Sir Christopher Wren (1632-1723) Architect-Astronomer

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Themes

- Context of Gresham College
- Wren – background and early career
- Gresham Professor of Astronomy; the Royal Society
- Architectural works – how far influenced by astronomy?
- Case studies: St Pauls and The Monument
- The City churches and other works

Sir Thomas Gresham (1519-79)

Sir Thomas Gresham, 1544 (aged 26)

Sir Thomas Gresham, Antonis Van Doshorst, 1565-70 (aged 46-50)

- Financier, merchant, philanthropist
- Studied at Cambridge and as apprentice/merchant
- Royal agent for Henry VIII, Edward VI, Mary, Elizabeth I
- In Antwerp, Flanders, Spain
- Trading, negotiating loans etc - saved the monarchy from bankruptcy ('Gresham's Law')
- Huge estates; built 'Royal' Exchange – visited by Elizabeth I, 1571
- Son died in 1564

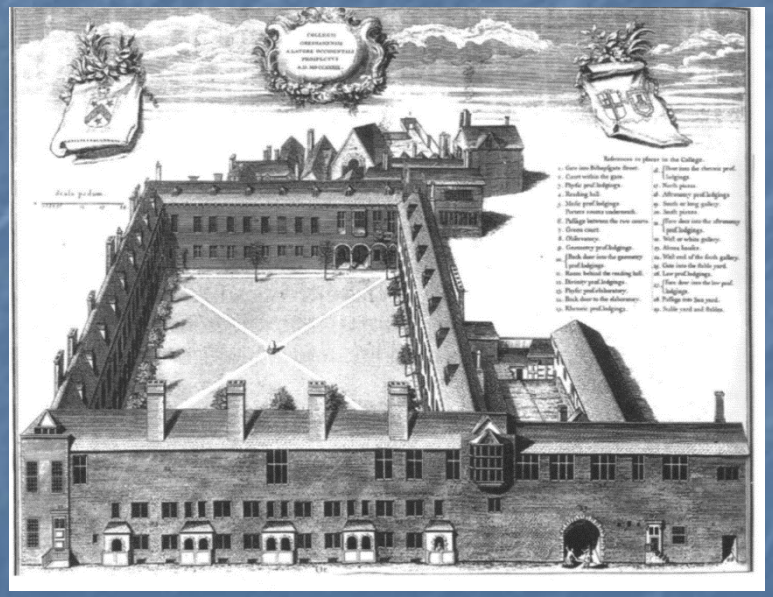
Sir Ernest Crofts,
Elizabeth and Gresham, 1899

23 January 1571

Gresham's Will, 20 May 1575

To appoint Professors in Divinity, Astronomy, Musick, Geometry, Law, Physick and Rhetorick '*for the benefit of the Mayor and Commonalty and Citizens of London, henceforth and …. for ever* '
[Commerce, Environment & IT added later]

'



Gresham's House in Bishopsgate, sold 1768

Gresham's Coat of arms (stars and comets)

Barnard's Inn

- Mainly 14th century; 16th century panelling
- Survived Great Fire 1666
- Gatehouse 1770
- Mercers' School 1892-1959
- Mentioned by Charles Dickens' *Great Expectations*
- Home of Gresham College from 1991

City of London, 1572

Sir Christopher Wren (1632- 1723)

- Early life and career
  - Father, Rector at East Knoyle and Dean of Windsor; Uncle, Bishop of Ely
  - Royalist family; in favour again after Cromwell d 1658;18 year Civil War
  - Studied - Westminster School; Wadham Oxford; Fellow, All Souls (1656)

From East Knoyle, Wiltshire …. to St Paul's Cathedral

Sir Christopher Wren (1632- 1723)

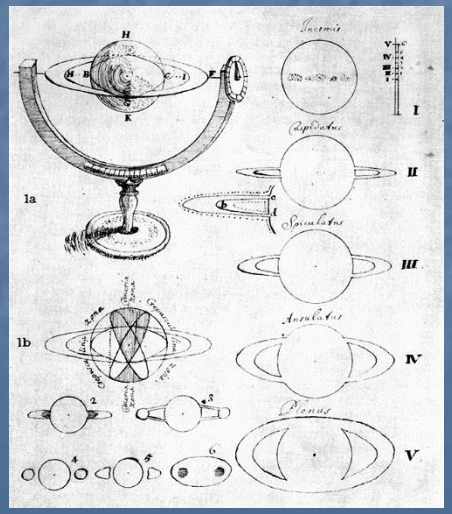
'Since the time of Archimedes there scarce ever met in one man in so great perfection such a mechanical hand and so philosophical mind.' (Robert Hooke)

- Early observational work; beginning age 13 with sundials and a '*panorgamum astronomicum*' (wheels and circles showing phases and movements); terrestrial magnetism; medical experiments (blood, transfusions); experiment as a way of testing hypotheses
- Familiar with the classics – especially Vitruvius, who significantly specified that it is essential for all architects to '*be acquainted with astronomy and the theory of the heavens"* (Vitruvius, *Ten Books on Architecture*)
- Came to specialise in astronomy; lunar surveys

Career as astronomer

- Gresham College - practice rather than theory
- '*The focus of scientific life in the capital' at the time*' (Hoskin)
- First Professorship of Astronomy
- 1657-1660 - Lectured (Wednesdays)
- Moon, Saturn, Satellites of Jupiter
- Cosmology; prediction of solar eclipses
- Aids to navigation; telescopes: astrolabe; longitude; optics; meteorology; mechanics
- Worked with Robert Boyle
- Influenced Newton's *Principia Mathematica* by challenging Hooke's explanation of motion round the sun
- 1661-68 Savilian Professor, Oxford; doctorate

