

Illustrated Holocene Era Timeline:

*Human Achievements, Advancements,
Innovations, and Understanding in Science
using EMILIANI's HE calendar*

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Phone Edition
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I dedicate this book

To: the wonderful man who is my husband Paul Premack, our adult children Tiffany and Benjamin, his wife Kira, my mother Jo Ann Simons Stier for their love, brains, attention to detail, laughter, and thoughtfulness and to my dad Herb Stier;

To: CESARE EMILIANI, who first had the idea for the Holocene Era (HE) calendar; and

To: any human who can open their mind to seeing the (HE) flow of human accomplishment and to being enchanted, shocked, disappointed, or amazed by the wonders and realities of science.

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About the HE Calendar and Formatting

This eBook, *Illustrated Holocene Era Timeline: Human Achievements, Advancements, Innovations, and Understanding in Science using EMILIANI's HE calendar* uses HE (Holocene Era) to count years. The word “Holocene” means “entirely recent”. The Holocene Era (**HE**) encompasses the growth, history, and impacts of the human species worldwide.

Some argue that the period should be referred to as the “Human Era” instead of the “Holocene Era”, but when the *HE Calendar* was first proposed by scientist CESARE (Chay-se-ree) EMILIANI in 1993 (think **11,993 HE**) he chose the label “Holocene”. We'll stay with *Holocene* instead of *Human* in order to be consistent with EMILIANI's proposal. EMILIANI died before

he was able to make his proposal a reality. We want to help bring his proposal into wide-spread use.

The HE calendar places year 1 at a time when humans were settling into agricultural communities. It loosely matches the beginning of the “Holocene epoch” of geology. Admittedly, the choice of a particular moment in time must be arbitrary, but a point must be chosen. EMILIANI for his calendar reform idea chose a point that would make the current AD/CE year numbers match with the addition of 10,000.

Conversion from AD/CE years into HE is done by adding 10,000 to the AD/CE year. The year 2015 AD/CE is **12,015 HE**. Conversion from BC/BCE years to HE is done by subtracting 10,001 from the BC/BCE year. The year 2015 BCE would be **7,986 HE**. My husband, Paul Premack, the technological advisor for this undertaking, built an Excel calculator to do the math. Find it at: www.premack.com/timeline.html

- Note that in the Gregorian calendar there is no year “0”; it went from 1 BC/BCE to 1 AD/CE with no intervening year. Hence, the year 1 BC/BCE is **10,000 HE** and the year 1 AD/CE is **10,001 HE**.
- The years before recorded human history are “Before Holocene Era” (**BHE**). BHE begins with the Big Bang, and all of the listed items are estimations based on research, evidence, and conclusions refined by modern scientists.
- **BHE** and **HE** dates are in **bold**.
- Books and texts are *bold, italicized, and underlined*.
- **SCIENTIST NAMES** are in ALL CAPITAL LETTERS.

About the confusion of using the standard calendar now in use: John Cleese said of his early experience teaching history before his Monty Python days, “I still got confused how dates with 16 on the front could occur in the 17th century. That’s about as basic as history gets.”¹

¹ Autobiography of John Cleese, *So, Anyway...*, 12,015 HE

Author / Compiler's Preface

I started a timeline on paper, in **12,014 HE**, to align various scientists with the dates they lived, as we learned about various scientists introduced by CERN Scientist PROFESSOR BRIAN COX in the BBC program “*The Science of Dr. Who*”.

It was my husband who researched, sifted through, and presented to me all the different calendars from which we decided that CESARE EMILIANI'S HOLOCENE ERA **HE** CALENDAR reforming idea was most fair and made the most sense *for every human!* Thank you, Paul!

After a year of compiling information our son said: “You must footnote everything, because you are compiling the work of others.” At the time I was not happy about it. Now it was a fundamental factor in the success of this quest. Thank you, Benjamin!

This is by no means a complete list. We consider it a Work in Progress done by amateurs, not professional researchers.

It was so exciting for me to have these puzzle pieces of human accomplishments flow together! It makes sense to see Human progress using EMILIANI's HE Calendar reform timeline!

The goals of *Illustrated Holocene Era Timeline: Human Achievements, Advancements, Innovations, and Understanding in Science using EMILIANI's HE calendar* are to: 1) Present historical information in a new light through the flowing lens of the Holocene Era, and 2) Perhaps grant a new perspective on the history of human accomplishments.

Chapter One Appetizers

Details are fun... so Chapter Two launches the body of the Illustrated Holocene Era Timeline. But here are some “Bites of Holocene Era Highlights” to whet your appetite! (Please note: date given for each entry/culture/person is that entry/culture/person’s either circa start date or birth; obviously, their important works were achieved in the years following.)

- **Circa 300,000 BHE:** At a site near Marrakesh, modern miners uncovered fossils which suggest our species may have emerged more than 100,000 years earlier than previously thought.²

² <https://www.history.com/news/how-homo-sapiens-fossils-found-in-morocco-may-rewrite-the-human-story>

- **Circa 39,999 BHE:** Sydney, Australia - Aboriginal stone tools.³
- **Circa 32,000 BHE:** Germany, Paleolithic flute from animal bone.⁴
- **Circa 30,000 BHE:** Spain, Altamira Cave, El Castillo, oldest known cave paintings.⁵
- **Circa 29,999 BHE – Current times HE:** Africa, San People inhabit the Kalahari Desert.⁶

³ ISAAC ASIMOV: ASIMOV'S Chronology of the World

⁴ https://en.wikipedia.org/wiki/Paleolithic_flutes

⁵ <http://whc.unesco.org/en/list/310>

⁶ https://en.wikipedia.org/wiki/San_people

- **Circa 24,999 BHE:** Discovered in the Lebombo Mountains located between South Africa and Swaziland, *The Lebombo bone* is the oldest mathematical fossil.⁷
- **Circa 23,000 BHE:** France, the *Venus of Laussel* is one of the oldest examples of carved figurative art of a human figure.⁸
- **Circa 22,000 BHE:** Republic of Georgia: Twisted rope fibers and flax fibers discovered, which were made by early humans.⁹
- **Circa 21,000 BHE:** Domestication of dogs.¹⁰

⁷ <http://www.math.buffalo.edu/mad/Ancient-Africa/lebombo.html>

⁸ https://en.wikipedia.org/wiki/Venus_of_Laussel

⁹ <http://news.harvard.edu/gazette/story/2009/09/oldest-known-fibers-discovered/>

¹⁰ <https://www.sciencedaily.com/releases/2012/01/120123152528.htm>

- **Circa 16,000 BHE:** Fired Clay; Czech Republic; or between Southern Russia and Spain.¹¹ *The Venus of Dolni Vestonice* figurine survives.¹²
- **Circa 13,000 BHE:** Africa: *The Ishango Bone* portrays what are believed to be a series of Prime numbers, and a lunar phase calendar.¹³
- **Circa 5,300 BHE:** Lascaux, France: cave painting of the Magdalenian Culture.¹⁴

¹¹ <http://news.bbc.co.uk/2/hi/science/nature/790569.stm>

¹² https://en.wikipedia.org/wiki/Venus_of_Doln%C3%AD_V%C4%Bstovice

¹³ https://en.wikipedia.org/wiki/Ishango_bone

¹⁴ <http://www.ancient-wisdom.com/francelascaux.htm>

- **Circa 1 HE – Circa 6,401 HE: THE STONE AGE**
- **Circa 1 HE:** The End of the Last Ice Age
- **Circa 1 HE:** This is a rough approximation of the start of the current geologic epoch, the Holocene Epoch.¹⁵
- **Circa 1 HE:** The world-wide population of humans is approximately 5 million.¹⁶
- **Circa 1 HE:** Organized agriculture begins.¹⁷

¹⁵ https://en.wikipedia.org/wiki/Holocene_calendar

¹⁶ <https://www.worldometers.info/world-population/>

¹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of the World

- **Circa 500 HE:** Göbekli Tepe, an archaeological site in the Southeastern Turkey.¹⁸
- **Circa 2,000 HE:** Scotland, Lunar Calendar.¹⁹
- **Circa 3,000 HE:** China: fermentation.²⁰
- **Circa 3,000 HE:** The Chinchorro culture in Chile and southern Peru.²¹
- **Circa 4,000 HE:** Sumeria, beginning of priest-kings and organized religion.²²

¹⁸ https://en.wikipedia.org/wiki/Gobekli_Tepe

¹⁹ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>

²⁰ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

²¹ https://en.wikipedia.org/wiki/Chinchorro_culture

²² ISAAC ASIMOV: ASIMOV'S Chronology of the World

- **Circa 4,001 HE:** China; a canoe-shaped pottery and six wooden oars dating from the **4,001 HE** has been discovered in a Hemudu culture site at Yuyao, Zhejiang.
- **Circa 4,301 HE – 5,501 HE:** Vinca culture period Neolithic archaeological culture in present-day Serbia and smaller parts of Bulgaria and Romania (particularly Transylvania).²³
- **Circa 5,000 HE:** Scales for measurement developed, Irrigation used.²⁴

5,001 HE: Author / Compiler's Note: This HE date "**5,001 HE**" is descriptive. "**5,001 HE**" equals the outdated calendar number 5000 BC/BCE. But where that BC/BCE number leaves a reader speculating or calculating – the number "**5,001 HE**" simply flows as it puts into

²³ https://en.wikipedia.org/wiki/Vinca_culture

²⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

perspective the “scale” of this huge timeline of human advancement and accomplishments. “**5,001 HE**” shows the reality of human development and advancement based on what came before them. It is both circa 5,000 years after the start of the Holocene Era and circa 7,000 years before our own time.

