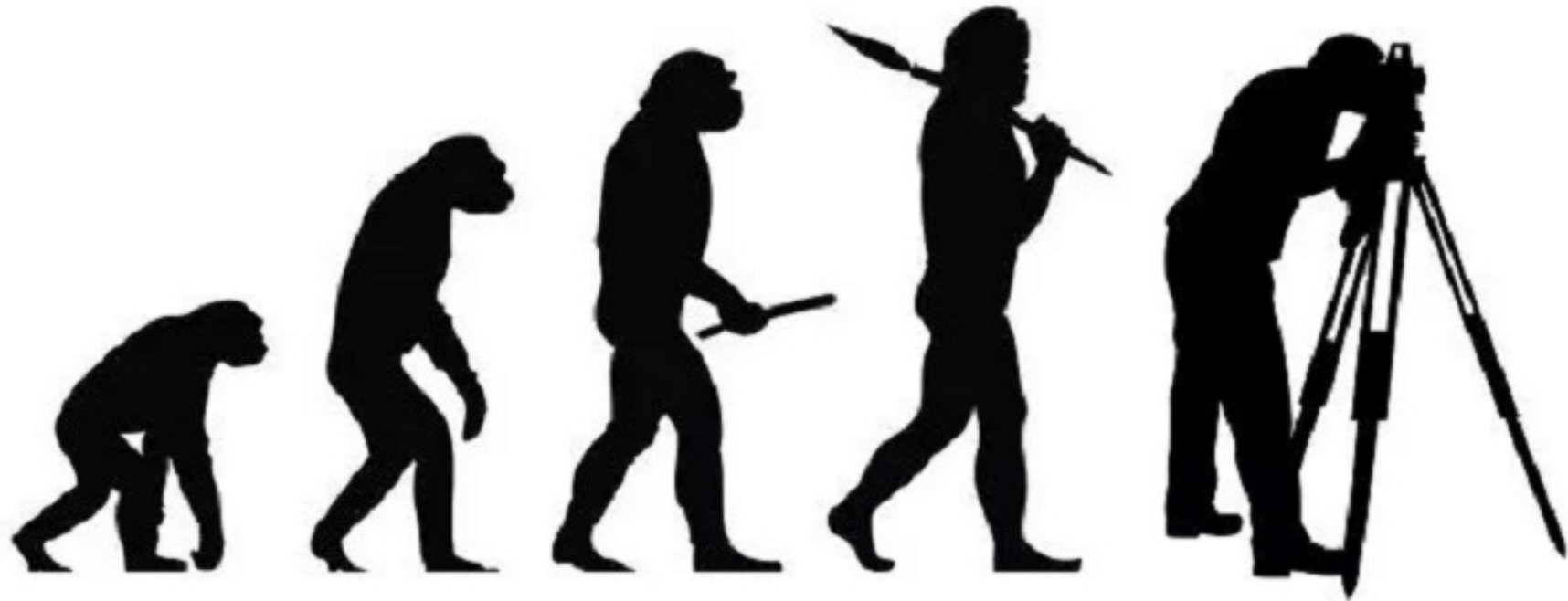


Lecture 2: Digital Surveying



<https://www.satpalda.com/blogs/evolution-in-surveying-techniques>

surveying in British

(sɜːˈveɪɪŋ 🔊)

Word Frequency 🔴 🔴 🔴 🔴 🔴

noun

1. the study or practice of measuring altitudes, angles, and distances on the land surface so that they can be accurately plotted on a map
2. the setting out on the ground of the positions of proposed construction or engineering works

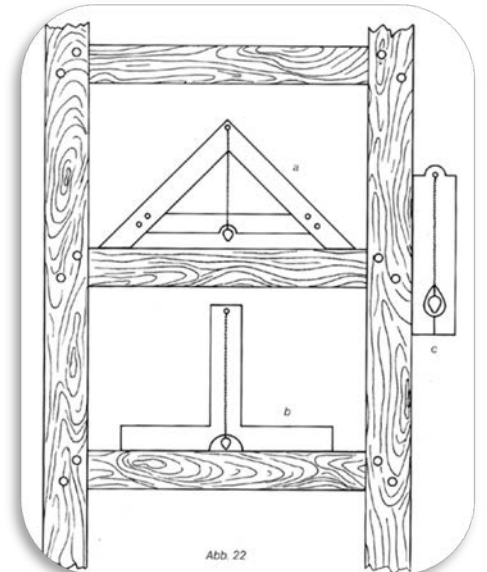
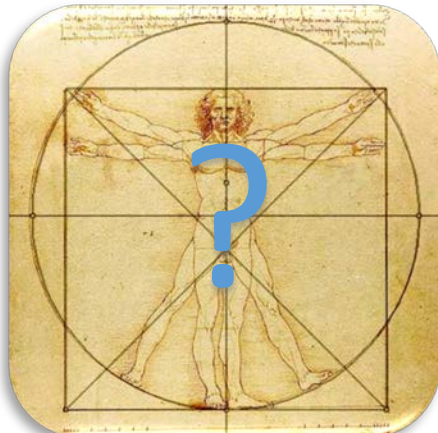
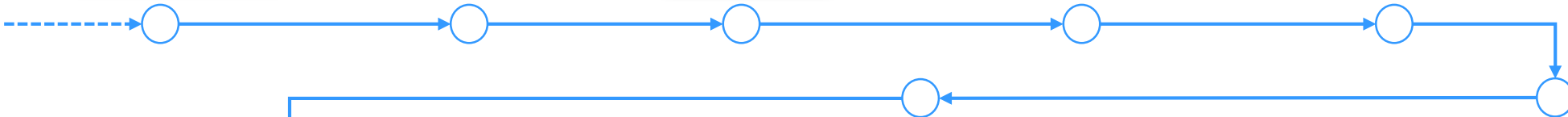
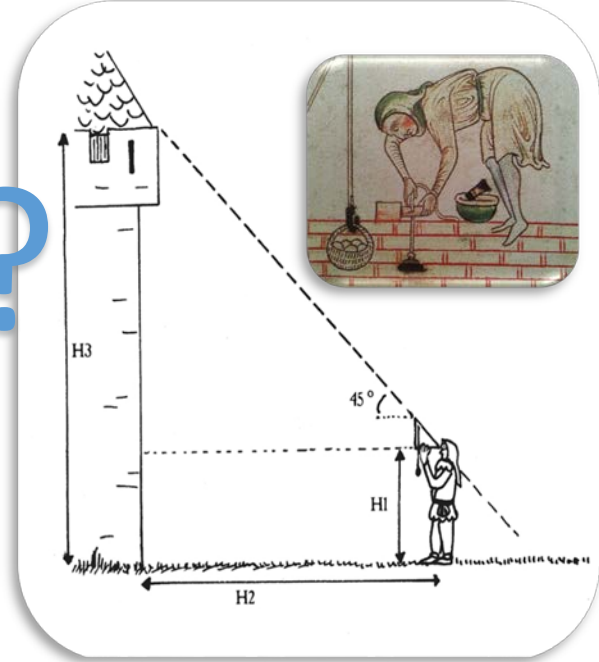
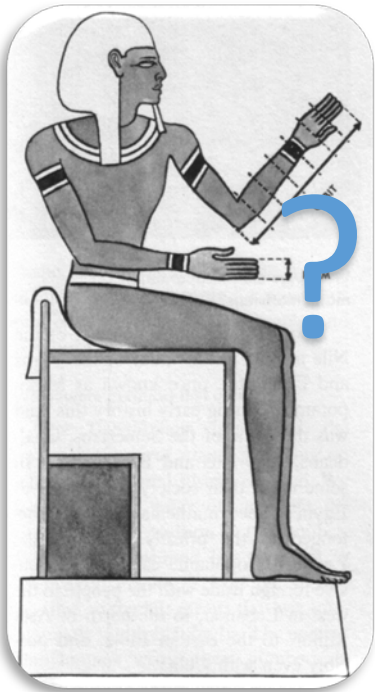
Collins English Dictionary. Copyright © HarperCollins Publishers