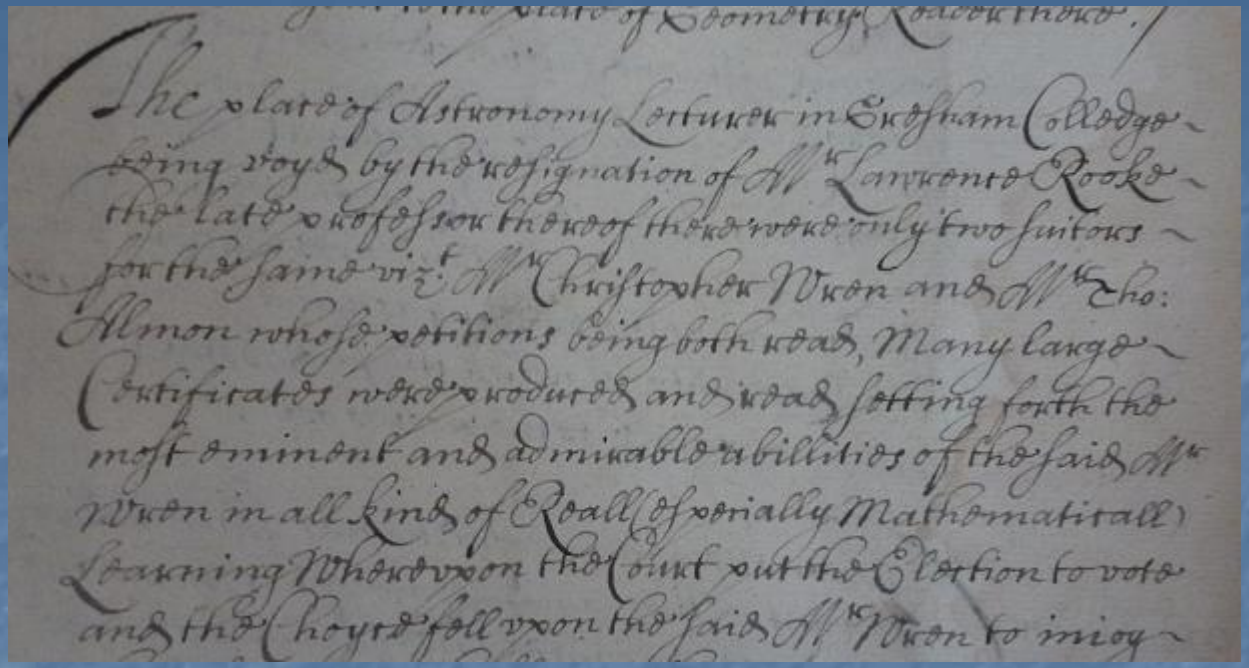
By Edward Pearce c 1673



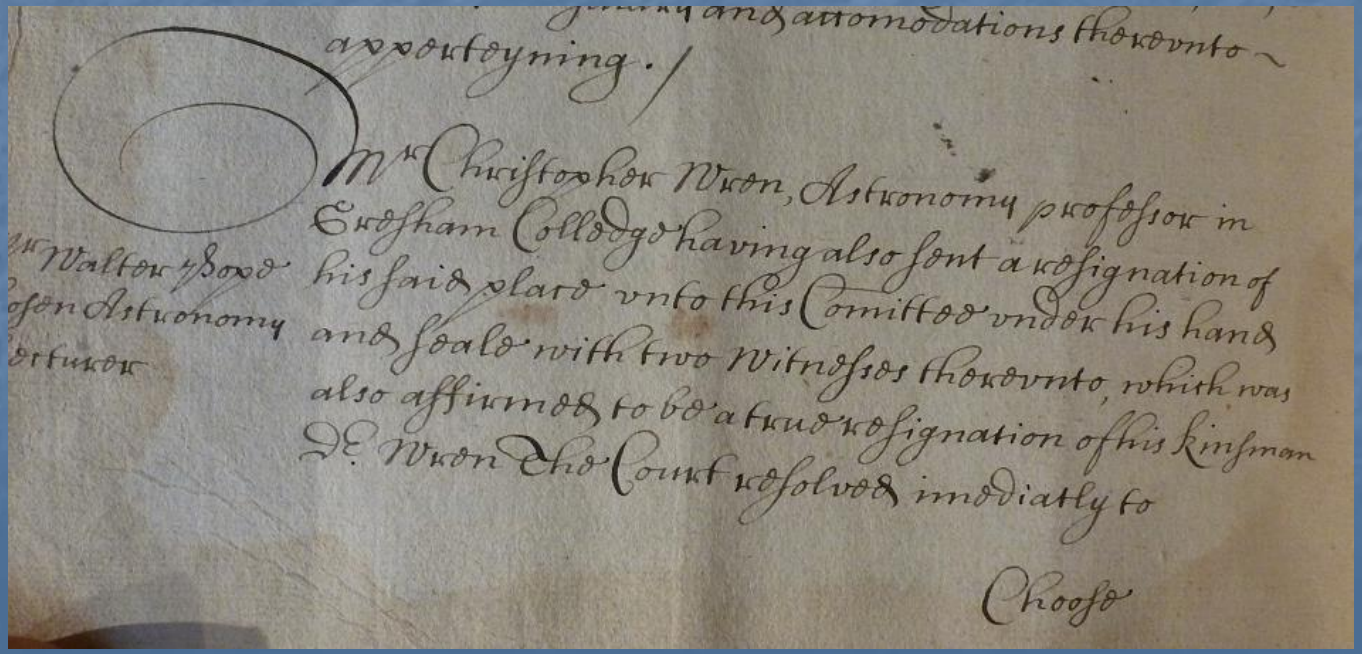
Wren's model and sketches of Saturn

Christopher Wren, 7 August 1657 - 1660

(age 25)



The place of Astronomy Lecturer in Gresham Colledge being voyd by the resignation of Mr Lawrence Rooke the late professor thereof there were only two suitors for the same viz.t Mr Christopher Wren and Mr Tho: Almon whose petitions being both read, Many large Certificates were produced and read setting forth the most eminent and admirable abilities of the said Mr Wren in all kinds of Reall (especially Mathematicall) Learning Whereupon the Court put the Election to vote and the Choyce fell upon the said Mr Wren to inioy



appertayning./

Mr Christopher Wren, Astronomy professor in Gresham Colledge having also sent a resignation of his said place vnto this Committee vnder his hand and seale with two Witnesses thereunto, which was also affirmed to be a true resignation of his kinsman Dr. Wren the Court resolved imediatly to

Choose

Mr Walter Pope chosen Astronomy Lecturer

Resignation 1660

Inaugural Gresham lecture – in Latin (also delivered in English)

- *'Oratio inauguralis, habita Londini in collegio Greshamensi per Christophorum Wren, astronomiae professorem electum, ann. 1657, aetatis suae 25.'*
- Extensive classical references, including Greek, Vitruvius
- Emphasis on Astronomy for navigation ('*Astronomia navigantium tutelam puma suscepit*')
- References to role of astronomy in geography and exploration; Christopher Columbus and circumnavigation; also summary of contributions of Copernicus, Galileo, Kepler
- Planets (esp work on Saturn), elliptical orbits, telescopes etc
- Acknowledges Gresham, and predecessor professors.

Foundation of the Royal Society

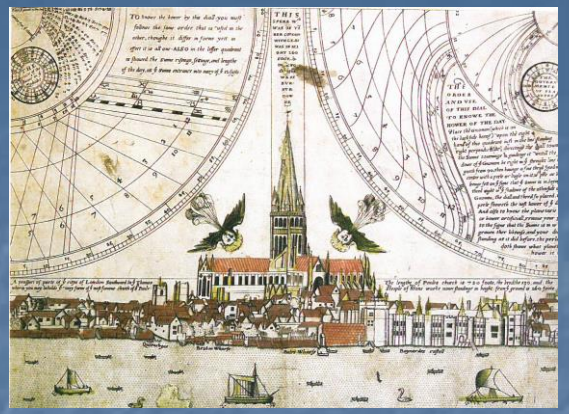
- On a damp November evening in 1660 (28th) Wren, Hooke, Boyle and others set up a society ‘for the promotion of Physico-Mathematical Experimental Learning’
- Oldest scientific academy in continuous existence, led to some of the most fundamental, significant, and life-changing discoveries in the history of science
- Fellowship of the world's most eminent scientists in all areas of science, engineering and medicine
- Aimed/aims to recognise, promote, and support excellence in science and encourage the development and use of science for the benefit of humanity
- The Royal Society led to whole new branches of science, profound theories on atoms, evolution, gravity and motion

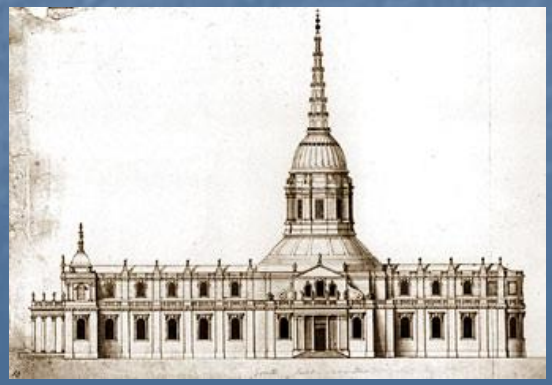
Architectural works

- 1665 visited Paris, huge influences (met Bernini)
- Key Architectural works (English 'Wrenaissance'?)
  - Pembroke College (1663) – commissioned by his uncle
  - Sheldonian Oxford (1668) – personification of sciences on ceiling (Astronomy), Robert Streeter 1668, Wren's conception as a Roman theatre open to the sky
  - Emmanuel College Chapel
  - St Paul's Cathedral (foundation stone 1674 -1711)
  - 51 other 'Wren' churches in London – overall designs rather than detail
  - The Monument (1671-76)
  - Royal Observatory Greenwich (1675-76) – Flamsteed Astronomer Royal
  - Library at Trinity College (1676-84)
  - Chelsea Hospital (1682-92)
  - Whitehall (1685-87)
  - Kensington Palace (1689-96)
  - South front, Hampton Court palace (1689-1700)
  - Winchester Palace designs (cf Versailles) …….. etc

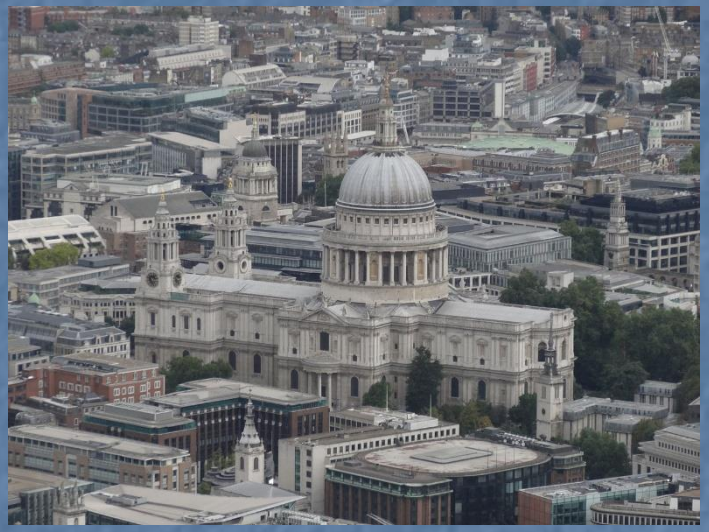
St Paul's Cathedral

- Design to restore St Paul's (27 Aug 1666)
- Great Fire, 2-5 September 1666
- 1667 Rebuilding Act; King's Surveyor
  - First Model (winter 1669/70)
  - Greek Cross design (1671/72)
  - 'Great Model' (1673)
  - Warrant 'Royal Commission' Design (1674)
  - Latin Cross, Dome, Spire ('*make variations … as from Time to Time he should see proper*')
  - Foundation stone – 21 June 1675
  - First service (1697 – no dome)
  - Complete with dome (1711) [c 70K tons]