- **Circa 6,000 HE:** Sundial invented.²⁵
- **Circa 6,401 HE - Circa 9,001 HE:** THE BRONZE AGE
- **Circa 6,500 HE:** Wheeled carts invented; river boats used, writing developed.²⁶

²⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

²⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

- **Circa 6,801 HE – Circa 8,001 HE:** Peru, The Norte Chico civilization (AKA Caral or Caral-Supe civilization).²⁷
- **Circa 6,887 HE - 10,250 HE:** Mayan Culture, Yucatan Peninsula.
- **Circa 6,901 HE:** The first “nation” united in Egypt²⁸, called the First Dynasty of Egypt.²⁹

²⁷ https://en.wikipedia.org/wiki/Norte_Chico_civilization

²⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁹ https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt

- **Circa 7,400 HE:** Indus Valley Civilization in the Indian Sub-continent.³⁰
- **Circa 7,400 HE:** Greece; the Minoan Civilization.³¹
- **Circa 7,412 HE:** Fourth Dynasty of Egypt; "the Age of the Pyramids."³²
- **Circa 7,701 HE – Circa 8,419 HE:** Central European Bronze Age Únětice culture.³³ The Nebra Sky Disc, made of bronze by the Únětice culture is considered to be one of the most important archaeological finds of the **11,900's HE**. It contains an

³⁰ <https://en.wikipedia.org/wiki/Harappa>

³¹ https://en.wikipedia.org/wiki/Minoan_civilization

³² https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt

³³ https://en.wikipedia.org/wiki/Unetice_culture

extraordinary comprehension of astronomical phenomena that enable unique glimpses into the early knowledge of the skies.³⁴

- **Circa 8,247 HE:** Babylonia; *Code of Hammurabi*, first surviving law code established.³⁵
- **Circa 8,500 HE:** The Alphabet from which all alphabets grew is invented by a Phoenician.³⁶
- **Circa 8,600 HE:** SOAP and HYGIENE! Ancient Egypt, developed soaps and aromatic oils not only used for washing but

³⁴ <http://www.unesco.org/new/en/communication-and-information/flagship-project-activities/memory-of-the-world/register/full-list-of-registered-heritage/registered-heritage-page-6/nebra-sky-disc/>

³⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

also as an important medical cure for many skin and muscle diseases.³⁷

- **Circa 8,800 HE:** The decimal Hindu-Arabic numeral system was invented in India.³⁸
- **Circa 9,000 HE:** Steel was developed.³⁹
- **Circa 9,001 HE – Circa 11,543 HE:** THE IRON AGE

³⁷ <http://www.soaphistory.net/soap-history/first-soap/>

³⁸ https://en.wikipedia.org/wiki/Hindu%E2%80%93Arabic_numeral_system

³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

- **Circa 9,100 HE:** Camels were domesticated in the southern Levant (Israel/Jordan area), in conjunction with expanding copper mining.⁴⁰
- **Circa 9,530 HE:** MOZI, Chinese philosopher; included early stirrings of the scientific approach.⁴¹
- **Circa 9,574 HE:** PLATO, Greek philosopher who laid the very foundations of Western philosophy and science.⁴²

⁴⁰ <https://www.sciencedaily.com/releases/2014/02/140203131518.htm>

⁴¹ Mozu". New World Encyclopedia.

⁴² "Plato". Encyclopedia Britannica. 2002

- **Circa 9,617 HE:** ARISTOTLE, Greek philosopher who developed the pre-cursor to the now used Scientific Method.⁴³
- **Circa 9,701 HE:** Chankillo, Thirteen Towers Solar Observatory, a monthly sunset / sunrise complex built by still un-named culture of people in NW Peru.⁴⁴
- **Built Circa 9,721 HE:** At Alexandria in Egypt: The Library of Alexandria or The Museum or Museum of Alexandria, or Alexandrian Museum, or The Greek Mouseion (“Seat of the Muses”) was the ancient centre of classical learning. It was a

⁴³ <https://en.wikipedia.org/wiki/Aristotle>

⁴⁴ Professor BRIAN COX VIDEO:

https://smile.amazon.com/gp/product/B005EVWDZU/ref=dv_web_yvl_list_pr_0_ba

research institute that was especially noted for its scientific and literary scholarship.⁴⁵

- **Circa 9,725 HE:** ERATOSTHENES,⁴⁶ Greek, measured the Earth's circumference of 25,000 miles / 40,000 km in diameter.⁴⁷
- **Circa 9,731 HE:** EUCLID⁴⁸, Greek, the "*father of geometry*".⁴⁹
- **Circa 9,831 HE:** In the small Hellenistic kingdom of Pergamum the ruler Eumemes II wanted to build a library to rival Alexandria. Egypt would not share papyrus, so Pergamum invented Parchment. The parchment skins could not be rolled

⁴⁵ <https://www.britannica.com/topic/Alexandrian-Museum>

⁴⁶ MAX TEGMARK, Our Mathematical Universe

⁴⁷ <https://en.wikipedia.org/wiki/Eratosthenes>

⁴⁸ MAX TEGMARK, Our Mathematical Universe

⁴⁹ https://en.wikipedia.org/wiki/Euclid%27s_Elements

into scrolls, they could only be cut into sheets and glued together into a Codex. This is the first form of printed books.⁵⁰

- **Circa 9,916 HE:** Waterwheels were first mentioned in a poem.⁵¹
- **Circa 9,953 HE:** Circa 232 years after being built, the main section of the Library or Museum of Alexandria was an “unfortunate casualty of war.”⁵²
- **Circa 9,955 HE:** The Julian Calendar was introduced.⁵³

⁵⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 56

⁵¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵² <https://www.britannica.com/topic/Alexandrian-Museum>

⁵³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

- **Circa 10,370 HE - Circa 11,500 HE:** European DARK AGES.⁵⁴
- **Circa 10,391 HE:** The daughter library of the Library or Museum of Alexandria, protected by the Serapeum, subsisted another circa 438 years after the main library and was then destroyed by the then ruling powers.⁵⁵
- **Circa 10,476 HE:** India, ARYABHATA correctly insisted that the earth rotates about its axis daily.⁵⁶

⁵⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁵ <https://www.britannica.com/topic/Alexandrian-Museum>

⁵⁶ <https://en.wikipedia.org/wiki/Aryabhata>

- **Circa 10,598 HE: BRAHMAGUPTA:** Indian mathematician and astronomer⁵⁷ was the first person to give rules to compute with zero.⁵⁸
- **Circa 10,660 HE:** China invents Woodblock Printing and Porcelain.⁵⁹
- **Circa 10,733 HE** Vikings explore and colonize Iceland, Greenland, Newfoundland.⁶⁰
- **Circa 10,750 HE - Circa 11,300 HE:** *The Islamic Golden Age.* Cultural works flourished.⁶¹ Much of the light of Ancient Greek science would have been permanently extinguished without their

⁵⁷ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

⁵⁸ <https://en.wikipedia.org/wiki/Brahmagupta>

⁵⁹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁶⁰ https://en.wikipedia.org/wiki/History_of_Greenland

⁶¹ https://en.wikipedia.org/wiki/Islamic_Golden_Age

efforts. Arabic astronomy was so influential that we still call most of the bright stars by their Arabic names. The "al's" in algebra, algorithm, alchemy, and alcohol are just some of the traces left from the time when Arabic was the language of science.⁶²

- **Circa 10,825 HE:** AL-KHWARIZMI and AL-KINDI, spread the Indian system of numeration in the Middle East and the West.⁶³ The transition to Arabic numerals democratized arithmetical computation, bringing it within reach of everyone.⁶⁴

⁶² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶³ https://en.wikipedia.org/wiki/Arabic_numerals

⁶⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

- **Circa 10,973 HE:** ABURAYHAN AL-BIRUNI, Persian chronicler of India, Geodesy and Earth scientist; astronomer; conversant in 7 languages⁶⁵
- **Circa 10,986 HE:** IBN SAHL was a Persian mathematician, physicist and optics engineer credited with first discovering the law of refraction, usually called Snell's law.⁶⁶
- **Circa 11,006 HE:** ALI IBN RIDWAN, Egyptian astronomer⁶⁷ who observed and wrote about Supernova SN 1006⁶⁸

⁶⁵ <https://en.wikipedia.org/wiki/Al-Biruni>

⁶⁶ https://en.wikipedia.org/wiki/Ibn_Sahl

⁶⁷ https://en.wikipedia.org/wiki/Ali_ibn_Ridwan

⁶⁸ <https://en.wikipedia.org/wiki/Star>

- **Circa 11,111 HE:** Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES, he popularized “revelation over research”. The Islamic world has not yet recovered.⁶⁹
- **Circa 11,403 HE:** Venice. By this time in HE history, the knowledge for the use of soap for hygiene or cleaning was lost. European society did not know how to control the resulting spread of disease. The Venetians invented the idea of “Quarantine” (from the French word for “forty”).⁷⁰

⁶⁹ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⁷⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

- **Circa 11,438 HE:** The Inca civilization⁷¹ arose in the Andes Mountains in the highlands of Peru⁷² and Ecuador.⁷³
- **Circa 11,543 HE – Now HE:** Launch of the SCIENTIFIC REVOLUTION
- **11,543 HE:** NICOLAUS COPERNICUS defined the HELIOCENTRIC SYSTEM, against all belief of the time, that the Sun is the center of the solar system, not the Earth.⁷⁴

⁷¹ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

⁷² https://en.wikipedia.org/wiki/Inca_Empire

⁷³ <https://www.youtube.com/watch?v=Nry1SO45RT4>

⁷⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

- **Born 11,560 HE: SIR JOHN HARRINGTON:** inventor of the flush toilet.⁷⁵ We call toilets “johns” after Sir John Harrington.⁷⁶
- **Born 11,564 HE: GALILEO,**⁷⁷ among so much else, invented the brass telescope, discovered four of the moons of Jupiter (Galilean moons), and viewed mountains and valleys on the surface of the moon.⁷⁸
- **11,582 HE:** The Gregorian calendar was introduced 1,627 years after the Julian calendar, to keep religious holidays from drifting.⁷⁹

⁷⁵ [https://en.wikipedia.org/wiki/John_Harrington_\(writer\)](https://en.wikipedia.org/wiki/John_Harrington_(writer))

⁷⁶ <https://pintsofhistory.com/2014/09/17/how-queen-elizabeth-i-held-back-the-toilet/>

⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁷⁸ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

- **Born 11,600 HE:** GIORDANO BRUNO was burned at the stake by the Inquisition for insisting the universe - space - is in fact infinite and could have no celestial body at its center.^{80 81}
- **Born 11,623 HE:** MARGARET LUCAS CAVENDISH, wrote one of the earliest examples of science fiction,⁸² and is singular in having published extensively in natural philosophy and early modern science.⁸³
- **Born 11,625 HE:** GIOVANNI DOMENICO CASSINI, (CASSINI I) Italy & France, mathematician, astronomer,

⁸⁰ Max Tegmark, Our Mathematical Universe

⁸¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode

⁸² Audible 7-22-16 Podcast “Get Smart”

⁸³ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne#Books

engineer, and astrologer. First of 4 “CASSINIs” referred to in the history of astronomical science.⁸⁴

- **Born 11,644 HE:** OLE ROEMER (RÓMER), Danish, Astronomer, first demonstrated that light travels at a finite speed using GALILEO’S observations of the moons of Jupiter.⁸⁵
- **Born 11,627 HE:** JOHN RAY, English naturalist started classifying animals and his system is still in use to this day.⁸⁶

⁸⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁸⁵ https://en.wikipedia.org/wiki/ole_roemer

⁸⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

- **Born 11,629 HE: CHRISTIAAN HUYGENS**⁸⁷ Dutch astronomer, inventor of the first clock accurate enough to be used by scientists.⁸⁸
- **Born 11,642 HE: SIR ISAAC NEWTON**, English Physicist and Mathematician: John Maynard Keynes said: “Newton was not the first of the Age of Reason, he was the last of the magicians...”⁸⁹ See more about SIR ISAAC NEWTON in the full HE timeline!
- **Born 11,656 HE: EDMOND HALLEY** privately paid for the publishing of NEWTON’S *Principia*, computed the orbit of Halley’s Comet,⁹⁰ published a catalogue of 321 stars in the

⁸⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁸⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁸⁹ LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