Measurement and Recording

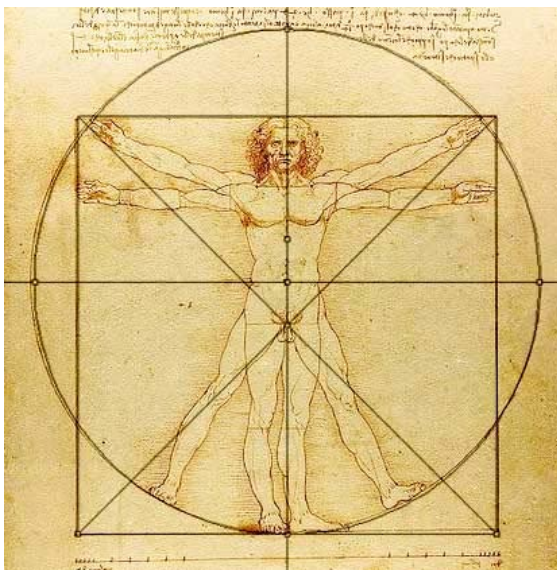


Mathematics and Writing





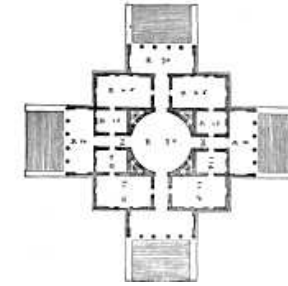
Filippo Brunelleschi 1377-1446 (Florence Cathedral)



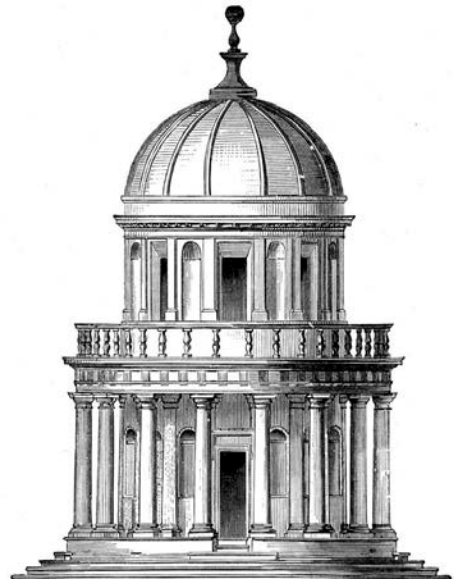
Leonardo Da Vinci 1452 -1519
'Vitruvian Man'



Villa Rotunda. Andrea Palladio 1508-1580
I Quattro Libri dell'Architettura, 1570

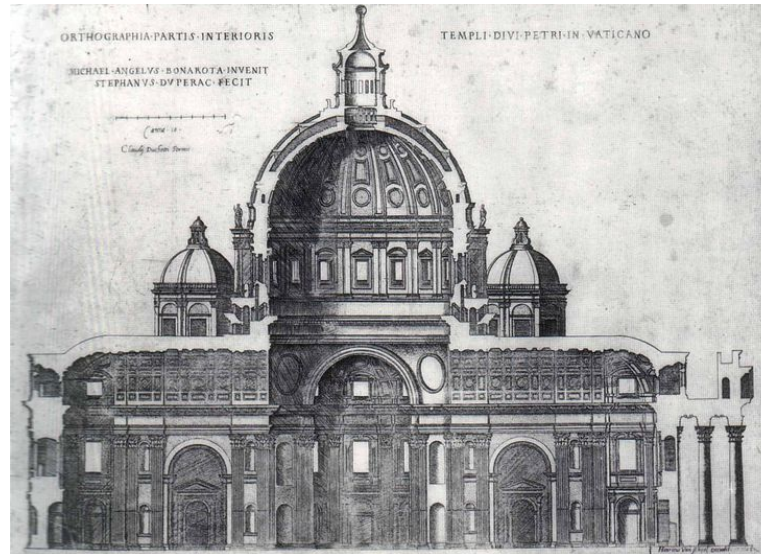


https://en.wikipedia.org/wiki/Andrea_Palladio#/media/File:PalladioRotondaPlan.jpg



