the appointed time
Of every empty dream of joy.
Or wait in agony the chime
Which might such dreams
destroy?

To thee the eager eye was turned,
Of pride, of policy, and power,
And love's own longing heart has burned
To hear thee mark his hour.

Pleasure and pastime, grief and care
Have heard thee chime some
change of lot;
While the dull ear of cold despair
Has heard, but marked thee not.

And thou art silent now, and still,
While round thy mystic dial runs
The legend of man's hours - though ill
As thou, he marks the suns -

Those rolling suns - those rolling suns
Unchronicled by both go on;
Though still each comments as it runs,
Till man's brief day be done.

Man's heart's too like thy face! on it
Records of passing hours may
stand,
But stand unmarked by movement fit,
By chimes or pointing hand.

O dial! art thou raised on high
To speak reproach for life's
abuse?
Or give to eager hope the lie?
Or tell time's future use?
The future! Thou has nought to do
With it! The solemn past alone
Is that whereon thy comments go,

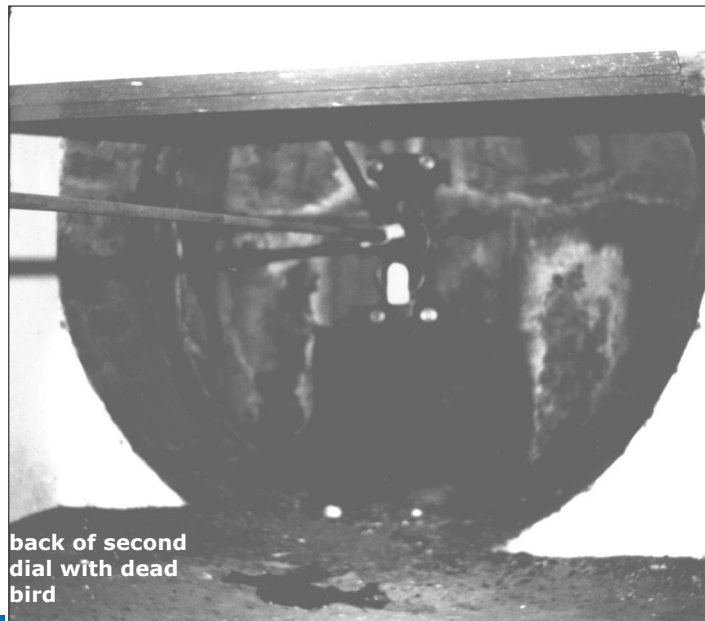
Fit gravestone of hours gone!
The future! Yes! at least to me
Thus plainly, thus, thy moral
stands
"Good deeds mark hours! Let not life be
A dial without hands."

King William IV to the Rescue - almost

The clock tower at Henry VIII's palace of St. James, which is part of the gatehouse there is very similar to the clock tower at Hampton Court. It was built by the same Master Mason, John Molton, at about the same time. The clock itself had been replaced several times.

In 1799 a clock with a slate dial had been made by the father of Benjamin Lewis Vulliamy whose shop was in Pall Mall, near St. James's Palace. When this clock was removed in 1831 and not replaced on the grounds that the clock tower was not strong enough to bear a clock, a great protest was raised by the surrounding neighbourhood, who pointed out that the clock tower had been strong enough to bear the weight of crowds of people watching William IV's coronation. The protesters were joined by King William IV and the King in 1835 commissioned Benjamin Lewis Vulliamy to make a new clock for St. James's and another for Hampton Court.

The clock for St. James's Palace was made first. At Hampton Court the old clock removed from St. James's was installed together with its slate dial. This is the clock dial we can see today facing the outer courtyard. The astronomical dial was removed and put away to await restoration and the hole it left in the tower was boarded up. Vulliamy never got round to making a new clock for Hampton Court and the drawings he made were lost.