⁹⁰ https://en.wikipedia.org/wiki/Edmond_Halley

southern hemisphere,⁹¹ wrote the first Mortality Tables, and predicted an eclipse of the sun.⁹²

- **Born 11,693 HE:** JOHN HARRISON, made the first accurate, portable timepiece that did not rely on a pendulum and allowed *Longitude* to be calculated on ships.⁹³
- **Born 11,706 HE:** GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL, MARQUISE DU CHÂTELET introduced the idea of “Conservation of Energy” where “energy cannot be created or destroyed”.⁹⁴

⁹¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 166

⁹² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 185

⁹³ Dava Sobel’s book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*

⁹⁴ <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

- **Born 11,706 HE: BENJAMIN FRANKLIN** polymath known for among much else: electricity research, inventing the lightning rod, bifocals, and the Franklin stove.⁹⁵
- **Born 11,718 HE: MARIA GAETANA AGNESI**, Italy, Mathematician⁹⁶ was the first woman to appointed as a Mathematics Professor at a university.⁹⁷

⁹⁵ https://en.wikipedia.org/wiki/Benjamin_Franklin

⁹⁶ Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*

⁹⁷ Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*

- **Born 11,725 HE: NICOLAS-JOSEPH CUGNOT**, French inventor, built a working self-propelled land-based mechanical vehicle: the world's first automobile⁹⁸ fueled by hydrogen.⁹⁹
- **Born 11,726 HE: JAMES HUTTON**¹⁰⁰ Scottish geologist, naturalist, experimental agriculturalist,¹⁰¹ physician, and chemical manufacturer who among so much else originated the theory of uniformitarianism — a fundamental principle of geology — that explains the features of the Earth's crust by means of natural processes over geologic time.¹⁰²

⁹⁸ https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot

⁹⁹ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁰⁰ Benjamin Premack

¹⁰¹ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁰² https://en.wikipedia.org/wiki/James_Hutton

- **Born 11,731 HE:** HENRY CAVENDISH, British scientist who experimented in electricity, heat, gravity, gases and anything having to do with the composition of matter.¹⁰³
- **Circa 11,760 HE – Now:** INDUSTRIAL REVOLUTION
- **Born 11,769 HE:** ALEXANDER VON HUMBOLDT¹⁰⁴ was among so much more, the first person who defined aspects of nature in different lands, different climates with scientific elucidations and applied the knowledge globally,¹⁰⁵ and specifically highlighted the human threat to nature.¹⁰⁶

¹⁰³ https://en.wikipedia.org/wiki/Henry_Cavendish

¹⁰⁴ Author/Compiler's son Benjamin Premack actually introduced author to knowledge of ALEXANDER VON HUMBOLDT

¹⁰⁵ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

¹⁰⁶ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- **Born 11,773 HE:** SIR GEORGE CAYLEY, 6th Baronet: English engineer, inventor, and aviator considered the "*father of the aeroplane*," designed a full-size manned glider.¹⁰⁷
- **Born 11,775 HE:** ANTOINE-LAURENT LAVOISIER,¹⁰⁸ French chemist, a founder of modern chemistry.¹⁰⁹
- **Born 11,776 HE:** MARIE-SOPHIE GERMAIN, French, Mathematician, physicist, and philosopher was one of the (unpaid because of her sex) pioneers of elasticity theory.¹¹⁰

¹⁰⁷ https://en.wikipedia.org/wiki/History_of_aviation

¹⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰⁹ https://en.wikipedia.org/wiki/Antoine_Lavoisier

¹¹⁰ https://en.wikipedia.org/wiki/Sophie_Germain

- **Born 11,791 HE: MICHAEL FARADAY,**¹¹¹ British experimenter who solved the mystery of the unification of electricity and magnetism and showed how the Sun told the planets how to move without touching them.¹¹²
- **Born 11,831 HE: JAMES CLERK MAXWELL,**¹¹³ Scottish scientist & physics mathematician who among so much else predicted the existence of radio waves, and whose research into electromagnetic radiation (based on MICHAEL FARADAY's observations) led to the development of television, mobile phones, radio, color photography, and infra-red telescopes. MAXWELL concluded that the Rings of Saturn were made of numerous small particles. ALBERT EINSTEIN acknowledged

¹¹¹ BRIAN COX, BBC show The Science of Dr. Who

¹¹² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

¹¹³ Professor BRIAN COX, BBC show: The Science of Dr. Who

that the origins of *The Special Theory of Relativity* lay in JAMES CLERK MAXWELL'S theories, saying “The work of JAMES CLERK MAXWELL changed the world forever”.¹¹⁴

- **Circa 11,859 HE – Now: MODERN SCIENTIFIC ERA**
- So, into Chapter Two we launch!

¹¹⁴ http://www.bbc.co.uk/history/people/james_clerk_maxwell

Chapter Two Before the Holocene Era: The Big Bang to the Stone Age

Circa 13,700,000,000 BHE: The universe began.^{115 116 117 118}

Circa 13,400,000,000 BHE: The universe cooled to the point where the plasma became transparent to light. The cooling plasma formed the

¹¹⁵ NASA WMAP (Wilkinson Microwave Anisotropy Probe) SCIENCE TEAM

¹¹⁶ ALAN GUTH, The Inflationary Universe: The Quest for a New Theory of Cosmic Origins

¹¹⁷ SEAN CARROLL, *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself* and Royal Institution YouTube videos

¹¹⁸ MAX TEGMARK, *Our Mathematical Universe* and Royal Institution YouTube videos

Star-stuff element Hydrogen from protons and electrons.¹¹⁹ Star-stuff elements Helium and Lithium were also formed.^{120 121}

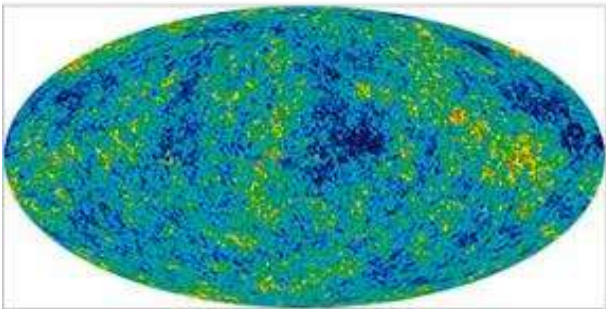
- ⇒ The amount of time from the previous entry to this entry is circa 300,000 years which is approximately 25 times longer than the entire Holocene Era.
- ⇒ The Cosmic Microwave Background (CMB) is the remnant of the big bang's energy and is direct evidence of the Big Bang.¹²²

¹¹⁹ LAWRENCE M. KRAUSE *A Universe from Nothing*, page 43

¹²⁰ https://en.wikipedia.org/wiki/Big_Bang_nucleosynthesis

¹²¹ https://en.wikipedia.org/wiki/Chemical_element

¹²² LAWRENCE M. KRAUSE *A Universe from Nothing*, page 42



Nine Year Microwave Sky Survey of the CMB.¹²³

⇒ CARL SAGAN said: “We are made of Star Stuff” in his TV series ***Cosmos: A Personal Voyage***¹²⁴. Throughout the Holocene Era Timeline, the term “Star Stuff” is inserted by Author / Compiler to reflect CARL SAGAN’s comment. We are made of what is in our

¹²³ <https://map.gsfc.nasa.gov/media/121238/index.html>

¹²⁴ https://en.wikipedia.org/wiki/Carl_Sagan

universe and the universe is made of us. Many elements are further described with the scientist and at the HE time each was isolated.

Circa 13,300,000,000 BHE: Large volumes of matter are coaxed by gravity into forming trillions of stars in billions of galaxies. The first stars, called Population III stars, start the process of turning the light “Star Stuff” element Hydrogen into the heavier “Star Stuff” elements. Population II stars are formed early on in this process and continue today. Population I stars formed later and continue today.¹²⁵

⇒ Partial **12,018 HE** updated lyrics from the **11,982 HE** Monty Python “GALAXY SONG” sung by Eric Idle (which he says was accurate at the time – but of course science has moved forward, and more accurate information exists in **12,018 HE**): “Our galaxy itself contains 300 billion stars, It’s 100,000 light years side to side. It bulges in the middle 16,000 light years thick, but out by us it’s just

¹²⁵ https://en.wikipedia.org/wiki/Chronology_of_the_universe

3 thousand light years wide. We're 30,000 light years from galactic central point; We go round every 200 million years; And our galaxy is only one of millions and billions, in this amazing and expanding Universe."¹²⁶

Circa 13,200,000,000 BHE: The Milky Way Galaxy formed.¹²⁷

¹²⁶ Eric Idle song updated with help from Professor BRIAN COX <http://www.comedy-songs.com/news.php?ID=38>

¹²⁷ https://en.wikipedia.org/wiki/Milky_Way



Artist's concept of the Milky Way Galaxy, Credit JPL.¹²⁸

Circa 13,200,000,000 BHE: Many Population III stars have lived their lifetimes, resulting in Hypernova stellar explosions which are energetic enough to form heavier “Star Stuff” elements: Beryllium, Boron, Carbon, Nitrogen, Oxygen, Fluorine, Neon, Sodium, Magnesium, Aluminum, Silicon, Phosphorus, Sulphur, Chlorine,

¹²⁸ https://www.nasa.gov/mission_pages/GLAST/science/milky_way_galaxy.html

Argon, Potassium, Calcium, Scandium, Titanium, Vanadium, Chromium, Manganese, and Iron.^{129 130 131}

⇒ Second and third generation super novae produce heavier elements beyond iron because very massive stars live fast and die young in cataclysmic supernova explosions. In our galaxy, such stars go supernova about once a century. These explosions are far hotter than the core of our sun, hot enough to transform elements like Iron into all the heavier ones and spew them into space.¹³² These next heavier “Star Stuff” elements are: Cobalt, Nickel, Copper, Zinc, Gallium, Germanium, Arsenic, Selenium, Bromine, Krypton, Rubidium, Strontium, Yttrium, Zirconium, Niobium, Molybdenum, Technetium, Ruthenium (atomic number 44, author really likes this

¹²⁹ https://en.wikipedia.org/wiki/Chemical_element

¹³⁰ https://en.wikipedia.org/wiki/Stellar_nucleosynthesis

¹³¹ https://en.wikipedia.org/wiki/B2FH_paper

¹³² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

element one because it relates my name to science), Rhodium, Palladium, Silver, Cadmium, Indium, Tin, Antimony, Tellurium, Iodine, Xenon, Cerium, Praseodymium, Neodymium, Promethium, Samarium, Europium, Gadolinium, Terbium, Dysprosium, Holmium, Erbium, Thulium, Ytterbium, Lutetium, Hafnium, Tantalum, Tungsten, Rhenium, Osmium, Iridium, Platinum, Gold, Mercury, Thallium, Lead, Bismuth, Polonium, Astatine, Radon, Francium, Actinium, Thorium, Protactinium, Uranium, through Element with atomic number 93, Neptunium.^{133 134 135 136}

⇒ *The B2FH Paper* (See **11,957 HE**¹³⁷) comprehensively outlined and analyzed several key processes that are responsible for the

¹³³ https://en.wikipedia.org/wiki/Stellar_nucleosynthesis

¹³⁴ https://en.wikipedia.org/wiki/Periodic_table

¹³⁵ https://en.wikipedia.org/wiki/B2FH_paper

¹³⁶ VERITAS IUM DEREK MULLER <https://www.youtube.com/watch?v=EAYk2OsKvtU>

¹³⁷ https://en.wikipedia.org/wiki/B2FH_paper

nucleosynthesis of the elements heavier than iron and their relative abundance by the capture within stars of free neutrons.^{138 139 140 141}

Circa 4,600,000,000 BHE: Our sun was formed from the elements and material expelled by second and third generations of exploding stars.^{142 143} Despite the lore from Superman comics, our sun is not a yellow sun, it is a white sun.¹⁴⁴

¹³⁸ https://en.wikipedia.org/wiki/Stellar_nucleosynthesis

¹³⁹ https://en.wikipedia.org/wiki/Periodic_table

¹⁴⁰ https://en.wikipedia.org/wiki/B2FH_paper

¹⁴¹ VERITAS IUM DEREK MULLER <https://www.youtube.com/watch?v=EAYk2OsKvtU>

¹⁴² "Sun Fact Sheet". NASA Goddard Space Flight Center.

