Sir Christopher Wren

Born: 20 Oct 1632 in East Knoyle, Wiltshire, England
Died: 25 Feb 1723 in London, England

Christopher Wren's father was also called Christopher Wren. Christopher Wren senior was a well educated man, having graduated from St John's College Oxford before entering the Church. He became rector of Fonthill, Wiltshire in 1620 and then East Knoyle, Wiltshire in 1623. He married Mary Cox, the only child of the Wiltshire squire Robert Cox from Fonthill, and it was while they were living at East Knoyle that all their children were born. Mary, Catherine, and Susan were all born by 1628 but then several children were born who died within a few weeks of their birth. Their son Christopher was born in 1632 then, two years later, another daughter named Elizabeth was born. Mary must have died shortly after the birth of Elizabeth, although there does not appear to be any surviving record of the date. Through Mary, however, the family became well off financially for, as the only heir, she had inherited her father's estate.

In 1634 Christopher Wren senior was offered the position of Dean of Windsor, a post held by his brother Mathew Wren who was becoming Bishop of Hereford. Christopher Wren senior was installed as Dean on 4 April 1635 and there the young Christopher was brought up by his father and by an older sister who slotted into the role of a mother to him. He grew up with the close friendship of another relation, for his uncle Mathew Wren had a son, also called Mathew Wren, who became part of Christopher's close family. Another childhood friend was the son of Charles I, the Prince of Wales, and they often played together.

Physically Christopher was a rather frail child who was quite small in stature. He loved drawing from a young age and he developed this markedly as he grew older. Science fascinated him, he showed a natural curiosity in everything around him and loved to conduct little experiments which he devised himself. Christopher had a private tutor during his early years, then when he was nine years old he was sent to Westminster School in London. This school was run by Dr Busby who was noted both for the exceptionally strict discipline he maintained and for his considerable ability which led to great success for many of his pupils. At this school Christopher quickly became proficient in Latin and this is shown by letters he wrote in Latin to his father which still survive.

The Wren family, obviously much favoured by the King, were staunch Royalists. This led to difficulties when, not long after Christopher began his schooling at Westminster, the English Civil War broke out between King and Parliament. Matthew Wren, who was by this time the Bishop of Ely, was imprisoned in the Tower of London for eighteen years. The deanery at Windsor was attacked and Christopher's father was forced to move out. At first he went to Bristol but, when Christopher was eleven years old his sister married William Holder and shortly after this Christopher Wren senior went to live in the rectory in Bletchingham, Oxfordshire, the home of his daughter and son-in-law. William Holder was a mathematician and was to have a very strong influence on Christopher who spent much time at Bletchingham. Holder essentially took on the role of mathematics tutor to Wren and also encouraged him to experiment with astronomy.

In 1646 Wren left Westminster school but he did not enter university immediately. During the next three years he built up a broad knowledge of science. We know of experiments he made with sundials, probably in 1646, and also a pasteboard model of the solar system which exhibited his artistic as well as astronomical skills. He was employed as an assistant to Dr Charles Scarburgh, helping him with various anatomical experiments. Wren created pasteboard models to illustrate how muscles worked which Scarburgh used for demonstrations during his course of anatomy lectures. Some have conjectured that Wren's health at this time may have been poor and that this may have led to him being sent to Dr Scarburgh for treatment. Whatever the reason, the work Wren

carried out for Scarburgh was his first significant scientific contribution. After this, and still before entering university, Wren was recommended to Oughtred as an appropriate person to translate into Latin his work on the mathematics of sundials.

Wren entered Wadham College, Oxford on 25 June 1649, received a B.A degree on 18 March 1651and his M.A. from Oxford in 1653. He was elected a Fellow of All Souls, Oxford, in 1653 and lived in the College until 1657. At Oxford Wren carried out many scientific experiments. He worked on anatomy, making drawings of the human brain for Willis's *Cerebri anatome.* He devised a blood transfusion method which he demonstrated by transfusing blood from one dog to another. Perhaps what was most remarkable about the years Wren spent in Oxford was the breadth of his interests. His mind leapt from one topic to another as he came up with ideas such as: an instrument to measure angles, instruments for surveying, machines to lift water, ways to find longitude and distance at sea, military devices for defending cities, and means for fortifying ports. Summerson writes in [14]:-

The diffusion of his abilities is amazing and frustrating to us as it very possibly was eventually to himself.

In 1657 he became Professor of Astronomy at Gresham College, London. He had been making observations of the planet Saturn from around 1652 with the aim of explaining its appearance. His hypothesis was written up in *De corpore saturni* but before the work was published Huygens presented his theory of the rings of Saturn. Immediately Wren recognised this as a better hypothesis than his own and *De corpore saturni* was never published.