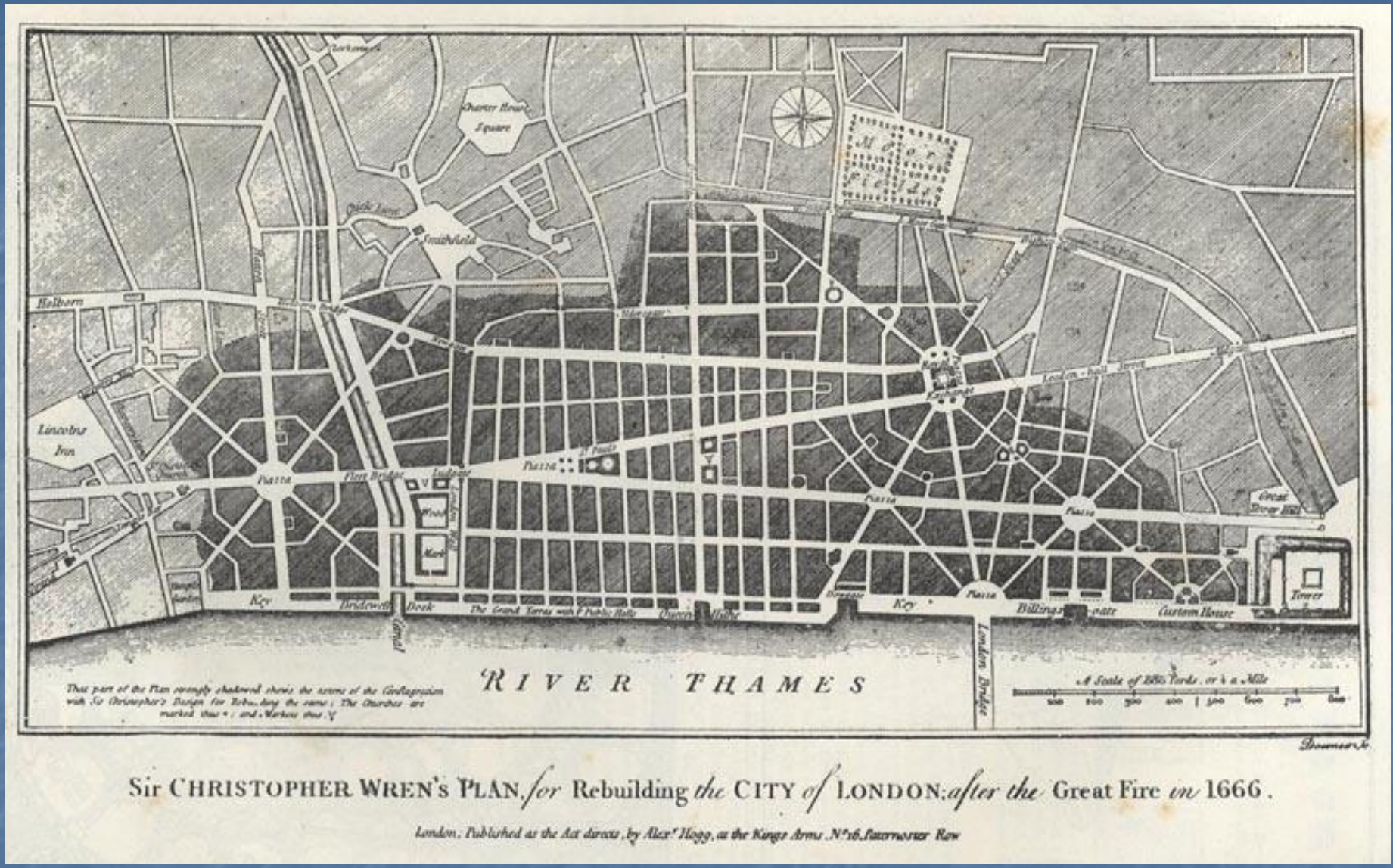
St Paul's Cathedral 1675-1711



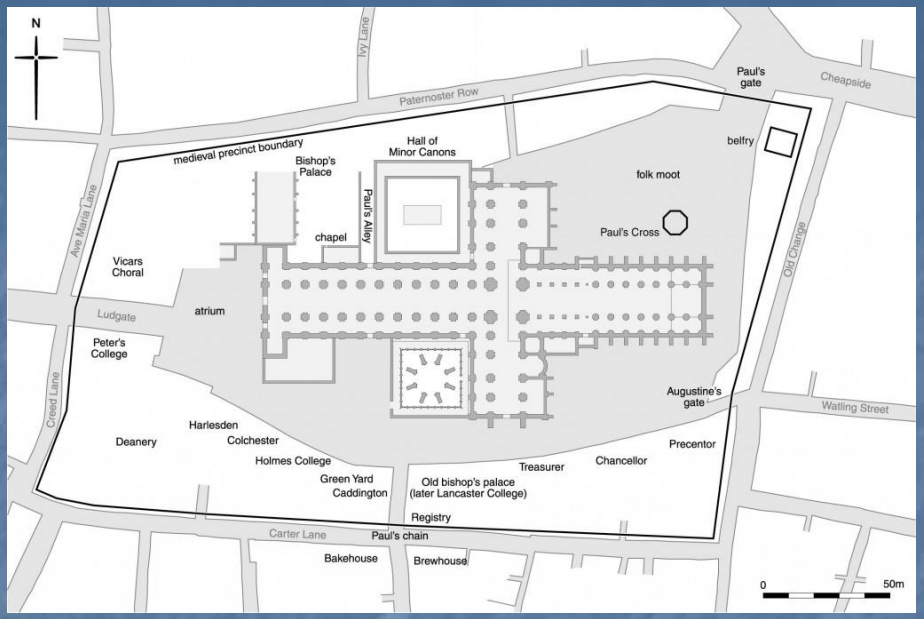
St Paul's from the Shard, Jonathan Cardy via Wikimedia Commons

Astronomical elements of St Paul's

- Domed architecture is traditionally cosmological (earth covered by the dome of heaven); unknown in England
- 365 feet high to top of cross; catenery arches
- South west tower as scientific instrument (pendulum experiments and telescope)
- Orientation



Rare chance to redesign a capital, focussed on St Paul's in the West and Gresham's Royal Exchange (North East)



Medieval St Paul's:
orientation due East

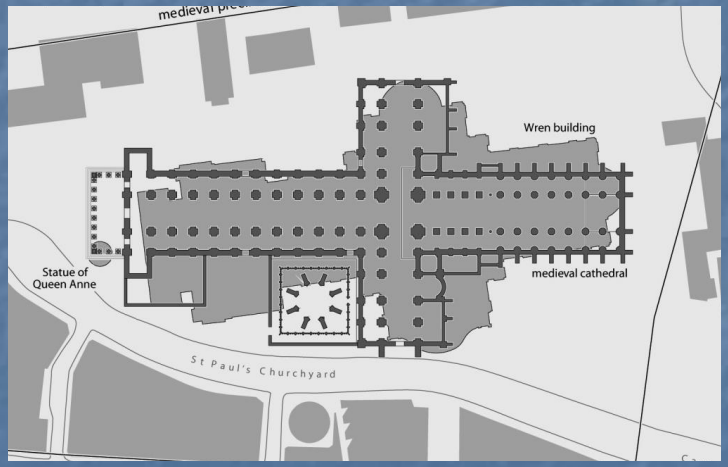
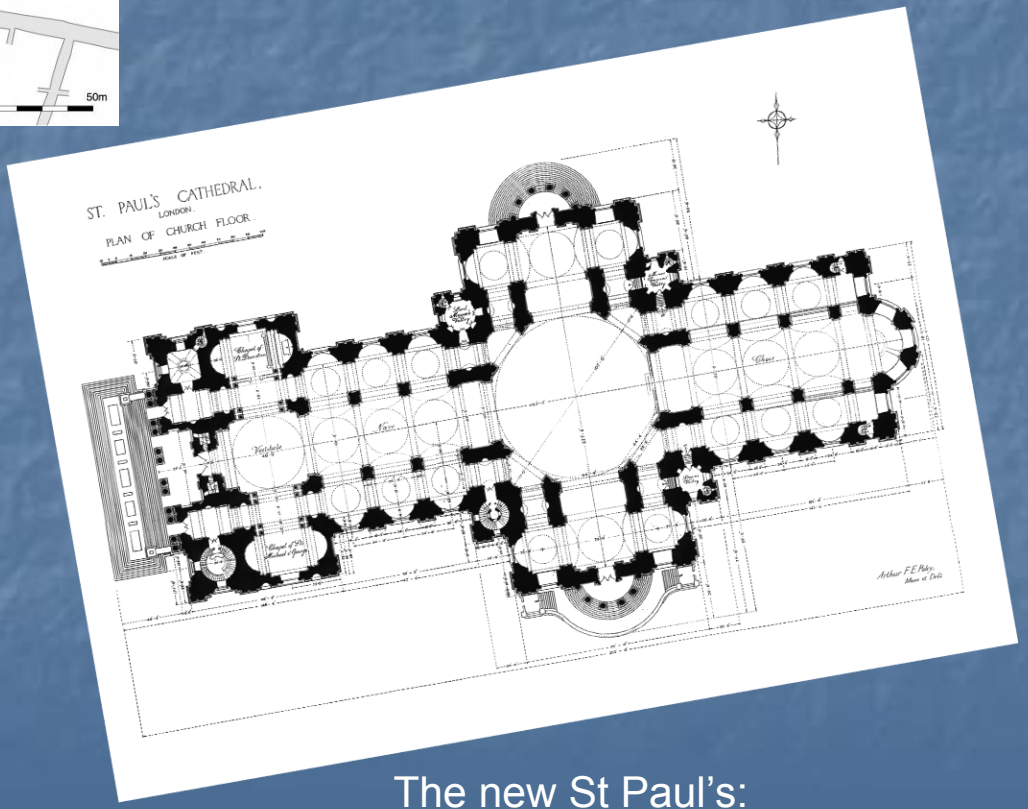