¹⁴³ Bonanno, A.; Schlattl, H.; Paternò, L. (2008). "The age of the Sun and the relativistic corrections in the EOS". *Astronomy and Astrophysics*. 390(3): 1115–1118. arXiv:astro-ph/0204331. Bibcode:2002A&A...390.1115B.doi:10.1051/0004-6361:20020749.

¹⁴⁴ Neil deGrasse Tyson explains 10 Things You have Heard and Re-told



Photo of our white sun.¹⁴⁵

Circa 4,550,000,000 BHE Gravity congeals the stellar cloud of star stuff elements from which our sun was formed into the beginnings of our solar system, including planet Earth.^{146 147 148}

¹⁴⁵ Photo taken by Paul Premack, in the Southern Caribbean

¹⁴⁶ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

¹⁴⁷ JULI PERETO <http://www.im.microbios.org/0801/0801023.pdf>

¹⁴⁸ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

⇒ More updated lyrics from Monty Python's "THE GALAXY SONG": "Just remember that you're standing on a planet that's evolving and revolving at 900 miles an hour. That's orbiting at 19 miles a second, so it's reckoned, A sun that is the source of so much power. The sun and you and me and all the stars that we can see, are moving at six million miles a day in an outer spiral arm, 200,000 miles an hour, Of the galaxy we call the Milky Way."¹⁴⁹

Circa 4,100,000,000 BHE to 3,700,000,000 BHE: Abiogenesis: the first basic life forms evolved on Earth.^{150 151}

¹⁴⁹ Eric Idle song updated with help from Professor BRIAN COX <http://www.comedy-songs.com/news.php?ID=38>

¹⁵⁰ JULI PERETO <http://www.im.microbios.org/0801/0801023.pdf>

¹⁵¹ <https://en.wikipedia.org/wiki/Abiogenesis>

Circa 3,000,000,000 BHE: It was at this point that blue-green algae started to develop on Earth. Photosynthesis is the process by which plants use light to produce complex carbohydrates and release oxygen as a waste product. These changes in oxygen levels triggered the move toward biodiversity on Earth.¹⁵²

Circa 3,000,000,000 BHE to Circa 2,000,000,000 BHE: Most of the extra oxygen produced went into the oxidation of iron.¹⁵³ The Earth rusted.¹⁵⁴

¹⁵² PAUL PARSONS & GAIL DIXON, *The Periodic Table*

¹⁵³ PAUL PARSONS & GAIL DIXON, *The Periodic Table*

¹⁵⁴ Paul Premack

Circa 500,000,000 BHE: As land plants began to grow on Earth, atmospheric oxygen reached the level of around 21%, where it has remained ever since.¹⁵⁵

Circa 450,000,000 BHE: The beginning of Amphibia.¹⁵⁶ This means the beginning of amphibian life on Earth started circa 3 billion 650 million years after the first basic life forms began evolving on Earth.

Circa 300,000,000 BHE: The land-based egg.¹⁵⁷

Circa 300,000,000 BHE: The beginning of reptiles.¹⁵⁸

¹⁵⁵ PAUL PARSONS & GAIL DIXON, *The Periodic Table*

¹⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of the World

Circa 300,000,000 BHE: The beginning of dinosaurs.¹⁵⁹

Circa 220,000,000 BHE: The beginning of placental mammals.¹⁶⁰

Circa 100,000,000 BHE: The beginning of primates.¹⁶¹

Circa 100,000,000 BHE: Plants covered the surface of the earth for 100's of millions of years before they grew their first flower--- just before the extinctions of the dinosaurs.¹⁶²

Circa 65,000,000 BHE: The end of large land dinosaurs.¹⁶³

¹⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁶² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

¹⁶³ ISAAC ASIMOV: ASIMOV'S Chronology of the World

Circa 40,000,000 BHE: The beginning of monkeys.¹⁶⁴

Circa 30,000,000 BHE: The beginning of apes.¹⁶⁵

Circa 5,000,000 BHE: The beginning of hominids, the fossil ancestor of humans.¹⁶⁶ Wait about 4.7 million years for humans (See **circa 300,000 BHE**).

Circa 3,980,000 BHE: Bipedal species emerged, *Australopithecines* Genus *Homo*.¹⁶⁷

¹⁶⁴ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁶⁵ ISAAC ASIMOV: ASIMOV'S Chronology of the World

¹⁶⁶ https://en.wikipedia.org/wiki/Human_evolution#First_fossils

¹⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Australopithecus Africanus reconstruction, San Diego Museum of Man, photographer unknown.¹⁶⁸

- Author / Compiler note: Science has determined it took individuals in those bipedal species circa 580,000 years to start making tools and to launch the Stone Age.

¹⁶⁸ https://en.wikipedia.org/wiki/San_Diego_Museum_of_Man

Circa 3,400,000 BHE: During **12,010 HE**, fossilized animal bones bearing marks from stone tools were found in the Lower Awash Valley in Ethiopia. Discovered by an international team led by SHANNON MCPHERRON.¹⁶⁹

Circa 3,300,000 BHE: Kenya: Archaeological discoveries in Kenya in **12,015 HE**, identifying possibly evidence of hominin use of tools, have indicated that Kenyanthropus platyops (an early hominin species) were the earliest known tool users¹⁷⁰.

¹⁶⁹ https://en.wikipedia.org/wiki/History_of_Ethiopia#Prehistory

¹⁷⁰ <https://en.wikipedia.org/wiki/Kenyanthropus>



Pliocene Kenyanthropus platyops skull, photographer and location unknown¹⁷¹

⇒ The oldest known stone tools have been excavated from the site of Lomekwi 3 in West Turkana, northwestern Kenya, and date to 3.3 million years old.¹⁷²

¹⁷¹ <https://en.wikipedia.org/wiki/Kenyanthropus>

¹⁷² <http://www.nature.com/nature/journal/v521/n7552/full/nature14464.html>



The oldest known stone tools.¹⁷³

¹⁷³ <http://www.nature.com/nature/journal/v521/n7552/full/nature14464.html>

Circa 3,200,000 BHE: Ethiopia, “Lucy,” Bipedal walking.¹⁷⁴



Lucy skeleton reconstruction at the Cleveland Museum of Natural History.¹⁷⁵

¹⁷⁴ [https://en.wikipedia.org/wiki/Lucy_\(Australopithecus\)](https://en.wikipedia.org/wiki/Lucy_(Australopithecus))

¹⁷⁵ [https://en.wikipedia.org/wiki/Lucy_\(Australopithecus\)](https://en.wikipedia.org/wiki/Lucy_(Australopithecus))

⇒ Discovered by DONALD JOHANSON, MAURICE TAIEB, YVES COPPENS AND TOM GRAY.¹⁷⁶

Circa 2,900,000 BHE to 2,700,000 BHE: Ethiopia: the species who made the Pliocene tools remains unknown. Fragments of *Australopithecus garhi*, *Australopithecus aethiopicus* and *Homo*, possibly *Homo habilis* have been found in sites near the age of the Gona tools. Stone tools had been found several sites at Gona, Ethiopia, on the sediments of the paleo-Awash River, which serve to date them. All the tools come from the Busidama Formation, which lies above a disconformity, or missing layer, which would have been from 2.9 to 2.7 million years ago.¹⁷⁷

¹⁷⁶ [https://en.wikipedia.org/wiki/Lucy_\(Australopithecus\)](https://en.wikipedia.org/wiki/Lucy_(Australopithecus))

¹⁷⁷ https://en.wikipedia.org/wiki/Stone_Age



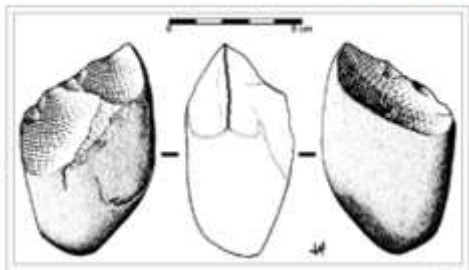
Gona tools, photographer and location unknown.¹⁷⁸



Oldowan tradition chopper, photographer and location unknown.¹⁷⁹

¹⁷⁹ <https://en.wikipedia.org/wiki/Oldowan>

Mode I: The Oldowan Industry



A typical Oldowan simple chopping tool. This example is from the Duero Valley, Valladolid, artist unknown.¹⁸⁰

Circa 2,600,000 BHE: The old sites containing tools are dated to 2.6–2.55 million years ago. One of the most striking circumstances about these sites is that they are from the Late Pliocene, where previous to their

¹⁸⁰ <https://en.wikipedia.org/wiki/Oldowan>

discovery tools were thought to have evolved only in the Pleistocene. ROGERS and SEMAW, excavators at the locality, point out that: "...the earliest stone tool makers were skilled flintknappers The possible reasons behind this seeming abrupt transition from the absence of stone tools to the presence thereof include ... gaps in the geological record."¹⁸¹

¹⁸¹ https://en.wikipedia.org/wiki/Stone_Age



Obsidian projectile point, photographer and location unknown.¹⁸²

Circa 2,580,000 BHE: *Homo erectus*; *Homo erectus* may be divided into:

⇒ *Homo erectus sensu stricto*, African origins¹⁸³ and *Homo erectus sensu lato*, Asian origins.¹⁸⁴

¹⁸² <https://en.wikipedia.org/wiki/Oldowan>

¹⁸³ https://en.wikipedia.org/wiki/Homo_erectus

¹⁸⁴ https://en.wikipedia.org/wiki/Homo_erectus



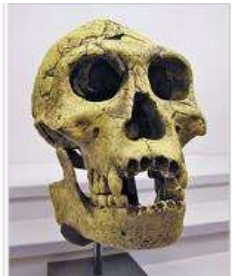
Reconstruction of a *Homo erectus* specimen from Tautavel, France, photographer unknown.¹⁸⁵

