AHST 2331-001 (21573)
Understanding Art
Dr. Charissa N. Terranova
Spring 2019
Tuesdays and Thursdays 11:30-12:45
ATC 1.102

Tuesday February 26

Optics, Lenses, and Prosthetic Vision: Iraq, Egypt, China, The Netherlands, Italy and England

The history of art and history of science are bound together by the human sense of vision.

Optics Lenses Prosthetic Vision

What do you think of when I say “prosthetic”?

Conceptual Prosthetics

TECHNOLOGICAL MEDIATION AND THE CAR IN CONCEPTUAL ART

CHARISSA N. TERRANOVA

A DIALECTIC OF IMMERSION (VR) AND PROSTHETICS

Oculus

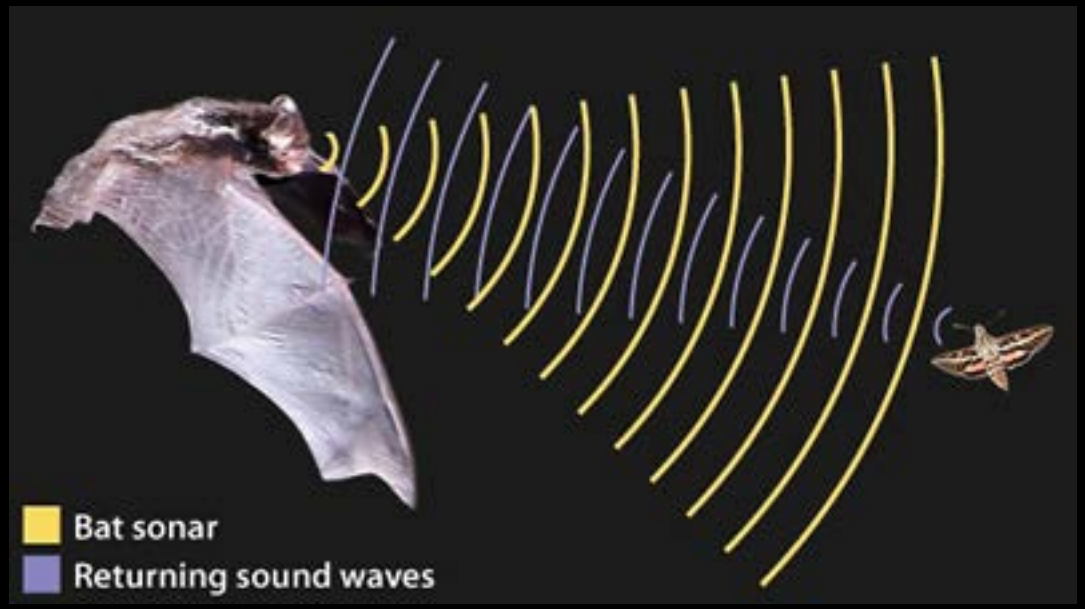
© Touch Bionics / Rex Features

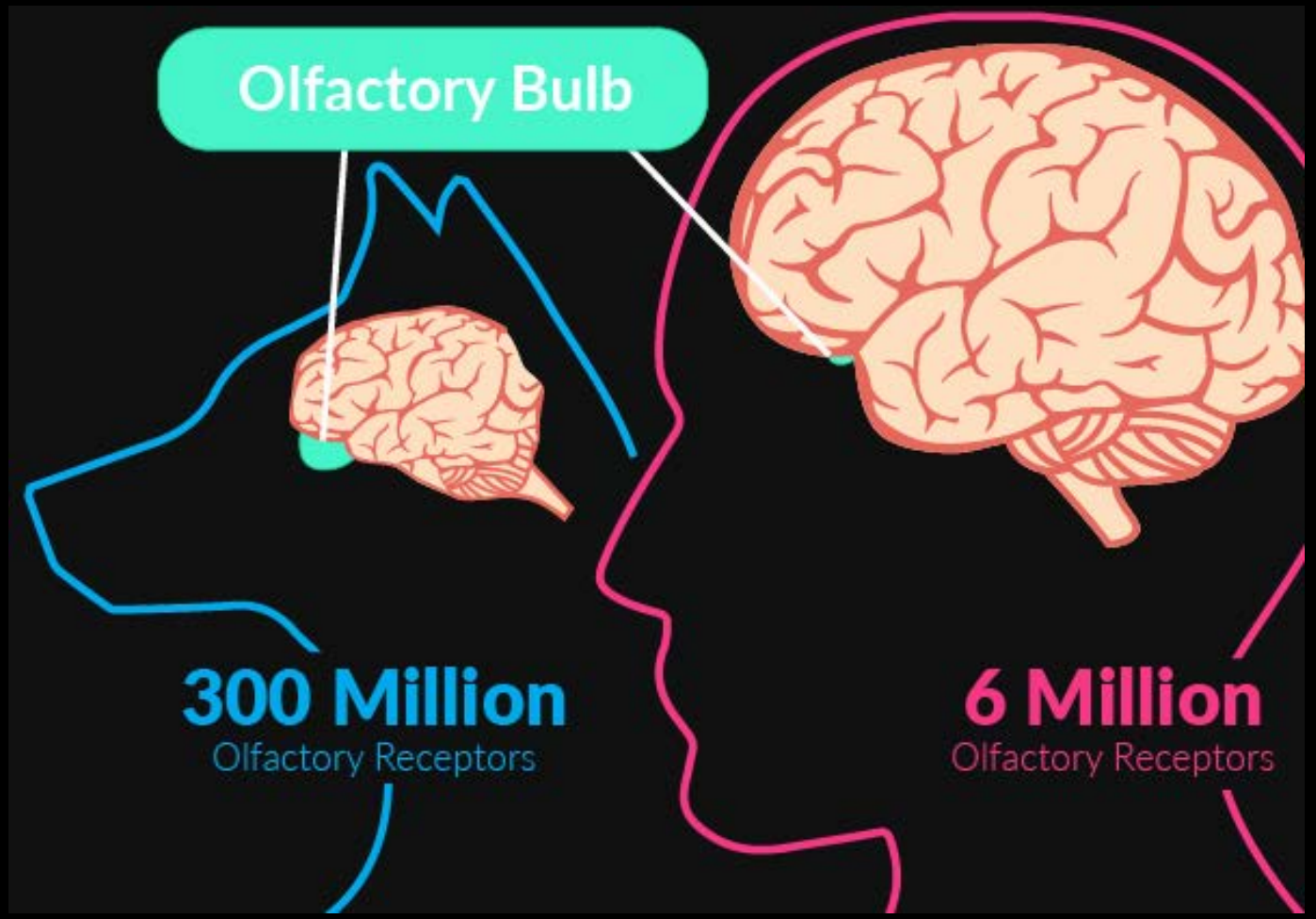
EXTERIORIZATION
THROUGH TECHNOLOGY

EXTERIORIZING AND
EXTENDING SELF

THE SENSE OF SIGHT AND ANTHROPOCENTRISM

How do we know and understand the worlds of other creatures? Say, a bat, or a dog?





The German biologist Jacob von Uexküll called these unique sensorial worlds of individual creatures the “umwelt”.

The umwelt is the world as it is experienced by a particular organism.

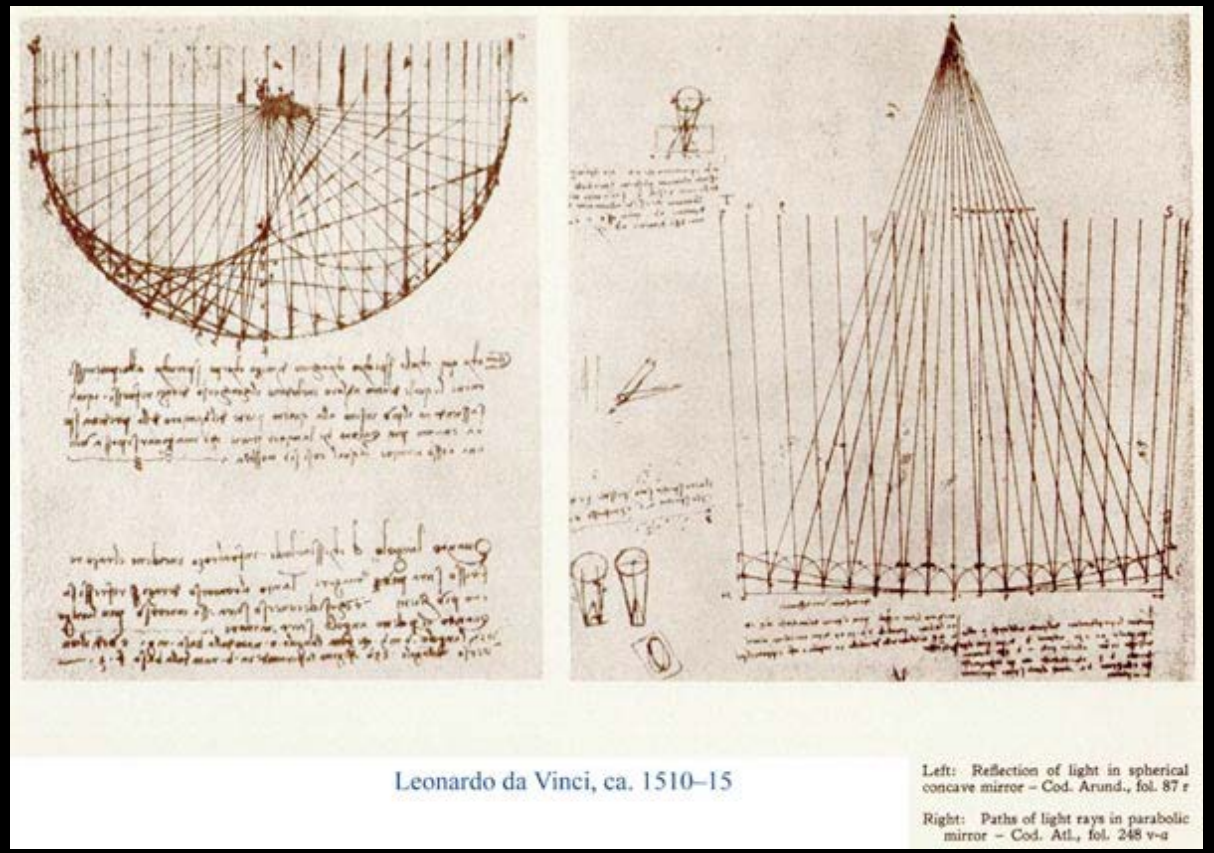
The human umwelt is formed primarily by sight.

Extensions of the Senses (and Self) and/or Prosthetic Extensions:

The great Canadian media theorist Marshall McLuhan used the word "extension" to describe various technological media, ranging from writing and moveable print-type to film and the automobile to photography and the computer. This class explores how such technological extensions function as prosthetics which enhance the capabilities of the basic human body.

Optics:

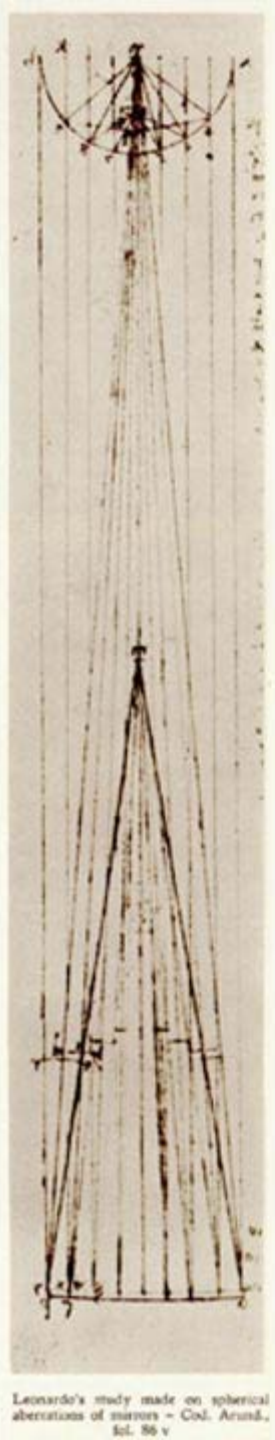
The scientific study of sight and the behavior of light, or the properties of transmission and deflection of other forms of radiation. Here we see figures from Leonardo da Vinci's surviving notebooks showing his interest in the optical properties of concave mirrors as well as in ways to use machines to replace skilled manual labor for their manufacture.



Leonardo da Vinci, ca. 1510–15

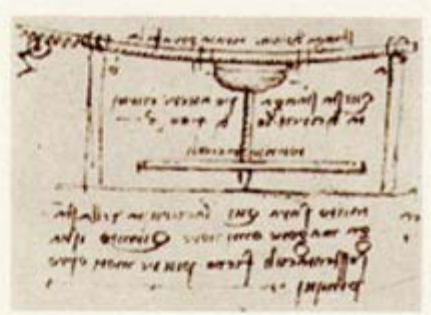
Left: Reflection of light in spherical concave mirror – Cod. Arund., fol. 87 r

Right: Paths of light rays in parabolic mirror – Cod. Atl., fol. 248 v-a

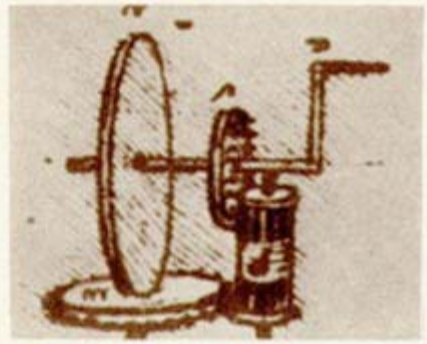


Leonardo's study made on spherical aberrations of mirrors – Cod. Arund., fol. 86 v

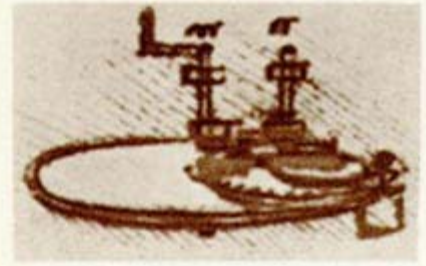
Leonardo da Vinci
ca. 1510–15



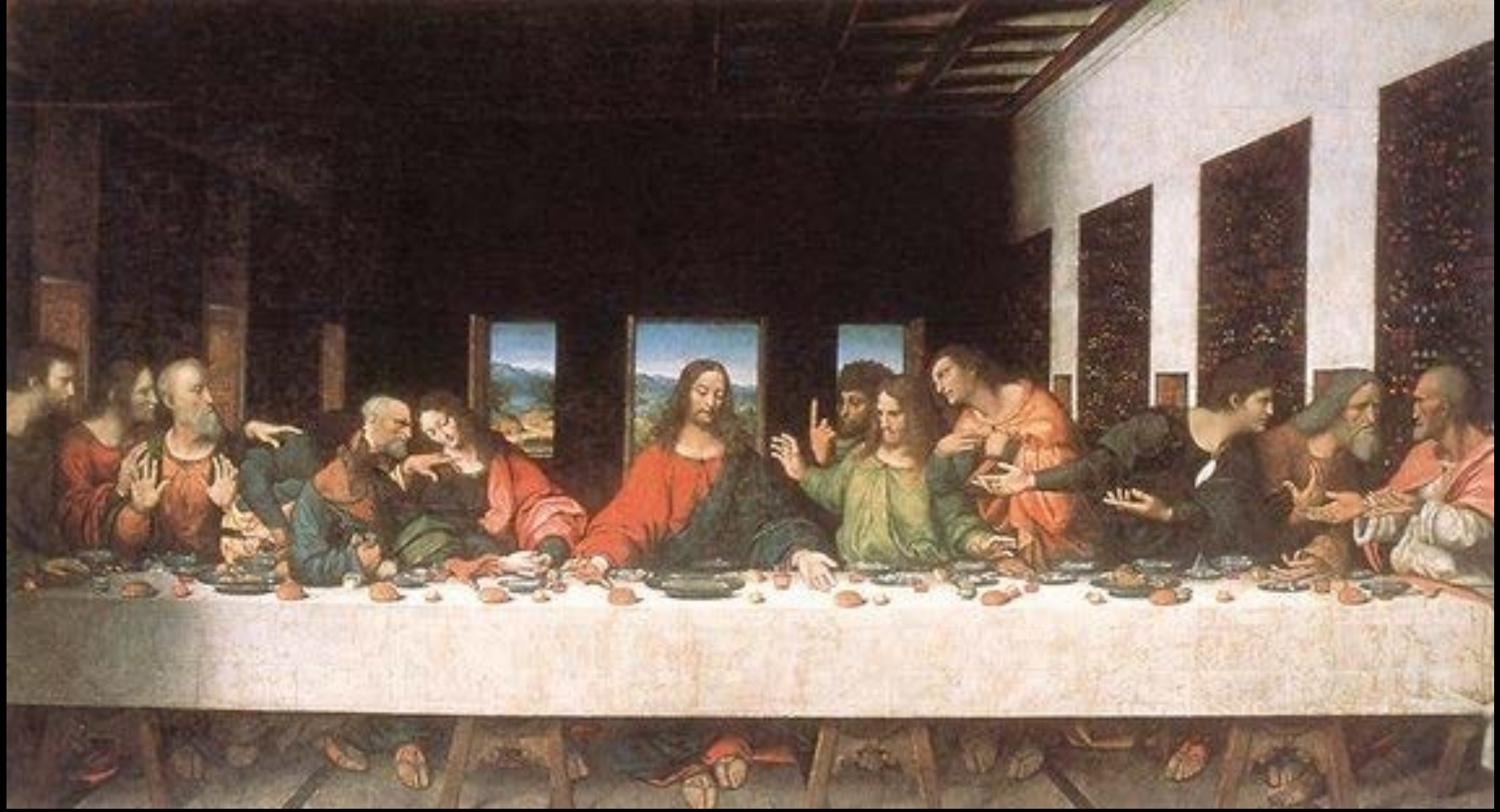
Potter's wheel for making mirrors with large focal length – Cod. Arund., fol. 84 v



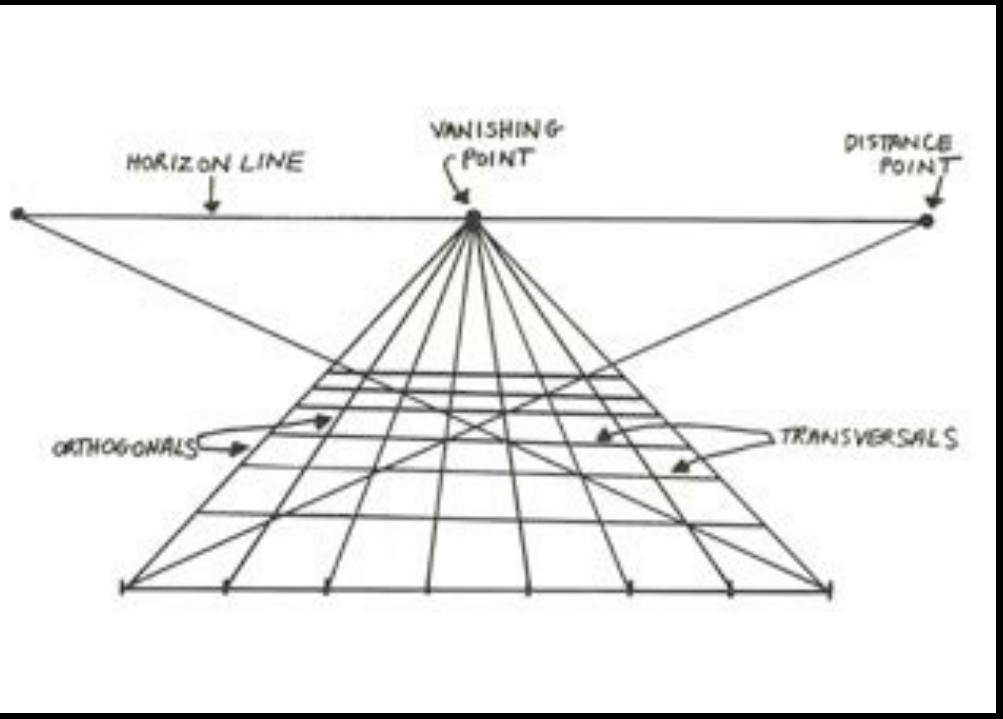
Machine for grinding concave mirrors with large radius of curvature – Cod. Atl., fol. 396 v-*f*



Machine for grinding mirrors – Cod. Atl., fol. 396 v-*f*



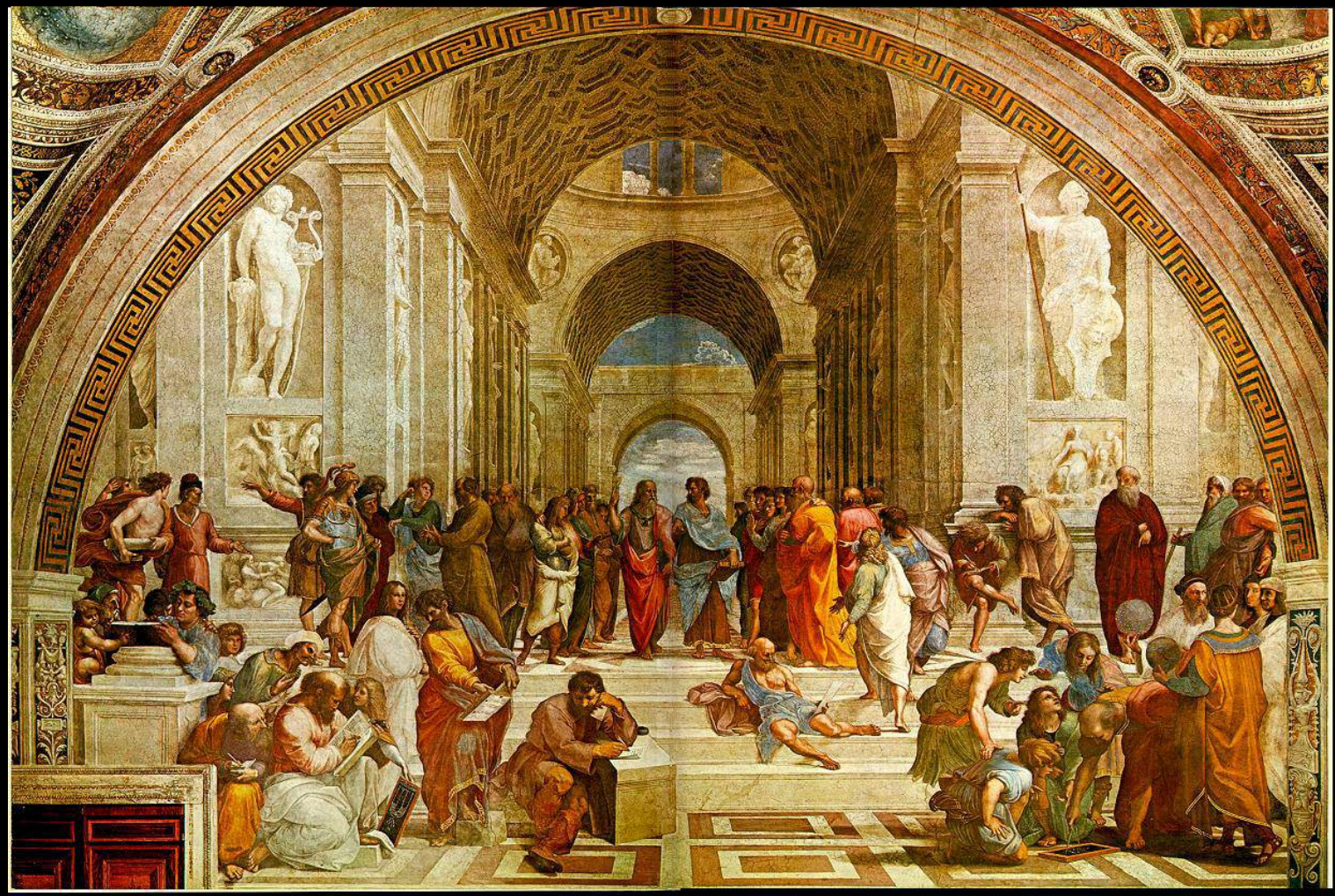
Leonardo da Vinci, The Last Supper, 1520