<https://www.pinterest.co.uk/pin/70720656625314854/>

Donato Bramante 1444 – 1514
Tempietto Rome



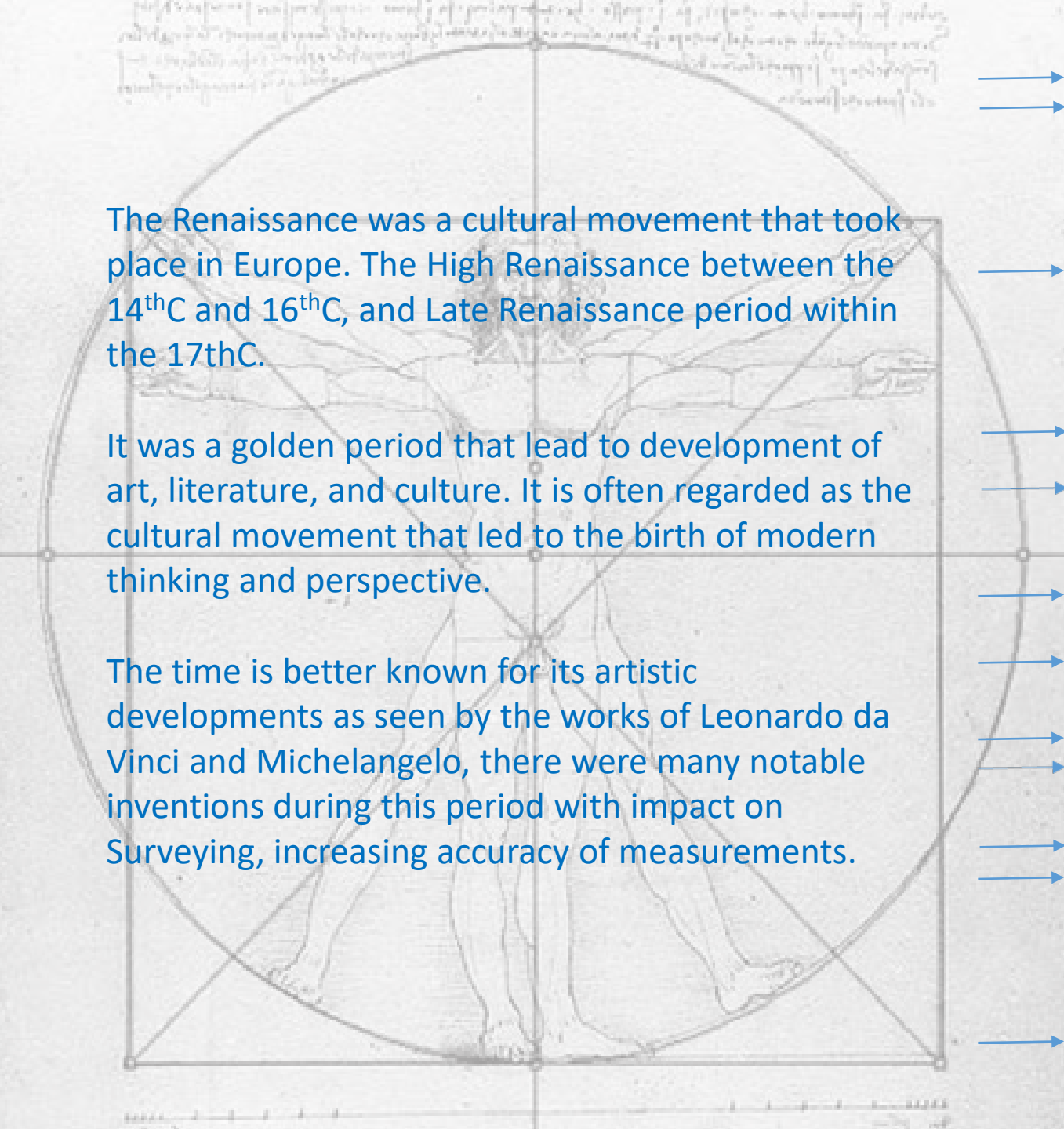
<https://www.pinterest.co.uk/pin/283304632782621349/>

Michelangelo 1475-1564 St Peters Dome, Rome

Renaissance: Cultural melting pot for Art, Architecture, Science, Philosophy, Engineering, Mathematics. Emerging from Italy and spreading throughout Europe.

Proportion – Geometry - Mathematics

Renaissance Europe 14thC - 16thC

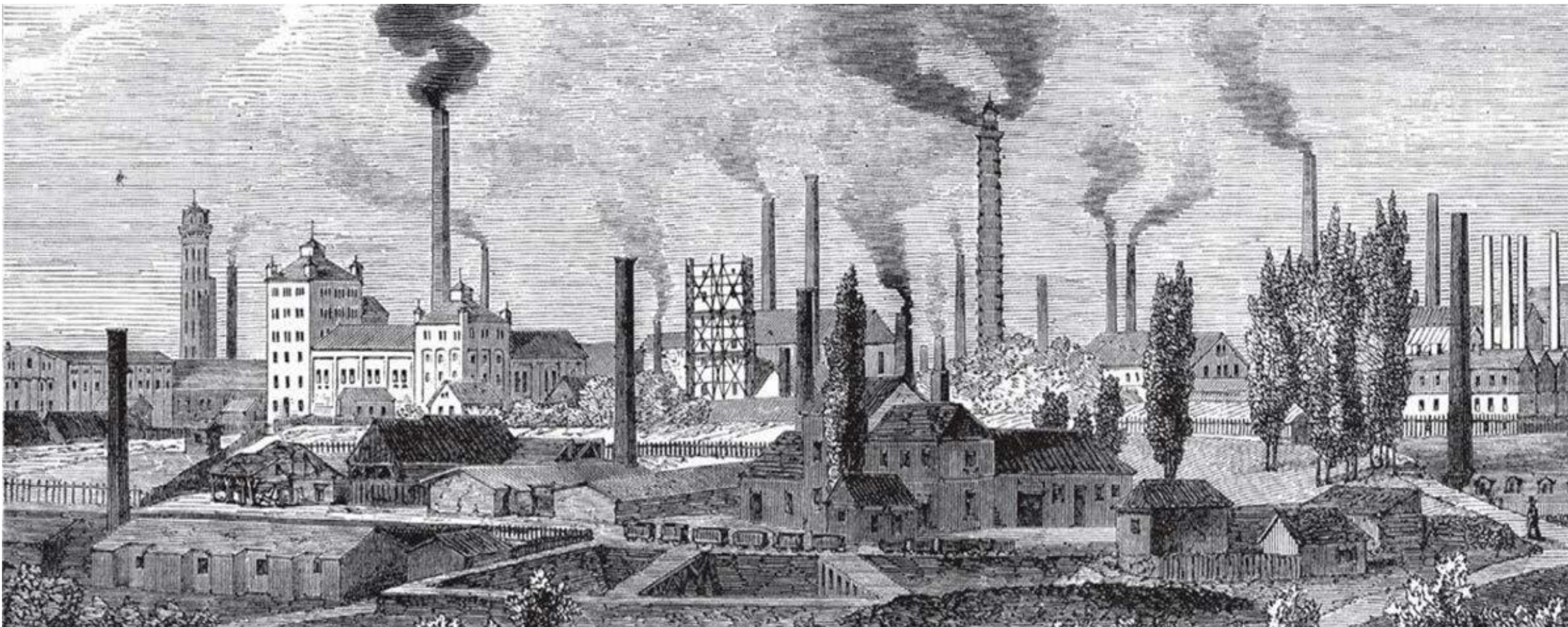


The Renaissance was a cultural movement that took place in Europe. The High Renaissance between the 14thC and 16thC, and Late Renaissance period within the 17thC.