Diagram: Dr John Schofield



The new St Paul's:
c 6 degrees North of due East

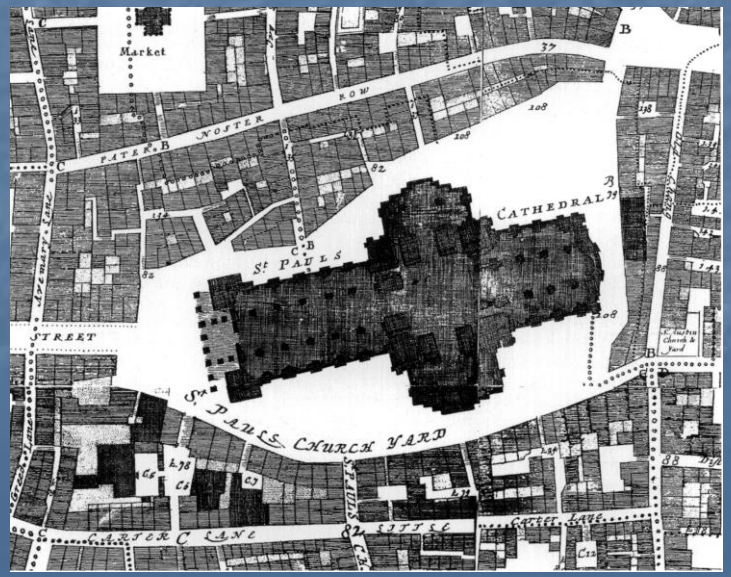
Why?

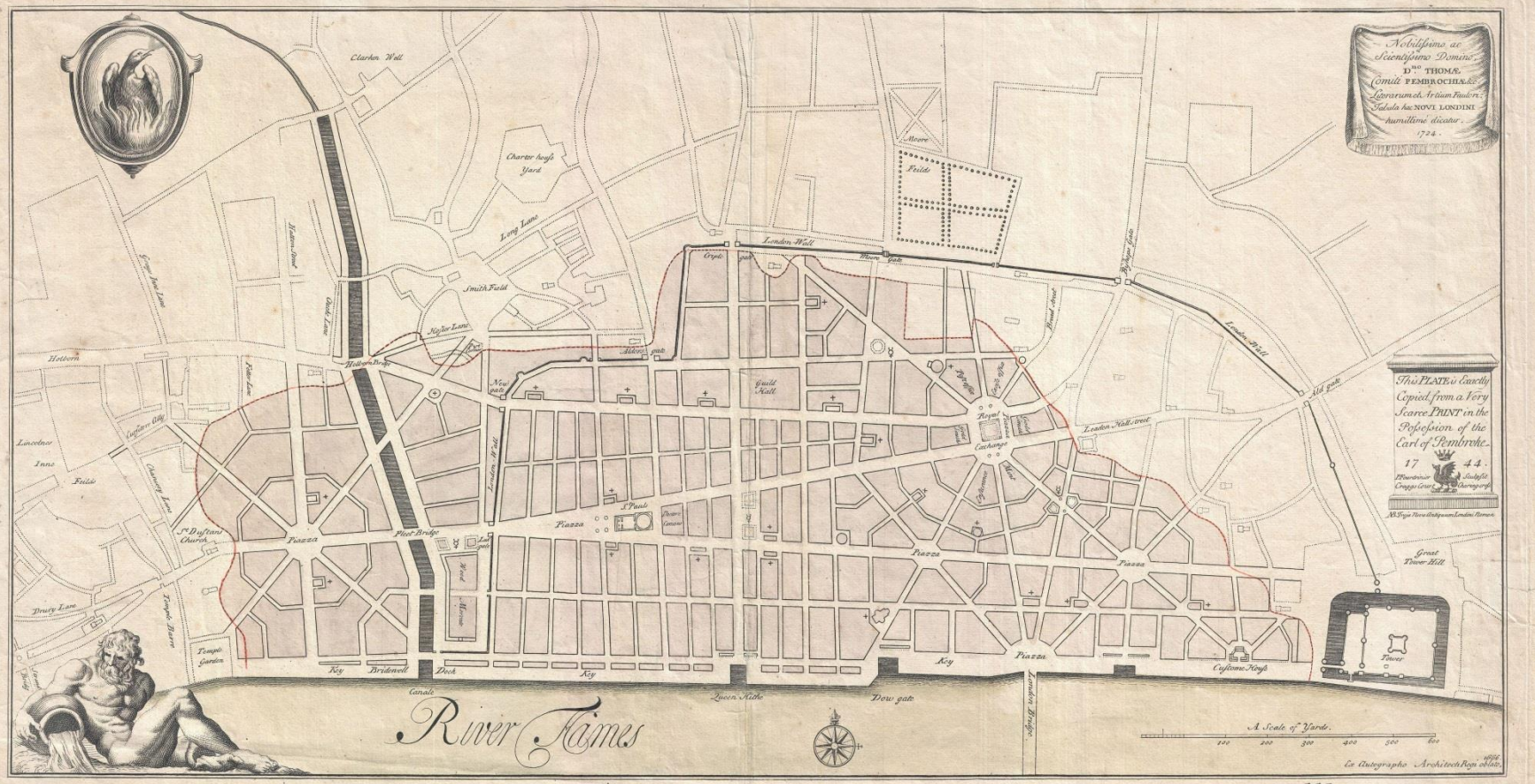
- Simply to fit site?
- Foundations – sand, gravel, clay (old ruins?)
- Sunrise on Saints' day, 25 January?
- Sunrise 'Foundation Day' 21 June 1675?
- Sunrise Spring Equinox/Easter? 1673,4,5?
- Still hopes of implementing the City plan?
- NB more complex due to Julian/Gregorian calendar variation (Gregorian 1582, adopted in 1752 in England, Protestant)

To fit the site? (Crayford, Schofield)
Or astronomical reasons?

- 19 May 1675 Warrant Design approved
- 21 June 1675 Foundation stone laid
- May-September 1674 some evidence of staking out – for Great Model design
- Accounts April-Sept 1673 indicate scaffolding for Dome set up by then
- (knighted Nov 1673)

Robert Crayford, *The Setting Out of St Pau's Cathedral*





ICHNOGRAPHIA *Urbis* LONDINII, *post Magnum et fatale* INCENDIUM. *An.o D.ni* MDCLXVI. *cum* IDEA. *Novæ Urbis Qualem, tunc temporis, ex Cineribus Renatam esse Desiderabat Clarissimus Vir D.nus* CHRISTOPHORUS WREN *Eq.s Ædificiorum Regiæ Maj.tis nec non Templorum Omnium, Operumq. Publicorum Indytæ Urbis Architectus.* – *NB. Lineæ rectæ et rectangulæ &c. Modulum Novæ Urbis exhibent.* – *Lineæ decurtatæ Conflagrationis totius Terminos.* – *Lineæ Puncta notatæ, Urbis Veteris Partes Flammarum Diluvio non absorptas.* – *Signa Crucis (+) Ecclesias Parochiales.* – *Mercurii (☿) Macella denotant.* ∽ *Circuit Sionem Numerate Turres ejus Apponite animum vestrum ad Præmunitionem, Erigite ejus Palatia, ab Hac narretis Posteritati. (Psalm. XLVIII.)*

A PLAN *of the City of* LONDON, *after the great* FIRE *in the Year of* OUR LORD *1666. with the* MODELL *of the New City, according to the Design, and Proposal of* S.r CHRISTOPHER WREN K.t &c. *for Rebuilding three of Approved beauty.*