Filippo Brunelleschi, Linear, or one-point perspective, c. 1420

Technics of Vision
Codification of Vision
Rationalization of Vision

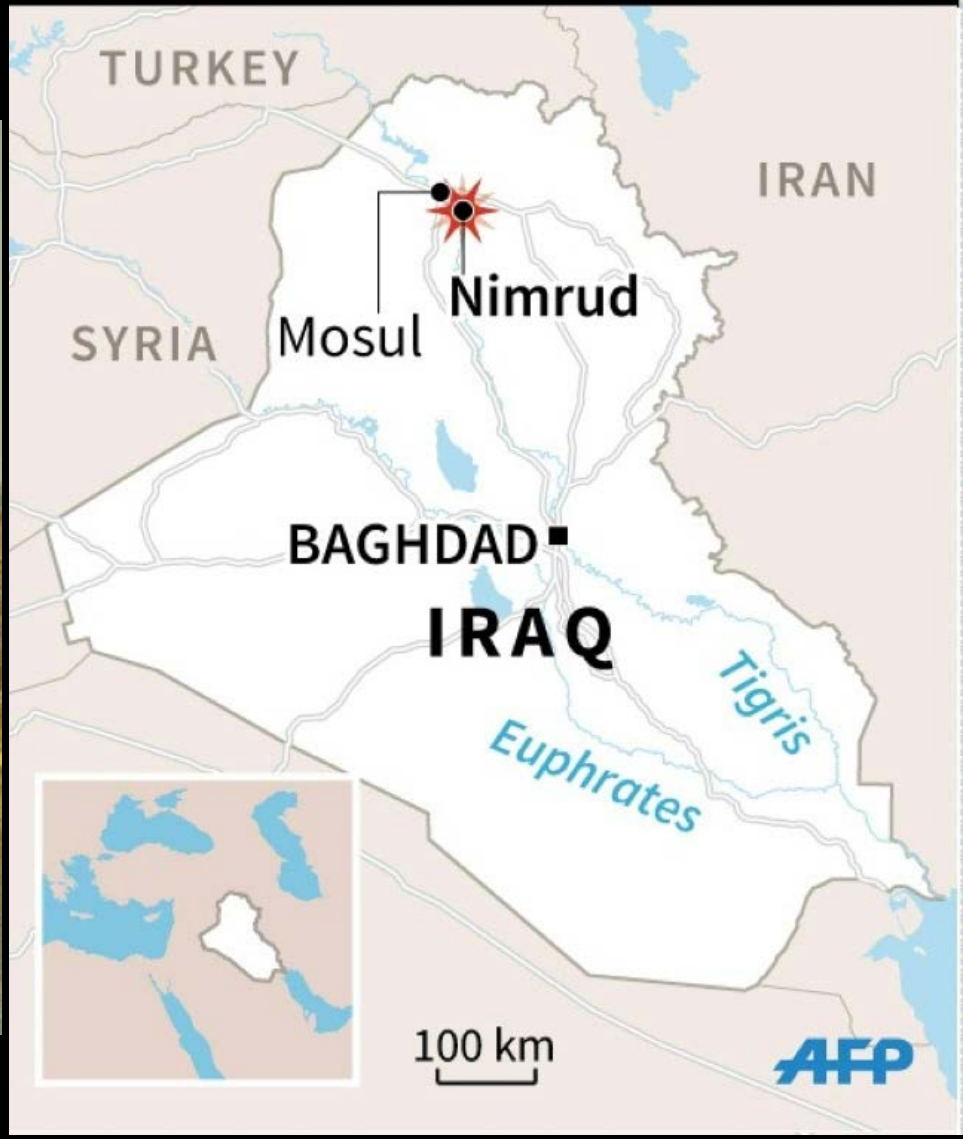
Raphael, School of Athens, 1509-10



Nimrud or Layard Lens, 3000-1000 BCE,
Assyrian palace of Nimrud, modern Iraq

The 1st Lens ~3000BC

- Artifact unearthed and called The Nimrud Lens
- Possible magnifying lens (3x power)
- Posited to be a visual aid for etching
  Or a "burning glass" to start fires



Reconstruction of Assyrian palace of Nimrud in modern-day Iraq, c. 750-710 BCE. Nimrud was a major Assyrian city between approximately 1350 and 610 BCE

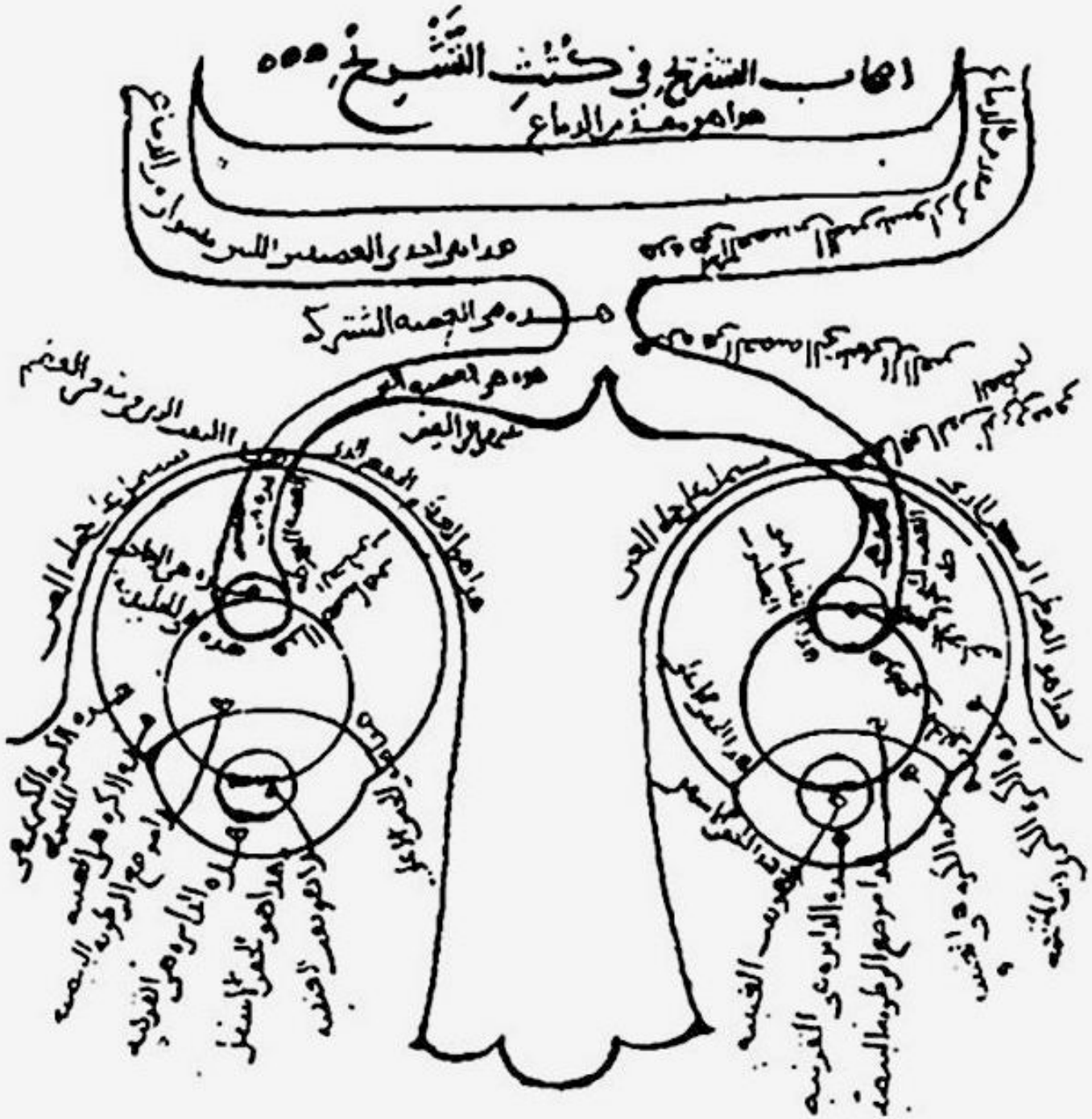
Nimrud or Layard Lens, 750-710 BCE, Assyrian palace of Nimrud, modern Iraq

Oval rock-crystal inlay: ground and polished, with one plane and one slightly convex face. Potentially a 3000-year-old piece of rock crystal, it was unearthed in 1850 by Austen Henry Layard at the Assyrian palace of Nimrud, in modern-day Iraq. When it was found by Layard this oval piece of ground quartz or rock crystal was immediately identified as a lens, and it has come to be known as the 'Nimrud lens'. It could certainly have been used as a crude magnifying glass, with a focal length of 12 centimeters from the plane surface. Over the years it has been examined by a number of opticians (e.g. Gasson 1972), many of whom believe that it was deliberately manufactured as a lens (Layard 1853: 198)*

*http://www.britishmuseum.org/research/collection_online/collection_object_details.aspx?objectId=369215&partId=1

Reading Stones

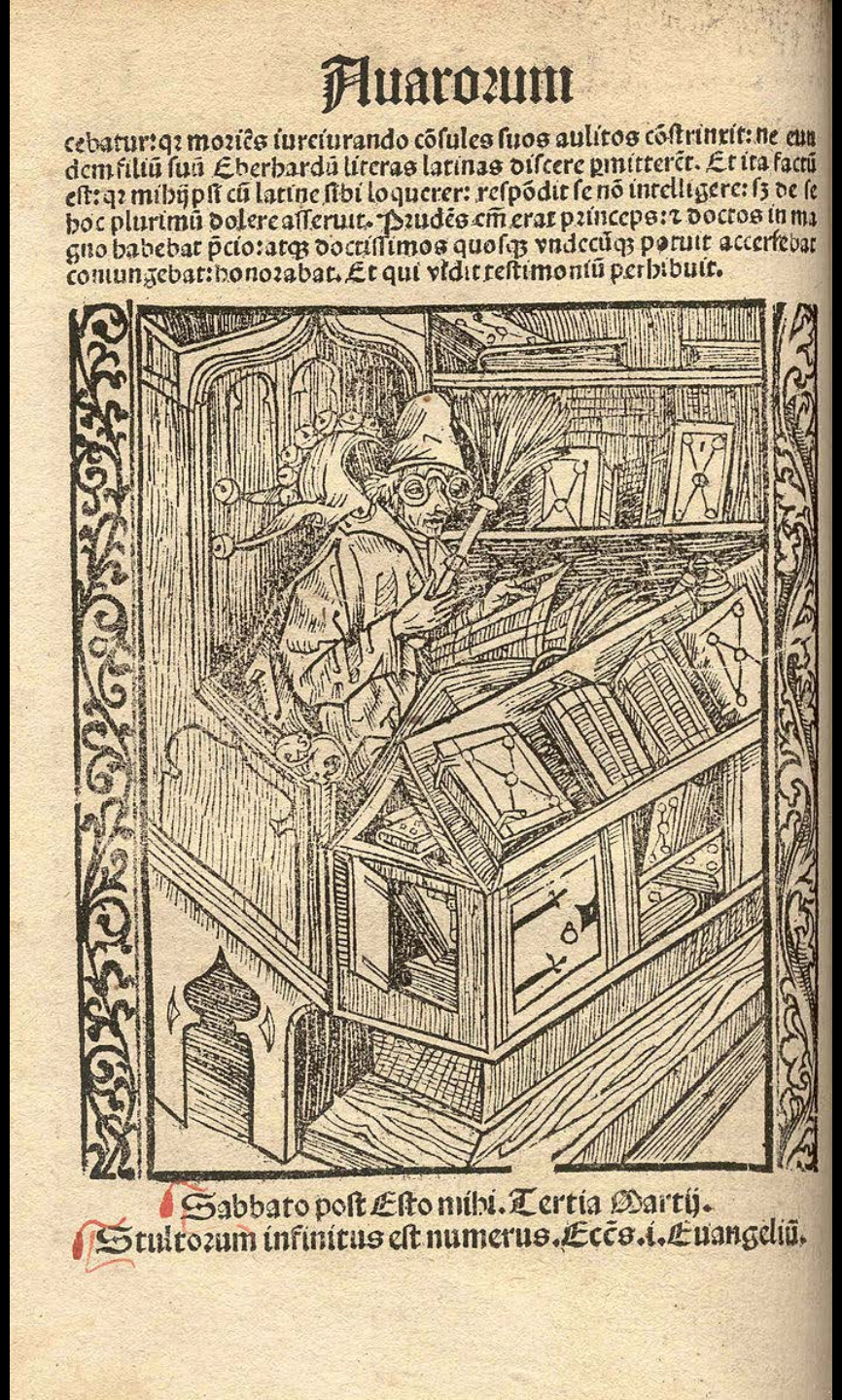
A **reading stone** was an approximately hemispherical lens that was placed on top of text to magnify the letters so that people with presbyopia (farsightedness often from aging) could read it more easily. Reading stones were among the earliest common uses of lenses.



The use of a convex lens to create a magnified image is discussed in the Muslim scholar Alhazen's [Ibn al-Hatham in Egypt] 11th century *Book of Optics* (below), a seven-volume treatise translated from Arabic into Latin in the 12th century.

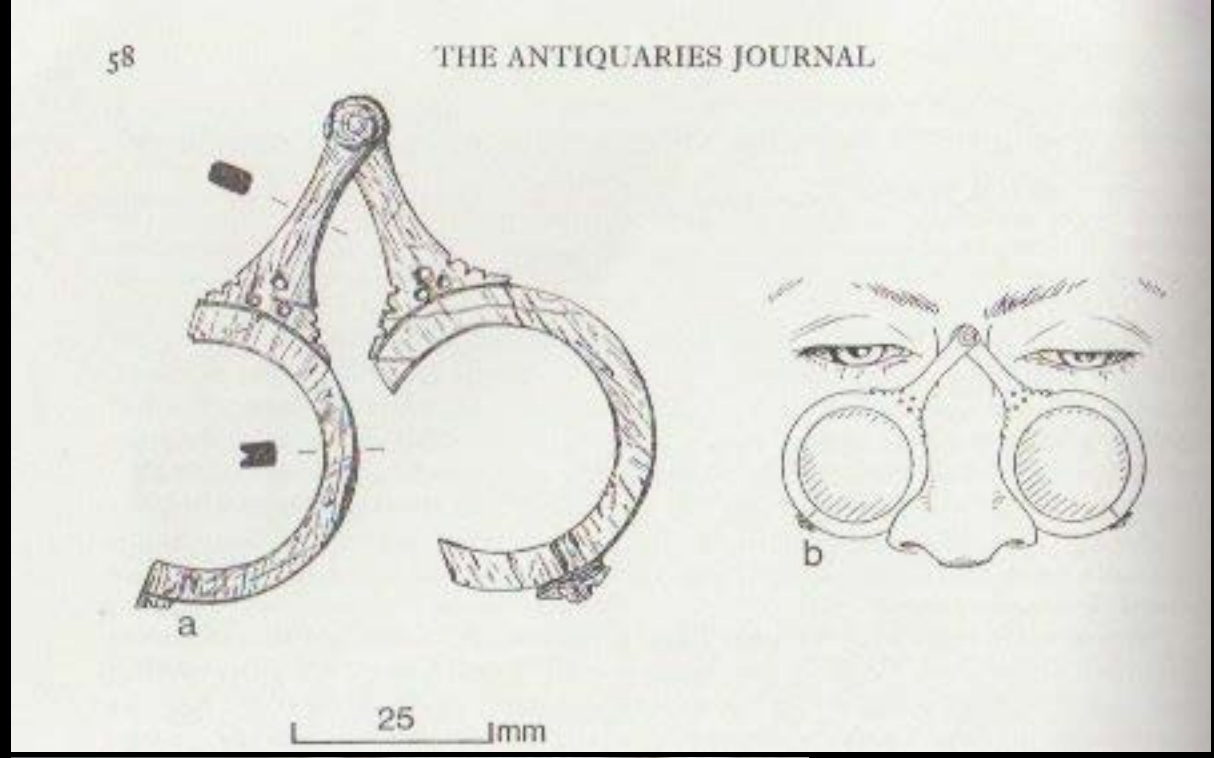
On the left we see the visual system according to Alhazen. The diagram shows two human eyes seen from above, the principal humors and the optic nerves connecting the eyeballs to the brain.

The use of a convex lens to form an enlarged or magnified image is discussed in Alhazen's *Book of Optics* (1021). Its translation into Latin from Arabic in the 12th century was instrumental to the invention of eyeglasses in 13th century Italy. By 1301, there were guild regulations in Venice governing the sale of eyeglasses.



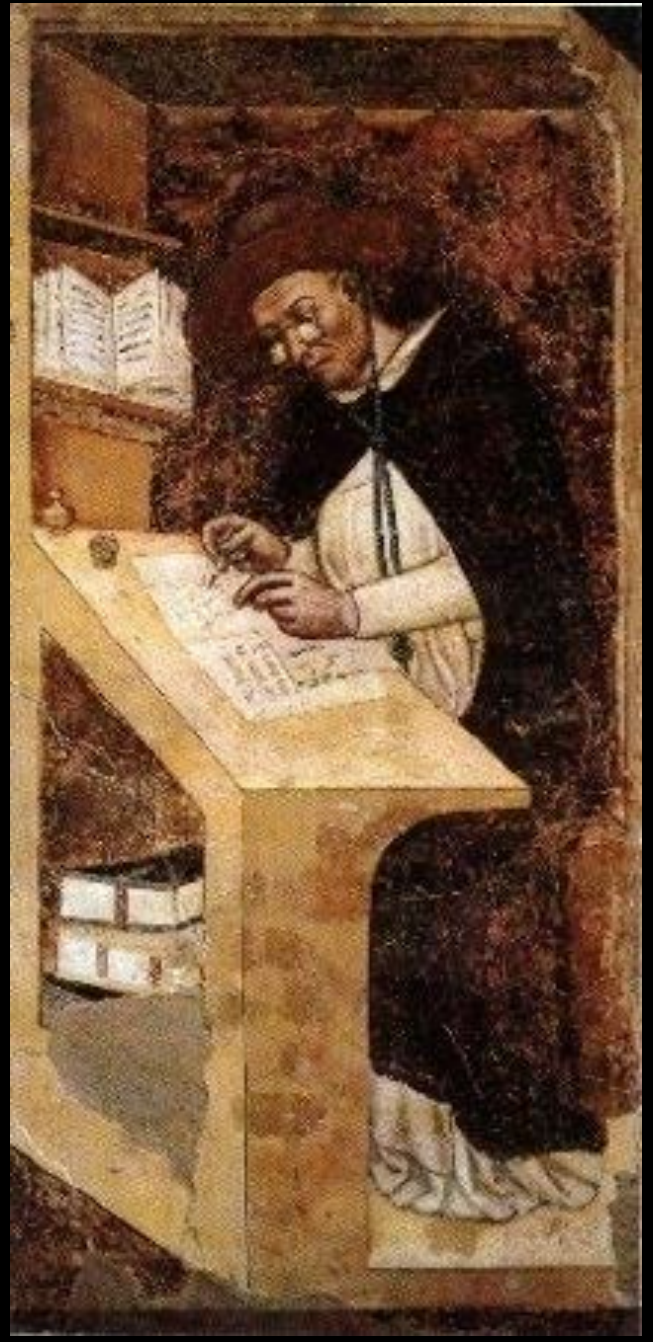
A page from Johannes Geiler von Kaysersberg's Ship of Fools (Navicula sive Speculum fatuorum), 1510

Early frames for glasses consisted of two magnifying glasses riveted together by the handles so that they could grip the nose. These are referred to as "rivet spectacles.”

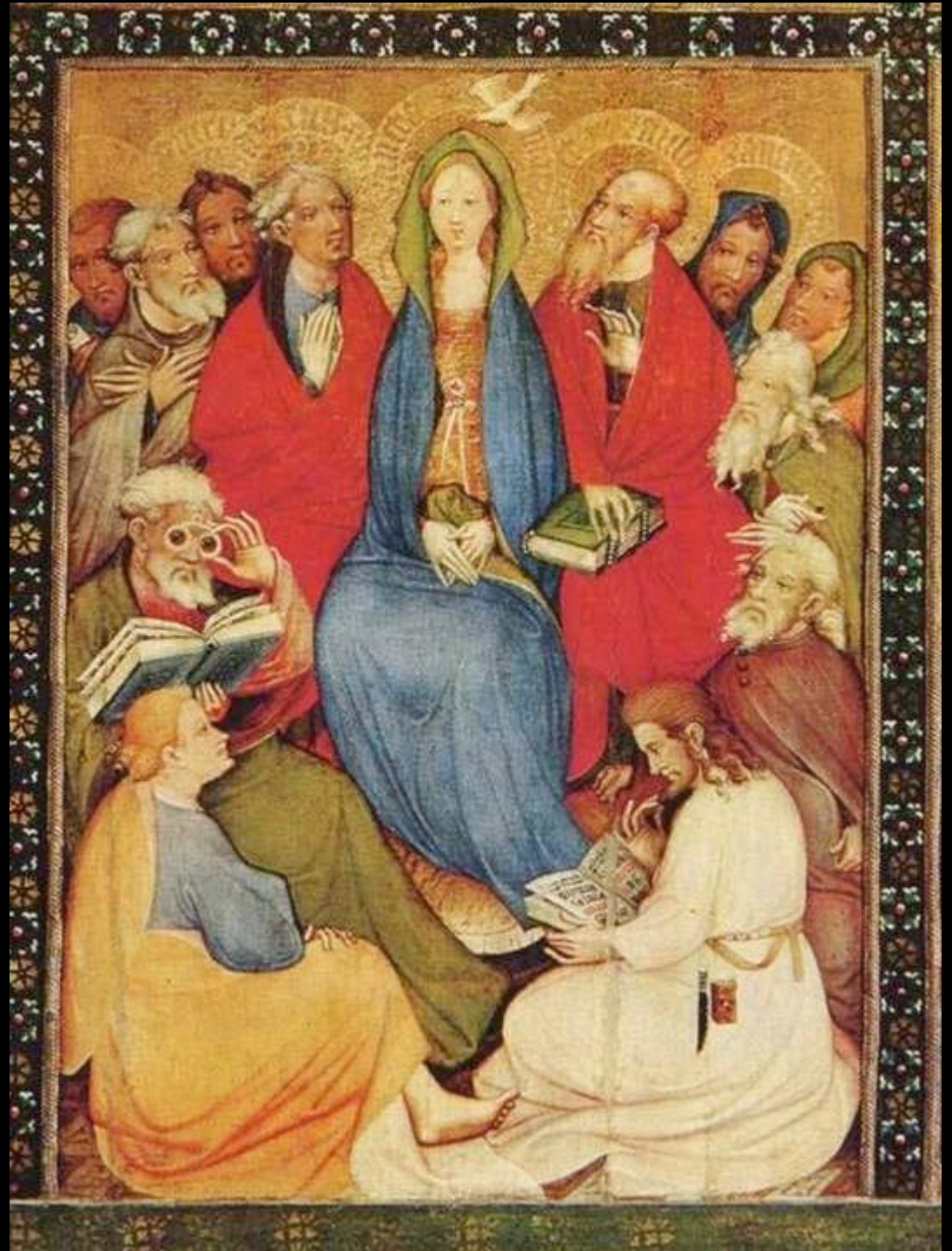


Above: rivet spectacles

Bottom Left: corbel displayed high up in the church of St Martin, Salisbury in Wiltshire, England, 1430-1440



Tommaso da Modena, Portrait of Cardinal Hugh de Provence Reading in a Scriptorium, 1352

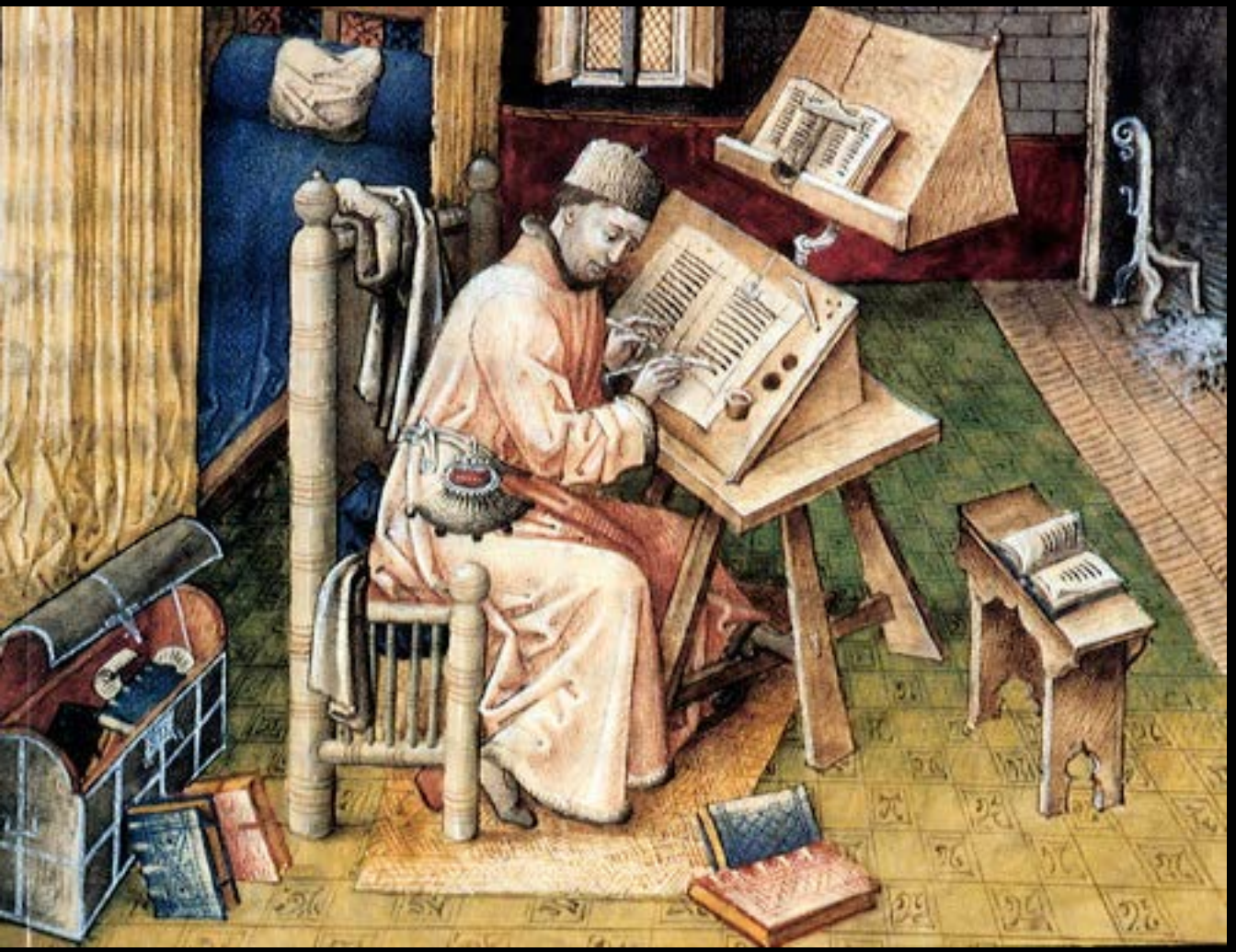


Left and Above: Conrad von Soest, Virgin Enthroned with bespectacled Apostle, 1403, in the Altarpiece of the church of Bad Wildungen, Germany

Portrait of Cardinal Fernando Niño de Guevara by El Greco circa 1600 shows glasses with temples passing over and beyond the ears.