It was a golden period that led to development of art, literature, and culture. It is often regarded as the cultural movement that led to the birth of modern thinking and perspective.

The time is better known for its artistic developments as seen by the works of Leonardo da Vinci and Michelangelo, there were many notable inventions during this period with impact on Surveying, increasing accuracy of measurements.

- 1300 - The first mechanical clock.
- 1366 - Scales for weighing.
- 1400 - First golf ball was invented
- 1411 - The trigger for the gun. The first piano called the Spinet invented.
- 1420 - Oil painting was invented.
- 1421 - Hoisting gear invented in Florence.
- 1450 - Lenses for near-sighted people invented by Nicholas of Cusa.
- 1456 - Printing press by Gutenberg.
- 1465 - Drypoint engravings invented.
- 1475 - Muzzle loaded rifles invented in Italy.
- 1485 - Leonardo da Vinci designed the first parachute.
- 1487 - Bell chimes.
- 1500 - The first flush toilets were invented.
- 1510 - Pocket watch invented by Peter Henlein.
- 1514 - Nicolaus Copernicus established the fact that the centre of the universe is not the Earth.
- 1579 - Azimuth Instrument 'Theodolite'
- 1589 - Knitting machine invented by William Lee.
- 1590 - Compound microscope invented by Zacharias Janssen.
- 1593 - Galileo Galilei invented the water thermometer.
- 1608 - First refracting telescope was invented by Hans Lippershey.
- 1620 - The first submarine was invented by Cornelis Drebbel.
- 1624 - Slide Rule was invented by William Oughtred.
- 1625 - Method of blood transfusion was invented by Jean Baptiste Denys.
- 1636 - W. Gascoigne invents the micrometer.
- 1642 - Adding Machine invented by Blaise Pascal.
- 1643 - Barometer invented by Torricelli.
- 1650 - The first air pump.
- 1656 - The pendulum clock was invented by Christian Huygens.
- 1661 - Thevenot invented the Bubble Spirit Level .
- 1663 - The first reflecting telescope was constructed by James Gregory.
- 1670 - Champagne was invented by Dom Perignon.
- 1671 - The first calculating machine invented by Gottfried Wilhelm Leibniz.
- 1671 - Sir Isaac Newton publishes his major work, Principia, which contains the three laws of motion and the law of universal gravitation.
- 1679 - Pressure cooker invented by Denis Papin.
- 1698 - Steam pump invented by Thomas Savery.



<https://www.learnodo-newtonic.com/wp-content/uploads/2018/03/Industrial-Revolution-Facts-Featured.jpg>

Industrial Revolution 18thC/ 19thC



https://d3d00swyhr67nd.cloudfront.net/w944h944/SW/SW_MTLIB_PCF3.jpg

Industrial Revolution 18thC/ 19thC



<https://i.pinimg.com/736x/48/74/ca/4874cabde94482adfe48d830608b6ad0--coal-mining-south-wales.jpg>

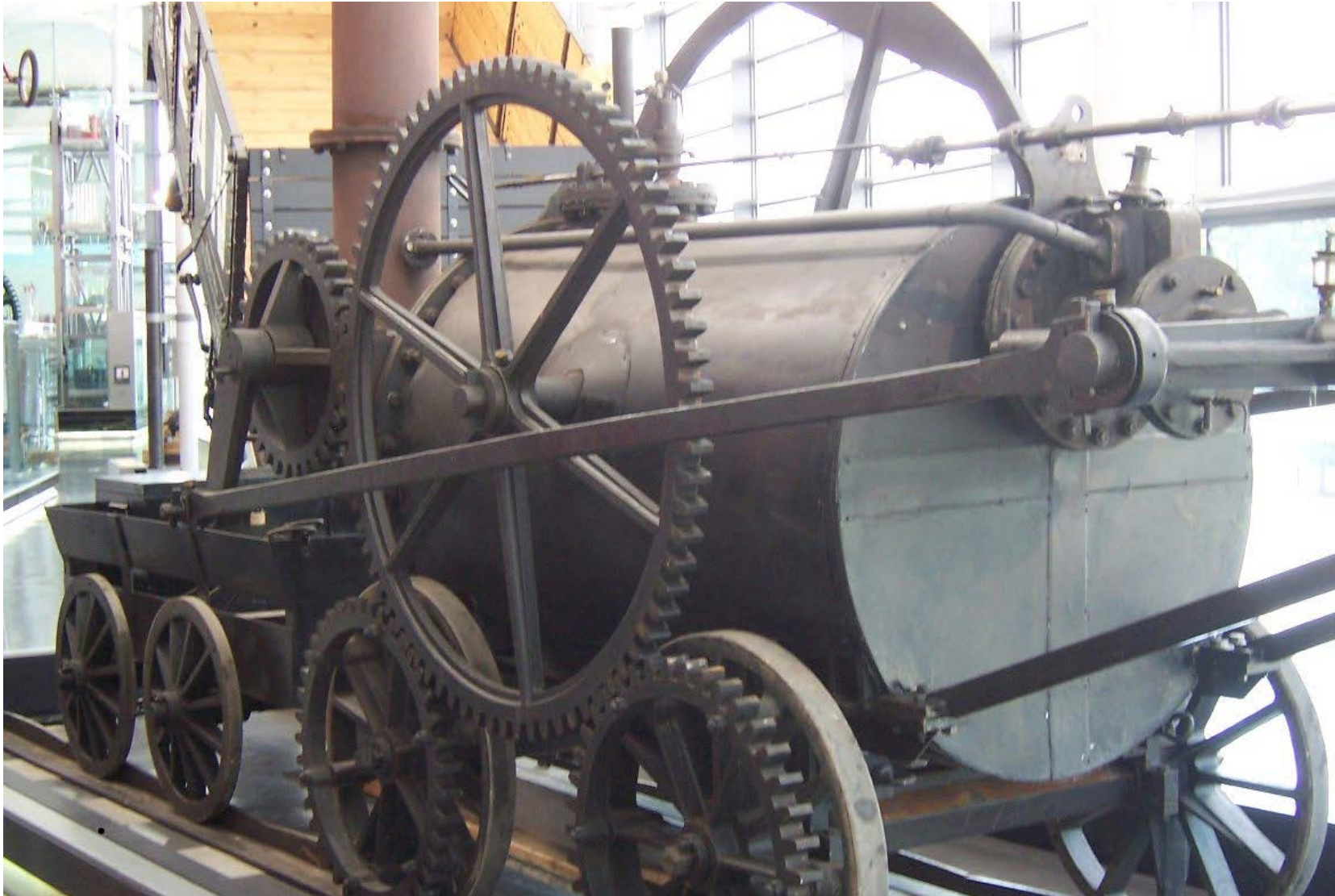
Industrial Revolution 18thC/ 19thC



http://lightmoor.co.uk/BDLbooksample_pics/B9129_samp2.jpg

Industrial Revolution 18thC/ 19thC

ABCA 4002
DIGITAL SURVEYING: LEVEL 4



The world's first locomotive-hauled railway journey took place on 21 February 1804, when Richard Trevithick's unnamed steam locomotive hauled a train along the tramway of the Penydarren Ironworks, in Merthyr Tydfil.