NB. The right and right angular Lines &c. shew the Model of the New City. – *The Short Lines colour'd shew the whole Cessions of the Burning.* – *The Prick Lines shew the Parts of the Old Town which escaped the Flames.* (+) *the Parochial Churches.* (☿) *Markets.* – ∽ *Walk about Sion tell the Towers thereof: Mark well her Bulwarks, Set up her Houses, that ye may tell them that come after. (Psalm. 48.)*

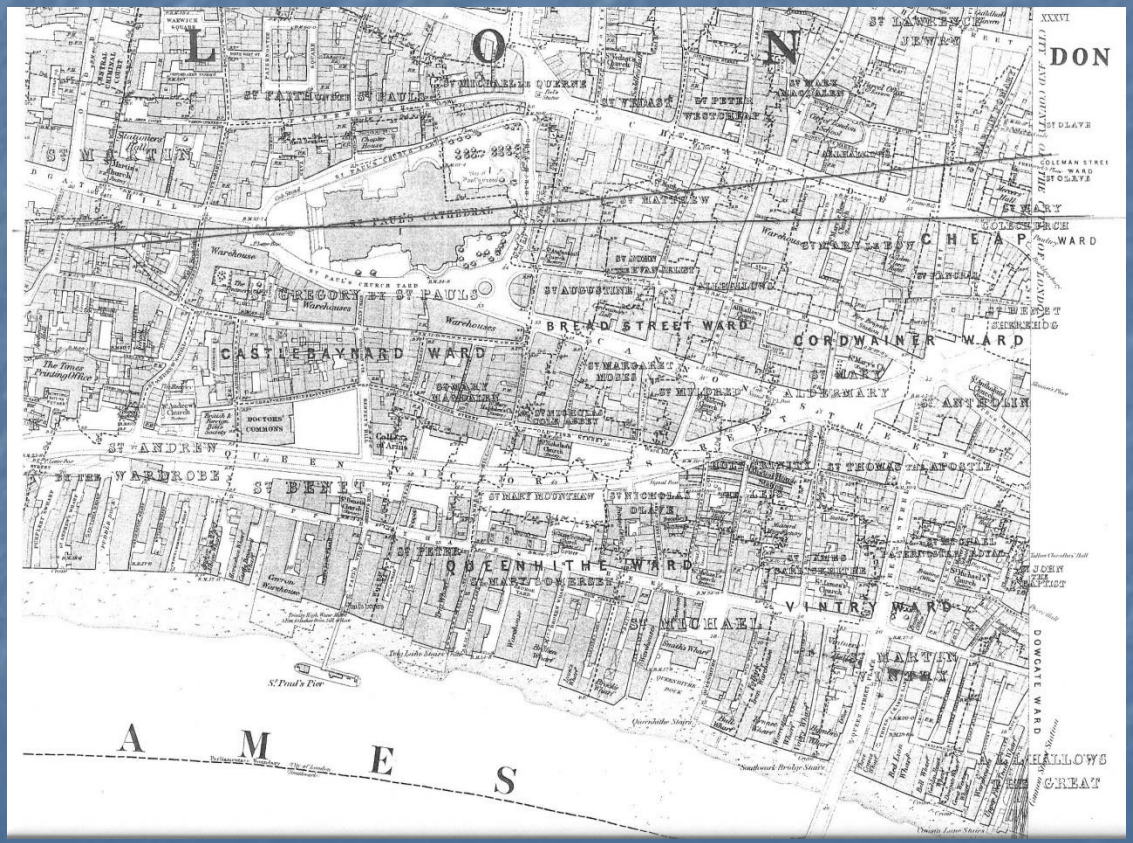
EXPLANATION OF THE PLAN

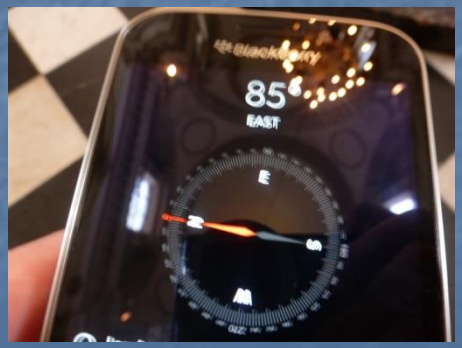
From the remaining Part of FLEET-STREET *which escaped the* FIRE *about* S.t DUNSTANS CHURCH *a Streight and wide Street crosses the Valley passing by the South side of* LUDGATE, *and thence in a direct line through y.e whole City terminats at* TOWER-HILL, *but before it descends into the Valley where the Great Sewer runs, it Opens into a Round Piazza, the Center of Eight Ways, where at one station we see (I) straight forward quits through the* CITY; *(II) Obliquely towards the Right hand, to the beginning of the* KEY *that runs from* BRIDEWELL DOCK *to the* TOWER: *(III) Obliquely on the Left to* SMITH FIELD: *(IV) streight on the Right to the* THAMES: *(V) streight on the Left to* HATTEN STREET *and* CLARKENWELL: *(VI) streight Backwards towards* TEMPLE-BARR: *(VII) Obliquely on the Right to the* TEMPLE GARDEN: *(VIII) Obliquely on the Left to* CURSITORS ALLEY. *Passing forward we cross the Valley, once sulled with an offensive Sewer, now beautified with a usefull Canal, with Wharfs on each side, passable by as many Bridges as Streets that cross it: Leaving* LUDGATE, *this great Street presently divides into another as large which carries our Eyes and Passage to y.e Front of the* EXCHANGE, *and before these two Streets spreading at Acute Angles can be clear of one another, They form a Triangular Piazza, the Basis of which is filled by the* CATHEDRAL CHURCH *of* S.t PAUL. *But leaving* S.t PAULS *on the Left, we proceed as our first way led us towards the* TOWER. *We return again to* LUDGATE, *and leaving* S.t PAULS *on the Right hand, pass along the other great Branch to the* ROYAL EXCHANGE, *Seated in the Place where it was, but free from Building, in the Middle of a Piazza included between Two great Streets, One from* LUDGATE *leading to the South Front, and another from* HOLBORN *over the Canal to* NEWGATE, *and thence streight to the North Front. &c. Instead of* LUDGATE-PRISON *was Designed a Triumphal Arch to the Founder of the New City King* CHARLES *the* SECOND. ∽

From Google earth

Orientation of c 6 degrees north

So when was sunrise c 6 degrees North, in 1673, 1674, 1675?





1875 Ordnance survey

Table of the Declination of the Sun Mean Value for the Four Years of a Leap-Year Cycle (current)

Positive sign (+) Sun north of Celestial Equator; negative sign (-) Sun south of Celestial Equator

Orientation of c 6 degrees yields a declination of c 3.5, that is, for 31 March, around Eastertime – but this would have been 11 days earlier in 1673 (since Julian, not Gregorian, Calendar used in England until 1752) – so more likely 21 March, Spring Equinox