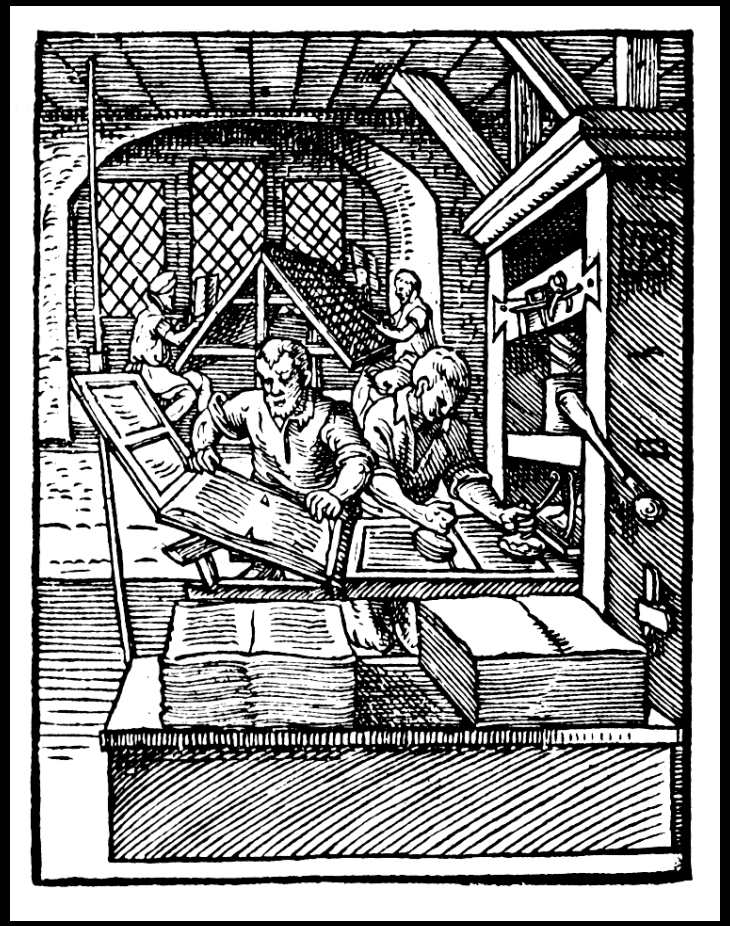
Lenses, eyeglasses, and prosthetics of vision **at once constitute and follow** the evolution of technology.

Lenses and eyeglasses are technologies themselves and respond to other technologies.



From hand-written texts to…

Movable print and the mechanized Gutenberg printing press 1450 (China originated this technology in the 11th century)

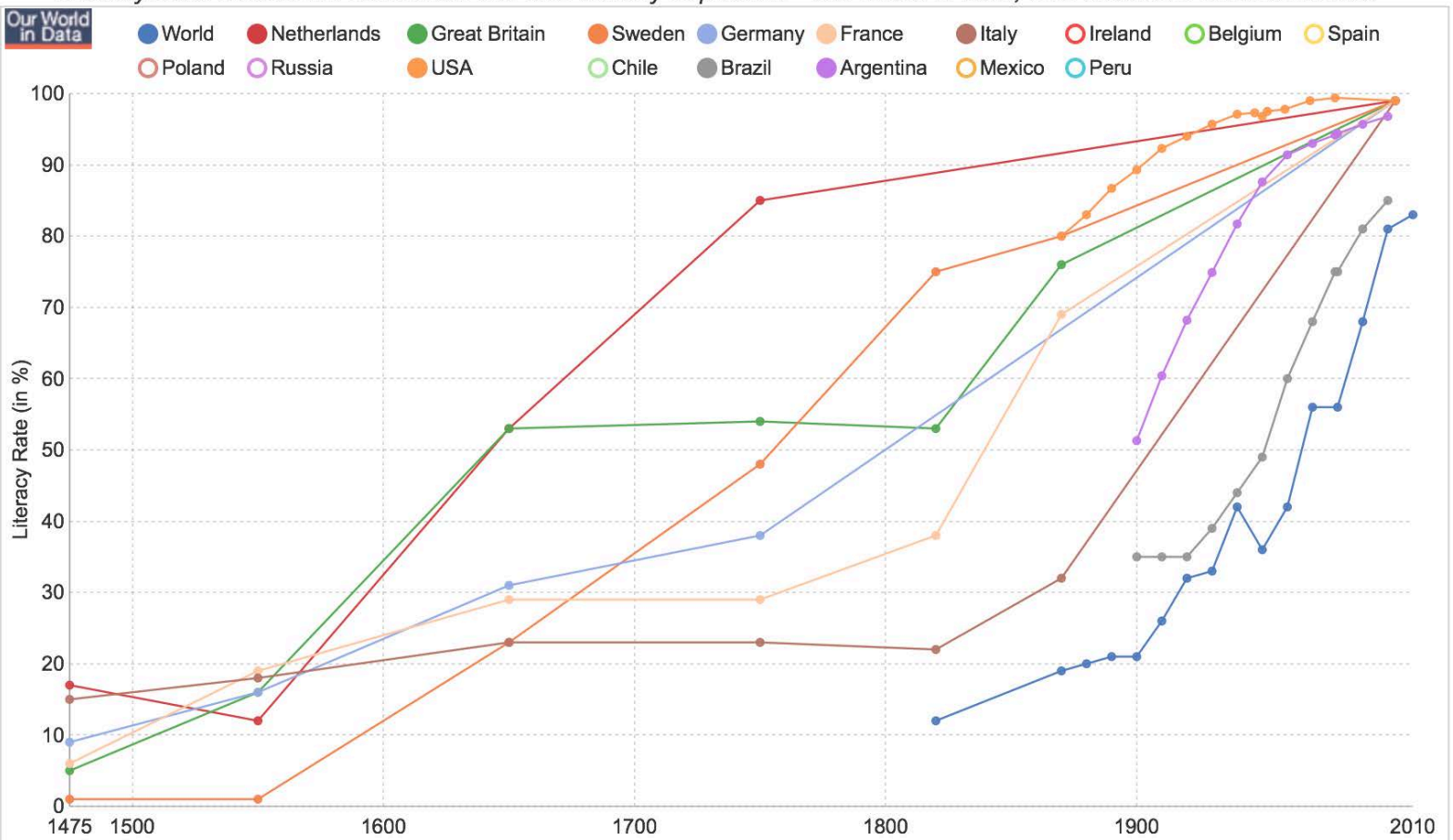


Early wooden printing press, depicted in 1568. Such presses could produce up to 240 impressions per hour.

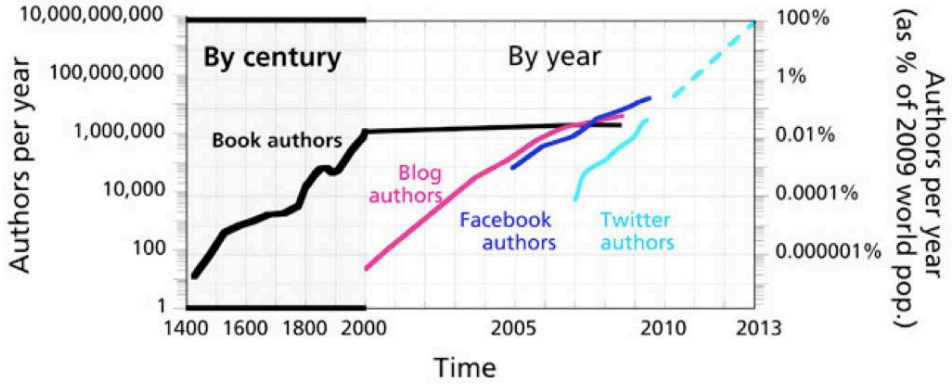
Johannes Gutenberg [1398-1468] An artist's visualization of Johannes Gutenberg in his workshop, showing his first proof sheet. Gutenberg conceptualized and then built the first print with movable type in 1450.

The rise of literacy…

Literacy rates around the world from the 15th century to present – Our World in Data, with data from various sources[3]



The author Max Roser licensed this visualisation under a CC BY-SA license . You are welcome to share but please refer to its source where you find more information: www.ourworldindata.org/data/education-knowledge/literacy
Data Sources: Buringh & Van Zanden (2009), Van Zandel et al (2014), OxLAD, Broadberry & O'Rourke (2010), CIA and US National Center for Education Statistics.
Full screen view Download Data



Near-universal Authorization of content
http://seedmagazine.com/content/article/a_writing_revolution/

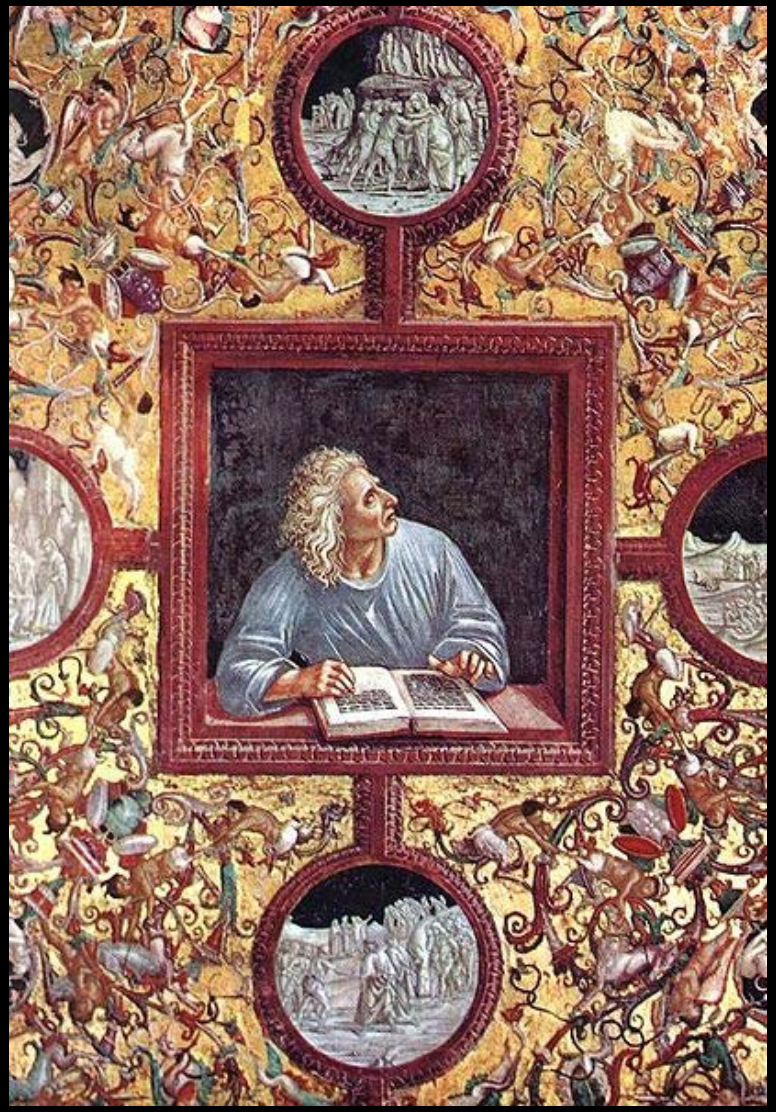
Movable type was a massive improvement of the handwritten manuscript and allowed for much faster production of printed materials. Movable type was also invented in China, though earlier than Gutenberg's. However, Gutenberg was instrumental in spreading its use across Europe and the World.

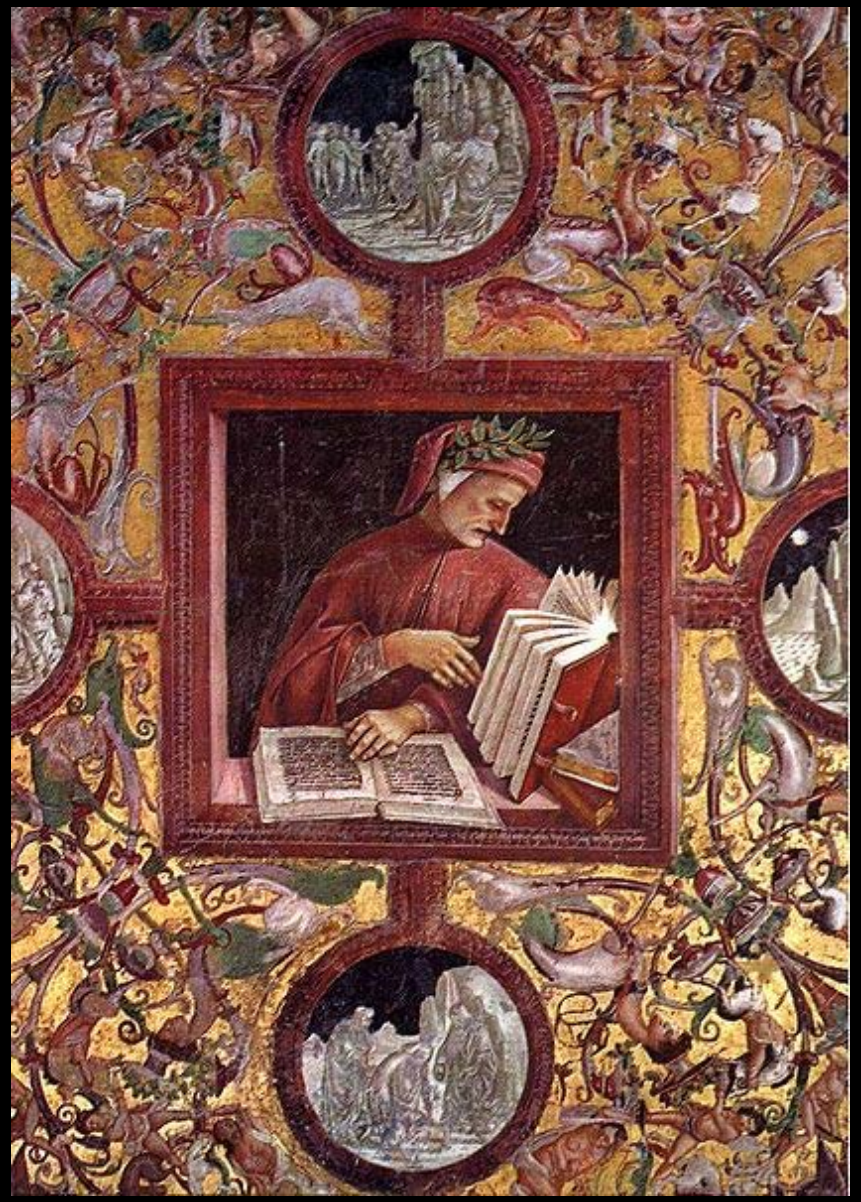
Gutenberg's major publication was a Bible, which is referred to as the *42-line Bible*, the *Mazarin Bible* or the *Gutenberg Bible*. The book first appeared in 1455, although it is thought to have undergone production starting in 1454, and there were approximately 180 copies produced, of which 21 complete copies still exist. The book set many of the printing standards for future publications and is still referenced for its quality in production and typography.

The rise of the vernacular in print

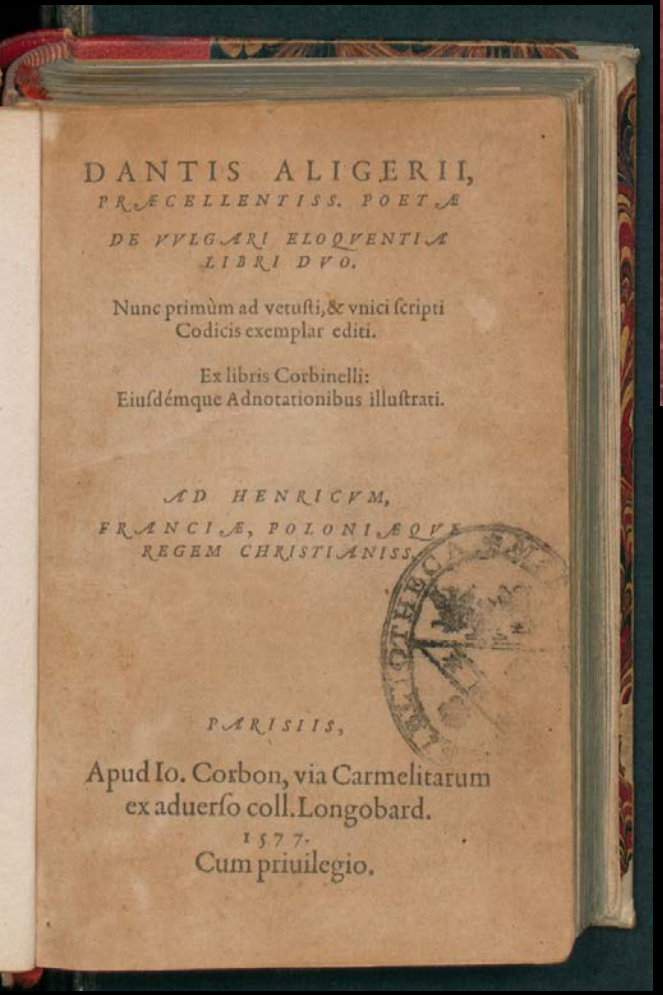
The *vernacular* is different from literary or official language: it's the way people really talk with each other, like how families talk at home.

You know how some language is fancy and formal? Vernacular is different: think of it as how friends talk when no one is listening. Vernacular language includes slang and obscenities. One of the hardest things about writing for school is getting away from the vernacular and learning to write in more formal ways that don't come as naturally. You can also say specific groups have a vernacular, meaning the unique way people in a certain region or profession speak.





Details of thinkers/writers with book from Luca Signorelli's fresco, Chapel of San Brizio, Orvieto Cathedral, 1500-1503; from L-R Statius, Dante Alighieri, and Ovid


DANTIS ALIGERII,
PRÆCELLENTISS. POETÆ
DE VVLGARI ELOQVENTIA
LIBRI DVO.

Nunc primùm ad vetusti, & vnici scripti
Codicis exemplar editi.

Ex libris Corbinelli:
Eiusdémque Adnotationibus illustrati.

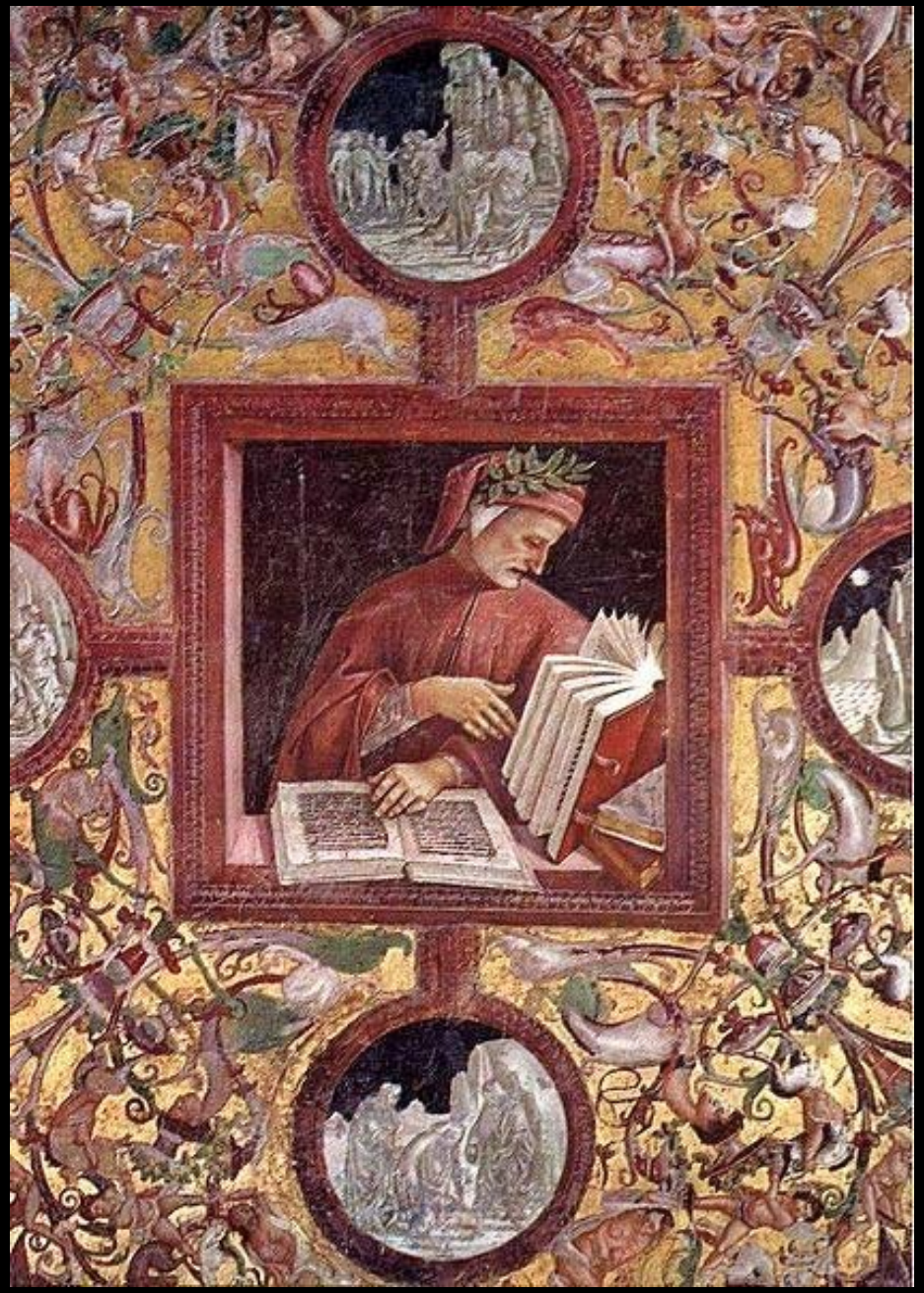
AD HENRICVM,
FRANCIÆ, POLONIÆQVE
REGEM CHRISTIANISS.

PARISIIS,
Apud Io. Corbon, via Carmelitarum
ex aduerso coll. Longobard.
1577.
Cum priuilegio.

Left: Dante Alighieri's *On Eloquence in the vernacular* (*De vulgari eloquentia),* 1302-1305

Dante Alighieri c. 1265 – 1321

Between 1437 and 1586, the first grammar of Italian, French, Spanish, Dutch, German, and English, were written, though not always immediately published. It is to be understood that the first vestiges of those languages preceded their standardization by up to several hundred years.



Dante Alighieri, detail from Luca Signorelli's fresco, Chapel of San Brizio, Orvieto Cathedral, 1500-1503; he was influential in establishing their Tuscan dialect as the most prominent literary language in all of Italy

The well defined traditional groups of readers knew Latin, and many read it with ease and better than their own mother tongue. Books in the vernacular languages were for 'every man, as well rude as learned,' and the student of literacy and literary taste must be as much concerned with the 'rude' as with the learned.

Latin, the language of the educated, was the international language throughout the Middle Ages; this fact is reflected by the book production. Slightly more than three-fourths of surviving incunables* (printed texts) are in Latin, the rest in different vernacular languages.

Throughout the 16th century the percentage of books in the vernacular increased, caused in part by the mounting concern of authors, printers and publishers with the 'rude' (men, women and children who were able or willing to read books in their own tongue, but not in Latin). It is also true that the importance of Latin as the language of communication among the learned declined, in spite of the revival of learning and increased concern with the classics and their style. Already during the first half of the 16th century books in Latin and those in the vernacular languages were much more evenly distributed, and by the end of the 16th century the latter accounted probably for more than half of the total production.

*An **incunable**, or sometimes incunabulum (plural **incunables** or incunabula, respectively), is a book, pamphlet, or broadside (such as the Almanach cracoviense ad annum 1474) that was printed—not handwritten—before the year 1501 in Europe.