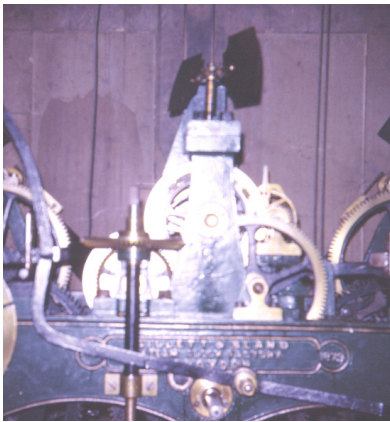


Queen Victoria reorganised Hampton Court. It was officially opened to the public, H.M.'s government taking the entrance fees. The grounds were made into a public park, with the maze as a popular feature. Those parts of the building which it was thought would be of little interest to tourists were made into "Grace and Favour" apartments. These are rent-free flats given to retired servants of the Crown. The accommodation and tenants were supervised by the Housekeeper.

Flats at Hampton Court were in great demand, but they were not very well designed for comfort, safety or convenience even by 19th century standards. One of these was the flat under the clock which we have already described. There was a lift for easier access, but it is hard to imagine how anyone could get a good night's rest in a bed directly under a huge turret clock with clonking mechanism, chiming every quarter of an hour on huge mediaeval bells which can be heard all over Hampton Court and beyond.

Restoration

In 1879, the astronomical dial was discovered in a storeroom. The Board of Works commissioned Gillet and Bland of Croyden (now Gillet and Johnson) to make a new clock to drive both the slate Vulliamy dial and the astronomical dial which was to be restored **"to its original condition, the same as it was when put up in the year AD 1540"**



The inscription on the clock reads "Gillett & Bland-Steam Clock Factory – Croyden. The new clock with the restored dial was installed in March 1880. The clock movement has a central going train with the quarter and hour trains on either side, the whole carried in a cast iron flat bed frame. The striking work is locking plate.

There is a remontoire in the central part of the frame using two small auxiliary weights mounted on quadrant arms with lengths of clock fusee chain, each weight being used alternately, every 15 seconds, to drive the double-three-legged gravity escapement.

The one and a quarter second pendulum with zinc and iron compensation is shorter than the one of Langley Bradley's clock and therefore does not hang down into the room below. (Which is just as well since there was a bed directly underneath, the pendulum would have sliced across it.) As the remontoire rewinds, every 15 seconds, the motion shafts advance, moving the dials. As is traditional, coins were put on the pendulum to adjust it. A gleam of gold attracted our attention on one visit, but it was only part of a bracelet.

The clock was driven by three weights, one of 400 kg. for the going train, and two of 230 kg. each for the hour and quarter strikes, and it was wound twice weekly.

52

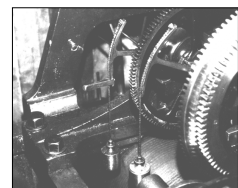
Hampton Court Palace

11/79

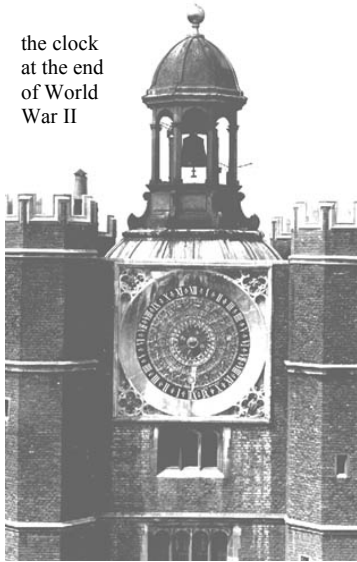
Restoring the Astronomical Clock

A. Stuart, Clerk sufficiently powerful
must be trusted to be in person. Bill of account
sent and to King Henry's Station and the
The other two will be to show them again
the present dial) and to also give all
the necessary instructions to the Astronomical
Dial showing days, months, signs of Zodiac
and degrees in each, date and position
of the Sun, Age of the Moon, days and
nights of days, also phases of the
Moon, and when it becomes the Moon
the Dial to be thoroughly restored to its
original condition the same as it was
when first put up in the year AD 1540
Years of London's printing (1540) in an Astronomical
Museum
The Astronomical figures on the Dial, some
of them, should outside of Astronomical
Dial to be painted, and also
Clarity except
Compensation 1/4 the Pend. Steel Rod
which should have been 14.14.18
To have a Remontoire Train
from main lines
Including forcing, which guarantee for 10
the and 2-3 day from then 5 day 10 years 200
Costs in Completion of forcing
not including Compensation work of any kind
Not including any changes, painting, etc.
to be restored