¹⁸⁵ https://en.wikipedia.org/wiki/Homo_erectus



Skull of *Homo erectus*, Indian Museum, photographer unknown.¹⁸⁶

¹⁸⁶ https://en.wikipedia.org/wiki/Homo_erectus

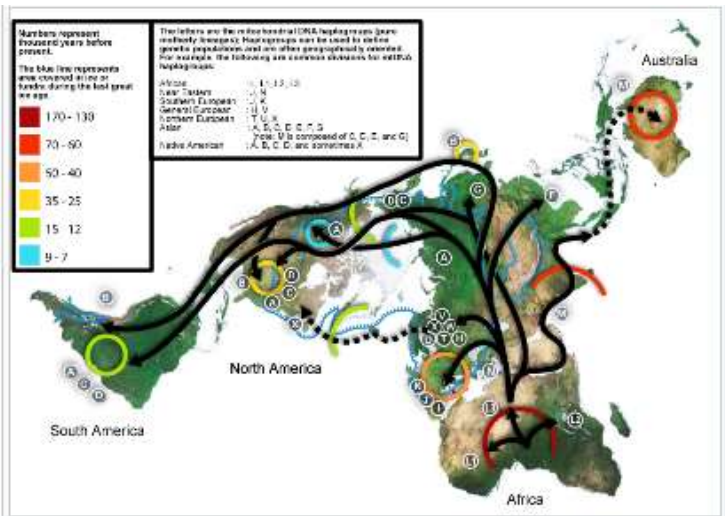


Dmanisi skull 3, Fossils skull D2700 and D2735 jaw, two of several found in Dmanisi in the Georgian Caucasus, photographer and location unknown.¹⁸⁷

Circa 1,989,999 BHE: Early migrations and expansions across continents began with the migration out of Africa of *Homo erectus*.¹⁸⁸

¹⁸⁷ https://en.wikipedia.org/wiki/Homo_erectus

¹⁸⁸ https://en.wikipedia.org/wiki/Early_human_migrations



Map of POSSIBLE early human migrations, according to

mitochondrial population genetics. Numbers are millennia before the present.¹⁸⁹

Circa 1,000,000 BHE: End of *Australopithecines*.¹⁹⁰

Circa 498,999 BHE: Primates first tamed and used fire.¹⁹¹

Circa 300,000 BHE: At Jebel Irhoud, a site near Marrakesh that was first discovered by barite miners in the **11,960s HE**, holds fossils which are the earliest known remains of *Homo Sapiens*. These fossils suggest our species may have emerged more than 100,000 years earlier than previously thought.¹⁹²

¹⁸⁹ <https://en.wikipedia.org/wiki/Prehistory>

¹⁹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁹² <https://www.history.com/news/how-homo-sapiens-fossils-found-in-morocco-may-rewrite-the-human-story>



12,017 HE: DR. JEAN-JACQUES HUBLIN seeing the finds at Jebel Irhoud (Morocco), is pointing to the human skull (Irhoud 10) whose orbits are visible just beyond his finger tip. (Credit: SHANNON MCPHERRON, MPI EVA Leipzig, License: CC-BY-SA 2.0).¹⁹³

¹⁹³ <https://www.history.com/news/how-homo-sapiens-fossils-found-in-morocco-may-rewrite-the-human-story>

Circa 200,000 BHE – Circa 144,000 BHE: Africa, time of “mitochondrial Eve” and “Y-chromosomal Adam” *homo sapiens* in Africa.¹⁹⁴

Circa 189,999 BHE: Homo Sapiens Neanderthalensis emerged in Europe.¹⁹⁵

Circa 183,000 BHE: Ethiopia: Rare *homo sapiens* fossils, from Kibish, Ethiopia.¹⁹⁶

¹⁹⁴ https://en.wikipedia.org/wiki/Mitochondrial_Eve

¹⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁹⁶ <https://www.sciencedaily.com/releases/2005/02/050223122209.htm>



The bones of an early member of our species *Homo Sapiens*, known as “Omo 1” were excavated from Ethiopia’s Kibish rock formation, photographer and location unknown.¹⁹⁷

¹⁹⁷ <https://www.sciencedaily.com/releases/2005/02/050223122209.htm>

⇒ Pushing the emergence of *Homo Sapiens* from about 160,000 years ago back to about 300,000 years ago “is significant because the cultural aspects of humanity in most cases appear much later in the record – only 50,000 years ago. Which would mean [many thousands of] years of *Homo Sapiens* without evidence of cultural stuff, such as evidence of eating fish, of harpoons, anything to do with music (flutes and that sort of thing), needles, even tools. This stuff – evidence- all comes in very late, except for stone knife blades, which appeared between 50,000 and 200,000 years ago.”¹⁹⁸

¹⁹⁸ <https://www.sciencedaily.com/releases/2005/02/050223122209.htm>



A selection of prehistoric stone tools, photographer and location unknown.¹⁹⁹

¹⁹⁹ https://en.wikipedia.org/wiki/Stone_tool

Circa 170,000 BHE: *Homo Sapiens* first start to wear clothing.²⁰⁰

Circa 119,999 BHE: The island of Crete is an early center of development.²⁰¹



Stone tools indicating ocean exploration capabilities of early humans. Photographer and location unknown.²⁰²

²⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of the World

²⁰¹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

²⁰² <http://www.nytimes.com/2010/02/16/science/16archo.html>

Circa 100,000 BHE: India: The Bhimbetka rock shelters are an archaeological site of the Paleolithic exhibiting the earliest traces of human life on the Indian sub-continent.²⁰³



Current entrance to the Bhimbetka rock shelters, photographer unknown.²⁰⁴

²⁰³ https://en.wikipedia.org/wiki/Bhimbetka_rock_shelters

²⁰⁴ https://en.wikipedia.org/wiki/Bhimbetka_rock_shelters

Circa 100,000 BHE – circa 77,000 BHE, to circa 61,000 BHE: South Africa: Blombos Cave is an archaeological site located in Blombosfontein Nature Reserve, about 300 km east of Cape Town on the Southern Cape coastline, South Africa.²⁰⁵



Bifacial silcrete point from M1 phase (**61,000 BHE**) layer of Blombos Cave, South Africa.²⁰⁶

²⁰⁵ https://en.wikipedia.org/wiki/Blombos_Cave

²⁰⁶ https://en.wikipedia.org/wiki/Blombos_Cave



● Tool from Toolkits at Blombos Cave, photographer and location unknown.²⁰⁷

²⁰⁷ https://en.wikipedia.org/wiki/Blombos_Cave



- Engraved ochre Tool from Toolkits at Blombos Cave, photographer and location unknown.²⁰⁸

²⁰⁸ https://en.wikipedia.org/wiki/Blombos_Cave



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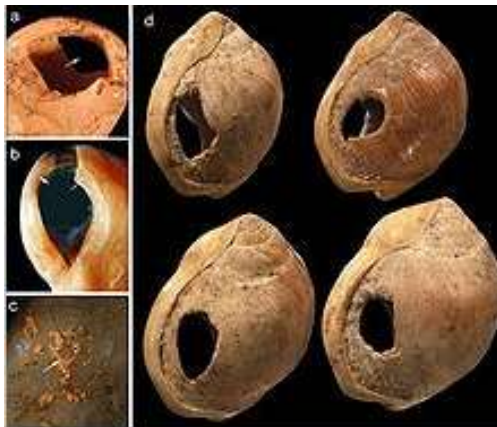
Tool from Toolkits at Blombos Cave, photographer and location unknown.²⁰⁹

²⁰⁹ https://en.wikipedia.org/wiki/Blombos_Cave



- Snail Shells Tool from Toolkits at Blombos Cave, photographer and location unknown.²¹⁰

²¹⁰ https://en.wikipedia.org/wiki/Blombos_Cave



● Blombos Cave shell beads, photographer and location unknown.²¹¹

²¹¹ https://en.wikipedia.org/wiki/Blombos_Cave

⇒ **Circa 78,000 BHE:** Besides Blombos Cave, there are a number of African and Middle Eastern sites that all have yielded strong evidence for the early use of personal ornaments: Skul and Qafzeh, Israel;²¹² Oued Djebbana, Algeria; ²¹³ Grotte des Pigeons, Rhafas, Ifri n'Amman and Contrebandiers, Morocco.^{214 215}

²¹² BAR-YOSEF MAYER, DANIELLA E. VANDERMEERSCH, BERNARD AND BAR-YOSEF, OFER (12,009HE) *Shells and ochre in Middle Paleolithic Skhul and Qafzeh, Israel: indications for modern behavior.* Journal of Human Evolution; VANHAEREN, MARIAN, et al. (12,006HE) Middle Paleolithic Shell Beads in Israel and Algeria. Science

²¹³ VANHAEREN, MARIAN, et al. (12,006 HE) Middle Paleolithic Shell Beads in Israel and Algeria. Science

²¹⁴ BOUZOUGGAR, A., et al. (12,007 HE) 82,000-year-old shell beads from North Africa and implications for the origins of modern human behavior. Proceedings of the National Academy of Sciences of the United States of America, 104, 9964-9. d'ERRICO, FRANCESCO, et al. (12,009 HE) *Out of Africa: modern human origins special feature: additional evidence on the use of personal ornaments in the Middle Paleolithic of North Africa. Proceedings of the National Academy of Sciences of the United States of America.*

²¹⁵ https://en.wikipedia.org/wiki/Blombos_Cave

Circa 82,000 BHE: Prehistoric religions emerge. Prehistoric humans explained natural phenomena by attributing causation to active agents, which they treated as their “gods”.²¹⁶ However, their curiosity and desire to seek explanations eventually will lead to scientific inquiry and illustrates the need to continue to move beyond superstition.

Circa 78,000 BHE, France: The location where current day scientist BRUCE HARDY and his colleagues have found slender 0.7-millimeter-long plant fibers that are twisted together near some stone artefacts at a site in south-east France that was occupied by Neanderthals 90,000 years ago. Such fibers are not twisted together in nature, says the team, suggesting that the Neanderthals were responsible.²¹⁷

²¹⁶ https://en.wikipedia.org/wiki/Prehistoric_religion

²¹⁷ Quaternary Science Reviews, doi.org/pzx

Circa 72,000 BHE: Morocco, Taforalt in Morocco; small perforated seashell beads are evidence of personal adornment found anywhere in the world.²¹⁸



The Bead Evidence: The shells belong to the species *N. gibbosulus*

²¹⁸ <http://www.pnas.org/content/104/24/9964.long>

living today only in the eastern Mediterranean. The few known Pleistocene specimens are bigger than the modern representatives and show a thicker parietal shield size distribution of the Taforalt specimens is significantly different ($P < 0.0001$) from that of a modern biocoenosis, photographer and location unknown.²¹⁹

Circa 50,000 BHE: Outdated beginning of “modern humans.”²²⁰ (See **Circa 300,000 BHE** for current evidence.)