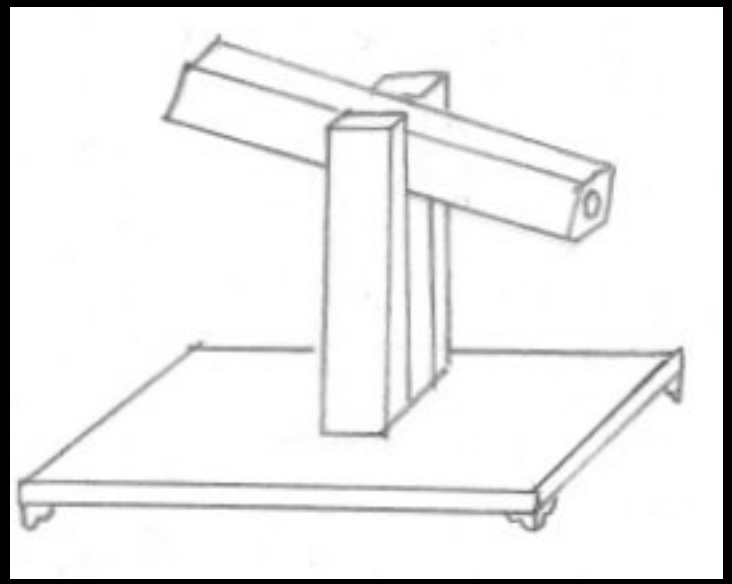
Optical Devices in Science and Art

Above: Charles Stoppelaer, Portrait of Admiral Sir Walter Stirling of Faskine, Holding a Telescope, 1755
Near Right: Circle of George Knapton, Portrait of Admiral Sir Hugh Palliser holding a telescope, c. 1750
Far Right: Anonymous, Portrait Of A Sea Captain With Telescope C. 1850

SCALAR VISION

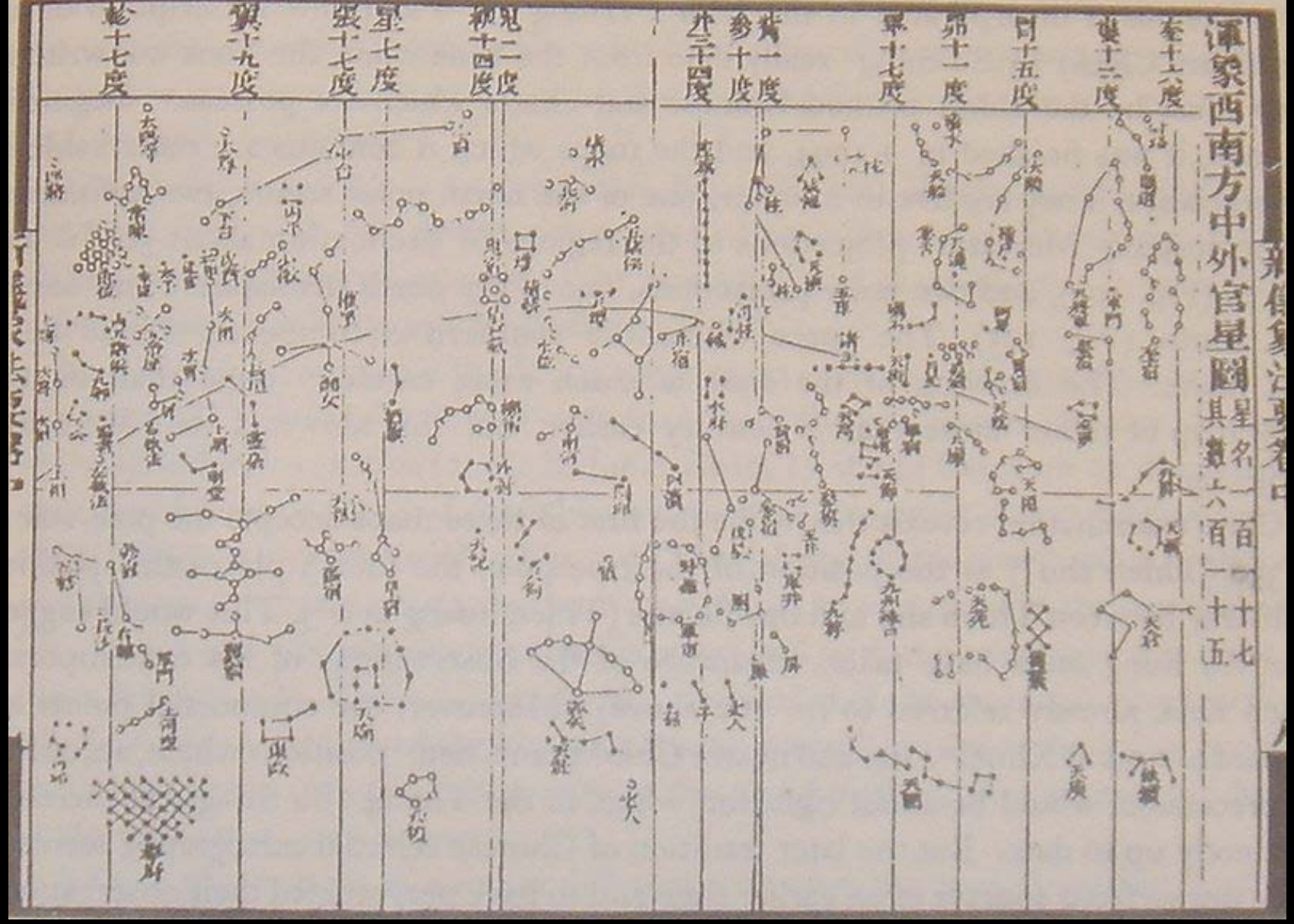
FROM MACRO TO MICRO

FAR-AWAY SIGHTINGS TO INTERNAL EXPLORATION

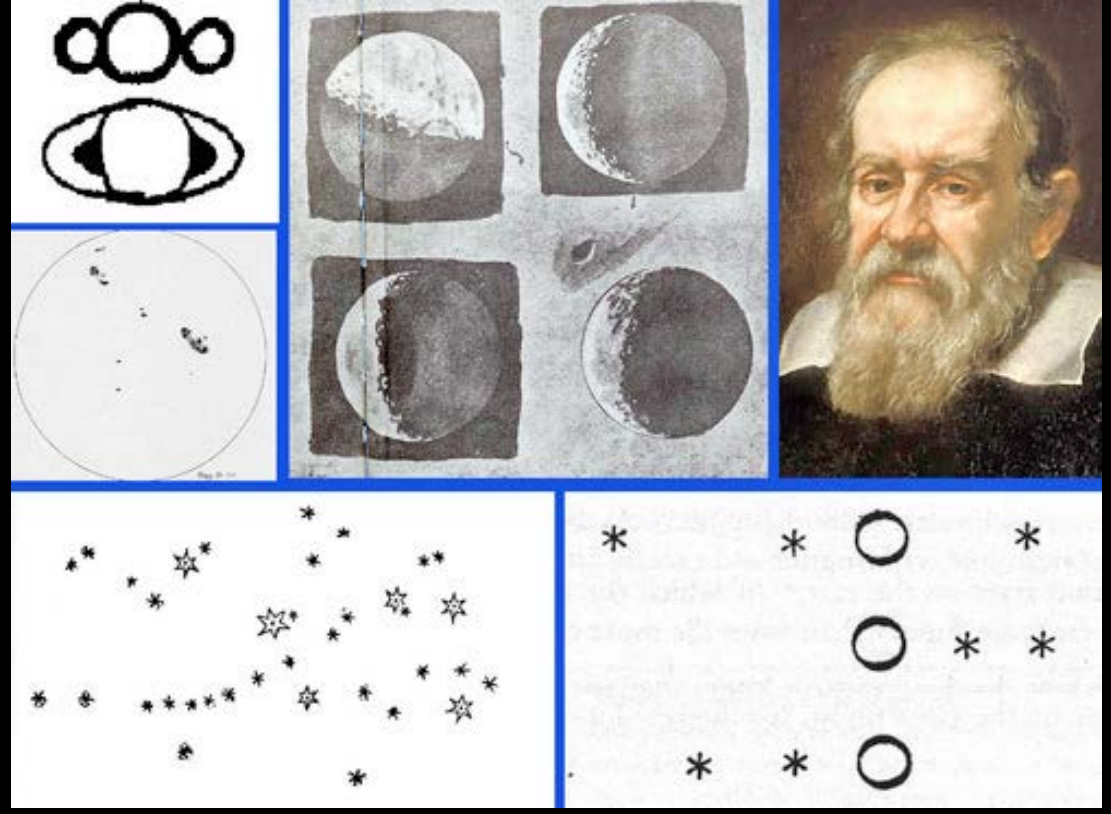


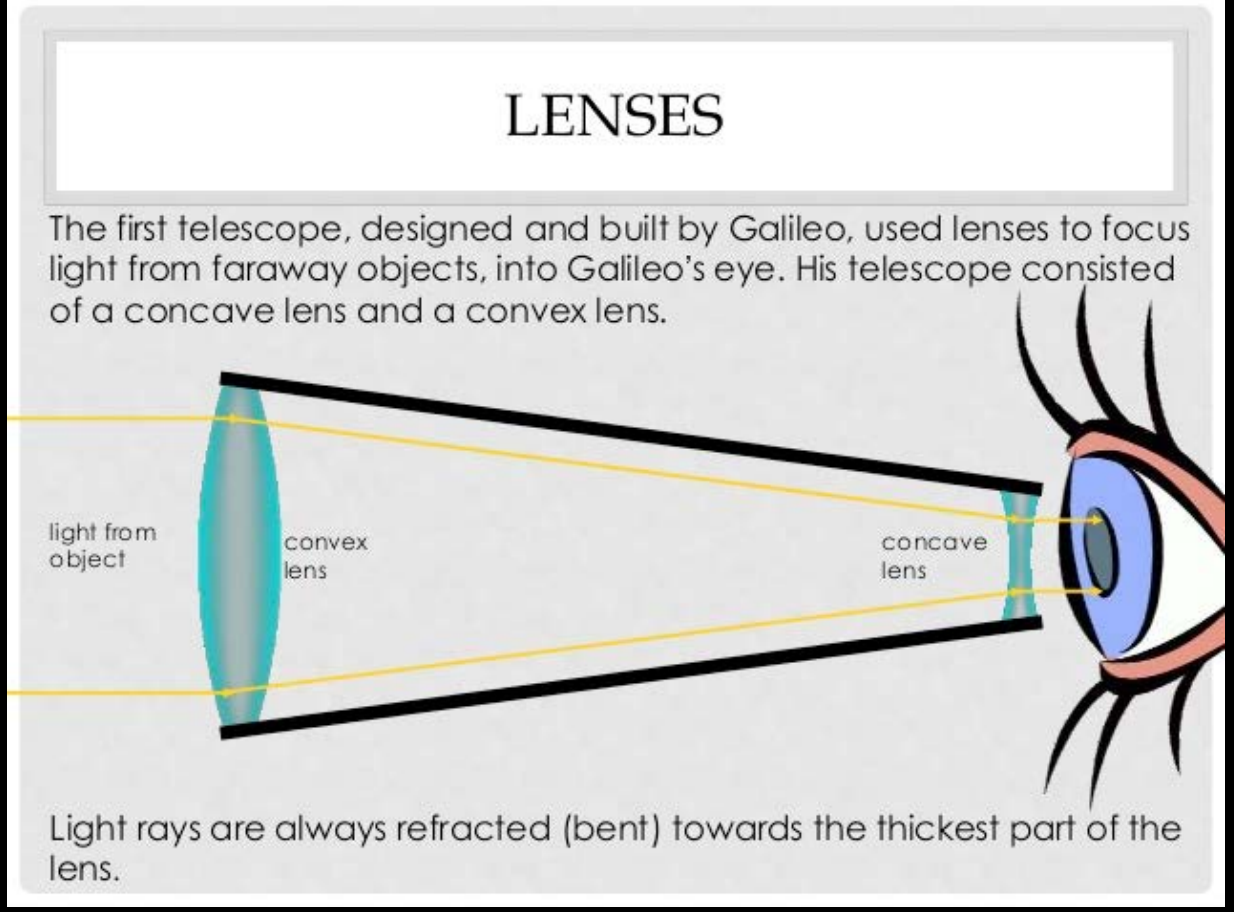
The ancient Chinese used instruments that look a lot like telescopes. These were sighting tubes and simply tubes that you could look through. They were somewhat effective in that they blocked out light around a viewer allowing them to see fainter objects and to better concentrate on a single object.

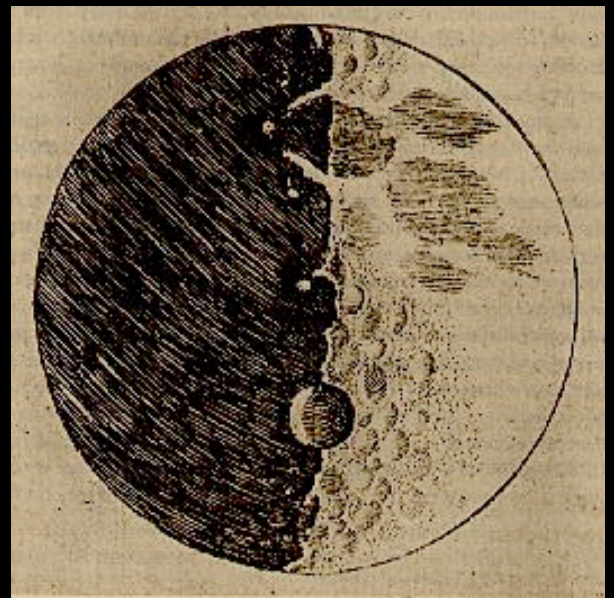
http://www.telescopenerd.com/telescope-astronomy-articles/ancient-chinese-astronomy.htm



Going back over 2,500 years, the Chinese were building observatories, and cataloging stars into maps and arrangements of constellations. The star map shown above dates back to the Song Dynasty [960-1279]. It was created by Su Song who was a Chinese scientist. This map was first published in 1092.

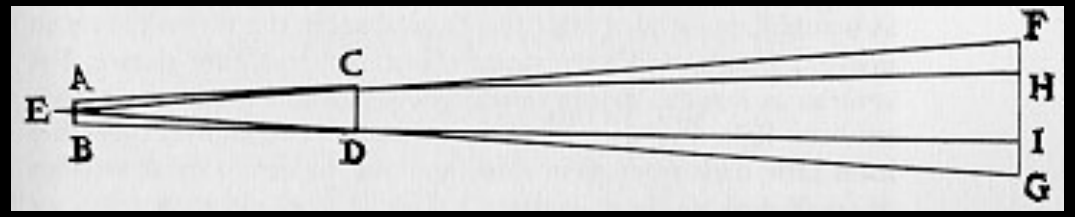






Galileo Galilei [1564-1642] did not invent the telescope. The Dutch, notably Christiaan Huygens, were the first to invent and experiment with lenses (to improve eye sight). But Galileo was the first to use the telescope to study the heavens systematically. His little telescope was poorer than even a cheap modern amateur telescope, but what he observed in the heavens rocked the very foundations of Aristotle's universe and the theological-philosophical worldview that it supported. It is said that what Galileo saw was so disturbing for some officials of the Church that they refused to even look through his telescope; they reasoned that the Devil was capable of making anything appear in the telescope, so it was best not to look through it. That is, the telescope was an instrument of the Devil. That such was so could be no clearer than the image of the moon as it appeared through Galileo's telescope.

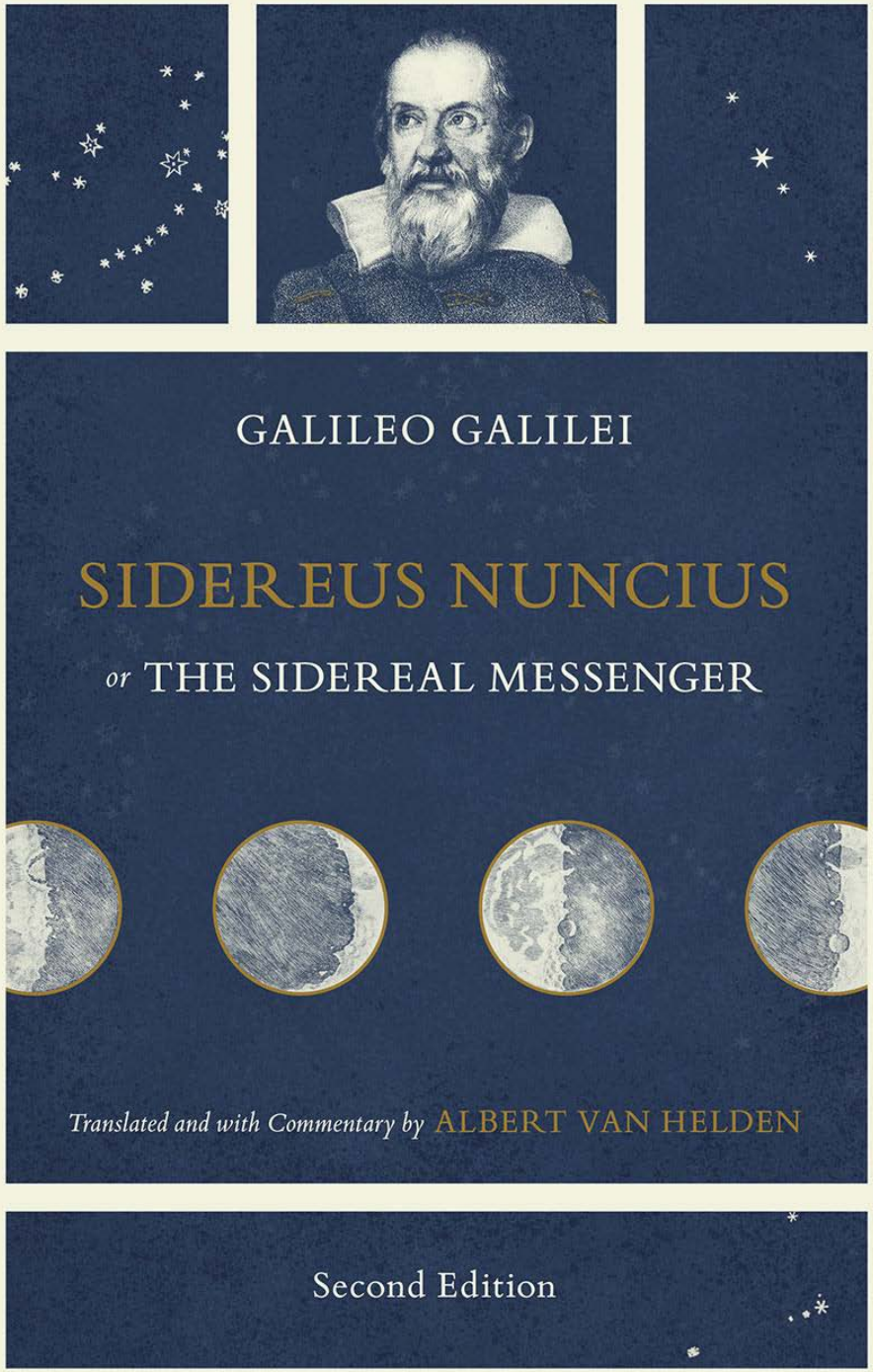
http://homework.uoregon.edu/pub/class/301/galileo.html

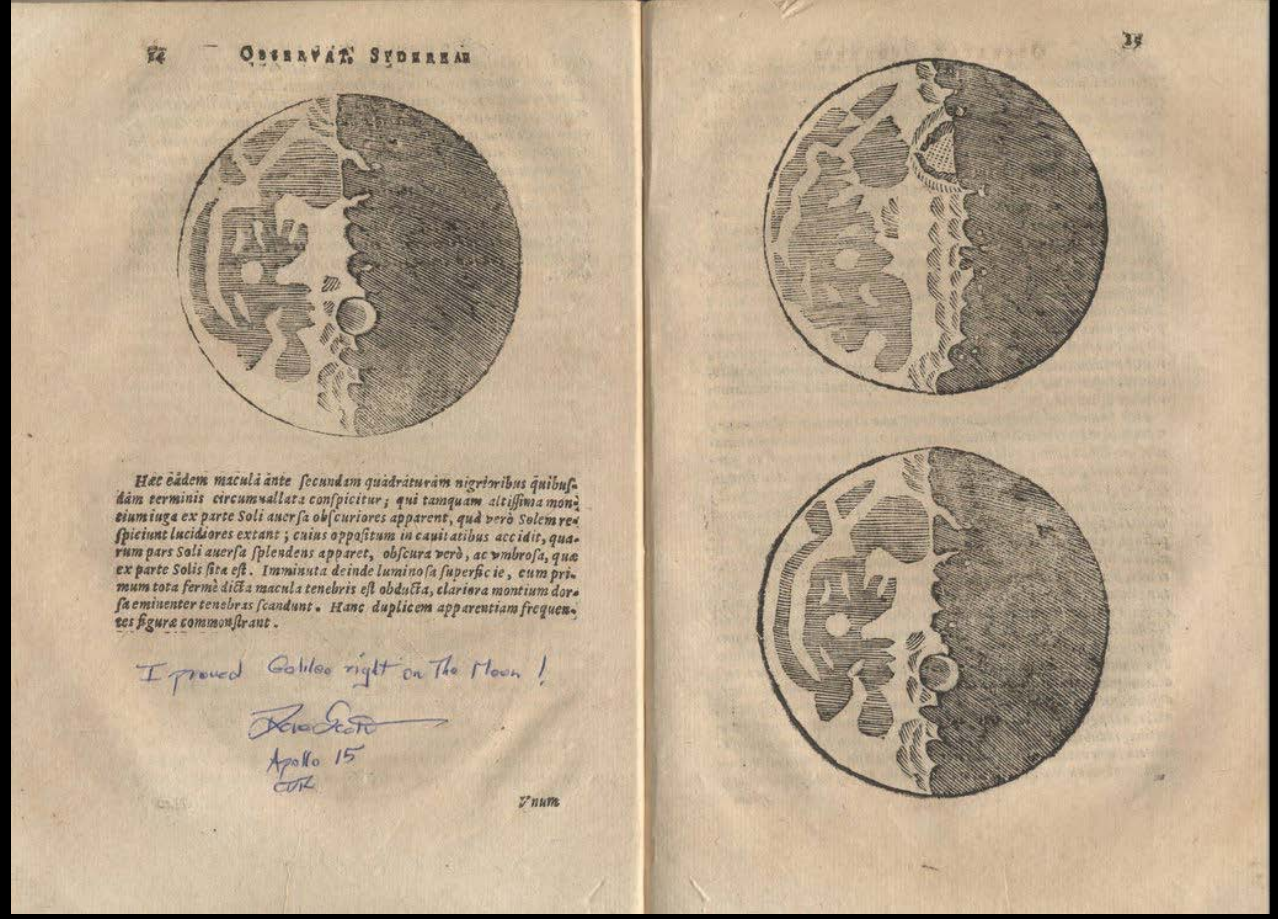


Galileo's drawing of the optical path of his telescope

Galileo made his first telescope in 1609, modeled after telescopes produced in other parts of Europe that could magnify objects three times. He created a telescope later that same year that could magnify objects twenty times. With this telescope, he was able to look at the moon, discover the four satellites of Jupiter, observe a supernova, verify the phases of Venus, and discover sunspots. His discoveries proved the Copernican system.

What is the Copernican system?





His book, *Sidereus nuncius* or *The Starry Messenger* was first published in 1610 and made him famous. In it he reported on his observations of the Moon, Jupiter and the Milky Way. These and subsequent observations and his interpretations of them eventually led to the demise of the geocentric Ptolemaic model of the universe and the adoption of a heliocentric model as proposed in 1543 by Copernicus. Galileo's discovery of mountains on the lunar surface, which had so long been traditionally thought to have a smooth surface, was pictured in his book above right.

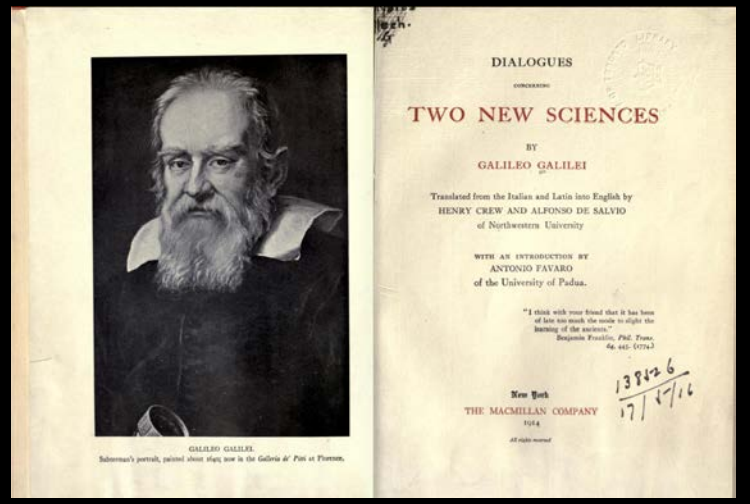
sidereal \ sī-ˈdir-ē-əl \

of, relating to, or expressed in relation to stars or constellations

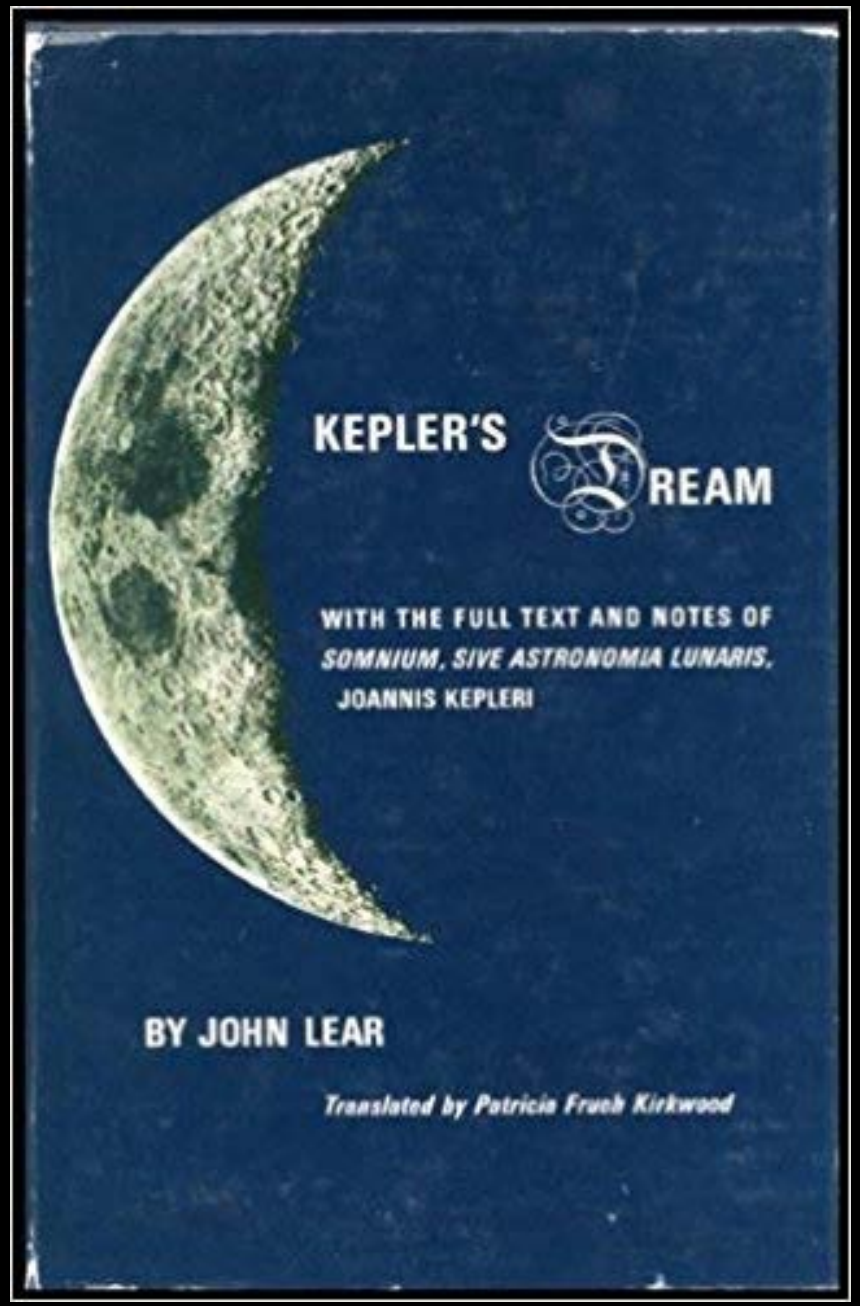
Heliocentrism or Copernicanism

Galileo’s discoveries proved the Copernican system, which states that the earth and other planets revolve around the sun. Prior to the Copernican system, it was held that the universe was geocentric, meaning the sun revolved around the earth.

Francisco Goya, The Inquisition Tribunal, or Auto de fe de la Inquisición, 1812-1819
The Spanish Inquisition officially lasted from 1478-1834. The firsts “auto-da-fé” took place in Seville in 1481, when six *conversos* (Jews forcibly converted to Christianity) were burnt at the stake.