[http://www.swansea docks.co.uk/images/E%20-%20H/geograph-2542410-by-Ben-Brooksbank%20\(5\).jpg](http://www.swansea docks.co.uk/images/E%20-%20H/geograph-2542410-by-Ben-Brooksbank%20(5).jpg)

Industrial Revolution 18thC/ 19thC

CYCLOPÆDIA: OR, AN UNIVERSAL DICTIONARY OF ARTS and SCIENCES;

CONTAINING
The DEFINITIONS of the TERMS;
And ACCOUNTS of
The THINGS signify'd thereby,

In the feveral ARTS,
Both LIBERAL and MECHANICAL,

And the feveral SCIENCES,
HUMAN and DIVINE:

The Figures, Kinds, Properties, Productions, Preparations, and Uses,
of Things NATURAL and ARTIFICIAL;

The Rise, Progress, and State of Things ECCLESIASTICAL,
CIVIL, MILITARY, and COMMERCIAL:

With the feveral Systems, Sects, Opinions, &c. among Philosophers, Divines,
Mathematicians, Physicians, Antiquaries, Critics, &c.

The Whole intended as a Course of Ancient and Modern LEARNING.

Compiled from the best Authors, Dictionaries, Journals, Memoirs,
Transactions, Ephemerides, &c. in feveral Languages.

In TWO VOLUMES.

By E. CHAMBERS Gent.

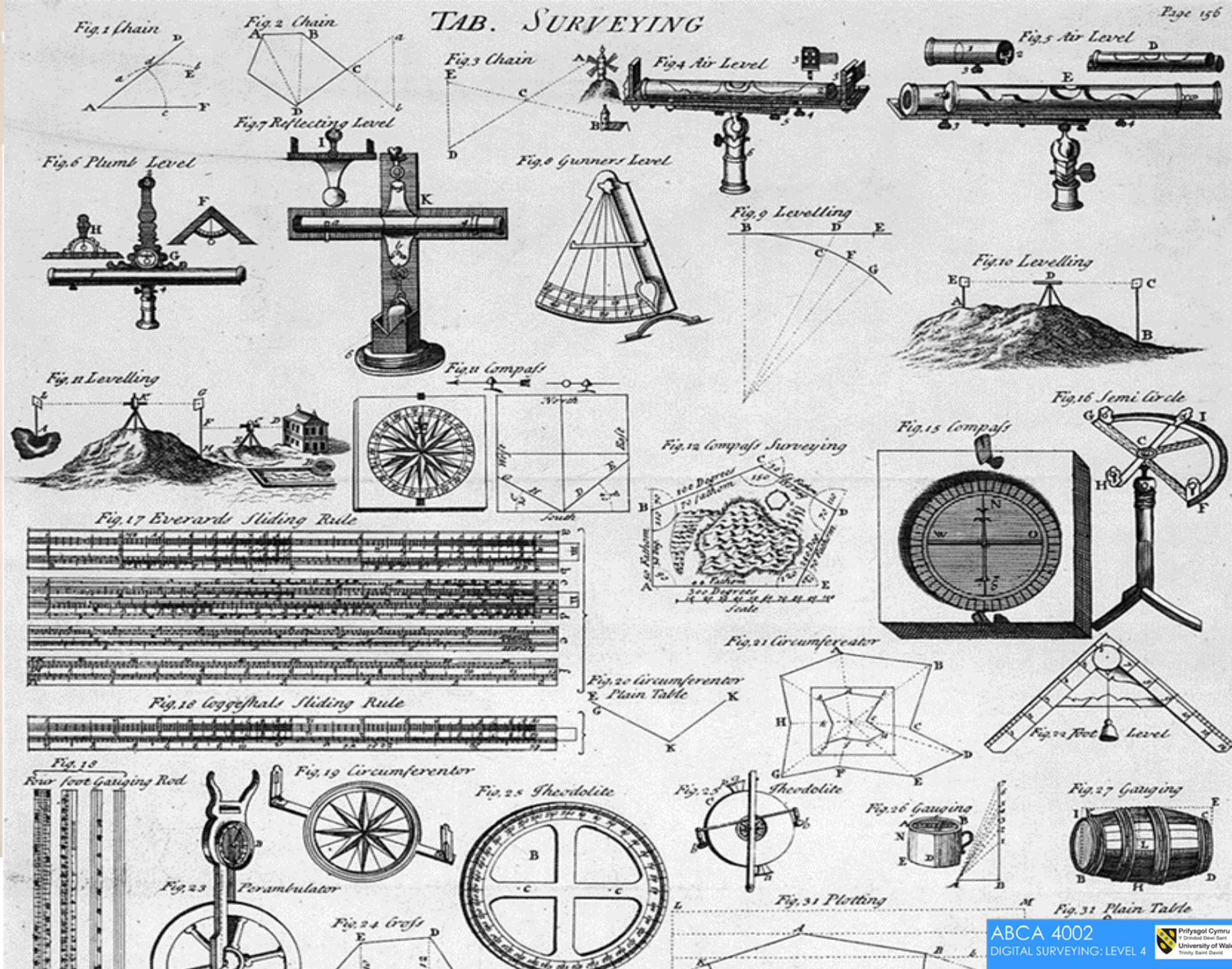
*Floris ut apes in falibus omnia libat,
Omnis nos* ———— *LUCRET.*

VOLUME the FIRST.

LONDON:

Printed for James and John Knapton, John Darby, David Midwinter, Arthur Bettsworth,
John Stacey, Robert Gifford, John Pomeroy, William and John Lewis, John Osborn and The
Longman; Charles Rivington, John Hulse, Renssela Robinson, Francis Clay, Aaron Ward,
Edward Symon, Daniel Browne, Andrew Johnson, and Thomas Osborn. MDCCLXXXVIII.

Chambers Cyclopedia 1728
More accurate instruments were
developed



A

Consider the horizontal distances between A – A and B – B
Are they the same ?