Circa 39,999 BHE: Sydney, Australia - Aboriginal stone tools.²²¹

²¹⁹ <http://www.pnas.org/content/104/24/9964.long>

²²⁰ ISAAC ASIMOV: ASIMOV'S Chronology of the World

²²¹ <https://strathbogierangesnaturereview.files.wordpress.com>



Possible examples of these Aboriginal tools, photographer and location unknown.²²²

²²² <https://strathbogierangesnaturereview.files.wordpress.com/2012/07/dscf0534.jpg>

Circa 39,000 BHE: “Counting” in prehistory was first assisted by using body parts, primarily fingers; roughly coinciding with the appearance of behavioral modernity and before the development of agriculture.²²³

Circa 39,000 BHE: In hunter-gatherer, pre-agricultural times, the human life expectancy was about 20-30 years.²²⁴ (Note: the next major increase in human life expectancy is not for another circa 50,870 years – until **11,870 HE** when science and medical advancements started to benefit people and helped average age expectancy reach about 40 years.)²²⁵

Circa 35,000 BHE: Cro-Magnon colonization of Europe.²²⁶

²²³ https://en.wikipedia.org/wiki/History_of_ancient_numeral_systems

²²⁴ CARL SAGAN, *The Demon-Haunted World; Science as a Candle in the Dark* p.10

²²⁵ CARL SAGAN, *The Demon-Haunted World; Science as a Candle in the Dark* p.10

²²⁶ <https://en.wikipedia.org/wiki/Cro-Magnon>



The "Old man of Cro-Magnon", Musée de l'Homme, Paris.²²⁷



Tool from Cro-Magnon – Louis Lartet Collection.²²⁸

²²⁷ <https://en.wikipedia.org/wiki/Cro-Magnon>

²²⁸ <https://en.wikipedia.org/wiki/Cro-Magnon>

Circa 33,000 BHE: The finds in the Grotta del Cavallo, Apulia, Italy, and Kents Cavern, Devon, have been confirmed as some of the earliest known remains of *Homo Sapiens* in Europe.²²⁹

Circa 33,000 BHE: Europe's Neanderthals may have begun making a relatively sophisticated bone tool called a "lisseur", possibly to prepare animal skins, it is similar to those produced by our species.²³⁰



Four views of the most complete lisseur found during excavations at

²²⁹ <http://www.bbc.com/news/science-environment-15540464>

²³⁰ <https://www.theguardian.com/science/2013/aug/12/neanderthals-invented-tool-leather-lisseur>

the Neanderthal site of Abri Peyrony in France, artist and photographer unknown.^{231 232}

Circa 33,000 BHE: Western Australia, Carpenters Gap Rock Shelter.²³³



Ground edge tiny hard stone Axe Flake, photographer and location unknown.²³⁴

²³¹ Photograph: Abri Peyrony/Pech-de-l'Azé I Projects

²³² <https://www.theguardian.com/science/2013/aug/12/neanderthals-invented-tool-leather-lissoir>

²³³ <http://www.abc.net.au/news/2016-05-11/world's-oldest-known-ground-edge-stone-axe-fragments-found/7401728>

²³⁴ <http://www.abc.net.au/news/2016-05-11/world's-oldest-known-ground-edge-stone-axe-fragments-found/7401728>

Circa 32,000 BHE: Germany, Paleolithic flute.²³⁵



Aurignacian flute made from animal bone, Geissenklösterle (Swabia).²³⁶

Circa 31,000 BHE: Altai Mountains, Siberia: Denisova hominin lived.
Denisova hominins or Denisovans are Paleolithic members of the

<https://www.bing.com/images/search?q=susan+o%27connor+axe+flake&view=detailv2&&id=A55A98EABB84E3489B132BA55C2A870D9E9CEDA5&selectedIndex=3&ccid=e4hyO58%2b&simid=608026744578574860&thid=OIP.M7b88723b9f3e6e1ce05f0fbfae4dc11do0&ajaxhist=0>

²³⁵ https://en.wikipedia.org/wiki/Paleolithic_flutes

²³⁶ https://en.wikipedia.org/wiki/Paleolithic_flutes

Homo genus that may belong to a previously unknown species of human. The Denisovans occupied a vast realm stretching from the chill expanse of Siberia to the steamy tropical forests of Indonesia - suggesting the third human of the Pleistocene displayed a level of adaptability previously thought to be unique to modern humans.²³⁷



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²³⁷ http://www.bradshawfoundation.com/origins/denisova_hominin.php

²³⁸ http://www.bradshawfoundation.com/origins/denisova_hominin.php

Circa 30,000 BHE: Spain, Altamira Cave, El Castillo,²³⁹



Altamira Cave, Oldest known cave paintings, photographer unknown.²⁴⁰

²³⁹ <http://whc.unesco.org/en/list/310>

²⁴⁰ <http://whc.unesco.org/en/list/310>

Circa 30,000 BHE – 20,000 BHE: Australia: First human settlement of Aboriginal Australians in the areas which are now known as Sydney, Perth, and Melbourne.²⁴¹



Bradshaw rock paintings found in the north-west Kimberly Region of Western Australia.²⁴²

²⁴¹ <http://www.australiaforeveryone.com.au/wa/bradshaw-art.htm>

²⁴² <http://www.australiaforeveryone.com.au/wa/bradshaw-art.htm>

Circa 29,999 BHE – Circa 1 HE: Australia: Kakadu National Park is a protected area in the Northern Territory of Australia, 171 km southeast of Darwin. The site was added to the Australian National Heritage List in **12,007 HE**. There are more than 5,000 recorded art sites illustrating Ubirr Aboriginal culture over thousands of years. The archaeological sites demonstrate Aboriginal occupation for at least 20,000 and possibly up to 40,000 years.²⁴³

²⁴³ https://en.wikipedia.org/wiki/Kakadu_National_Park



The Ubirr Aboriginal rock art site, photographer unknown.²⁴⁴

²⁴⁴ https://en.wikipedia.org/wiki/Kakadu_National_Park



Rock art painting at Ubirr, photographer unknown.²⁴⁵

²⁴⁵ https://en.wikipedia.org/wiki/Kakadu_National_Park

Circa 29,999 BHE – Current times HE: Africa, San People inhabit the Kalahari Desert.²⁴⁶



Rock paintings in the Cederberg, Western Cape, photographer unknown.²⁴⁷

²⁴⁶ https://en.wikipedia.org/wiki/San_people

²⁴⁷ https://en.wikipedia.org/wiki/San_people



San paintings near Murewa, Zimbabwe, photographer unknown.²⁴⁸

²⁴⁸ https://en.wikipedia.org/wiki/San_people



San paintings near Murewa, photographer unknown.²⁴⁹

²⁴⁹ https://en.wikipedia.org/wiki/San_people

Circa 29,000 BHE: Remains of humans found to have lived in Australia; named Mungo Man, Mungo Lady; oldest known ritual cremation, the Mungo Lady, in Lake Mungo, Australia.²⁵⁰



Image of bones of Mungo Man, photographer unknown.²⁵¹

²⁵⁰ https://upload.wikimedia.org/wikipedia/commons/f/fc/Mungo_Man.jpg

²⁵¹ https://upload.wikimedia.org/wikipedia/commons/f/fc/Mungo_Man.jpg



Image of Mungo Lake where remains of Mungo Man and Mungo Lady were discovered.²⁵² Photographer unknown.

Circa 28,000 BHE: New Guinea: some of the first farmers came to New Guinea from the South-East Asian Peninsula.²⁵³

²⁵² <http://www.donsmaps.com/images17/mungophotob.jpg>

²⁵³ https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

Circa 28,000 BHE – 23,000 BHE: Germany: oldest known figurative art; the artifact currently is displayed in the Ulm Museum, Germany.²⁵⁴



⇒ *Löwenmensch*, a lion-headed figurine found in Germany, dating to circa 35,000 to 40,000 years ago, photographer unknown.²⁵⁵

²⁵⁴ <https://en.wikipedia.org/wiki/Lion-man>

²⁵⁵ http://www.loewenmensch.de/lion_man.html

Circa 24,999 BHE: discovered in the Lebombo Mountains located between South Africa and Swaziland, *The Lebombo bone*: is the oldest mathematical fossil. It has tally marks, counting aids other than body parts, in the form of notched bone.²⁵⁶

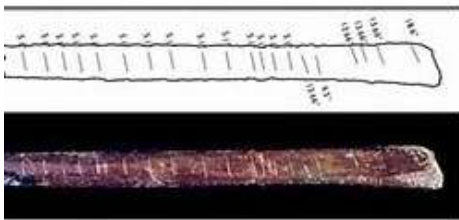


Image and drawing of *Lebombo Bone*; artist, photographer, location unknown.²⁵⁷

²⁵⁶ <http://www.math.buffalo.edu/mad/Ancient-Africa/lebombo.html>

²⁵⁷ <https://trueddotorg.files.wordpress.com/2014/04/lebombo.png>

Circa 24,999 BHE: It is thought that human beings developed language circa **24,999 HE** as evidenced by cave paintings from the period of the Cro-Magnon Man (**c. 39,999 BHE- c. 19,999 BHE**) which appear to express concepts concerning daily life. These images suggest a language because, in some instances, they seem to tell a story (say, of a hunting expedition in which specific events occurred) rather than being simply pictures of animals and people.²⁵⁸

²⁵⁸ <https://www.ancient.eu/writing/>

Circa 23,000 BHE: France: one of the oldest carved figurative art of a human figure.