Galileo was tried by the Catholic Inquisition, and found "vehemently suspect of heresy", and forced to recant. He spent the rest of his life under house arrest. While under house arrest, he wrote one of his best-known works, *Two New Sciences*, in which he summarized work he had done some forty years earlier on the two sciences now called kinematics (physics) and strength of materials.



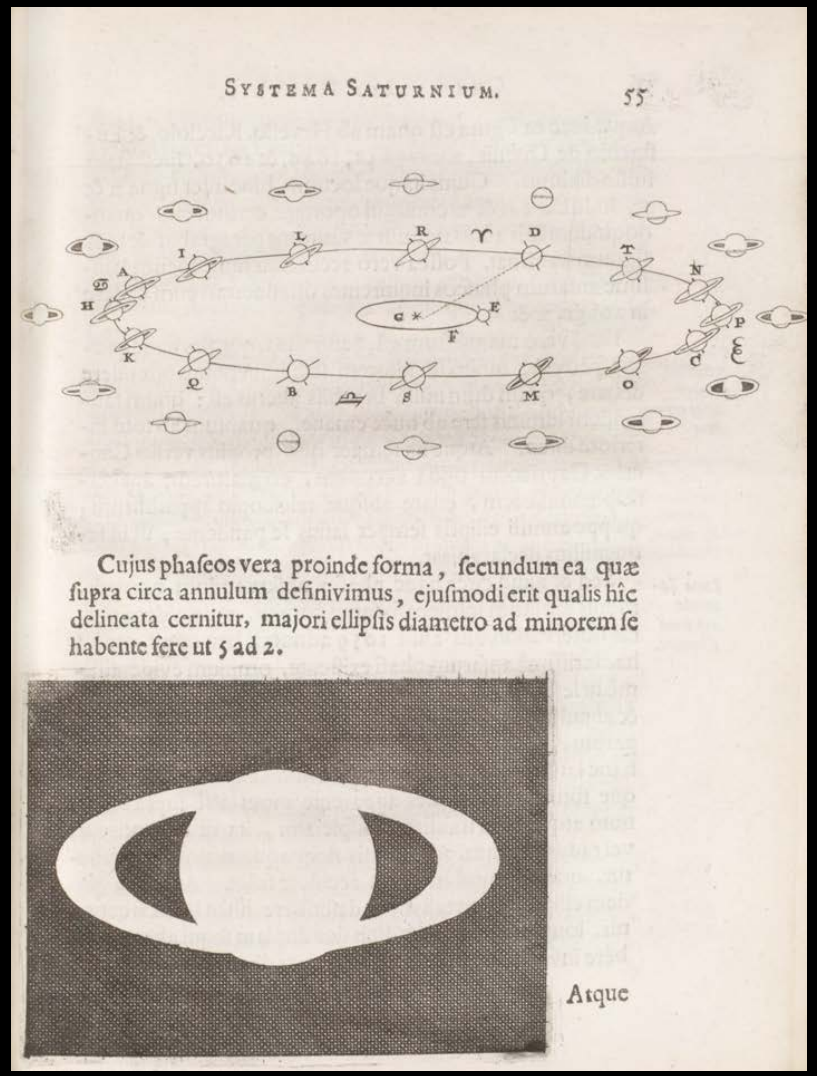
How do these prosthetic devices extend and catalyze the imagination?

Somnium (Latin for "The Dream") is a novel written in 1608 (published 1634), in Latin, by the German astronomer Johannes Kepler.

In the narrative, an Icelandic boy and his witch mother learn of an island named Levania (our Moon) from a daemon, a spiritual guide.

Somnium presents a detailed imaginative description of how the Earth might look when viewed from the Moon, and is considered the first serious scientific treatise on lunar astronomy.

It is the first work of science fiction.



SYSTEMA SATURNIUM. 55

Cujus phaſeos vera proinde forma, ſecundum ea quæ ſupra circa annulum definivimus, ejuſmodi erit qualis hîc delineata cernitur, majori ellipſis diametro ad minorem ſe habente fere ut 5 ad 2.

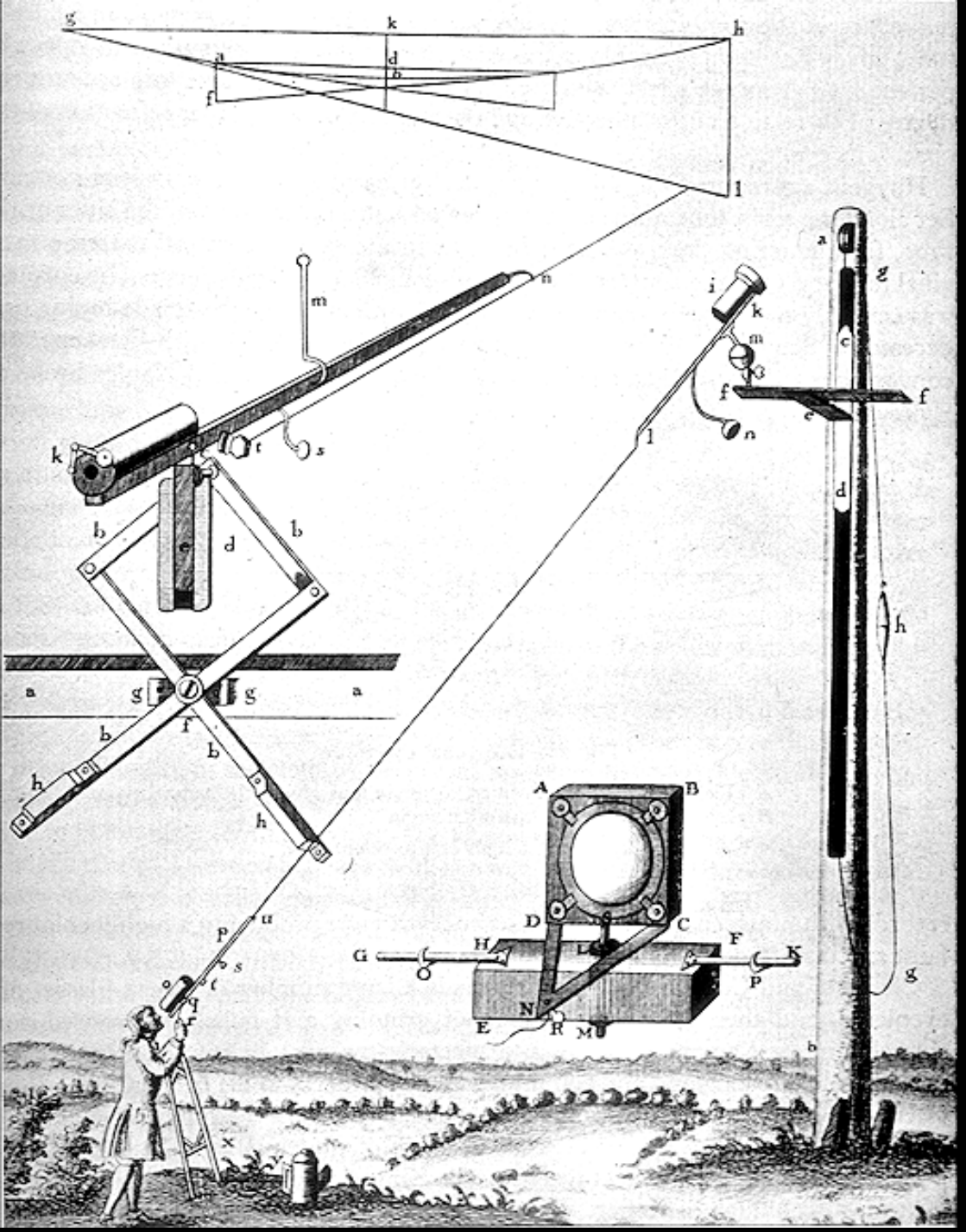
Atque

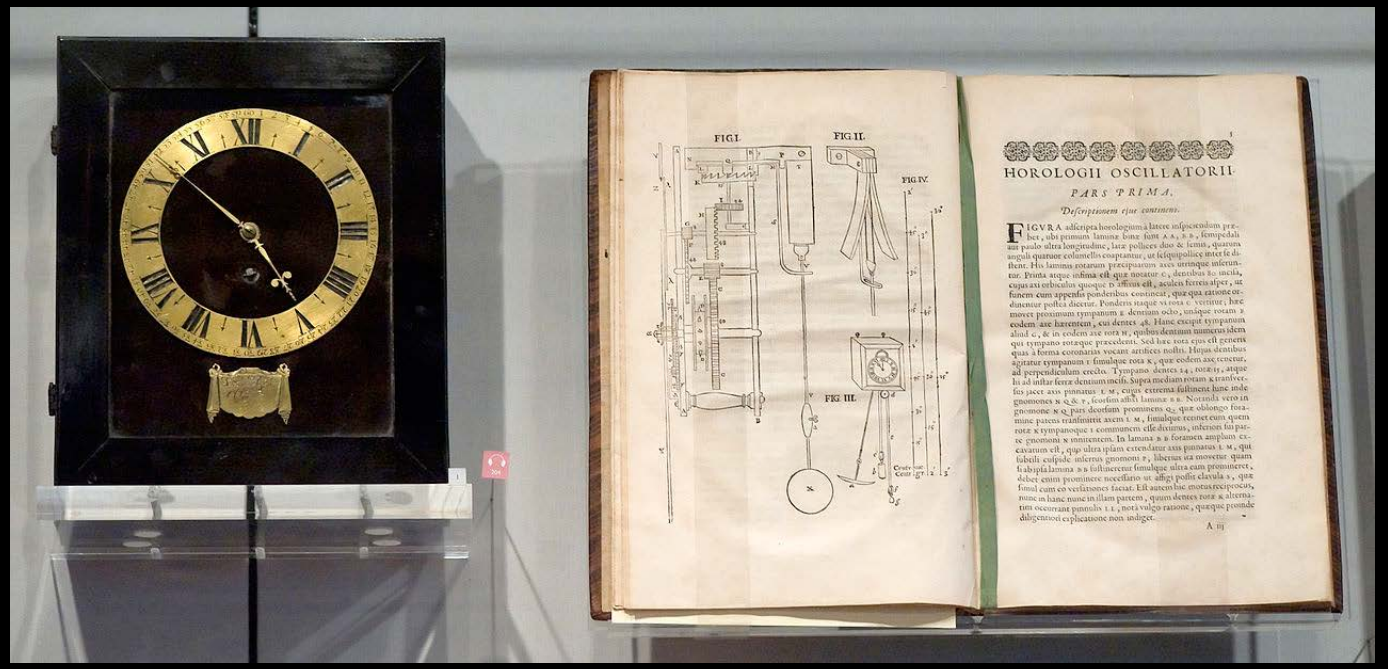
Huygens' explanation for the aspects of Saturn, Systema Saturnium, 1659

In 1655, the Dutchman Christiaan Huygens proposed that Saturn was surrounded by a solid ring, "a thin, flat ring, nowhere touching, and inclined to the ecliptic."

Using a 50 power refracting telescope that he designed himself, Huygens also discovered the first of Saturn's moons, Titan. In the same year he observed and sketched the Orion Nebula. His drawing, the first such known of the Orion nebula, was published in *Systema Saturnium* in 1659. Using his modern telescope he succeeded in subdividing the nebula into different stars. The brighter interior now bears the name of the Huygenian region in his honor. He also discovered several interstellar nebulae and some double stars. Shortly before his death in 1695, Huygens completed *Cosmotheoros*, published posthumously in 1698. In it he speculated on the existence of extraterrestrial life, on other planets, which he imagined was similar to that on Earth.

Christiaan Huygens [1629-1695]. Cut from the engraving following the painting of Caspart Netscher by G. Edelinck, between 1684 and 1687.

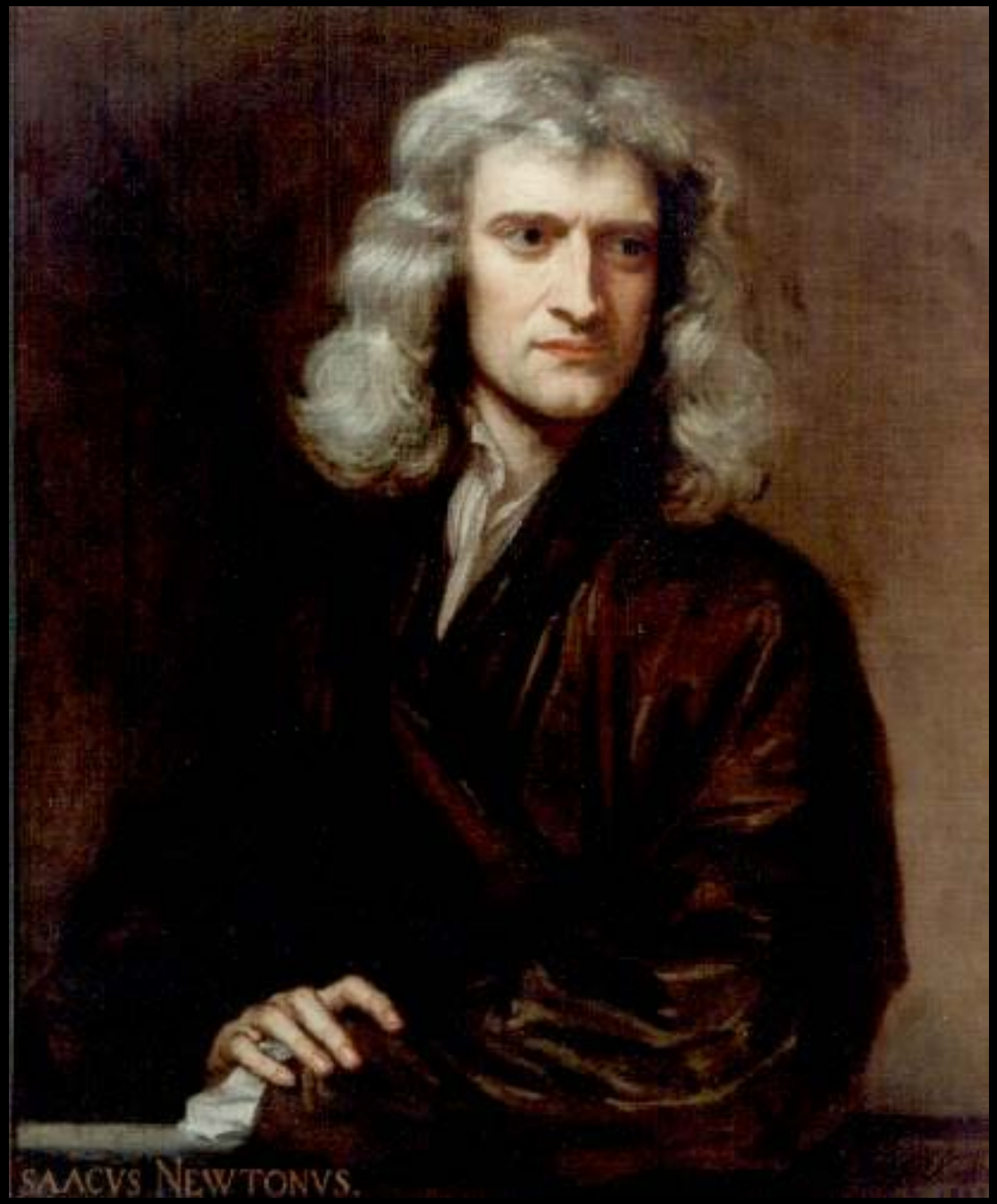




Above: Spring driven pendulum clock, designed by Huygens, built by instrument maker Salomon Coster (1657), and copy of the *Horologium Oscillatorium*

Left: An engraving of Christiaan Huygens's 210-foot aerial telescope showing the eyepiece and objective mounts and connecting string. The aerial telescope is a type of very long focal length refracting telescope, built in the second half of the 17th century, that did not use a tube. Instead, the objective* was mounted on a pole, tree, tower, building or other structure on a swivel ball-joint. The observer stood on the ground and held the eyepiece, which was connected to the objective by a string or connecting rod. By holding the string tight and maneuvering the eyepiece, the observer could aim the telescope at objects in the sky.

*The **objective** is the optical element that gathers light from the object being observed and focuses the light rays to produce a real image. Objectives can be a single lens or mirror, or combinations of several optical elements.

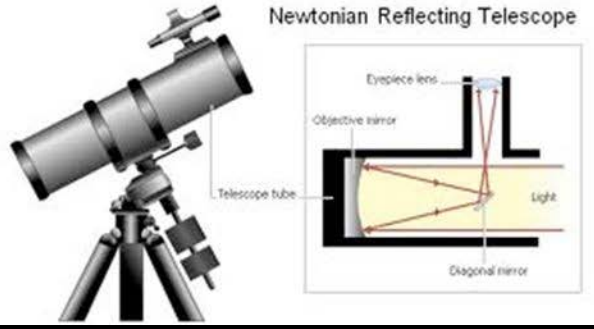


This is the earliest portrait of Sir Isaac Newton [1642-1727] to survive. It was painted in 1689 when Newton was in London as a member of the Convention Parliament, following the "Glorious Revolution" of 1688. The artist was Godfrey Kneller, perhaps the greatest portrait painter of his day.

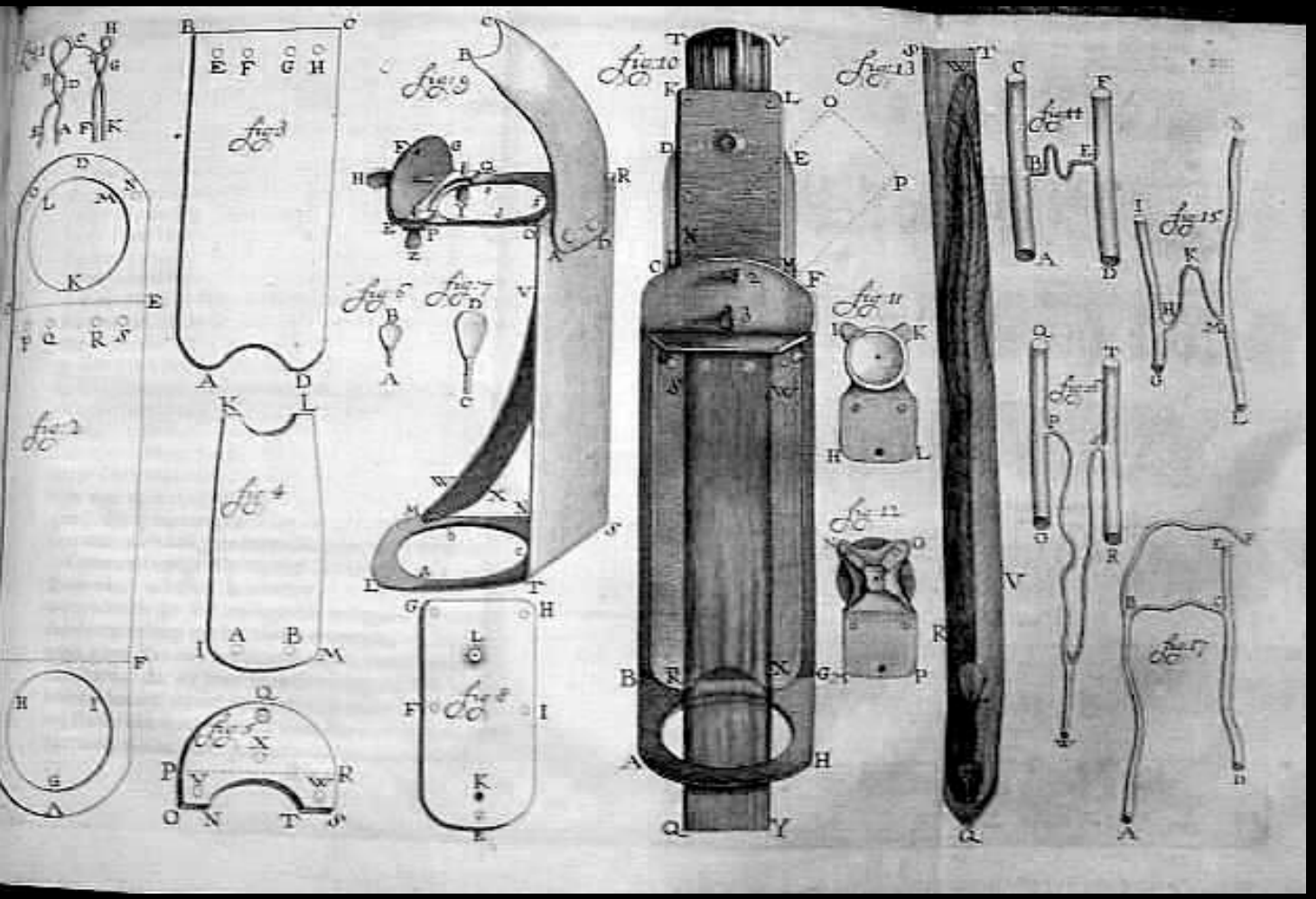
Newton was 46 years old and *Principia*, or *Mathematical Principles of Natural Philosophy*, had been published two years previously. It represents Newton "at the height of his powers."

Reflecting Telescope

- **Reflecting Telescopes** use a large concave mirror to gather light
  - The mirror collects light from distant objects and focuses the rays to form a *real* image
  - A *small* mirror inside the telescope reflects the image to the **eyepiece**
    - **The images you see are upside down**



Replica of Newton's second Reflecting Telescope that he presented to the Royal Society in 1672



Leeuwenhoek made more than 500 optical lenses. He also created at least 25 single-lens microscopes, of differing types, of which only nine have survived. These microscopes were made of silver or copper frames, holding hand-made lenses. Those that have survived are capable of magnification up to 275 times.

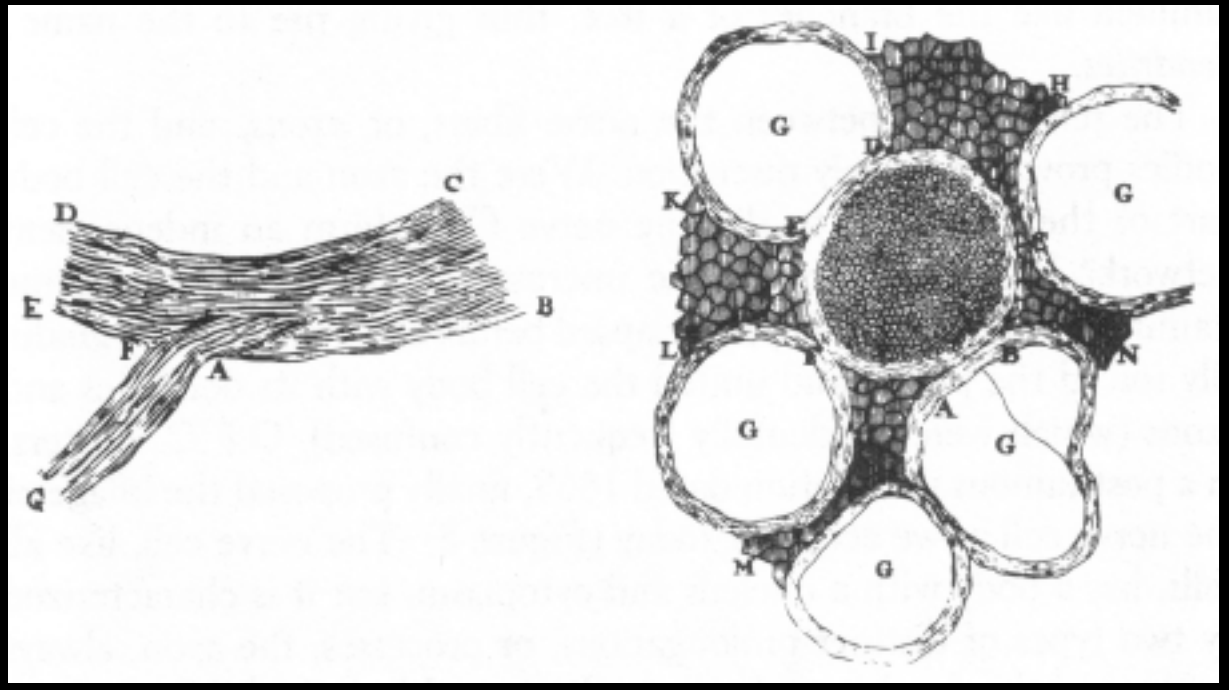
Anton van Leeuwenhoek [1632-1723]

Cell Theory

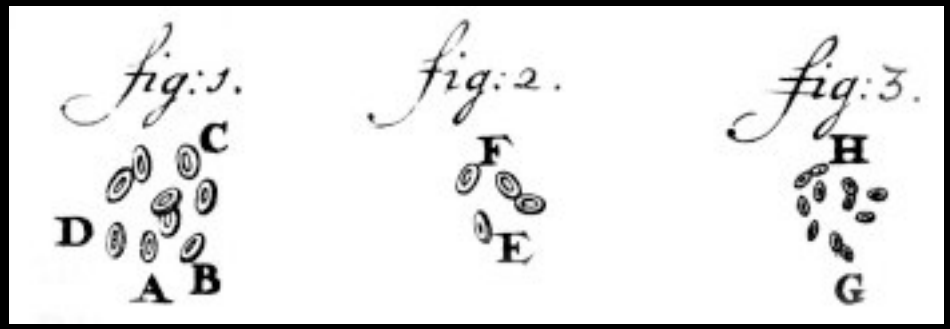
Anton van Leeuwenhoek (1632-1723)