11.16.18	75.0.0	Remontoire	10
Rest done	5	Work on Dial	10
	68		
King Henry	32	Leaves, etc.	10
Young & Wile	14.8	Painted Dial	31
Paint	4.0.0	Materials	3.17.6
Carrying Exp	5		132.5.6
	113.8.0	London	210.0.0



the clock
at the end
of World
War II



After World War II, in 1947, the clock was overhauled. It was restored more thoroughly in the winter of 1959 to 1960. The restoration work and continued maintenance of the clock was carried out by Thwaites and Reed Ltd. The surrounding stonework with the badges of Henry VIII was restored, and the outer scale of hours repainted onto a metal ring fixed to the stone work.

The dials were taken down to be repainted by Gregg & Son of Clerkenwell. The intention was to restore the dial to its original colours. But the pointer of the inner dial was painted gold, thus rendering it invisible against the gold dial. This was pointed out by me in 1970, and it was repainted in black after I said that I would mention it in the guide book. The error had actually been copied in the replica of the dial made in 1965 for the Science Museum. This is of wood two thirds the size of the original and is driven by an electric motor. The gearing is slightly different.

The original clock room under Wren's new cupola and clock room, and the rooms about it formed one of the "Grace and Favour" apartments in George III's reign and was tenanted for about 200 years. Mrs Margaret Vesey was the tenant 1818 to 1841, other members of her family also lived in the palace, including her son-in-law who stayed there to avoid being arrested for debt. Since it was still a royal palace its occupants were protected from arrest for civil offences and the bailiffs could not get at him as long as he remained inside. In 1841, Admiral Sir George Richard and his wife and family moved in under the clock.

From 1872 to 1902, the flat under the clock was occupied by Lady Emily Gordon-Moore, widow of Lord Cecil James Gordon-Moore. They had been married in 1841 and had 10 children. Two unmarried daughters, Adela and Evelyn lived with her. Her brother-in-law and his family had lived in another part of the palace, continually coming into conflict with the authorities until 1865 when bailiffs after Lord Gordon ignored the quaint concept of the palace as sanctuary and seized most of their furniture.

From 1902 Lady Katherine Keyes was living under the clock, from 1916 Mrs Alice Madden widow of Edward VIII's Surgeon-General, in 1925, Mrs Evelyn Galloway lived there and moved out in 1934.

The last tenant from 1935 to 1957 when she died aged 87, was Mrs. Caroline (Lina) Offley Shore. Born in Philadelphia, her mother was from a wealthy Jewish family who had supplied quinine to the United States Army in the Civil War. Lina and her younger sisters were society belles and travelled abroad with their mother, but it was not until she was 37 that she met and married Offley Shore, then 45, of the 18th Tiwana Lancers, India Army. He looked very dashing in his exotic uniform, and Lina was presented to the King and Queen at Court. She found out later that the ancestral residence of Norton Hall had been sold when his grandfather went bankrupt.

They lived in India, until 1917, when moved to London, as Offley was sent on a mission to Tiflis. In 1919, when he left the army they went to the USA, and Lina hoped to buy a house in California. They could not afford a house they wanted, and were in Scotland in 1922 when Offley died. Lina lived in a flat in London, and was thrilled when in 1935 she was offered the apartment in the Clock Tower at Hampton Court Palace.

Less so when she saw the state it was in. After nearly three years of restoration. Finding dry rot, crumbling stone, and other effects of age and neglect. She was compensated by discovering many interesting features of Tudor times, when Wolsey, and then Henry VIII lived there. She wrote in her visitor's book: "I came here May 10 1938 to live in this most lovely part of this loveliest of old palaces."