Photo of *Venus of Laussel* in Musée d'Aquitaine in Bordeaux, France.²⁵⁹

²⁵⁹ https://en.wikipedia.org/wiki/Venus_of_Laussel

Circa 23,000 BHE: Hohle Fels is a cave in Schelklingen, Germany, “*Venus of Hohle Fels*” figurine of a woman hewn from the ivory of a mammoth tusk.²⁶⁰



Photo of Discovered in **12,008 HE** by a team from the University of Tübingen, led by archaeologist NICHOLAS CONARD.²⁶¹ Two

²⁶⁰ https://en.wikipedia.org/wiki/Venus_of_Hohle_Fels

²⁶¹ https://en.wikipedia.org/wiki/Hohle_Fels

views of the *Venus of Hohle Fels* 35,000-year-old figurine (height 6 cm (2.4 in)), which may have been worn as an amulet and is the one of the earliest known depiction of a human being in prehistoric art.²⁶²

Circa 23,000 BHE: France, The Chauvet-Pont-d'Arc Cave in the Ardèche department of southern France is a cave that contains some of the best-preserved figurative cave paintings in the world as well as other evidence of Upper Paleolithic life. It is located near the commune of Vallon-Pont-d'Arc on a limestone cliff above the former bed of the Ardèche River, in the Gorges de l'Ardèche.²⁶³

²⁶² https://en.wikipedia.org/wiki/Venus_of_Hohle_Fels

²⁶³ https://en.wikipedia.org/wiki/Chauvet_Cave



Closed to the public, this photo is a replica of Paintings in the Chauvet Cave.²⁶⁴

²⁶⁴ https://en.wikipedia.org/wiki/Chauvet_Cave

Circa 23,000 BHE: Japan, fragments from ground edge axes appear.^{265 266}

Circa 22,000 BHE: Republic of Georgia: twisted rope; team of archaeologists and paleo biologists discovered flax fibers that are more than 34,000 years old, which were made by early humans. The fibers were discovered during systematic excavations.²⁶⁷

²⁶⁵ Professor SUSAN O'CONNOR, from the Australian National University School of Culture, History and

Language, <http://esciencenews.com/articles/2016/05/10/archaeologists.find.worlds.oldest.axe.australia>

²⁶⁶ Jomon Era Japan: http://www.microsofttranslator.com/bv.aspx?ref=SERP&br=ro&mkt=en-US&dl=en&lp=JA_EN&a=http%3a%2f%2fjomon-japan.jp%2fkids%2fsee%2foutline%2f

²⁶⁷ <http://news.harvard.edu/gazette/story/2009/09/oldest-known-fibers-discovered/>



Clay bearing a textile imprint together with a cast.²⁶⁸



One photo from the collection on the website.²⁶⁹

⇒ “This was a critical invention for early humans. They might have used this fiber to create parts of clothing, ropes, or baskets — for

²⁶⁸ <http://news.bbc.co.uk/2/hi/science/nature/790569.stm>

²⁶⁹ <https://news.harvard.edu/gazette/story/2009/09/oldest-known-fibers-discovered/>

items that were mainly used for domestic activities,” says BAR-YOSEF. The items created with these fibers increased early humans’ chances of survival and mobility in the harsh conditions of this hilly region. The flax fibers could have been used to sew hides together for clothing and shoes, to create the warmth necessary to endure cold weather. They might have also been used to make packs for carrying essentials, which would have increased and eased mobility, offering a great advantage to a hunter-gatherer society.²⁷⁰

Circa 21,000 BHE: Siberia: domestication of dogs. A 33,000-year-old domesticated dog skull bone was found in a Siberian mountain cave in the Altai Mountains.²⁷¹

²⁷⁰ <https://news.harvard.edu/gazette/story/2009/09/oldest-known-fibers-discovered/>

²⁷¹ <https://www.sciencedaily.com/releases/2012/01/120123152528.htm>



Photo of the 33,000-year-old dog skull; Photographer: Greg Hodgins, location unknown.²⁷²



The dog skull presents some of the oldest known evidence of dog domestication and, together with an equally ancient find in a cave in Belgium, indicates that modern dogs may be descended from

²⁷² <https://www.sciencedaily.com/releases/2012/01/120123152528.htm>

multiple ancestors.^{273 274} Dogs accompanied humans while hunting and gathering,²⁷⁵ and have remained companions to humans until modern times.

Circa 20,000 BHE: Japan, Okinawa, Yamashita-cho cave, Naha city, Human Bone artifacts in a layer of ash.²⁷⁶

Circa 19,999 BHE: *Homo Sapiens* became dominant.²⁷⁷

Circa 18,000 BHE: India: Author / Compiler note: this entry is 80,000 years after the first Bhimbetka Rock Shelter BHE entry in this HE timeline because scientists have dated the rock paintings tradition

²⁷³ <https://www.sciencedaily.com/releases/2012/01/120123152528.htm>

²⁷⁴ <http://journals.plos.org/plosone/article?id=10.1371/journal.pone.0057754>

²⁷⁵ http://en.wikipedia.org/wiki/Origin_of_the_domestic_dog

²⁷⁶ https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

²⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

which began in Bhimbetka rock shelters in India to this time in the HE.²⁷⁸



Entrance of Bhimbetka, photographer and date unknown.²⁷⁹

²⁷⁸ https://en.wikipedia.org/wiki/Bhimbetka_rock_shelters

²⁷⁹ https://en.wikipedia.org/wiki/Bhimbetka_rock_shelters



More photos of The Bhimbetka rock shelter and art, photographer and date unknown.²⁸⁰

Circa 18,000 BHE: Russia, Sungir: first human burial site in Russia.²⁸¹

Circa 16,000 BHE to circa 12,000 BHE: Fired Clay; Czech Republic; or between Southern Russia and Spain.²⁸² The earliest ceramics made by humans were pottery objects (i.e. pots or vessels) or figurines made from clay, either by itself or mixed with other materials like silica,

²⁸⁰ https://en.wikipedia.org/wiki/Bhimbetka_rock_shelters

²⁸¹ https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

²⁸² <http://news.bbc.co.uk/2/hi/science/nature/790569.stm>

hardened, sintered, in fire.²⁸³ *The Venus of Dolni Vestonice* figurine and a few others from locations nearby are the oldest known ceramic articles in the world.²⁸⁴



Multiple views of the rarely displayed, ceramic Venus figurine *Dolní Věstonice*.²⁸⁵

²⁸³ <https://en.wikipedia.org/wiki/Ceramic>

²⁸⁴ https://en.wikipedia.org/wiki/Venus_of_Doln%C3%AD_V%C4%9Bstonice

²⁸⁵ https://en.wikipedia.org/wiki/Venus_of_Doln%C3%AD_V%C4%9Bstonice



When the *Venus of Dolni Vestonice* has to be moved, elaborate precautions are taken. Here is a photo of Venus arriving under armed escort at the Vienna Natural History Museum for the exhibit in the summer of **12,008 HE**. It was a very rare display of the *Venus of Dolni Vestonice*, photographer unknown.²⁸⁶

²⁸⁶ <https://www.youtube.com/watch?v=zAtmX5m12Jc>

Circa 13,000 BHE: Art, lamps.²⁸⁷

Circa 13,000 BHE: Africa: *The Ishango Bone* (discovered in the Democratic Republic of Congo) portrays what are believed to be a series of Prime numbers, and a lunar phase calendar.²⁸⁸



Ishango Bone on exhibition at the Royal Belgian Institute of Natural Sciences.²⁸⁹

²⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of the World

²⁸⁸ https://en.wikipedia.org/wiki/Ishango_bone

²⁸⁹ https://en.wikipedia.org/wiki/Ishango_bone

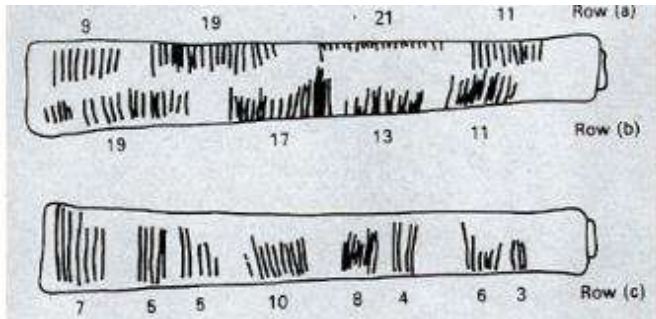


⇒ Other photos of *the Ishango Bone*, circa 12,000 years younger than *the Lebombo bone*, it is the second oldest mathematical object.²⁹⁰

⇒ Some say that *the Ishango Bone* is the oldest table of prime numbers. MARSHACK later concluded, on the basis of his

²⁹⁰ <http://www.math.buffalo.edu/mad/Ancient-Africa/ishango.html>

microscopic examination, that it represented a six-month lunar calendar or prime numbers or a menstrual calendar.²⁹¹



Recent studies with microscopes illustrate more markings and it is now understood the bone is also a lunar phase counter. Who but a

²⁹¹ <http://www.math.buffalo.edu/mad/Ancient-Africa/ishango.html>

woman keeping track of her cycles would need a lunar calendar?
Were women our first mathematicians?²⁹²

Circa 11,000 BHE - 4,000 BHE: Jerimalai cave site in East Timor.

Earliest evidence of advanced deep-sea fishing technology at the site demonstrates high-level maritime skills and, by implication, the technology needed to make ocean crossings to reach Australia and other islands, as they were catching and consuming large numbers of deep-sea fish such as tuna.²⁹³

²⁹² <http://www.math.buffalo.edu/mad/Ancient-Africa/ishango.html>

²⁹³ http://archive.archaeology.org/1203/trenches/jerimalai_cave_east_timor_fish_hooks.html



“Reeling in Evidence of Early Fishing.” SUE O’CONNOR, an archaeologist at Australian National University, coauthored a study on the finds.²⁹⁴

Circa 9,999 BHE: Modern humans had roamed the world by land. The men, women and children took advantage of access to Australia from South Eastern Asia and to North America from Northeastern Asia.

²⁹⁴ http://archive.archaeology.org/1203/trenches/jerimalai_cave_east_timor_fish_hooks.html

They found their way to Japan. They found their way to South America.²⁹⁵

Circa 8,000 BHE: Oil Lamp invented; Bow and Arrow used.²⁹⁶

Circa 8,000 BHE: Italy, Sicily: Human cranium dated by gamma-ray spectrometry.²⁹⁷

Circa 7,000 BHE: Pennsylvania, USA: evidence of colonization of North America, Meadowcroft Rockshelter.²⁹⁸

²⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 8

²⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁹⁷ https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

²⁹⁸ https://en.wikipedia.org/wiki/Meadowcroft_Rockshelter

⇒ The remarkably complete archaeological site located near the Ohio River, 27 miles west-southwest of Pittsburgh shows the earliest known evidence of human presence and the longest sequence of continuous human occupation in the New World.²⁹⁹



⇒ Outside view of Meadowcroft Rockshelter, PA, United States.³⁰⁰

²⁹⁹ https://en.wikipedia.org/wiki/Meadowcroft_Rockshelter

³⁰⁰ Donsmaps.com



Photo of Meadowcroft Rockshelter by heinzhistorycenter.org.³⁰¹

³⁰¹ https://en.wikipedia.org/wiki/Meadowcroft_Rockshelter

Circa 5,300 BHE: Lascaux, France: cave painting of the Magdalenian Culture (**Circa 4,981 BHE – Circa 1 HE**). Currently only 5 people a day / 5 days a week are allowed in the actual cave. Visitors are directed to the replica Lascaux II.³⁰²

⇒ It has been suggested that the complexity of the later cave art represents an attempt by Magdalenian man using “sympathetic magic” to cause the animals, they had hunted to almost extinction to once more become abundant.³⁰³

³⁰² <http://www.ancient-wisdom.com/francelascaux.htm>

³⁰³ <https://www.britannica.com/topic/Magdalenian-culture>



Photo of **11,940 HE** entrance to Lascaux Cave, France.³⁰⁴

³⁰⁴ <http://www.ancient-wisdom.com/francelascaux.htm>



“The Main Hall, photographer unknown.”³⁰⁵

³⁰⁵ <http://www.ancient-wisdom.com/francelascaux.htm>



“The Hall of Bulls”, photographer unknown.”³⁰⁶

³⁰⁶ <http://www.ancient-wisdom.com/francelascaux.htm>

Circa 4,981 BHE – Circa 1 HE: Magdalenian Culture in France and later Magdalenian sites have been found from Portugal in the west to Poland in the east.