Dutch microscopist

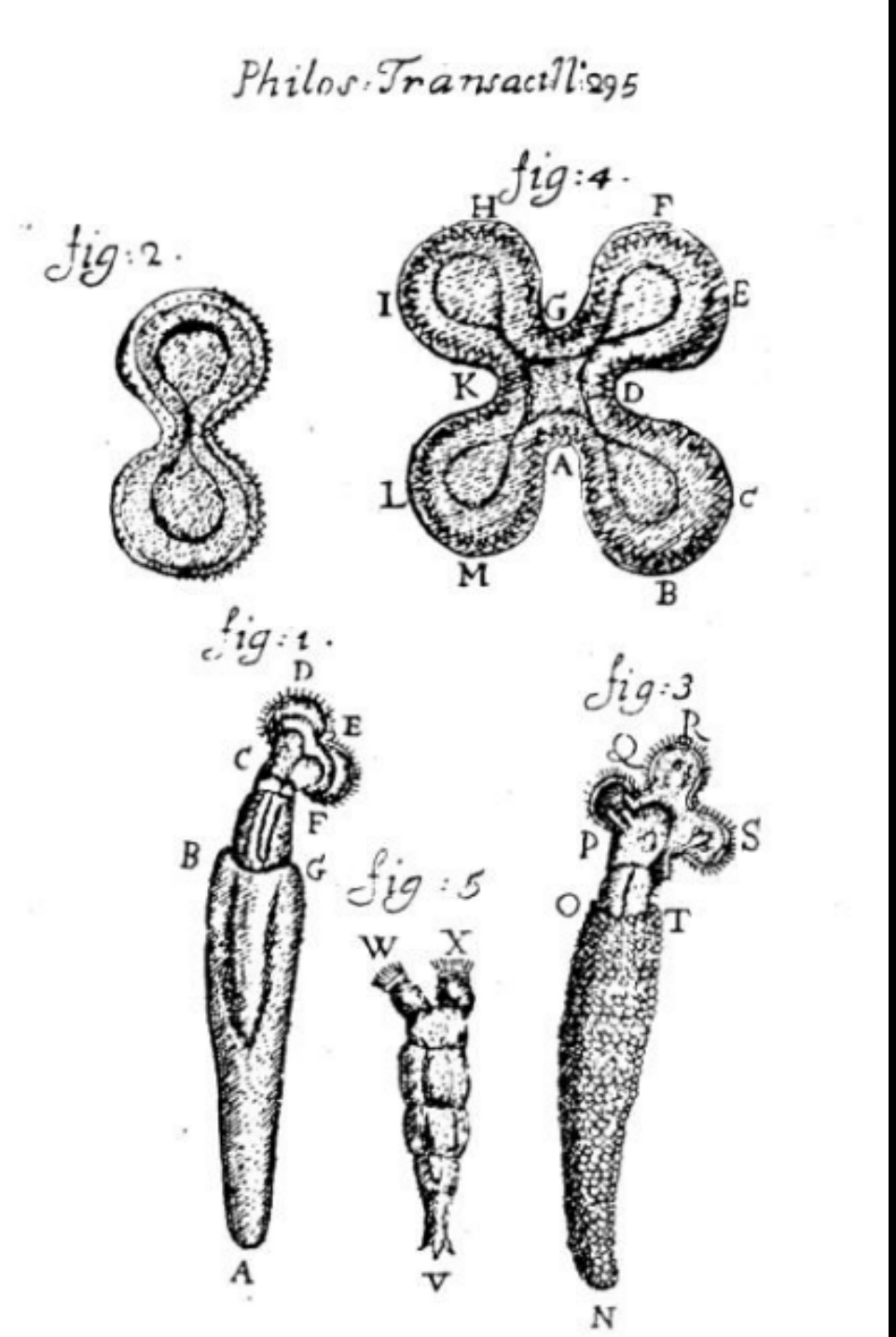
AKA: Antony van Leeuwenhoek was an unlikely scientist. Yet with skill, diligence, an endless curiosity, Leeuwenhoek succeeded in making some of the most important discoveries in the history of biology***. It was he who discovered bacteria in 1676***, his observations on the plaque between his own teeth, "a little white matter, which is as thick as if 'twere batter." He repeated these observations on two ladies (probably his own wife and daughter), and on two old men who had never cleaned their teeth in their lives. Leeuwenhoek found "an unbelievably great company of living ***animalcules***, These were among the first observations on living bacteria ever recorded. ***He observed and recorded living cells for the first time.***

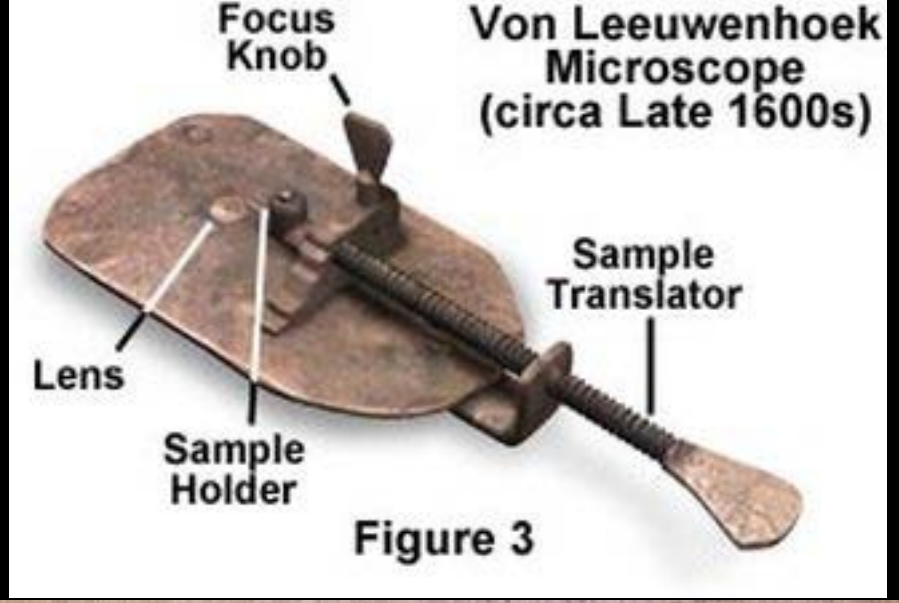


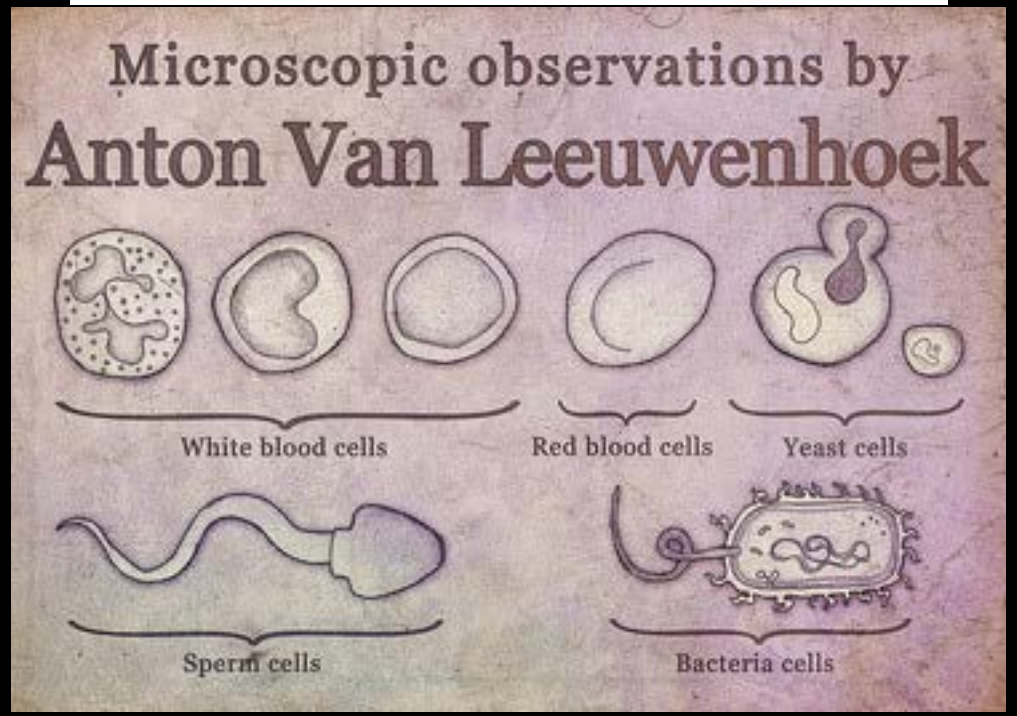
Drawings by van Leeuwenhoek in 1719, showing a longitudinal and a cross section of a nerve.



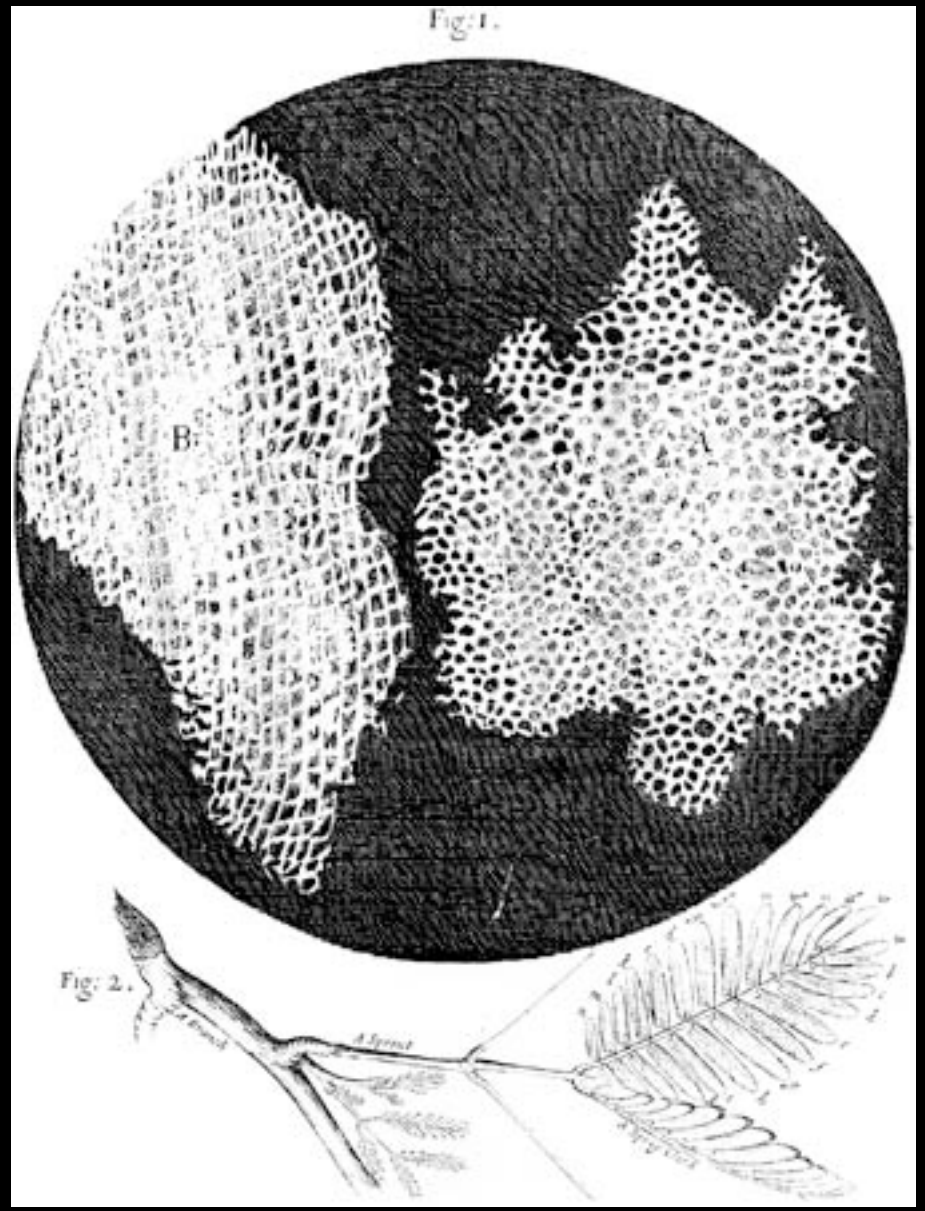
Red Blood Cells drawn by Leeuwenhoek in 1719







'Animalcules' observed by Anton van Leeuwenhoek; Left: Leeuwenhoek's earliest drawings of rotifers, from 1704



Robert Hooke's drawings of the cellular structure of cork and a sprig of sensitive plant

MICROGRAPHIA:

OR SOME

Physiological Descriptions

OF

MINUTE BODIES

MADE BY

MAGNIFYING GLASSES.

WITH

OBSERVATIONS and INQUIRIES thereupon.

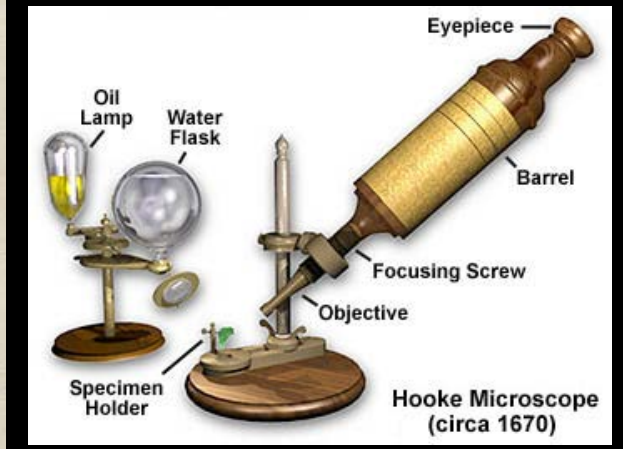
By *R. HOOKE*, Fellow of the ROYAL SOCIETY.

Non possis oculo quantum contendere Linceus,
Non tamen idcirco contemnas Lippus inungi. Horat. Ep. lib. 1.

LONDON, Printed by *Jo. Martyn*, and *Ja. Allestry*, Printers to the ROYAL SOCIETY, and are to be sold at their Shop at the *Bell* in S. *Paul's* Church-yard. M DC LX V.

Robert Hooke (1635–1703)

Hooke coined the term *cell* for describing biological organisms, the term being suggested by the resemblance of plant cells to cells of a honeycomb.

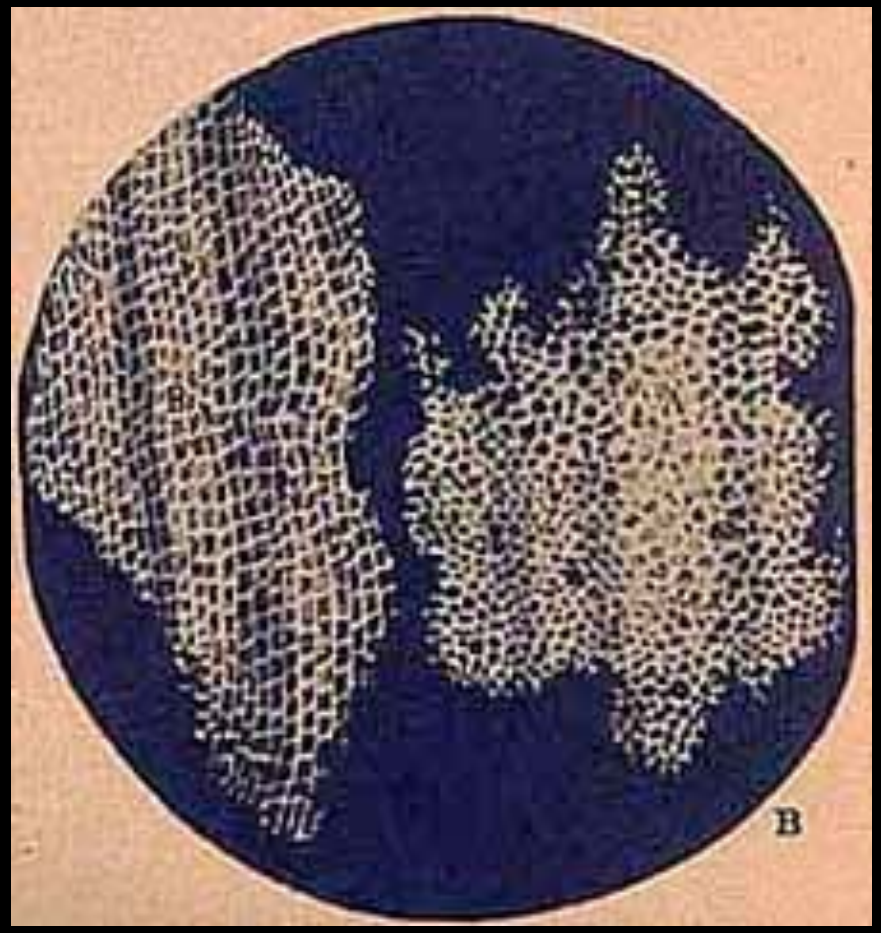


Observ. XLIX. *Of an* Ant *or* Pismire.

THis was a creature, more troublesom to be drawn, then any of the rest, for I could not, for a good while, think of a way to make it suffer its body to ly quiet in a natural posture; but whilst it was alive, if its feet were fixt'd in Wax or Glew, it would so twist and wind its body, that I could not any wayes get a good view of it; and if I killed it, its body was so little, that I did often spoile the shape of it, before I could throughly view it: for this is the nature of these minute Bodies, that as soon as ever their life is destroy'd, their parts immediately shrivel, and lose their beauty; and so is it also with small Plants, as I instanced before, in the description of Moss. And thence also is the reason of the variations in the beards of wild Oats, and in those of Meadow-grass seed, that their bodies, being exceeding small, those small variations which are made in the surfaces of all bodies, almost upon every change of Air, especially if the body be porous, do here become sensible, where the whole body is so small, that it is almost nothing but surface; for as in vegetable substances, I see no great reason to think, that the moisture of the Air (that, sticking to a wreath'd beard, does make it unwreath) should evaporate, or exhale away, any sooner then the moisture of other bodies, but rather that the avulsion from, or access of moisture to, the surfaces of bodies being much the same, those bodies become most sensible of it, which have the least proportion of body to their surface. So is it also with Animal substances; the dead body of an Ant, or such little creature, does almost instantly shrivel and dry, and your object shall be quite another thing, before you can half delineate it, which proceeds not from the extraordinary exhalation, but from the small proportion of body and juices, to the usual drying of bodies in the Air, especially if warm. For which inconvenience, where I could not otherwise remove it, I thought of this expedient.

I took the creature, that I design'd to delineate, and put it into a drop of very well rectified Spirit of Wine, this I found would presently dispatch, as it were, the Animal, and being taken out of it, and lay'd on a paper, the Spirit of Wine would immediately fly away, and leave the Animal dry, in its natural posture, or at least, in a contexture, that it might easily with a pin be plac'd, in what posture you desired to draw it, and the limbs would so remain, without either moving, or shriveling. And thus I dealt with this Ant, which I have here delineated, which was one of many, of a very large kind, that inhabited under the Roots of a Tree, from whence they would sally out in great parties, and make most grievous havock of the Flowers and Fruits, in the ambient Garden, and return back again very expertly, by the same ways and paths they went.

It was more then half the bigness of an Earwig, of a dark brown, or reddish colour, with long legs, on the hinder of which it would stand



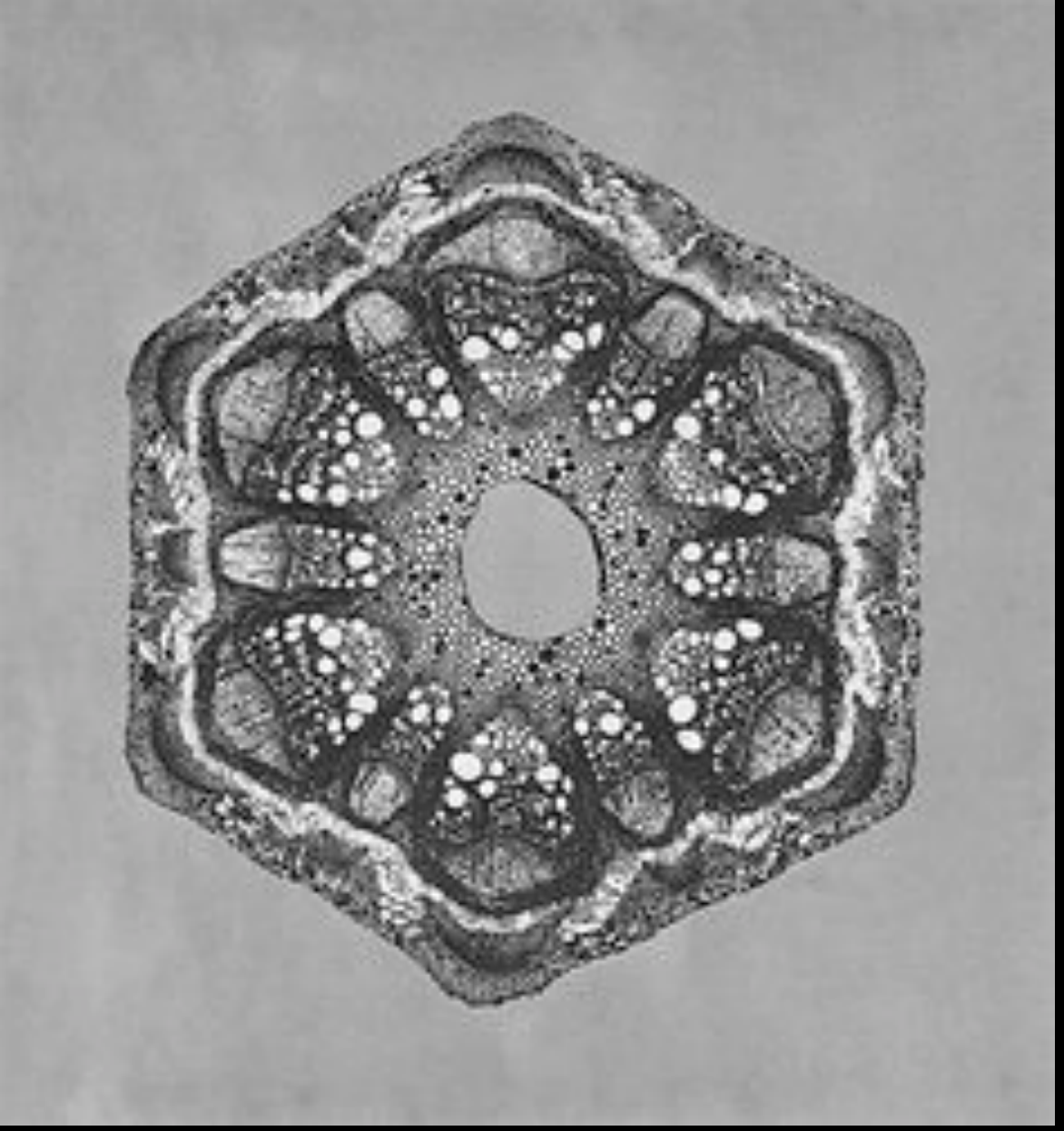
In "Observation XVIII" of the *Micrographia*, Hooke wrote:

. . . I could exceedingly plainly perceive it to be all perforated and porous, much like a Honey-comb, but that the pores of it were not regular. . . . these pores, or cells, . . . were indeed the first microscopical pores I ever saw, and perhaps, that were ever seen, for I had not met with any Writer or Person, that had made any mention of them before this. . .

Hooke had discovered plant cells -- more precisely, what Hooke saw were the cell walls in cork tissue. In fact, it was Hooke who coined the term "cells": the boxlike cells of cork reminded him of the cells of a monastery. Hooke also reported seeing similar structures in wood and in other plants. In 1678, after Leeuwenhoek had written to the Royal Society with a report of discovering "little animals" -- bacteria and protozoa -- Hooke was asked by the Society to confirm Leeuwenhoek's findings. He successfully did so, thus paving the way for the wide acceptance of Leeuwenhoek's discoveries. Hooke noted that Leeuwenhoek's simple microscopes gave clearer images than his compound microscope, but found simple microscopes difficult to use: he called them "offensive to my eye" and complained that they "much strained and weakened the sight."

BIOLOGY IN ART and BIOART
MODERN AND CONTEMPORARY ART

Above: Wassily Kandinsky, Réciproque, 1942-44
Left: Wassily Kandinsky, Variegated Black, 1935



Photomicrograph of a cross section of a twig, from *Structures in Art and in Science* in the *Vision + Value Series,* ed. by György Kepes (1965)

György Kepes [1906-2001]

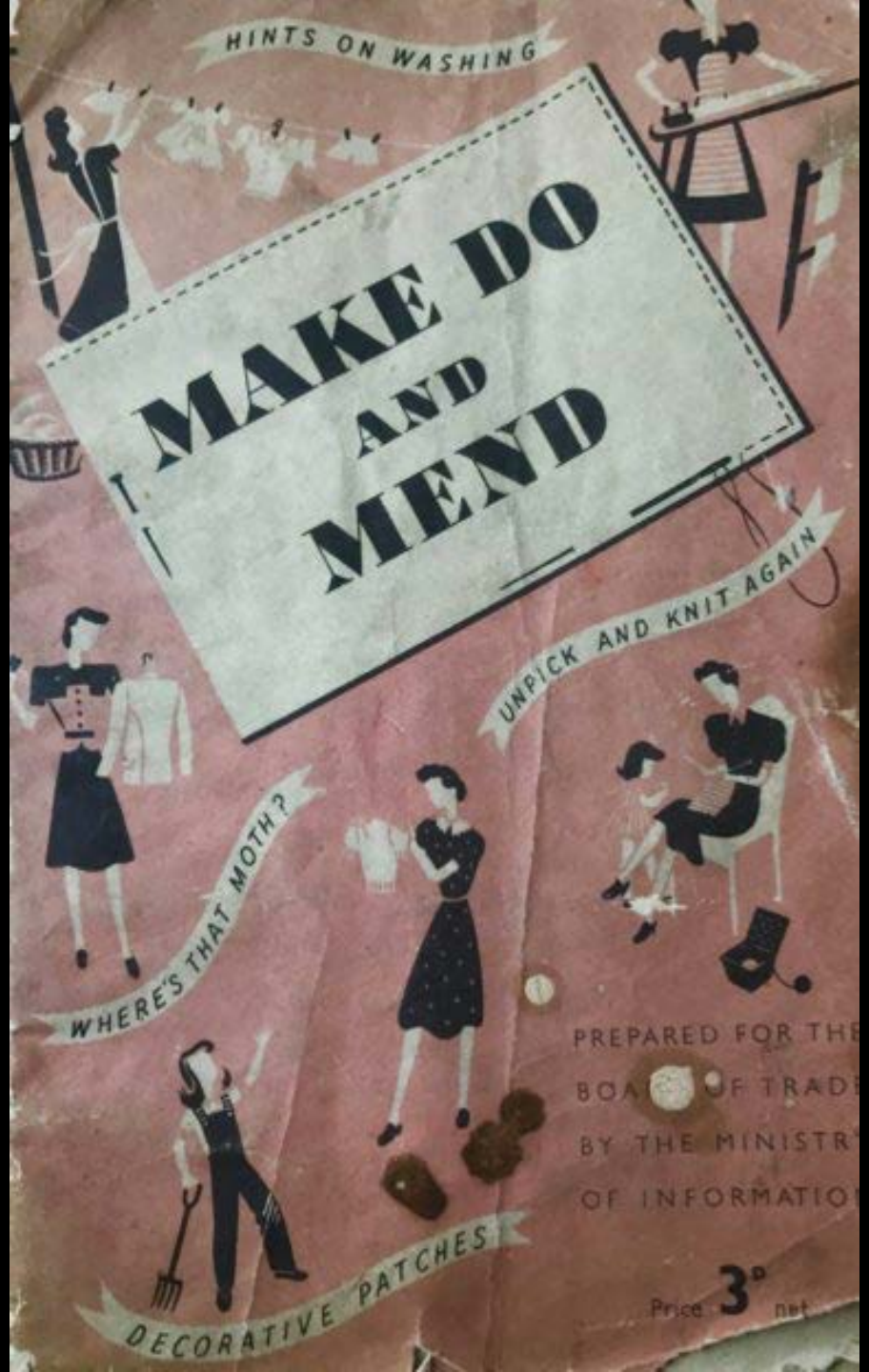
Bacterial Sublime

Cellular Sublime

Scientific Sublime

Anna Dumitriu, “Engineered Antibody,” 21 amino acids, polymer clay, Coomassie Brilliant Blue dye, jewellery wire, cotton calico, vintage tatted linen lace, silk, and embroidery, Based on research by Liu Lab member Xiang Li. 2015-2016

The shapes and forms of Dumitriu’s work elicit meaning within and beyond gender. The artist-scientist collaboration at work in all three pieces embodies an equally if not more powerful meaning-maker than sexual categories, even while the presence of Dumitriu – a woman *and* artist – in the lab is a resounding, even revolutionary, symbol of open frontiers and progressive thinking. A result of her residency working with researchers in the Liu Lab for Synthetic Evolution at the University of California Irvine, Dumitriu’s “Engineered Antibody” plays on the metaphor that amino acids are the “beads of life:” the idea that scientists enlist to describe structures of proteins constructed from chains of amino acids. The work is a necklace made up of 452 handmade beads containing the actual 21 amino acids of an antibody purified from the blood of an HIV positive patient.