Day	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
1	-23°04'	-17°20'	-7°49'	+4°18'	+14°54'	+21°58'	+23°09'	+18°10'	+8°30'	-2°57'	-14°14'	-21°43'
2	-22°59'	-17°03'	-7°26'	+4°42'	+15°12'	+22°06'	+23°05'	+17°55'	+8°09'	-3°20'	-14°34'	-21°52'
3	-22°54'	-16°46'	-7°03'	+5°05'	+15°30'	+22°14'	+23°01'	+17°40'	+7°47'	-3°44'	-14°53'	-22°01'
4	-22°48'	-16°28'	-6°40'	+5°28'	+15°47'	+22°22'	+22°56'	+17°24'	+7°25'	-4°07'	-15°11'	-22°10'
5	-22°42'	-16°10'	-6°17'	+5°51'	+16°05'	+22°29'	+22°51'	+17°08'	+7°03'	-4°30'	-15°30'	-22°18'
6	-22°36'	-15°52'	-5°54'	+6°13'	+16°22'	+22°35'	+22°45'	+16°52'	+6°40'	-4°53'	-15°48'	-22°25'
7	-22°28'	-15°34'	-5°30'	+6°36'	+16°39'	+22°42'	+22°39'	+16°36'	+6°18'	-5°16'	-16°06'	-22°32'
8	-22°21'	-15°15'	-5°07'	+6°59'	+16°55'	+22°47'	+22°33'	+16°19'	+5°56'	-5°39'	-16°24'	-22°39'
9	-22°13'	-14°56'	-4°44'	+7°21'	+17°12'	+22°53'	+22°26'	+16°02'	+5°33'	-6°02'	-16°41'	-22°46'
10	-22°05'	-14°37'	-4°20'	+7°43'	+17°27'	+22°58'	+22°19'	+15°45'	+5°10'	-6°25'	-16°58'	-22°52'
11	-21°56'	-14°18'	-3°57'	+8°07'	+17°43'	+23°02'	+22°11'	+15°27'	+4°48'	-6°48'	-17°15'	-22°57'
12	-21°47'	-13°58'	-3°33'	+8°28'	+17°59'	+23°07'	+22°04'	+15°10'	+4°25'	-7°10'	-17°32'	-23°02'
13	-21°37'	-13°38'	-3°10'	+8°50'	+18°14'	+23°11'	+21°55'	+14°52'	+4°02'	-7°32'	-17°48'	-23°07'
14	-21°27'	-13°18'	-2°46'	+9°11'	+18°29'	+23°14'	+21°46'	+14°33'	+3°39'	-7°55'	-18°04'	-23°11'
15	-21°16'	-12°58'	-2°22'	+9°33'	+18°43'	+23°17'	+21°37'	+14°15'	+3°16'	-8°18'	-18°20'	-23°14'
16	-21°06'	-12°37'	-1°59'	+9°54'	+18°58'	+23°20'	+21°28'	+13°56'	+2°53'	-8°40'	-18°35'	-23°17'
17	-20°54'	-12°16'	-1°35'	+10°16'	+19°11'	+23°22'	+21°18'	+13°37'	+2°30'	-9°02'	-18°50'	-23°20'
18	-20°42'	-11°55'	-1°11'	+10°37'	+19°25'	+23°24'	+21°08'	+13°18'	+2°06'	-9°24'	-19°05'	-23°22'
19	-20°30'	-11°34'	-0°48'	+10°58'	+19°38'	+23°25'	+20°58'	+12°59'	+1°43'	-9°45'	-19°19'	-23°24'
20	-20°18'	-11°13'	-0°24'	+11°19'	+19°51'	+23°26'	+20°47'	+12°39'	+1°20'	-10°07'	-19°33'	-23°25'
21	-20°05'	-10°52'	0°00'	+11°39'	+20°04'	+23°26'	+20°36'	+12°19'	+0°57'	-10°29'	-19°47'	-23°26'
22	-19°52'	-10°30'	+0°24'	+12°00'	+20°16'	+23°26'	+20°24'	+11°59'	+0°33'	-10°50'	-20°00'	-23°26'
23	-19°38'	-10°08'	+0°47'	+12°20'	+20°28'	+23°26'	+20°12'	+11°39'	+0°10'	-11°12'	-20°13'	-23°26'
24	-19°24'	-9°46'	+1°11'	+12°40'	+20°39'	+23°25'	+20°00'	+11°19'	-0°14'	-11°33'	-20°26'	-23°26'
25	-19°10'	-9°24'	+1°35'	+13°00'	+20°50'	+23°24'	+19°47'	+10°58'	-0°37'	-11°54'	-20°38'	-23°25'
26	-18°55'	-9°02'	+1°58'	+13°19'	+21°01'	+23°23'	+19°34'	+10°38'	-1°00'	-12°14'	-20°50'	-23°23'
27	-18°40'	-8°39'	+2°22'	+13°38'	+21°12'	+23°21'	+19°21'	+10°17'	-1°24'	-12°35'	-21°01'	-23°21'
28	-18°25'	-8°17'	+2°45'	+13°58'	+21°22'	+23°19'	+19°08'	+9°56'	-1°47'	-12°55'	-21°12'	-23°19'
29	-18°09'	-8°03'	+3°09'	+14°16'	+21°31'	+23°16'	+18°54'	+9°35'	-2°10'	-13°15'	-21°23'	-23°16'
30	-17°53'		+3°32'	+14°35'	+21°41'	+23°13'	+18°40'	+9°13'	-2°34'	-13°35'	-21°33'	-23°12'
31	-17°37'		+3°55'		+21°50'		+18°25'	+8°52'		-13°55'		-23°08'

Easter calendar references, 17th century (Gregorian/Julian/Orthodox)

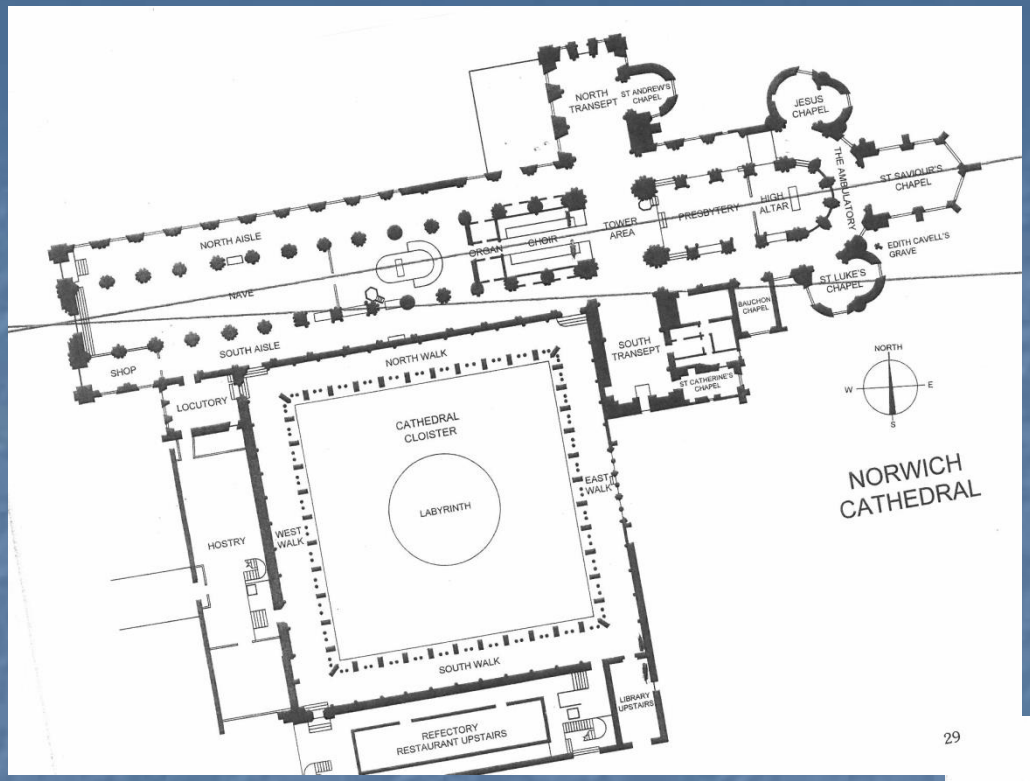
year	Old style (Julian)		New style (Gregorian)	
	Catholic	Orthodox	Catholic	Orthodox
1666	Apr-15		Apr-25	
1667	Mars 31	Apr-07	Apr-10	Apr-17
1668	Mars 22		Apr-01	
1669	Apr-11		Apr-21	
1670	Mars 27	Apr-03	Apr-06	Apr-13
1671	Mars 19	Apr-23	Mars 29	May-03
1672	Apr-07		Apr-17	
1673	Mars 23	Mars 30	Apr-02	Apr-09
1674	Mars 15	Apr-19	Mars 25	Apr-29
1675	Apr-04		Apr-14	
1676	Mars 26		Apr-05	

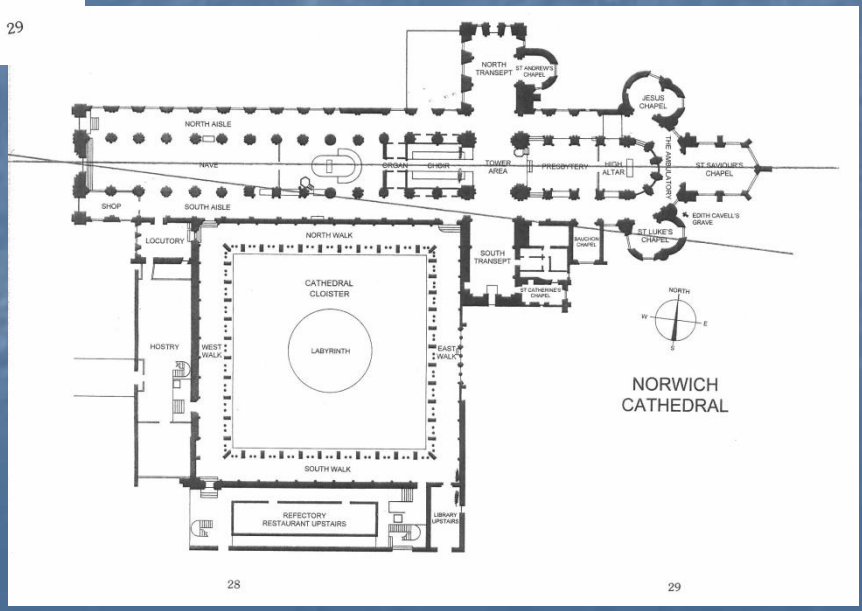
Easter sunrise was 2 April 1673

So …

- Not just due to awkward site (Grand Model or Warrant)
- Not Saint's Day (25 January). Sunrise would be south of East, for latitude of London
- Not Foundation Day (21 June 1675); summer solstice would be due/true East (and also too soon after the approval; laying out had already started in 1673)
- 6 degree deviation would yield a date (today) of 31 March which in Julian calendar would be 11 days earlier, which is 21 March, Spring Equinox (Gregorian Calendar from 1752)
- New orientation as sunrise at Spring equinox 1673
- Fits with Foundation stone, 21 June 1675 (Summer solstice)