We were able to see what remained of her furnishings in the 1970s. Reproduction Tudor oak panelling was used – which was fashionable at the time and also fitted the period of the building. A lift was installed, as an alternative to the spiral stone staircases.

The main bedroom was just under the clock in the original clock room. Above the ceiling over the oak-framed double bed ticked Gillet and Bland's turret clock movement with winding gear, ringing the large bells every quarter of an hour. The Tudor jakes were updated to make an ensuite. In the other corner is the open shaft of the weights tower. This was protected only by a large oak-framed triple mirror, closed it resembled a wardrobe. But it was a potential danger to an elderly lady stumbling in the wrong direction in the early hours. The bedroom must have been draughty with the open shaft, two windows, and two doors on opposite walls – one leading to the servants' rooms above the staircase to the great hall, the other to the rest of the flat.

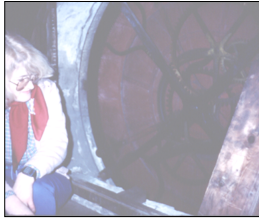
On the floor below, the door to a toilet – in the jakes tower – led directly off the kitchen in contravention of later housing regulations.

When the flat was empty once more, the building became neglected and increasingly derelict.

In 1975, after our first visit, the clock was given an electrical winding system, which meant it was no longer visited for winding and maintenance twice a week.

The clock mechanism itself had been kept in good condition, but now it was no longer regularly attended to, it and its surroundings became increasingly filthy and derelict. In 1983 (when we observed the same dead mouse and dead bird in the same positions as on previous visits) we were not allowed to climb out onto the roof as it was no longer considered safe. A shop had been made on the ground floor of the building.

The clock and its tower should be fully accessible to interested visitors, since it is an extremely important part of Britain's industrial heritage and much still remains to be discovered.



Finding Out About The Clock

By the end of the 17th century the name of the maker of the clock had been forgotten, all that was known was what Derham reported, the initials "N.O" and the date "1540" were inscribed on the clock. The only Tudor clockmaker or astronomer working for the Crown who was known to 19th century historians like Ernest Law, who wrote a history of Hampton Court Palace where he lived, was the Bavarian astronomer, Oxford academic, friend and drinking companion of Henry VIII, Nicolas Kratzer. Law assumed the initials "N.O" might really have been Kratzer's "N.C.". In fact Kratzer specialised in sundials, and is not known to have made any mechanical clocks. And he spelled his name Kratzer.

While some of the history of the clock could be found in old papers - the accounts for the building and maintenance of the palace, for example, these records have many gaps, being depleted over the centuries by pilfering, fire, war etc. Our investigations which began in 1970 with the writing of the first guide book to the clock (*The Astronomical Clock: Hampton Court Palace*, HMSO, London, 1973) also involved clambering and poking around in the filthy and decrepit chambers in and around the clock tower, over the roof tops and through blocked-up doorways.

In 2007, the clock was restored by the Cumbria Clock Company. They had samples of the metal in different parts of the clock tested. They also concluded that the bar with N.O. 1540 was possibly a 19th century replacement. They also observed that Gillet & Bland had restored the paintwork on the dial going by the traces of paint still remaining on the copper dials. However this is nothing like the colours and designs mentioned in the late 16th century and the design looks more like late 17th early 18th century, so probably dates from the restoration by Wren.

More updates with links can be found on the website:
<http://www.cosmicelk.net/hamptoncourtclock.htm>.