It is interesting to look at the topics that Wren covered in his inaugural lecture on taking up the chair at Gresham College. As well as speaking of ways that astronomical arguments could be used to explain difficulties in the biblical account of Christianity, he spoke of the distance to the nearest fixed star:-

... and yet probably some are infinitely more remote than others.

He discussed Kepler's theory of elliptical orbits for the planets and looked forward to the day when this could be properly explained. We should note that although Newton, about 30 years later, proved the connection between the inverse square law and elliptical orbits, Wren himself (as did Hooke) both independently suggested the inverse square law of attraction.

Also in his lecture Wren talked of the discoveries which had recently been made concerning the sun, moon and planets using the telescope. In particular he spoke of sunspots and of applications of the moon to the problem of determining longitude at sea:-

... so by the professors of this place was augmented by the first invention and observation of the mutation of the magnetical variation; a thing, I confess, as yet crude, yet what may prove of consequence in philosophy, and of so great use, possibly to the navigator, and thereby we may attain the knowledge of longitudes, than which, former industry hath hardly left any thing more glorious to be aimed at in art.

Wren was part of a scientific discussion group at Gresham College London that, in 1660, initiated formal weekly meetings. He undoubtedly played a major role in the early life of what would become the Royal Society, his great breadth of interests and his expertise in so many different subjects helping in the exchange of ideas between the various scientists. His lectures at Gresham also provided a focal point for meetings of the scientists prior to the formal inauguration of the Royal Society. In fact the report of the meeting at which the Royal Society was founded reads:-

Memorandum November 28 1660. *These persons following according to the usual custom of most of them, met together at Gresham College to hear Mr Wren's lecture, viz. The Lord Brouncker, Mr Boyle, Mr Bruce, Sir Robert Moray, Sir Paule Neile, Dr Wilkins, Dr Goddard, Dr Petty, Mr Ball, Mr Rooke, Mr Wren, Mr Hill. And after the lecture was ended they did according to the usual manner, withdraw for mutual converse.*

In 1662 this body received its Royal Charter from Charles II and 'The Royal Society of London for the Promotion of Natural Knowledge' was formed. In addition to being a founder member of the Society, Wren was president of the Royal Society from 1680 to 1682.

Wren became Savilian Professor of Astronomy at Oxford in 1661 and held this post until 1673. It was after this appointment that he made his important contributions to mathematics. Newton, never one to give excessive praise to others, states in the *Principia* that he ranks Wren together with Wallis and Huygens as the leading mathematicians of the day. Whiteside writes in [16]:-

Wren's mathematical work now exists, if at all, in detached fragments rescued from oblivion, some in print, and a little more in bare outline in the published work of contemporaries, especially Wallis.

Wren's fame in mathematics resulted from results he obtained in 1658. He found the length of an arc of the cycloid using an exhaustion proof based on dissections to reduce the problem to summing segments of chords of a circle which are in geometric progression.

He was the first to resolve Kepler's Problem on cutting a semicircle in a given ratio by a line through a given point on its diameter. This problem had a basis in astronomy for it had arisen in Kepler's work on elliptical orbits. Kepler reduced finding the mean motion of a planet to that of cutting an ellipse in a given ratio with a line through a focus. In addition to solving Kepler's Problem, Wren independently proved Kepler's third law and, as we noted above, formulated the inverse-square law of gravitational attraction.

Another topic to which Wren contributed was optics. He published a description of a machine to create perspective drawings and he discussed the grinding of conical lenses and mirrors. Out of this work came another of Wren's important mathematical results, namely that the hyperboloid of revolution is a ruled surface. These results were published in 1669.

Work on the logarithmic spiral, which had been rectified by Wallis in the late 1650s, led Wren to note that it was possible to consider an area preserving transformation which would transform a cone into a solid logarithmic spiral. This, he remarked, resembled snail shapes and sea shell shapes, ideas which D'Arcy Thompson was to examine 250 years later.

It is not quite clear where Wren's interest in architecture first arose although we have noted his contributions during his Oxford days to military devices for defending cities and means for fortifying ports. Certainly he read *On Architecture* by Vitruvius, written in the first century BC, while he was a student in Oxford. In 1661 he was invited to work on the fortifications of the harbour at Tangiers and, although he turned down this request, it is interesting to realise that even in 1661 Wren was considered someone who might take on a major architectural project. In 1663 Wren visited Rome where he made a thorough study of the Theatre of Marcellus, examining both the ruins of the theatre and drawings that showed its original form. This was important in Wren's development as an architect and the influence of the Theatre of Marcellus is clearly evident in his early designs. A visit to Paris in 1665 was also influential, particularly the impression that the church of the Sorbonne and the church of Les Invalides made on him.

In 1663 he designed the chapel at Pembroke College, Cambridge, commissioned by his uncle the Bishop of Ely.