CRISPR + Bioart

Anna Dumitriu, Make Do And Mend: An Artwork by Exploring CRISPR Gene Editing and Antibiotic Resistance, 2017
https://vimeo.com/214423418

Back to the Seventeenth Century… The Great Fire of London, 1666

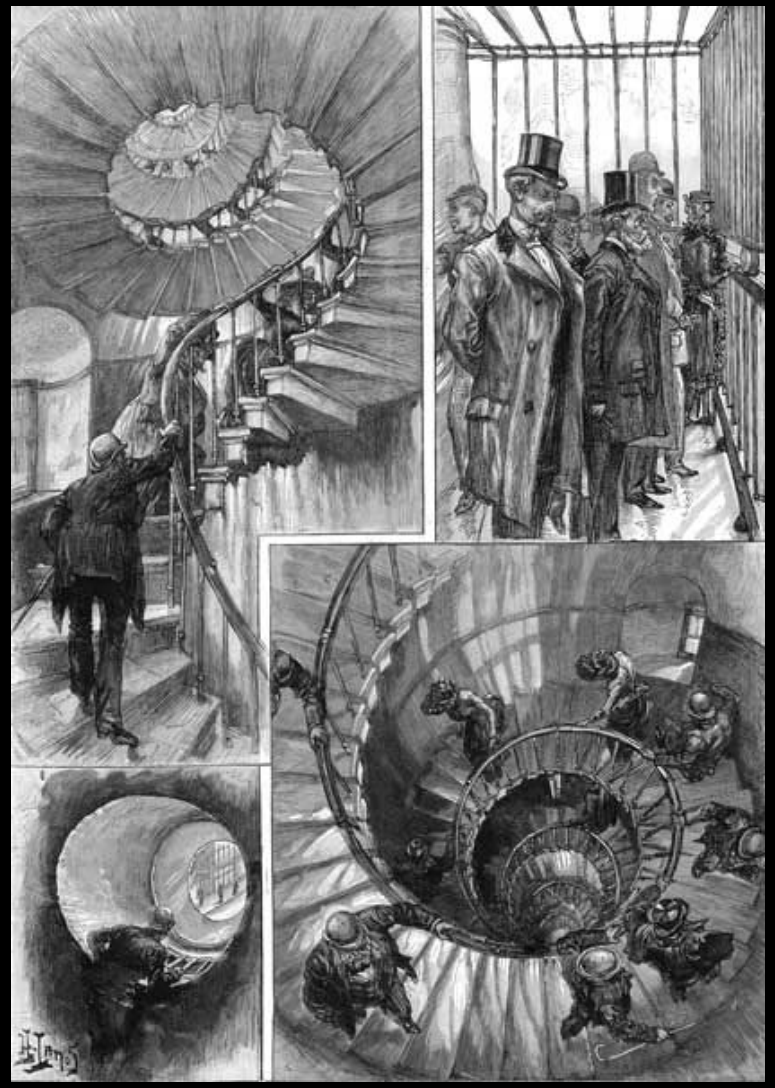
Christopher Wren and Robert Hooke, The Monument to the Great Fire of London, 1671-77

telescopes, architecture, monuments, prosthetics of vision

- Prosthetic visual instruments
- Architecture
- Monuments
- Politics, Immigration, Scapegoating

Lieve Verschuier, The Great Fire of London in 1666, 1666

Prosthetics, Exteriorization of Vision, Architecture as Extension, or How the Monument to the Great Fire of London is Also a Telescope!



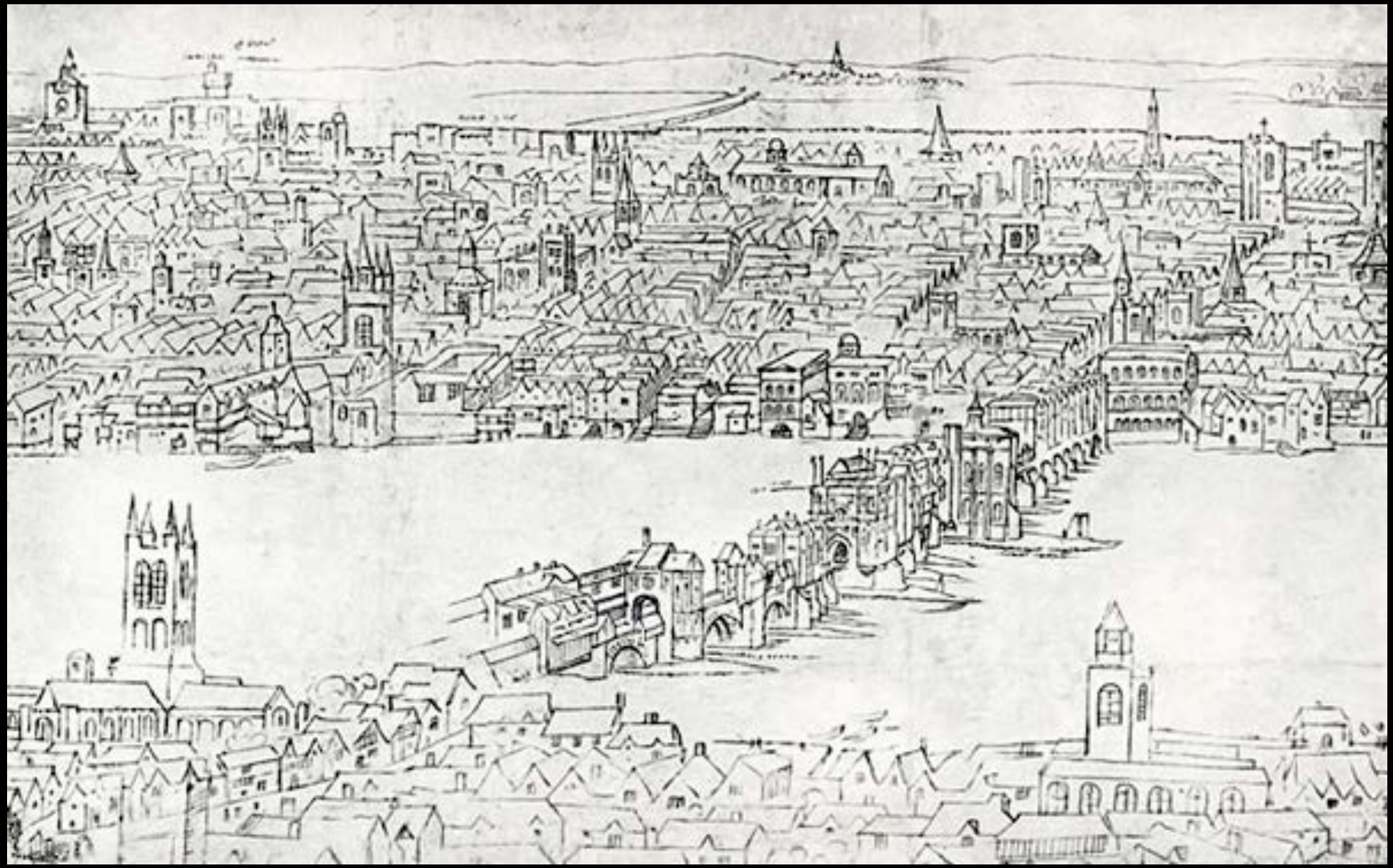
Christopher Wren and Robert Hooke, The Monument to the Great Fire of London, 1671-77

Robert Hooke (1635-1703)
English natural philosopher, architect and polymath. English natural philosopher, architect and polymath, Surveyor for the City of London after the fire of 1666

Christopher Wren (1632-1723)
English polymath, architect, King's Surveyor for the City of London after the fire of 1666

0 10 20 30 40 50 Miles
0 20 40 60 80 Kms
Principal road
Other main road
Urban area
Major City
Large City
City
Large Town
Town
Small Town
SCOTLAND
England
Wales
North Sea
English Channel
Glasgow
Edinburgh
Berwick-upon-Tweed
Newcastle-upon-Tyne
Sunderland
Carlisle
Middlesbrough
Stockton-on-Tees
Hartlepool
York
Scarborough
Leeds
Bradford
Kingston upon Hull
Preston
Blackpool
Liverpool
Manchester
Sheffield
Stockport
Lincoln
Nottingham
Derby
Stoke-on-Trent
Leicester
Norwich
Birmingham
Coventry
Wolverhampton
Peterborough
Cambridge
Northampton
Ipswich
Oxford
Gloucester
Swansea
Cardiff
Bristol
London
Brighton
Southampton
Portsmouth
Bournemouth
Exeter
Plymouth
Torquay
©itaveluk.co.uk

ATLANTIC OCEAN
North Sea
Norwegian Sea
Barents Sea
Baltic Sea
Black Sea
Mediterranean Sea
Bay of Biscay
Reykjavik
ICELAND
IRELAND
Dublin
U. K.
London
Paris
FRANCE
Madrid
SPAIN
Lisbon
PORTUGAL
Brussels
Amsterdam
The Hague
Berlin
GERMANY
Copenhagen
DENMARK
Oslo
NORWAY
Stockholm
SWEDEN
Helsinki
FINLAND
Tallinn
Riga
Vilnius
Minsk
Warsaw
POLAND
Prague
Vienna
Bern
Rome
Budapest
Belgrade
Bucharest
Sofia
Athens
Kiev
UKRAINE
Moscow
RUSSIA
Ankara
TURKEY
Tunis
Algers
Rabat
MOROCCO
Valletta
Nicosia
© MAPS and GLOBES / Alamy Stock Photo

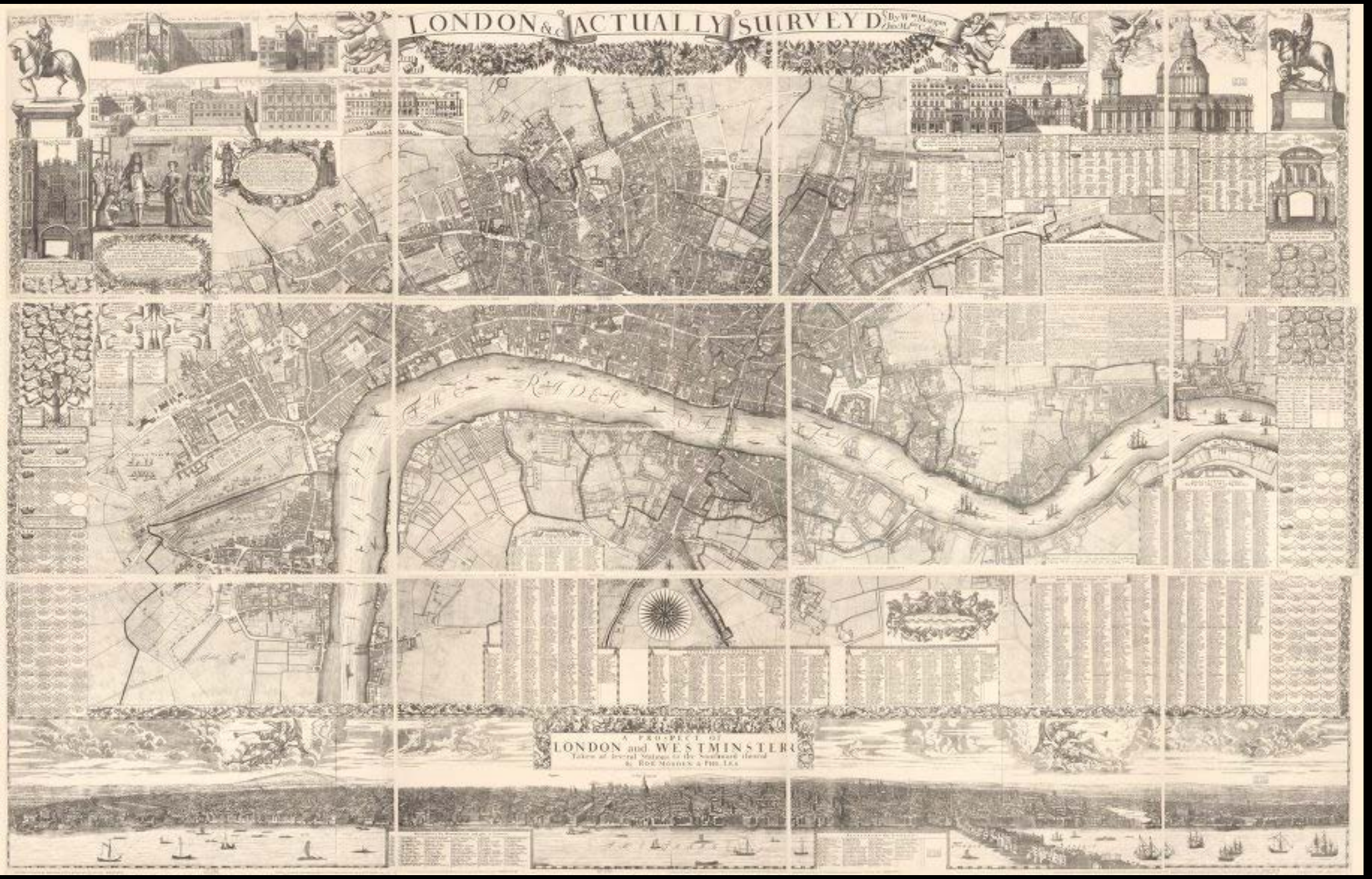


London Bridge 1554-57

London was vastly larger than any other English city, with a population of over 50,000 in the early sixteenth century. By 1600 about 200,000 people lived there, and London continued to grow despite losing about 80,000 of its inhabitants in the plague outbreak of 1665.

LONDON
Scala passuum 5 pedum
80 160 240 320 400 480
Mercers
Grocers
Drapers
Fishmongers
Goldsmiths
Skinners
Merchantayton
Haberdashers
Salters
Ironmongers
Vintners
Clothworkers
The Way to Ware
Islington
Lambeth marsh
T H A M Y S
fluuius
S. Katherynes
S. Towleyes
Soll by Peter Stent at y White horse in Gilt spur streete neere Newgate
Of one of the former 12 Companies is the Lo Mayor of the Cyte iomenly chosen
a. Bishops gate streete
b. Papis
c. Alhallowes in the wall
d. S. Taphyns
e. Sylver streete
f. Aldermanbury
g. Barbyan
h. Aldegate streete
i. Chorterhouse
k. Mylborne Conduit
l. Chauncery lane
m. Temple barr
n. Holborn
o. Grayes Inn lane
p. S. Andrews
q. Newgate
r. S. Iones
s. S. Nic shambels
t. Cheap side
u. Buckles bury
w. Bredstreete
x. The stockes
y. The Exchange
z. Cornehill
2. Colmanstreete
3. Bassings hall
4. Hounsditche
5. Leaden hall
6. Gratiens streete
7. Heneage house
8. Fanchurche
9. Marke lane
10. Mincbyn lane
11. Paules
12. Eastcheape
13. Eliestreete
14. Fetter lane
15. S. Dunshous
16. Thomes streete
17. Lilan shaue
18. Olde Baylye
19. Clerkenwell
20. Winchester house
21. Battle bridge
22. Bermedsey streete
Ioannes Norden Anglus descripsit
A guide for Cuntrey men In the famous Cittey of LONDON by the helpe of wich plot they shall be able to know how farr it is to any street. As allso to go vnto the same without forder troble. Anno 1653.
Long lane
St Johnstreete
Turnboule streete
Goulding lane
Red crosstreete
Beech lane
White crosse streete
Chisil streete
Grub streete
More Lane
The Posterne
Little More feild
Showe lane
Fleete lane
Wanwick lane
Pater noster Roe
Petecannons
Paules Crosse
Blacke fryers
St Martens
Faster Lane
Gutter Lane
Wood streete
Milke streete
Cateaten streete
St Laurence lane
Iremonger lane
Old Jury
Loathbury
Bartlomew lane
The Powltry
Lumbard streete
Burching lane
Finch lane
Threduceedle street
Fanchurch streete
Leaden hall streete
Lime streete
St Mary Axe
Billeter lane
Crutchar friars
Tower streete
Roode lane
Philpot lane
St Mary hill
Puddin lane
Bridge foote
St Laurence Poultney
Canning streete
Abchurch lane
St Swithens lane
St Clements lane
Dowgate
Walbrooke
Cloake lane
Budge Roe
St Sythes lane
St Tantlins
Whittington Colledge
St Thomes Apostles
Garlicke hill
Bee lane
Trynitie lane
Soper lane
Bredstreete
Watling streete
Friday streete
Old fish streete
Fishstreete hill
Nighfryday streete
Lambeth hill
Old Chaunge
Distafe lane
Carter lane
Pie Corner
Cow lane

LONDINVM FERACISSIMI ANGLIAE REGNI METROPOLIS
THE TOWRE



William Morgan
Map of London
1682

VISSCHER'S VIEW OF LONDON, 1616

A panorama of London by Claes Visscher, 1616; The tenement housing on London Bridge (detail at right) was a notorious death-trap in case of fire, although much would be destroyed in an earlier fire in 1632.

THE BRIDGE
ke

TENEMENT HOUSING

In 17th-century London, the human habitations were crowded to bursting point, intermingled with sources of heat, sparks, and pollution, and their construction increased the fire risk. The typical six- or seven-story timbered London tenement houses had ”jetties" (projecting upper floors). They had a narrow footprint at ground level, but maximized their use of land by "encroaching" on the street, as a contemporary observer put it, with the gradually increasing size of their upper stories. The fire hazard was well perceived when the top jetties all but met across the narrow alleys; "as it does facilitate a conflagration, so does it also hinder the remedy", wrote one observer —but "the covetousness of the citizens and connivancy [corruption] of Magistrates" worked in favor of jetties.

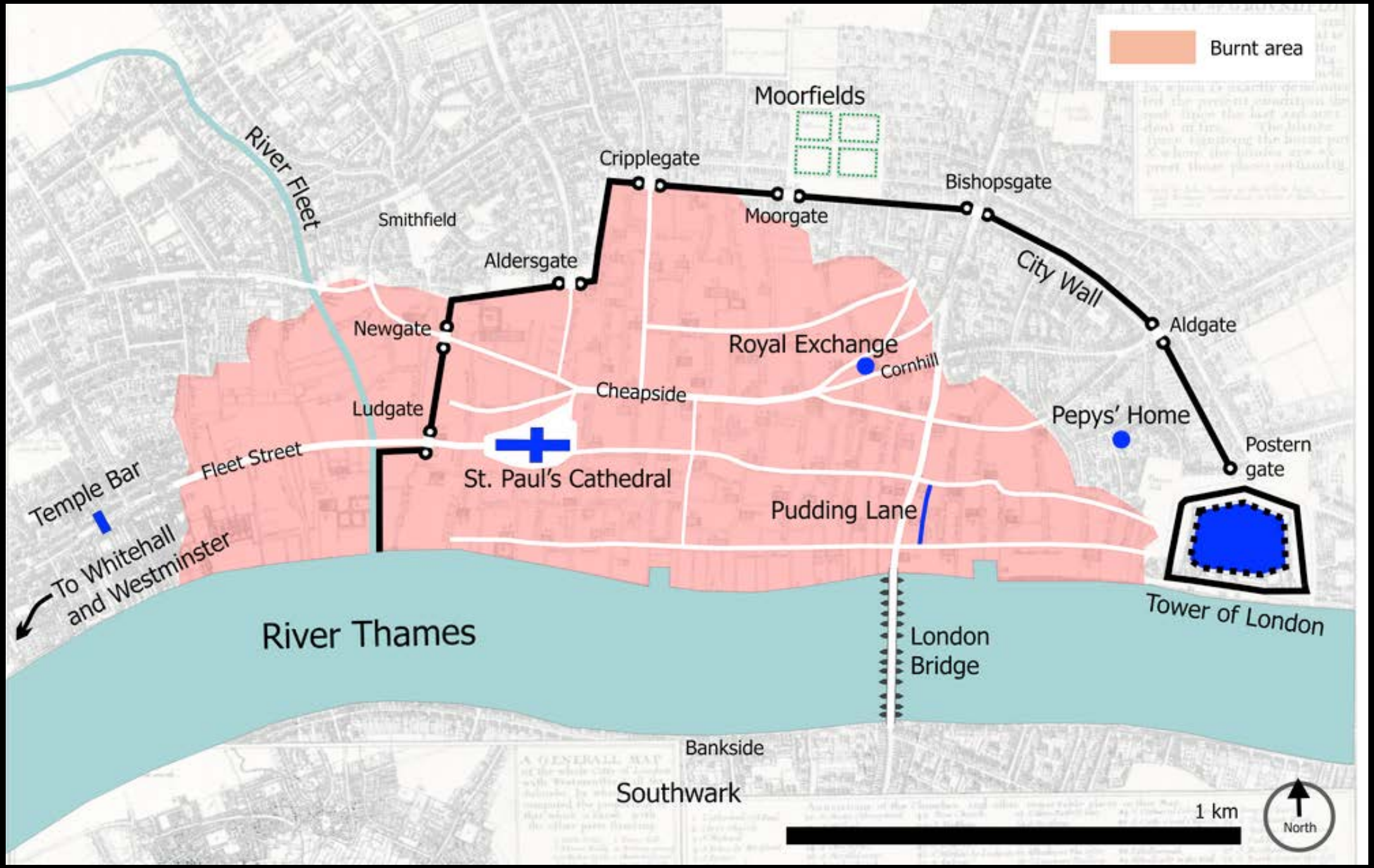
OLY'S
UDGE
NTRY
ORK
BARGHEST
SHAMBLES
SWEET
SHOP
VIA
VECCHIA
Artisan Bread
Tel
01904
627701
YE OLD
SHAMBLES TAVERN
Great Food

The Great Fire of London which happened in 1666, here painted later by an unknown painter. The painter depicts the fire as it would have appeared on the evening of Tuesday, 4 September 1666 from a boat in the vicinity of Tower Wharf. The Tower of London is on the right and London Bridge on the left, with St. Paul's Cathedral in the distance, surrounded by the tallest flames.

Matteus Merian, London on the left in 1650 and on the right during the fire of 1666

Wenceslaus Hollar, Before and After the Great Fire

The fire consumed 13,200 houses, 87 parish churches, St. Paul's Cathedral, and most of the buildings of the City authorities. It is estimated to have destroyed the homes of 70,000 of the City's 80,000 inhabitants. The death toll is unknown but traditionally thought to have been small, as only six verified deaths were recorded.



London in 1666, with the burnt area shown in pink

© © Museum of London

© © Museum of London

Left: Singed floor tile
Right: Waffle tongs

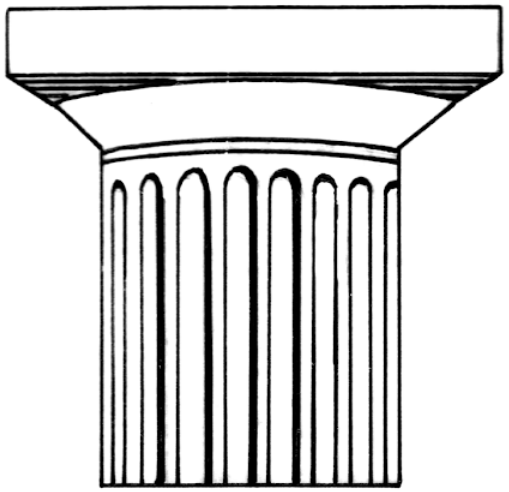
A melted piece of pottery found by archaeologists in Pudding Lane, where the fire started, shows that the temperature reached 1250 degrees Celsius.