A

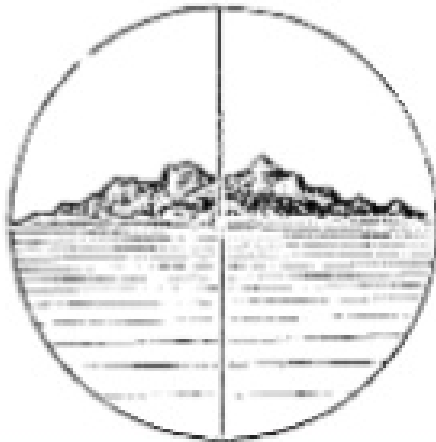
B

B

The science of Geodetic and Plane surveying were developed.

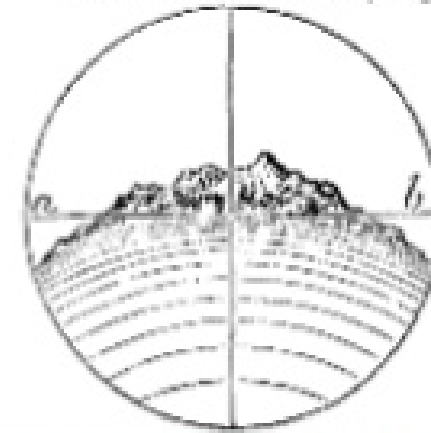
DIFFERENCE BETWEEN GEODETIC AND PLANE SURVEYING

Plane Surveying



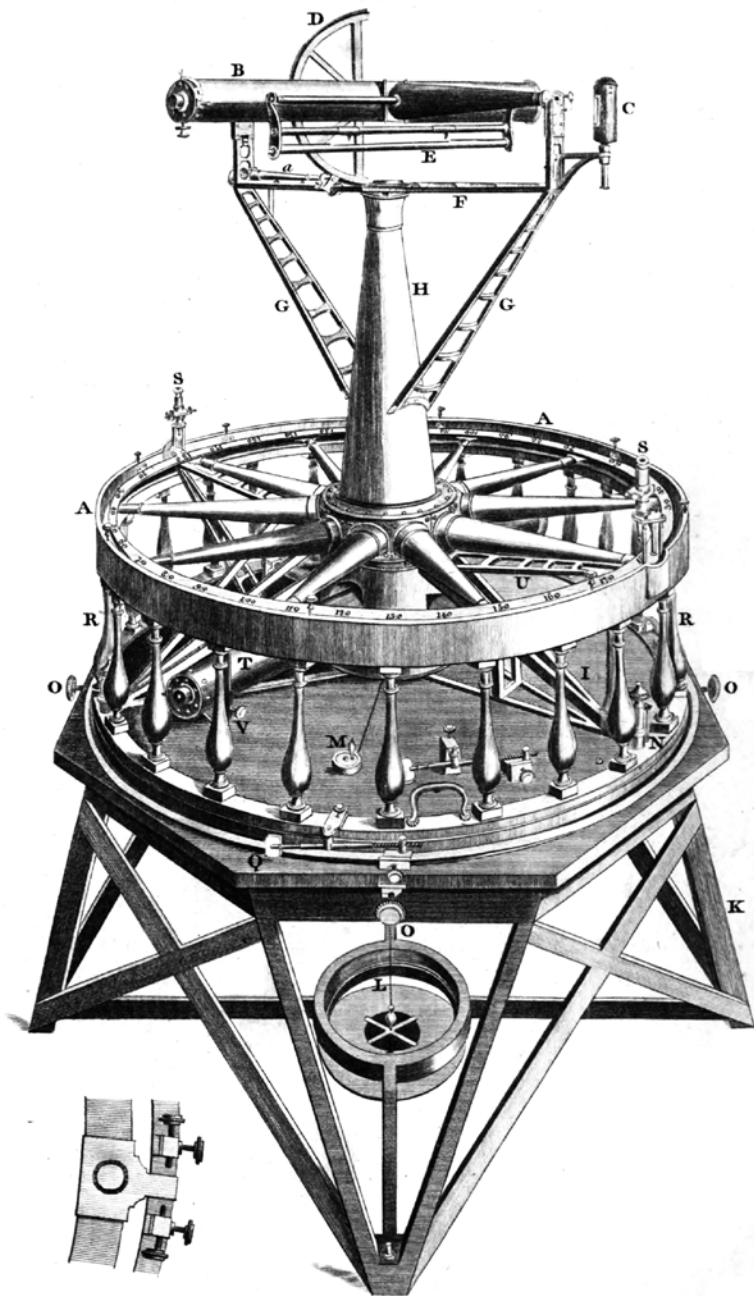
- ☐ Earth surface is considered as a **plane** surface.
- ☐ The curvature of the earth is **ignored**.
- ☐ The line joining any two stations is considered as a **straight line**.
- ☐ The **triangle** formed by any three points is considered as a **plane**.
- ☐ The angles of the triangle are considered to be **plane angles**.
- ☐ Carried out for a **small area < 250km²**.

Geodetic Surveying



- ☐ Earth surface is considered as a **curved** surface.
- ☐ The curvature of the earth is **taken into account**.
- ☐ The line joining any two stations is considered as a **curved line**.
- ☐ The **triangle** formed by any three points is considered as **spherical**.
- ☐ The **angles** of the triangle are considered to be **spherical**.
- ☐ Carried out for a **large area > 250km²**.

Industrial Revolution 18thC/ 19thC



William Roy's lifelong mission was to build a superior map of Britain, unparalleled in its accuracy. The day the Board of Ordnance set his suggested plan into action, Ordnance Survey was born.

In 1784 William Roy, founder of Ordnance Survey, was commissioned by The Royal Society to geodetically connect the Royal Observatories of Greenwich and Paris to resolve a dispute over their relative positions.

Jesse Ramsden, the leading instrument maker of the day took three years in the make the instrument that measured three feet across – The Great Theodolite.

Under the authority of the Master General of the Board of Ordnance, Roy began the London/Paris triangulation in 1785. By using angle measurements and at least a single measured baseline length, a whole country can be measured using the triangulation method. A dense framework of triangles with accurate coordinates at the nodes allows for accurate surveying of map features. Utilising the theodolite and trigonometry, Roy created a network of accurately measured triangles that extended to France and then back to a verification baseline in Kent.