In the same year he submitted a model of his design of the Sheldonian Theatre, Oxford, to the Royal Society. This project, with its construction beginning in 1664, was the first of his projects to include the design of a dome. It is seen by Summerson as the point at which Wren the mathematician turned into Wren the architect [14]:-

The Sheldonian demonstrates perfectly the parting of the ways. Its architecture and decoration are immature ... The hissed roof structure, on the other hand (*not now existing*)*, was a most interesting study in the problem of designing trusses for the considerable span involved a real piece of 'Royal Society' research. So here in one*

building we have Wren working in both his capacities at once - as a neat decorative draughtsman and an experimental philosopher attempting to solve a practical problem in a new scientific way.

In 1668 building work began on Wren's designs for the Emmanuel College Chapel, Cambridge and the Garden Quadrangle, Trinity College, Oxford.

Wren's greatest opportunity in architecture came with the rebuilding that followed the fire of London of 1666. Appointed Commissioner for Rebuilding the City of London in that year he carried out a survey of the area destroyed by the fire with the help of three surveyors, one of whom was Robert Hooke. Wren replanned the entire city and supervised the rebuilding of 51 churches. For example in 1670 he was architect for the following London buildings: The Custom House, St Christopher-le-Stocks, Threadneedle Street, St Dunstan in the East, St Benet Fink, Threadneedle Street, St Vedast, Foster Lane, St Dionis Backchurch, Fenchurch Street, St Michael, Wood Street, St Mildred, Poultry, St Olave, Old Jewry, St Mary-at-Hill, Thames Street, St Mary, Aldermanbury, and St Edmund King and Martyr, Lombard Street.

The year 1670 marked his appointment as Surveyor for Rebuilding the City Churches. With Hooke as an assistant he was given the task:-

... to direct and order the dimensions, forms and models of the said Churches.

It is worth noting that despite the remarkable number of designs Wren was working on at this time, he still held the Savilian Chair of Astronomy at Oxford. Clearly his love of the academic world made him reluctant to cut his links with it despite his position by this time of Britain's leading architect.

In 1669 Wren was appointed as Surveyor of St Paul's Cathedral. He had been involved in repairs of the old cathedral in 1663 and he was a natural choice to take over this role when, in 1669, he was appointed Surveyor-General of the King's Works. This appointment may also have convinced Wren that he was now secure enough to marry, for he married Faith Coghill, the daughter of Sir John Coghill of Bletchingham. Wren had spent much time with his brother-in-law William Holder in Bletchingham and had known Faith for a long time. The marriage lasted for only six years for Faith died in September 1675 shortly after giving birth to their second child. Wren, left with two young children, soon married again, this time to Jane Fitzwilliam in 1677. Wren's second marriage was, sadly, shorter than his first since Jane died of tuberculosis in 1679. There were two children from this second marriage.

Wren is best known today at the architect for St Paul's Cathedral. We noted above that he was appointed as Surveyor of St Paul's Cathedral in 1669. His first design for the new cathedral was rejected by London City Council as not sufficiently grand and Wren produced a second plan together with a model in 1674. This second plan was based on a Greek design which was rejected by the clergy as not in keeping with the proper form of a Christian church. Wren, despite the tragedy in his personal life at this time and his great disappointment at the reaction to his plans for St Paul's, set to work again and produced a third design based on a Latin Cross with a large dome. This third design would form the basis for the plans for the Cathedral that we see today, but Wren modified them as the work progressed over a period of 35 years. As Wren was already 43 years old when the project began, he might not have been expected to live to see its completion. However, he lived to the age of 90, and St Paul's Cathedral was completed 12 years before his death.

In 1675, the year in which Wren's plans for St Paul's were accepted, he received a commission from Charles II to build a Royal Observatory for Flamsteed who had been appointed as Astronomer Royal in that year. As is so often the case the King was short of money so Wren had to design a building to be constructed 'on the cheap'. Of course Charles II was not having an observatory built to push forward scientific research, rather he wanted a

solution to the longitude problem which would give England a huge advantage over its competitors as a sea-faring nation.

It is impossible in an article of this length to give even an indication of the range of architectural commissions which Wren carried out. We should, however, mention two further works. In 1696 he was appointed Surveyor of Greenwich Naval Hospital, and three years later Surveyor of Westminster Abbey. He resigned the former role in 1716 but held the latter until his death.

He died after catching a chill while travelling to his London home in February 1723 and was buried in St Paul's Cathedral on 5 March under the south aisle of the choir at the east end.

We can understand a little of Wren's character when we realise that he remained friends with some of the most awkward people of his time, particularly Hooke and Flamsteed. Phillimore's account, written in the 19th century, of Wren's nature paints a glowing picture:-

Loving, gentle, modest, he was as a boy; and the famous architect possessed these qualities still. In a corrupt age all testimony leaves him spotless; in positions of great trust and still greater difficulty his integrity was but the more clearly shown by the attacks made against him ...

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