Christopher Wren and Robert Hooke, The Monument to the Great Fire of London, 1671-77

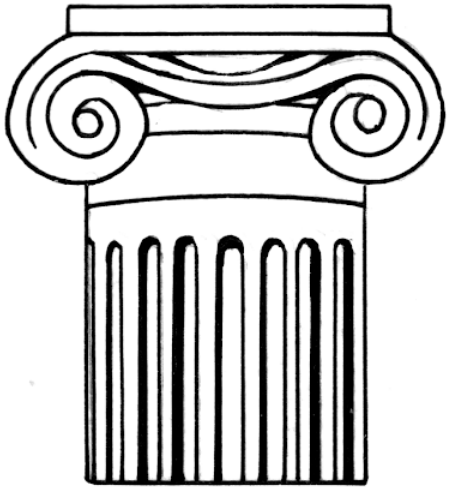
The Monument comprises a fluted Doric column built of Portland stone topped with a gilded urn of fire.

Its height marks its distance from the site of the shop of Thomas Farriner (or Farynor), the king's baker, where the Great Fire began.

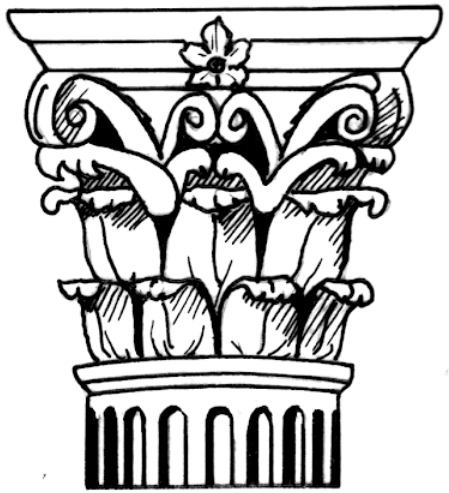
The top of the Monument is reached by a narrow winding staircase of 311 steps. A mesh cage was added in the mid-19th century at the top to prevent people jumping off, after six people had committed suicide from the structure between 1788 and 1842.



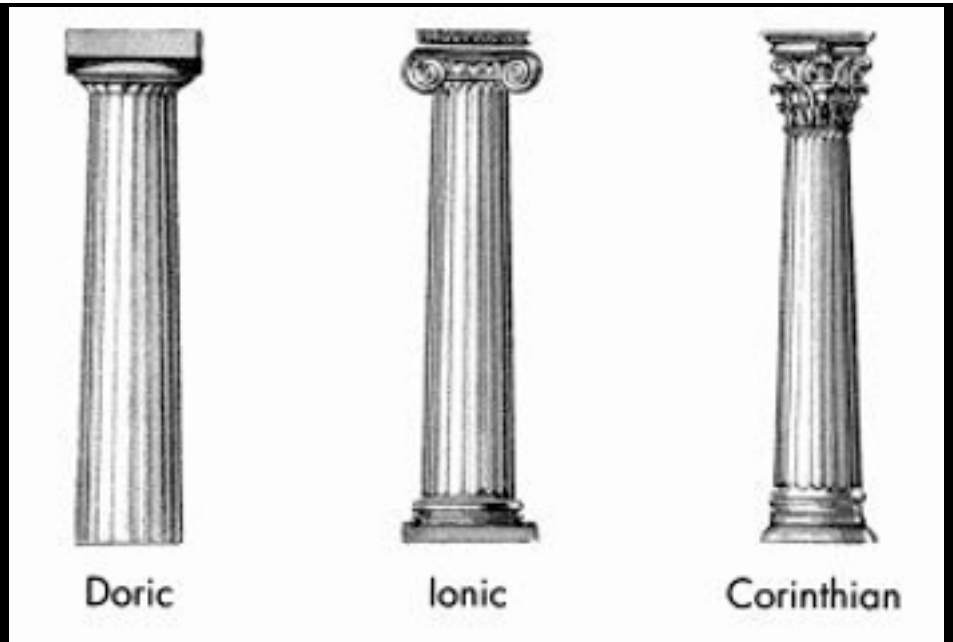
DORIC

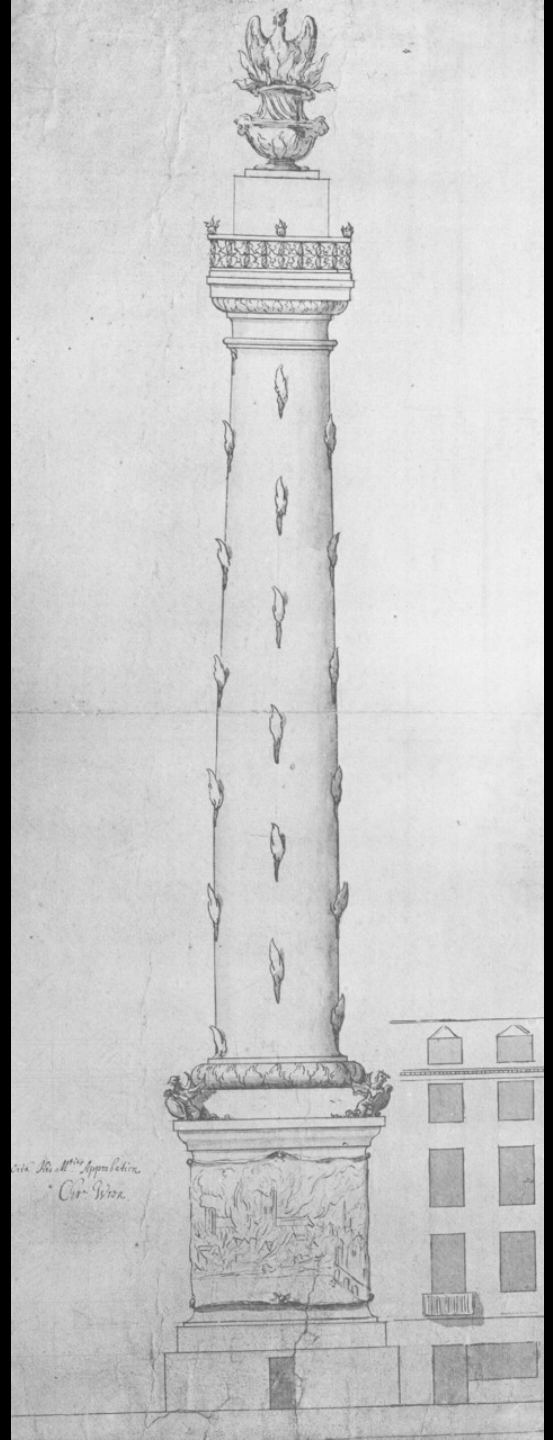


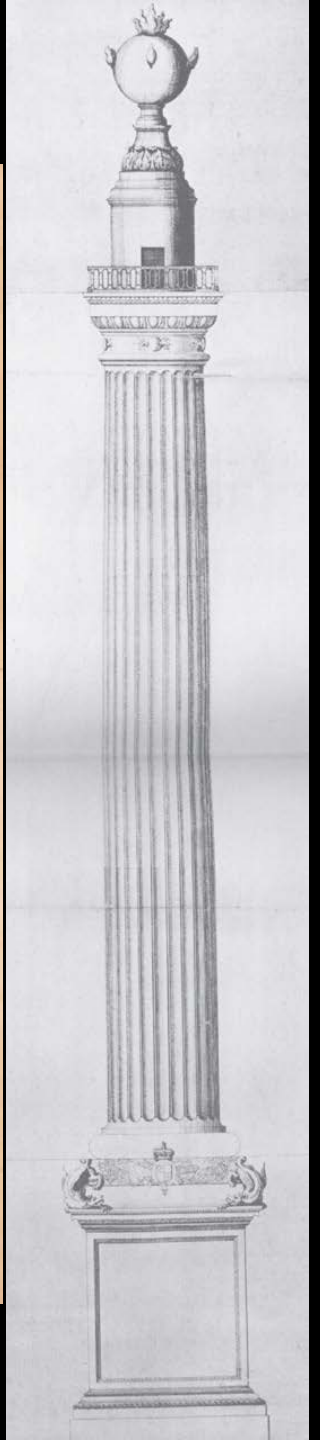
IONIC

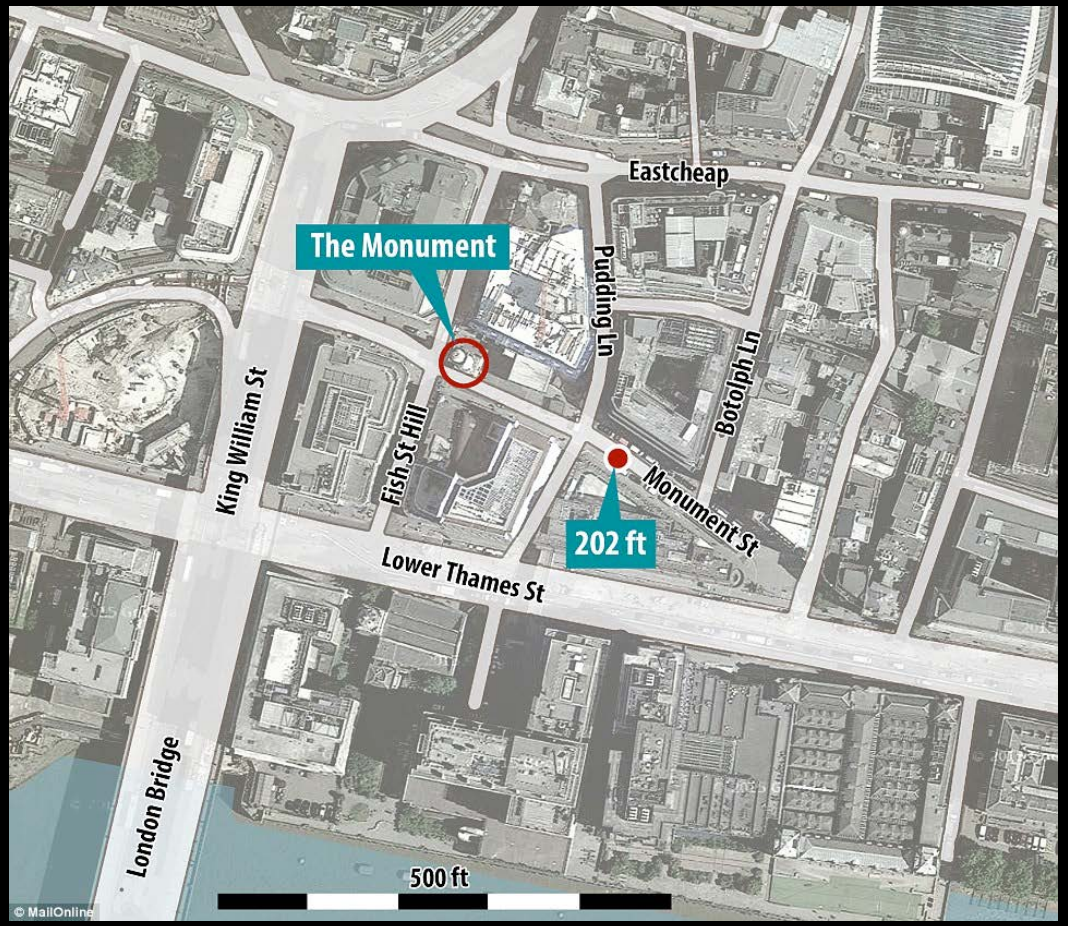


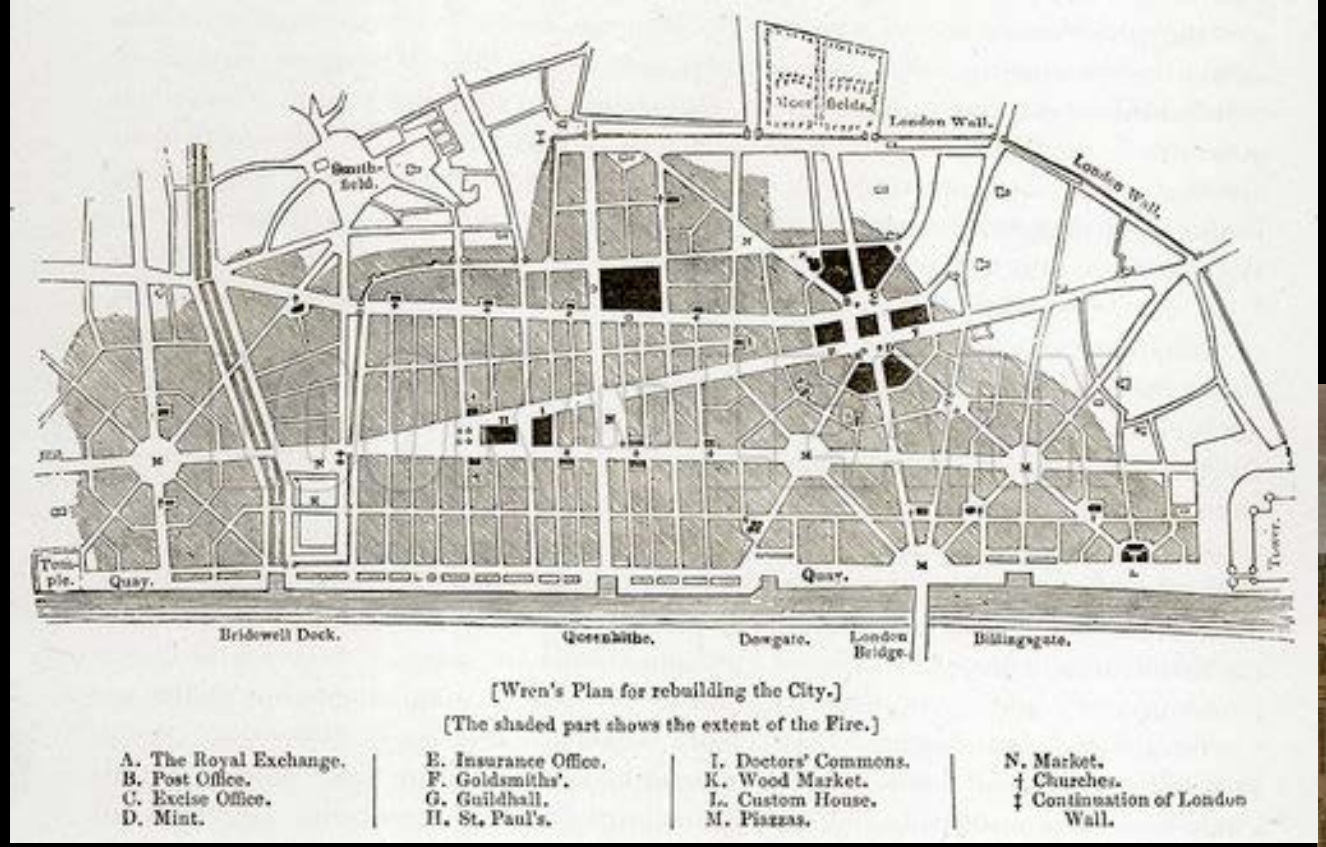
CORINTHIAN







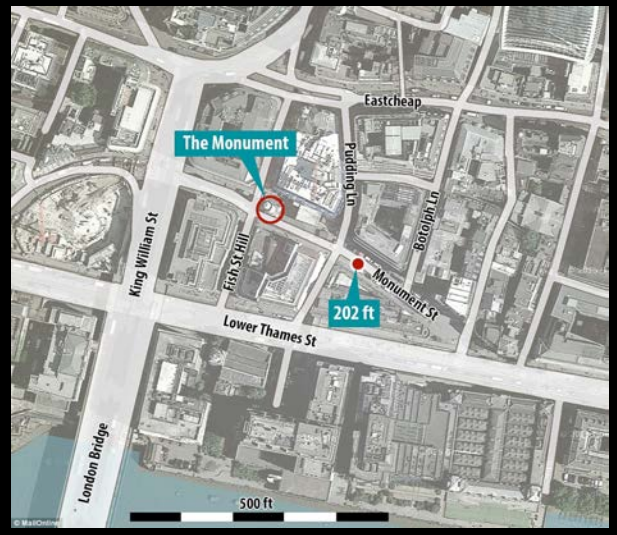

The Monument
Eastcheap
Pudding Ln
Botolph Ln
King William St
Fish St Hill
Monument St
202 ft
Lower Thames St
London Bridge
500 ft
© MailOnline



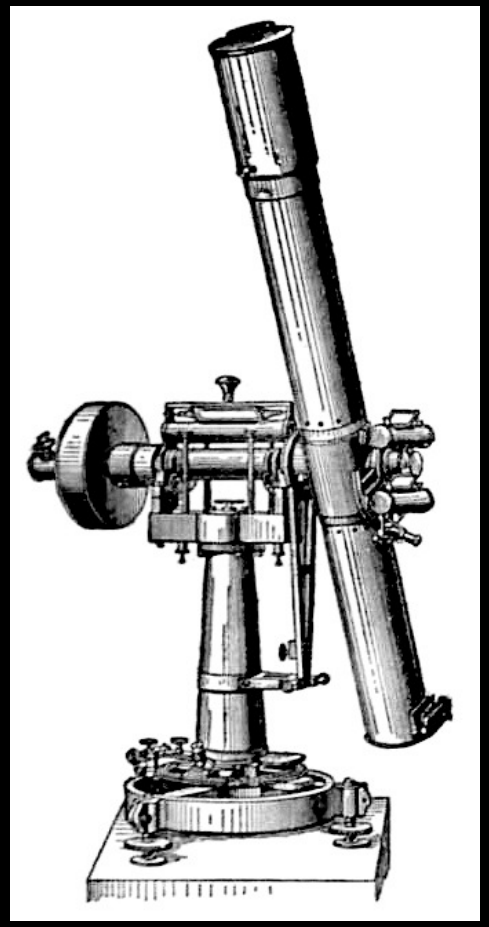
[Wren's Plan for rebuilding the City.]

[The shaded part shows the extent of the Fire.]

A. The Royal Exchange.
B. Post Office.
C. Excise Office.
D. Mint.
E. Insurance Office.
F. Goldsmiths'.
G. Guildhall.
H. St. Paul's.
I. Doctors' Commons.
K. Wood Market.
L. Custom House.
M. Piazzas.
N. Market.
† Churches.
‡ Continuation of London Wall.



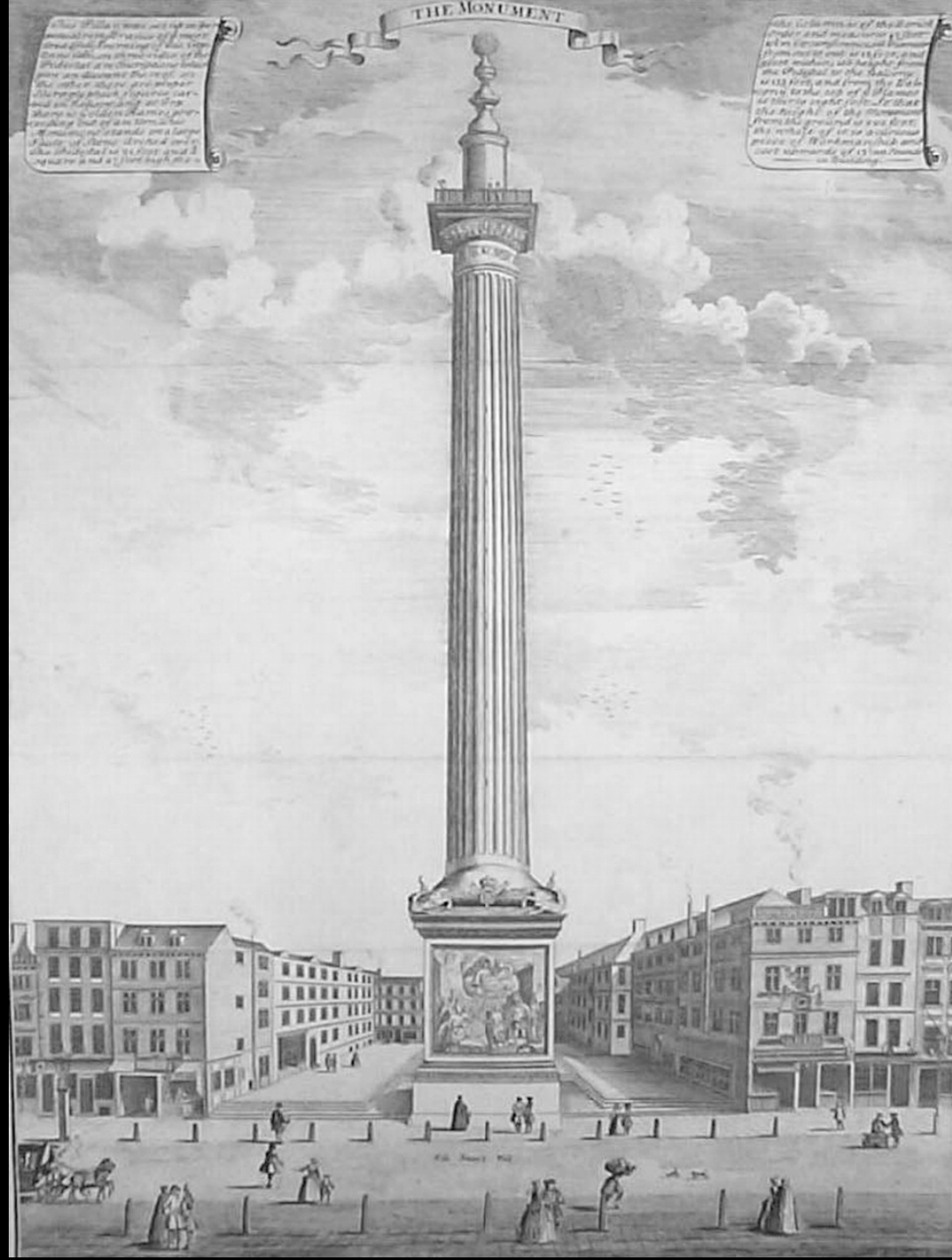
Its 202ft (61m) being the distance from its base to the bakery in Pudding Lane where the fire started…



A zenith telescope is designed to point straight up at or near the zenith. They are used for precision measurement of star positions, to simplify telescope construction, or both.

Wren and Hooke built the monument to double-up as a scientific instrument. It has a central shaft meant for use as a zenith telescope and for use in gravity and pendulum experiments that connects to an underground laboratory for observers to work (accessible from the present-day ticket booth). Vibrations from heavy traffic on Fish Street Hill rendered the experimental conditions unsuitable.

A hinged lid in the urn covers the opening to the shaft. The steps in the shaft of the tower are all six inches high, allowing them to be used for barometric pressure studies.



THE MONUMENT
THIS MONUMENT. DESIGNED BY SIR CHRISTOPHER WREN. WAS BUILT TO COMMEMORATE THE GREAT FIRE OF LONDON 1666. WHICH BURNED FOR THREE DAYS CONSUMING MORE THAN 13,000 HOUSES AND DEVASTATING 436 ACRES OF THE CITY. THE MONUMENT IS 202FT IN HEIGHT. BEING EQUAL TO THE DISTANCE WESTWARD FROM THE BAKEHOUSE IN PUDDING LANE WHERE THE FIRE BROKE OUT. IT TOOK SIX YEARS TO CONSTRUCT 1671-1677. THE BALCONY IS REACHED BY A SPIRAL STAIRWAY OF 311 STEPS AND AFFORDS PANORAMIC VIEWS OF THE .METROPOLIS A SUPERSTRUCTURE RISES FROM THE BALCONY AND SUPPORTS A COPPER VASE OF FLAMES.
THE ALLEGORICAL SCULPTURE ON THE PEDESTAL ABOVE WAS EXECUTED BY CAIUS GABRIEL CIBBER.
TIMES OF OPENING AND CLOSING
9.30A.M. TO 5.pm. DAILY.
CONCESSIONS £2-00
ADMISSION: ADULT £3-00 CHILD £1-00
ST. MAGNUS THE MARTYR
FISH STREET HILL. TO THE SOUTH. LEADS TO ST. MAGNUS THE MARTYR (A WREN CHURCH).
ALONGSIDE WHICH. IS THE ANCIENT FOOTPATH WHICH LED TO THE FIRST LONDON BRIDGE.

Three sides of the base carry inscriptions in Latin. The one on the south side describes actions taken by King Charles II following the fire. The one on the east describes how the Monument was started and brought to perfection, and under which mayors. Inscriptions on the north side describe how the fire started, how much damage it caused, and how it was eventually extinguished. In 1681, the words "but Popish frenzy, which wrought such horrors, is not yet quenched" were added to the end of the inscription. Text on the east side originally falsely blamed Roman Catholics for the fire ("burning of this protestant city, begun and carried on by the treachery and malice of the popish faction"), which prompted Alexander Pope (himself a Catholic) to say of the area:

Where London's column, pointing at the skies,
Like a tall bully, lifts the head, and lies.
– Moral Essays, Epistle iii. line 339 (1733–1734).

SCAPEGOATING AND DEHUMANIZING

Order in the streets broke down as rumors arose of suspicious foreigners setting fires. The fears of the homeless focused on the French and Dutch, England's enemies at the time. These substantial immigrant groups became victims of lynchings and street violence. They were scapegoated.

Scapegoat:

A person or group that is made to bear blame for others. According to the Old Testament, on the Day of Atonement, a priest would confess all the sins of the Israelites over the head of a goat and then drive it into the wilderness, symbolically bearing their sins away.

Scapegoating is a form of dehumanizing other people – making them less than human.

Do you know of examples of scapegoating today?

Wren's collaborator Robert Hooke (1635-1703) originally designed the interior as a giant telescope, with lenses at the top and bottom giving views from a small laboratory at the base. The flaming urn on top has a small trapdoor that opened to allow a view of the sky. Hooke thus used the column as a zenith telescope.

A number of trap doors in the column were opened and the urn at the top was lifted (it was hinged). Lenses were then placed at various heights which permitted various astronomical observations to be carried out. Wren and Hooke were both surveyors of the city of London after the Great Fire and both member of the Royal Society and a noted experimenter. Besides Hooke's telescope, he used the Monument's 311 steps – all exactly six inches high – to measure the effects of different heights on atmospheric pressure. The experiments were soon discontinued because of the constant vibration of traffic.

The Monument ended up as what has to be London’s largest scientific instrument. Hooke and Wren designed its steps to hug the wall so there was a clear view all the way up the middle to the urn, which still conceals a pair of iron doors opening to the heavens.