SOH CAH TOA

$$\sin \alpha = \frac{a}{c}$$

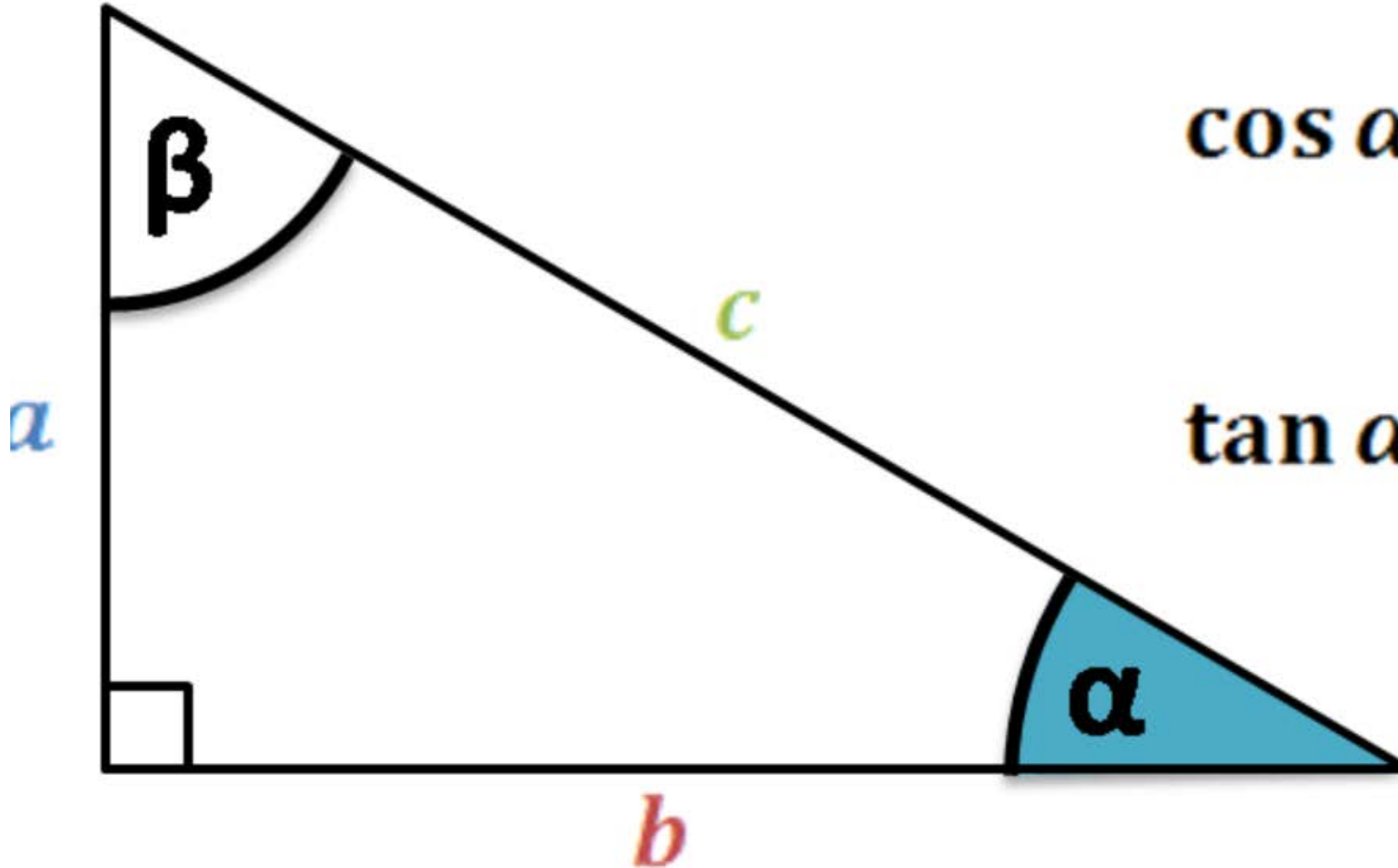
Opposite
Hypotenuse

$$\cos \alpha = \frac{b}{c}$$

Adjacent
Hypotenuse

$$\tan \alpha = \frac{a}{b}$$

Opposite
Adjacent





The first Ordnance Survey map was published in 1801. England's most south-easterly county, Kent, was one area most vulnerable to French invasion.

These early maps, with their elaborate hill shading and attention to communication routes, highlight the emphasis given to military use. In time, this military face would soften and the map design was developed to appeal to a much wider audience.



Modern Era – Surveying Today

Surveying Today - What do we use surveying for?

- Mapping the earth above and below the sea.
- Prepare navigational maps (land, air, sea).
- Establish boundaries of public and private lands.
- Develop data bases for natural resource management.
- Development of engineering data for:
 - Bridge construction.
 - Roads.
 - Buildings.
 - Land development.

Surveying Today - What are the Five Main Areas on Surveyors Work?

- Research, analysis, and decision making.
- Field work {Data acquisition}.
- Computing {Data processing}.
- Mapping {Data representation}.
- Stake-out

Surveying Today - What are the two Major Methods of Surveying?

- GEODETIC SURVEYING

Takes into account the theoretical shape of the earth.
Generally high in accuracy, and cover large areas.(greater than 300 sq. mi.).

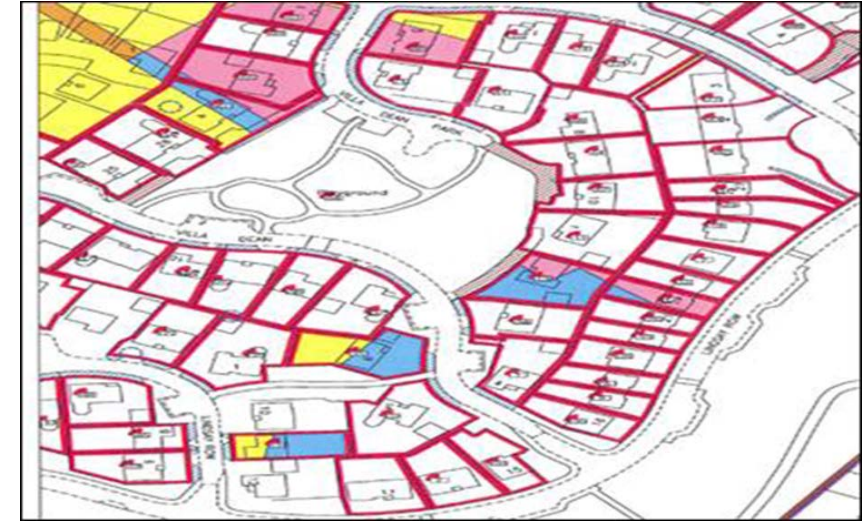
- PLANE SURVEYING

Assumes that the survey area is a flat plane. Generally covers small areas (less than 300 sq. mi.).
Most common method used.

Types of Surveying

CADASTRAL SURVEYS are usually closed surveys which are undertaken in urban and rural locations for the purpose of determining and defining property lines and boundaries, corners, and areas. These surveys are also made to fix the boundaries of municipalities, towns, and provincial jurisdictions.