[assistance from Dr Fabio Silva, UCL Archaeology and UWTSD, for access to and use of declination tables is gratefully acknowledged]



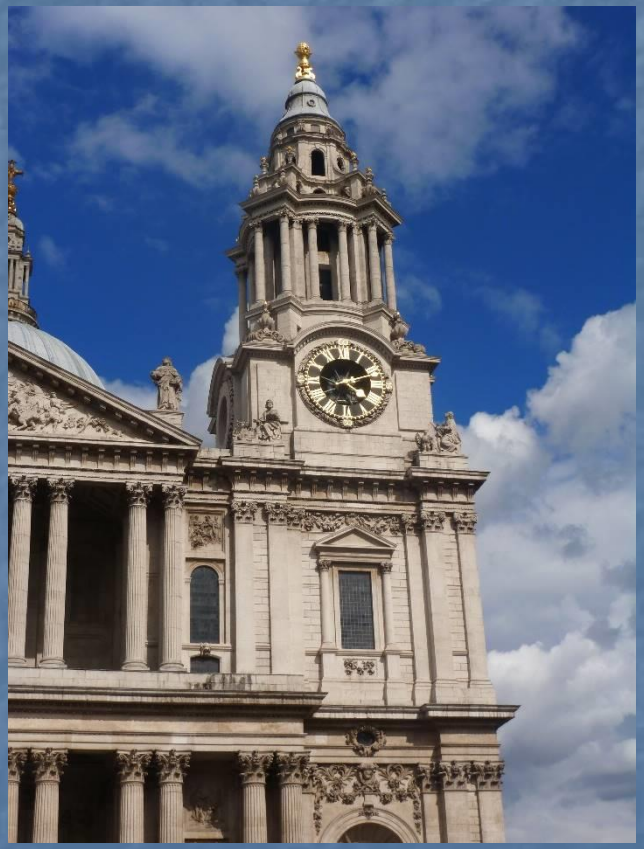


Norwich Cathedral – same (?) angle (more research and comparisons needed)

The South West Tower

- Very different, had rooms
- Aperture (for observation?) Pendulums
- Experiments - even if to be only for a few years; It turned out to be a long time, until 1711
- Planned telescope 'on the south side' between nave and transept? (Ward)
- '*Sir Christopher Wren proposed that the Telescope given by Mr Huygens to the Society should be set up in [St] Paul's and astronomical observations made*'

(Royal Society minutes February 1704)



23 other churches surviving - designs rather than details (28 destroyed or very much rebuilt)

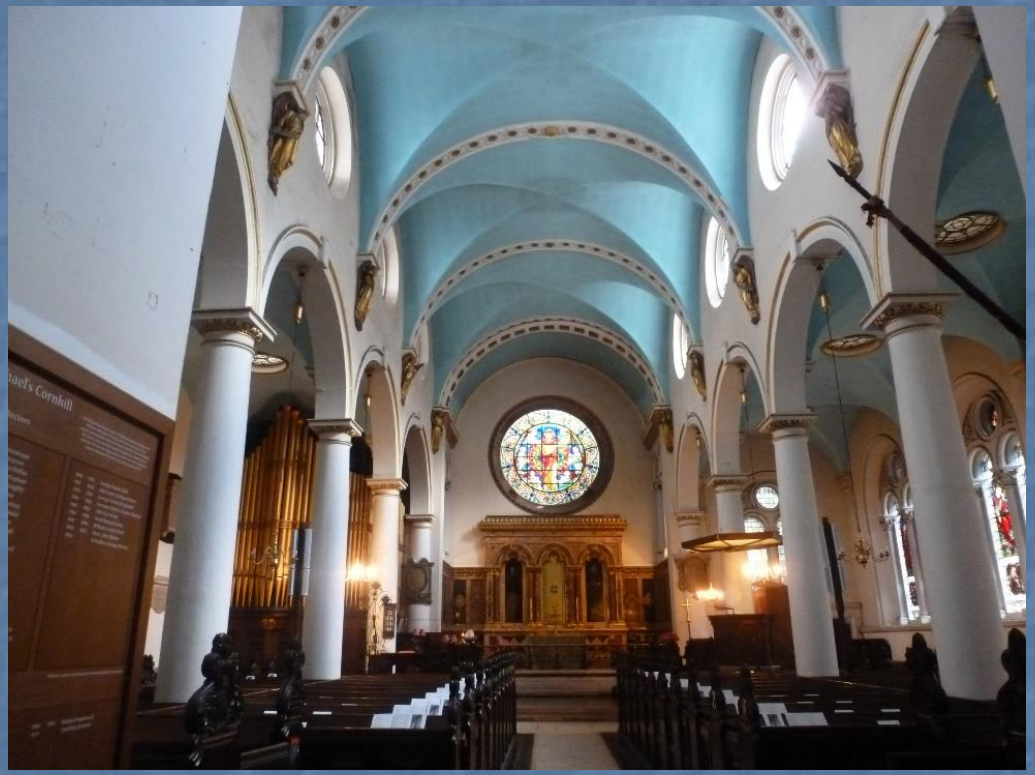
1. St Michael Cornhill
2. St Mary at Hill
3. St Mary Abchurch
4. St Stephen Walbrook

5. St Edmund King and Martyr
6. St Margaret Pattens
7. St Michael Paternoster
8. St Magnus the Martyr
9. St Mary le Bow
10. St Lawrence Jewry

11. St Andrew by the Wardrobe
12. St Andrew's Holborn
13. St Anne and St Agnes
14. St Benet's Paul's Wharf
15. St Brides Fleet St
16. St Clement Eastcheap
17. St James Garlickhythe
18. St Martin within Ludgate
19. St Margaret Lothbury
20. St Mary Aldermary
21. St Nicholas Cole Abbey
22. St Peter upon Cornhill
23. St Vedast Foster Lane


Farringdon
Barbican
Moorgate
Museum of London
City Thameslink
St. Paul's
Bank
Mansion House
Cannon Street
Monument
Blackfriars
Blackfriars
Blackfriars Bridge
Millennium Bridge
Southwark Bridge
RIVER THAMES
BARBICAN
MOORGATE
GUILDHALL
TEMPLE
BANK
MONUMENT
LONDON WALL
A 20 minute walk
A 15 minute walk
A 10 minute walk