Acknowledgements and Feedback

We were helped greatly by staff at Hampton Court, especially in 1978 by the Director of Works at that time, Harry Sellens. And in 1970, by the Principal Inspector of Ancient Monuments, John Charlton who commissioned the original booklet on the clock, and later by Juliet Allan. When we returned in 1978, the old apartments under the clock had been emptied prior to restoration work so we were able to examine far more of the building. In this way we were able to reconstruct the positions of the earlier clock mechanisms of the 16th, 17th and 18th centuries and discovered another example of Tudor technology, the remains of a loo installed at the time the clock tower was built or earlier, blocked off since the early 18th century and full of junk from then. Although little official interest was shown in a more complete version of the booklet, the additional information we had was published in articles and publicized in lectures. This was to lead to the publication of the Cosmic Elk booklet and website. We are grateful for the many interesting and helpful comments from recent visitors and the restorers, such as the Cumbria Clock Company, and people working at Hampton Court, about the clock and its surroundings – this feedback is extremely useful.

Some References and Further reading

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- card guide to the Hampton Court Clock HMSO 1984.

Information on inhabitants of the Clock Tower, in the booklet by Hampton Court Palace "Grace and Favour" in the 19th century" by Gerald Heath ISBN 0903341492 –from the Twickenham Local History Society 1988. and in a booklet by Sarah Parker 2005. Biography of Mrs Caroline Offley Shore by Alan Jones, "An Enchanted Journey" 1994. Many books on Hampton Court, including many informative and well illustrated, published recently – not listed below, and the Historic Royal Palaces website. Mervyn and Heather Hobden have also given talks on the clock.

More information on the website: <http://www.cosmicelk.net>.

Illustrations

- p.3. Clock Tower, diagram uses part of an aerial photo of Hampton Court, view of Hampton Court showing the entrance and the Clock Tower uses copy of an engraving dated 1558.
- p.4. Astronomical dial with labels and
- p.6. Clock Tower showing excavations of earlier bell tower 1970 and
- p. 8, the spiral staircase, the roof walkways – copyright Heather Hobden.
- p.9 from a copy of the portrait painted by Holbein of Nicolaus Kratzer in 1527.
- p.10. The inside of the clock dial showing gearing and "N.O.-1540", and
- p.11. Walkways on roof for guards, which originally led to roof of clock-tower and a toilet for the use of guards there which is the one in the present clock room, and
- p.11. Remains of ensuite, 1978, in bedroom of grace and favour flat below clock. Before the 18th century this was the for the convenience of the clock room, and the dials of the clock were situated where the windows of the bedroom are, and
- p.11. Blocked window in room now below the clock. Copyright Heather Hobden
- p.14. from small part of illustration dating from about 1710 of Hampton Court showing the clock tower just before the changes we see today.
- p.15. Derham and his diagram
- p.16. Diagram showing gearing as described by Derham in 1711 and in 1978 by Mervyn Hobden. Copyright Mervyn Hobden
- p.17. The belfry, the top of the clock tower, Mervyn Hobden in 1978 climbing the belfry and inside it, the cracks where the space for Langley Bradley's pendulum fitted, the windows put in when clock tower altered in 1713, the blocked up door and what was revealed behind it, and
- p.18. The weights tower in 1970, before the electrical winding system was installed. in the clockroom 1978, view from roof showing jakes tower, view from room showing parapet facing base court, all copyright Heather Hobden.
- p.18. Clock dial on the other side 1826. Part of copy of picture.
- p.19. "The Clock With No Hands" 1837. In a part of a copy of picture.
- p.20. The back of Vulliamy's clock dial. Photos taken in 1978 and 1983 show same dead bird. Copyright Heather and Mervyn Hobden. Outside of clock dial.
- p.21. Invoice from Gillet and Bland for the new clock in 1879 (photocopy of page from Gillet and Johnson). The 1879 clock works, the remontoire, the pendulum (detail) - copyright Mervyn and Heather Hobden
- p.22. The clock at the end of World War II from copy of photo given to us.
- p.24. Heather Hobden with dial 1983 photographed by Peter Hobden.

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Inside The Hampton Court Clock – latest update:
by Heather Hobden
 author of the official guides to the
 astronomical clock at Hampton Court Palace
 with information that was excluded from the official guide
 books on all the clockmakers involved in the construction,
 repair and maintenance of this famous clock and of the
 fascinating discoveries such as the hidden Tudor loo
 contents listed inside back cover

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