CITY SURVEYS are surveys of the areas in and near a city for the purpose of planning expansions or improvements, locating property lines, fixing reference monuments, determining the physical features and configuration of the land, and preparing maps.



CONSTRUCTION SURVEYS these are surveys which are undertaken at a construction site to provide data regarding grades, reference lines, dimensions, ground configuration, and the location and elevation of structures which are of concern to engineers, architects, and builders.



FORESTRY SURVEYS a type of survey executed in connection with forest management and mensuration, and the production and conservation of forest lands.



HYDROGRAPHIC SURVEYS refer to surveying streams, lakes, reservoirs, harbour's, oceans, and other bodies of water. These surveys are made to map shore lines, chart the shape of areas underlying water surfaces, and measure the flows of the stream. They are of general importance in connection with navigation, development of water supply and resources, flood control, irrigation, production of hydro-electric power, sub aqueous constructions, and recreations



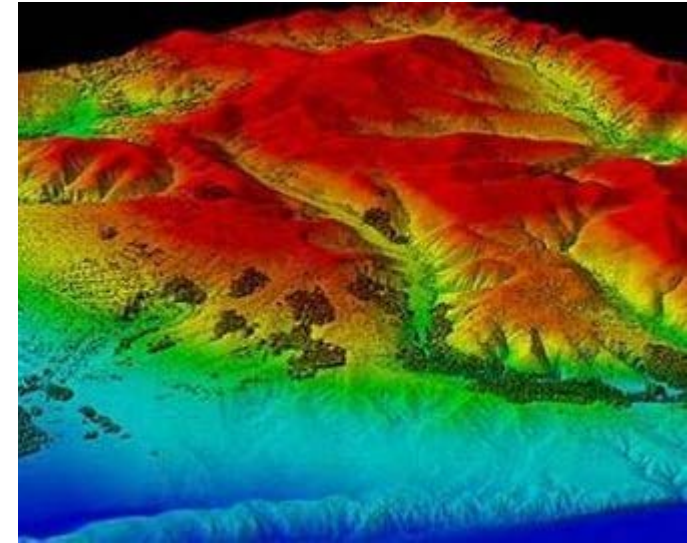
INDUSTRIAL SURVEY sometimes known as optical tooling. It refers to the use of surveying techniques in ship building, construction and assembly of aircraft, layout and installation of heavy and complex machinery, and in other industries where very accurate dimensional layouts are required.



MINE SURVEYS are surveys which are performed to determine the position of all underground excavations and surface mine structures, to fix surfaces boundaries of mining claims, determine geological formations, to calculate excavated volumes, and establish lines and grades for other related mining work.



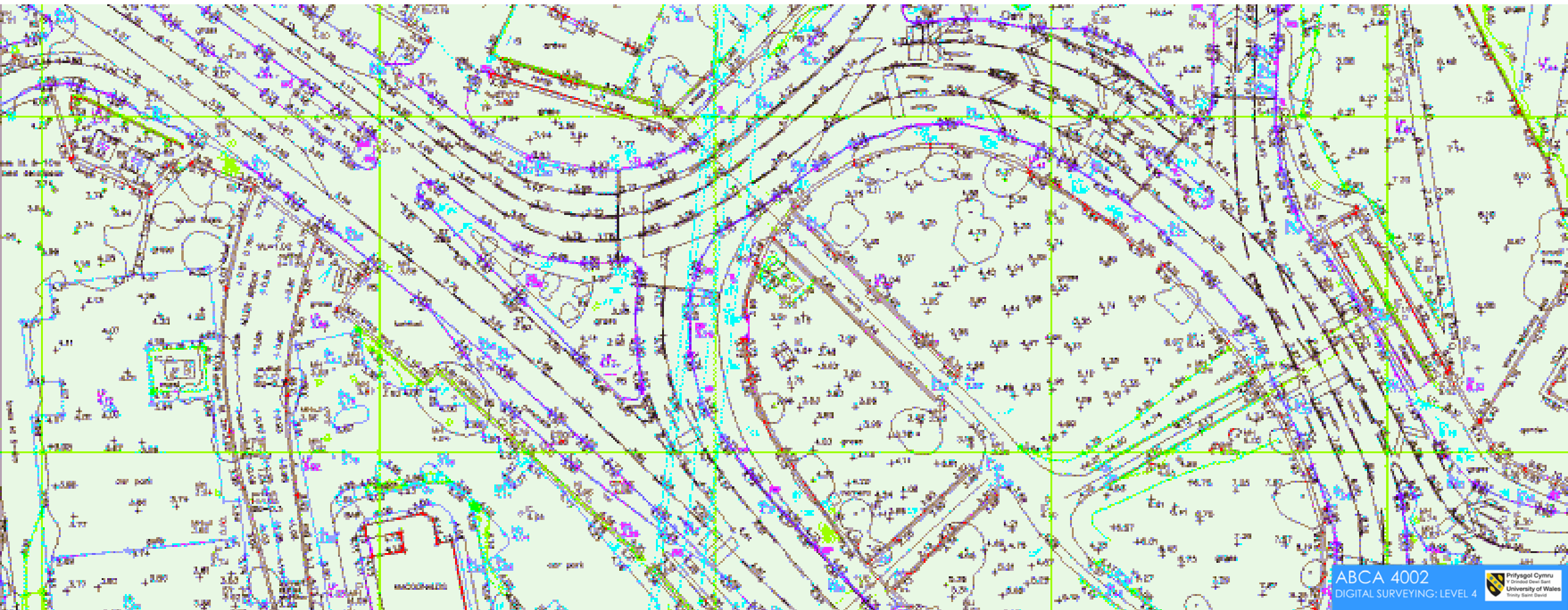
PHOTOGRAMMETRIC SURVEYS a type of survey which makes use of photographs taken with specially designed cameras either from airplanes or ground stations. Measurements are obtained from the photographs which are used in conjunction with limited ground surveys.



ROUTE SURVEYS involves the determination of alignment, grades, earthwork quantities, location of natural and artificial objects in connection with the planning, design, and construction of highways, railroads, pipelines, canals, transmission lines, and other linear projects.



TOPOGRAPHIC SURVEYS are those surveys made for determining the shape of the ground, and the location and elevation of natural and artificial features upon it. The features shown include such natural objects as hills, mountains, rivers, lakes, relief of the ground surface, etc.; and works , such as roads, building, ports, towns, municipalities, and bridges.



For next week – Consider some of the types of surveys discussed today.

What Modern Equipment can we use to assist us?