St Michael Cornhill

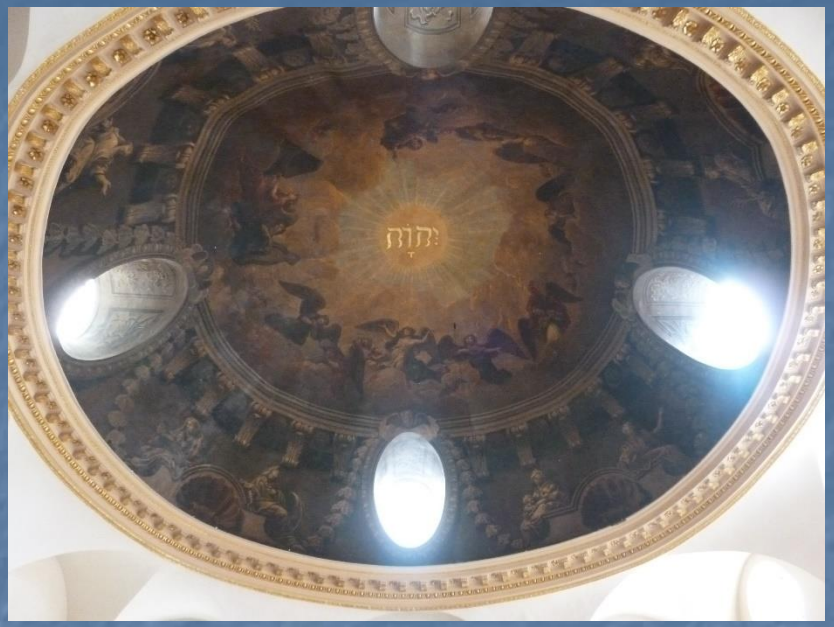


St Mary at Hill

NB use of the tetragrammaton for God/Yahweh

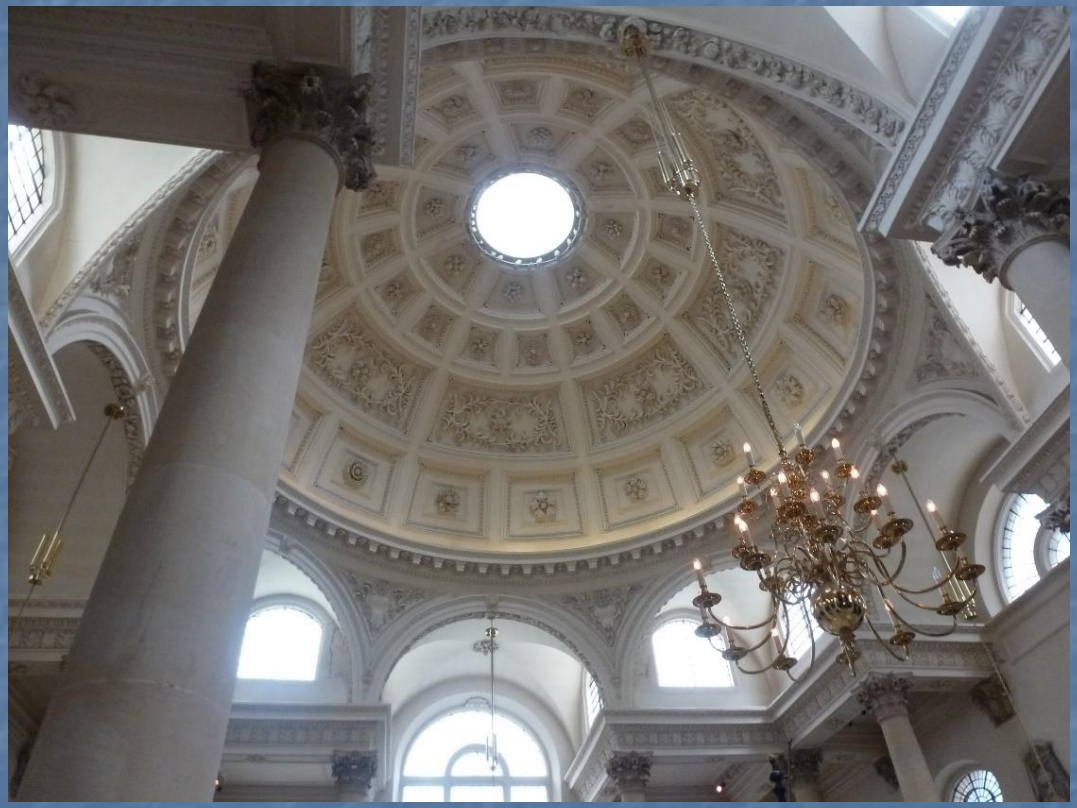
יְהוָה

St Mary Abchurch



40 foot dome held on brick walls, with ‘The Heavens’ in dome, painted 1708

St Stephen Walbrook



Wren took more control in his own parish (lived at 15, Walbrook)

Lightness, weightlessness and illumination
(lath/plaster over wooden frame)

St Edmund King and Martyr

St Margaret Pattens

St Michael
Paternoster Royal

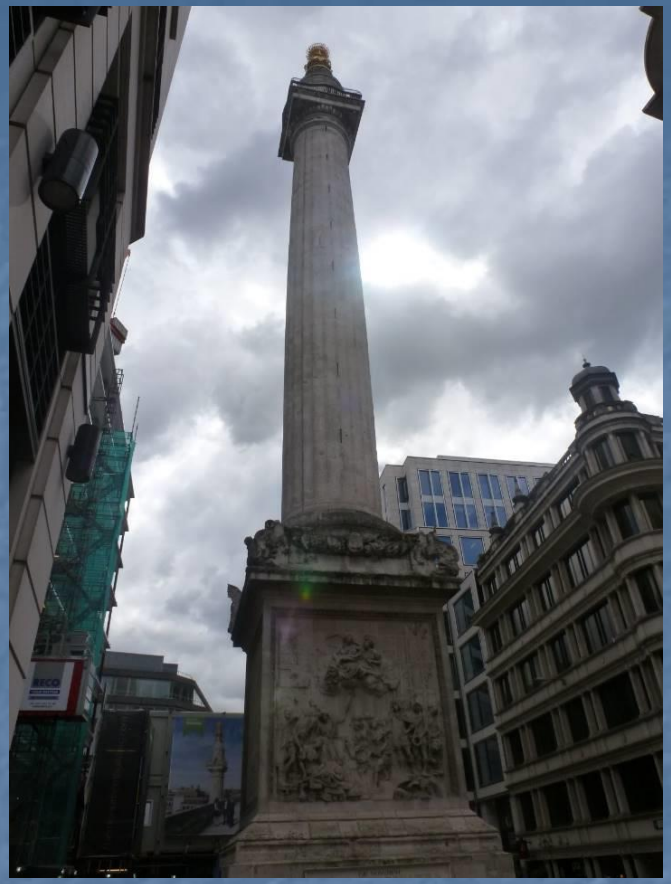
St Magnus the Martyr

St Mary le Bow

St Lawrence Jewry

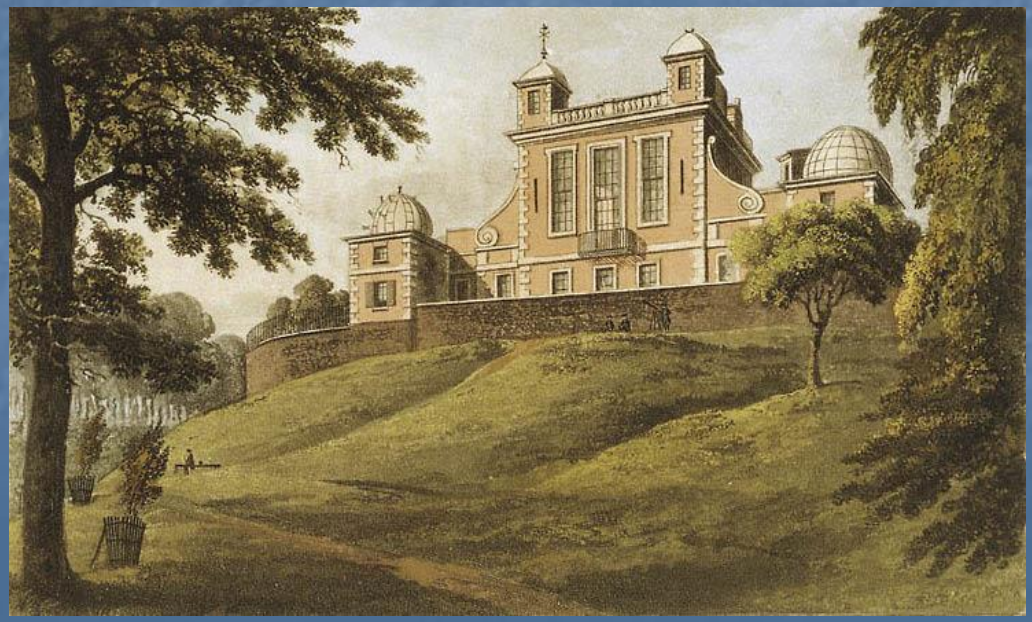
The Monument (1673-79)

- With Robert Hooke
- Conceived as Zenith telescope
- Possibly lens by Constantine Huygens (brother of Christian) – replacing urn of ashes
- Stellar Parallax, pendulum experiments
- Like St Paul's, both '*national Monument and over-sized scientific instrument*' (Jardine)



The Royal Observatory, Greenwich
by Thomas Shepherd, 1824

Built 1675-76. John Flamsteed, first Astronomer Royal, lived and worked there to his death in 1719



Later career

- President of the Royal Society (1681-83)
- Active in Scientific and medical circles (committees)
- Continued activity in Science and astronomy – not '*The Trade I was once well Acquainted with*' (Tinniswod)
- Solving Longitude problem via astronomy – in the last years of his life
- Continued links with Robert Hooke and Gresham College (1702 plans to expand Royal Society at Gresham College)

Cosmic? Both interior and exterior?

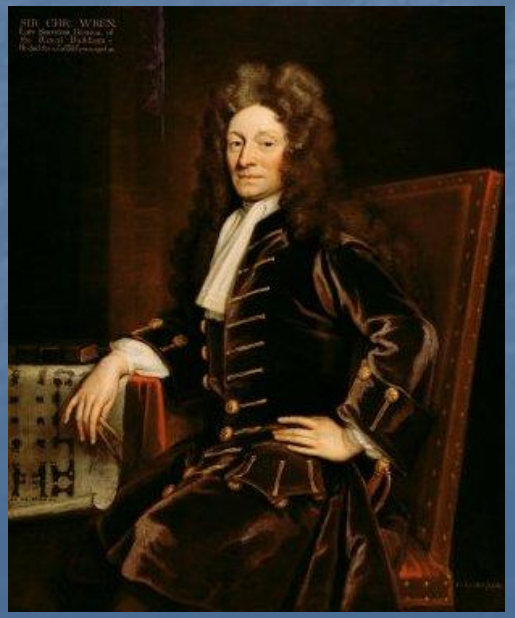
Creation cycle, 19th century

Lector, si Monumentum requires, circumspice

29 December 1940

‘*St Paul’s must be saved at all costs*’

Sir Winston Churchill



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