⇒ The Magdalenian epoch was a long one, represented by numerous stations, whose contents show progress in the arts and general culture. It was characterized by a cold and dry climate, the existence of humans in association with the reindeer, and the extinction of the mammoth. The use of bone and ivory for various implements, already begun in the preceding Solutrean epoch, was much increased, and the period is essentially a bone period. The bone instruments are quite varied: spear-points, harpoon-heads, borers, hooks, and needles.³⁰⁷

³⁰⁷ <https://en.wikipedia.org/wiki/Magdalenian>

Circa 4,500 BHE – 9,700 HE: Japan Jōmon period Japan was inhabited by a hunter-gatherer culture, which reached a considerable degree of cultural complexity.³⁰⁸



Photo of example of *Earliest Incipient Jomon Pottery* Tokyo National Museum, Japan, photographer unknown.³⁰⁹

³⁰⁸ https://en.wikipedia.org/wiki/Jomon_period

³⁰⁹ https://en.wikipedia.org/wiki/Jomon_period

Circa 2,999 BHE: Ancient Cyprus.³¹⁰

Circa 2,000 BHE: Herding.³¹¹

Circa 500 BHE – to current: Native American Tribes.³¹²

³¹⁰ Author / Compiler's daughter Tiffany Premack introduced knowledge of Ancient Cyprus

³¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

³¹² <http://www.native-languages.org>



Per Native Tech: Map of Culture Areas and the Locations of 32 Native American Tribes: NORTHEAST: 1. Virginia Algonquian; 2. North Carolina Algonquian; 3. Delaware; 4. Pequot; 5. Eastern

Niantic; 6. Narragansett; 7. Wampanoag; 8. Eastern Abenaki; 9. Penobscott; 11. Huron; 10. Iroquois (Seneca, Mohawk, Onondoga); LAKES: 12. Fox; 13. Sauk; 14. Menomini; 15. Winnebago; 16. Kickapoo; 17. Ottawa; 18. Chippewa; SOUTHEAST: 19. Cherokee; 20. Creek; 21. Seminole; 22. Choctaw; PRAIRIE: 23. Shawnee; 24. Miami; 25. Illinois; 26. Arikara; PLAINS: 27. Arapaho; 28. Lakota; 29. Crow; 30. Blackfeet; PLATEAU: 31. Flathead; BASIN: 32. Paiute.³¹³

- ⇒ This is a list of all known Native American Tribes and languages:
- Abenaki (Abnaki, Abanaki, Abenaqui), Acatec, Achi, Achumawi (Achomawi), Acoma, Adai, Ahtna (Atna), Ais, Akimel O'odham, Alabama-Coushatta, Aleut, Alsea, Alutiiq, Algonquians (Algonkians), Algonquin (Algonkin), Alsea, Andoke, Anishinaabe (Anishinabemowin, Anishnabay), Antoniaño, Apache, Apalachee, Apalachicola, Applegate,

³¹³ Tara Prindle **11,994 HE**: <http://www.nativetech.org/clothing/regions/regions.html>

Arabela, Arapaho (Arapahoe), Arara, Arawak, Arikara, Arua, Ashaninka, Assiniboine, Atakapa, Atikamekw, Atsina, Atsugewi (Atsuke), Araucano (Araucanian), Avoyel (Avoyelles), Aymara, Aztec,

- Babine, Bannock, Bare, Bari, Baure, Beaver, Bella Bella, Bella Coola, Beothuks, Bidai, Biloxi, Black Carib, Blackfoot (Blackfeet), Blood Indians, Bora,
- Caddo (Caddoe), Cahita, Cahto, Cahuilla, Calusa (Caloosa), Carib, Carquin, Carrier, Caska, Catawba, Cathlamet, Cayuga, Cayuse, Celilo, Central Pomo, Chahta, Chalaque, Chappaquiddick (Chappaquiddic, Chappiquidic), Chatot, Chawchilla, Chehalis, Chelan, Chemehuevi, Cheraw, Cheroenhaka, Cherokee, Chetco, Cheyenne (Cheyenne), Chiaha, Chickasaw, Chilcotin, Chimariko, Chinook, Chinook Jargon, Chipewyan, Chippewa, Chitimacha (Chitamacha), Choctaw, Cholon, Chontal de Tabasco, Chukchansi, Chumash, Clackamas (Clackama), Clallam, Clatskanie, Clatsop, Cmique, Cochimi,

Cochiti, Cocopa (Cocopah), Coeur d'Alene, Cofan, Columbia (Columbian), Colville, Comanche, Comcaac, Comox, Conestoga, Coos (Coosan), Copalis, Coquille, Cora, Coree, Coso, Costanoan, Coughatta, Cowichan, Cowlitz, Cree, Creek, Croatan (Croatoan), Crow, Cuna, Cucupa (Cucapa), Cupa, Cupik (Cuit),

- Dakelh, Dakota, Dawson, Deg Xinag (Deg Hit'an), Delaware, Deline, Dena'ina, Dene, Dene Tha, Diegueno, Dine (Dineh), Dogrib, Dumna, Dunne-za,
- Eastern Inland Cree, Eastern Pomo, Eel River Athabaskan, Eeyou, Endeve, Eno, Entiat, Erie, Eskimo, Esselen, Etchemin, Euchee, Excelen, Eyak,
- Flathead Salish, Fox,
- Gabrielino, Gae, Galibi, Galice, Garifuna, Gitxsan (Gitksan), Gosiute (Goshute), Grand Ronde, Grigra, Gros Ventre, Guarani, Guarijio, Gulf, Gwich'in (Gwichin, Gwitchin),

- Haida, Haisla, Halkomelem, Hän, Hanis, Hare, Hatteras, Haudenosaunee, Havasupai, Hawaiian, Heiltsuk, Heve, Hiaki, Hichiti (Hitchiti), Hidatsa, Hocak (Ho-Chunk, Hochunk), Hoh, Holikachuk, Hoopa, Hopi, Hualapai, Huichol, Huichun, Humptulips, Hupa, Huron,
- Illini (Illiniwek, Illinois), Inca, Ingalik, Innoko, Innu, Inuktitut (Inupiat, Inupiaq, Inupiatun), Iowa-Oto (Ioway), Iroquois Confederacy, Ishak, Isleño, Isleta, Itza Maya, Iynu,
- Jaqaru, James Bay Cree, Jemez, Juaneno (Juaneño), Jumano,
- Kainai (Kainaiwa), Kalapuya (Kalapuyan), Kalina, Kallawaya, Kanien'kehaka (Kanienkehaka), Kalispel, Kansa (Kanza, Kanze), Karankawa, Karkin, Karok (Karuk), Kashaya, Kaska, Kaskaskia, Kathlamet, Kato, Kaw, Kawki, Keres (Keresan), Kickapoo (Kikapu), Kiliwa (Kiliwi), Kiowa, Kiowa Apache, Kitanemuk, Kitsai, Klallam, Klamath-Modoc, Klickitat, Koasati, Konkow, Kootenai (Ktunaxa, Kutenai), Koso, Koyukon,

- Kulanapan, Kumeyaay (Kumiai), Kuna, Kupa, KUnited Statesn,
Kuskokwim, Kutchin, Kwakiutl (Kwakwala), Kwantlen,
- Laguna, Lake Indians, Lakhota (Lakota), Lassik, Laurentian (Lawrencian), Lenape (Lenni Lenape), Lillooet, Lipan Apache, Listiguj (Listuguj), Lnu (Lnu), Lokono, Loup, Lower Umpqua, Luckiamute, Luiseño, Lumbee, Lummi, Lushootseed,
 - Mahican, Maidu, Maina (Mayna), Makah, Makushi, Maliseet (Maliceet), Mandan, Mapuche (Mapudungun), Maricopa, Mattole, Matlatzinca, Mayan, Mayo, Meherrin, Mengwe, Menominee (Menomini), Meskwaki (Mesquakie), Methow, Miami-Illinois, Mical, Miccosukee, Michif, Micmac (Mi'gmaq), Mikasuki, Mi'kmaq, Mingo, Minqua, Minsi, Minto, Miskito (Mosquito), Missouriia, Miwok (Miwuk), Mixe, Mixtec (Mixteco, Mixteca), Mobile, Mobilian Jargon, Mococo, Modoc, Mohave, Mohawk, Mohegan, Mohican, Mojave, Molale (Molalla, Molala), Monacan, Monache (Mono), Montagnais,

- Montauk, Multnomah, Munsee (Munsie, Muncey, Muncie), Muskogee (Muscogee, Mvskoke), Musqueam, Mutsun,
- Nabesna, Nahane (Nahani), Nahuat, Nahuatl, Nakoda (Nakota), Nambe, Nanaimo, Nanticoke, Nantucket, Narragansett, Naskapi, Natchez, Natchitoches, Natick, Naugutuck, Nauset, Navajo (Navaho), Nawat, Nespelem, Neutral, Nez Perce, Niantic, Nipmuc, Nisenan, Nisga'a (Nisgaa), Nlaka'pamux (Nlakapamux), Nooksack (Nooksak), Nootka (Nutka), Nottoway, Nuuchahnulth, Nuxalk,
 - Ocuilteco, Oconee, Odawa, Ofo, Ohlone, Ojibwa (Ojibway, Ojibwe, Ojibwemowin), Okanagan (Okanogan), Okmulgee, Omaha-Ponca, Oneida, Onondaga, O'odham (Oodham), Opata, Osage, Otchipwe, Otoe, Ottawa, Ozette,
 - Pai, Paipai, Paiute, Palouse, Pamlico, Panamint, Papago-Pima, Pascua Yaqui, Passamaquoddy, Patuxet, Patwin, Paugussett (Paugusset), Pawnee, Pecos, Pee Dee, Peigan, Pend D'Oreille, Pennacook, Penobscot (Pentagoet), Pensacola, Peoria, Pequot,

Petun, Picuris, Piegan (Piikani), Pima, Pima Bajo, Pipil, Piscataway, Pit River, Plains Indian Sign Language, Pojoaque, Pomo (Pomoan), Ponca, Poospatuck (Poosepatuck), Popoluca (Popoloca), Potawatomi (Pottawatomie, Potawatomie), Powhatan, Pueblo, Puquina,

- Quapaw (Quapa), Qualicum, Quechan, Quechua, Queets, Quilcene, Quileute, Quinault, Quinpiac,
- Raramuri, Red Indians, Restigouche, Rumsen, Runasimi,
- Saanich, Sac, Saliba, Salinan, Salish, Samish, Sanpoil, Santee, Santiam, Santo Domingo, Saponi, Sarcee (Sarsi), Sasta, Satsop, Savannah, Sauk, Saulteaux, Sechelt, Sekani, Seminoles, Seneca, Seri, Serrano, Shakori, Shanel, Shasta, Shawnee (Shawano), Shinnecock, Shoshone (Shoshoni), Shuar, Shuswap, Siksika, Siletz, Sinkyone, Sioux, Siuslaw, Skagit, Skin, S'Klallam, Skokomish, Slavey (Slave, Slavi), Sm'algyax, Snohomish, Sooke, Southern Paiute, Spokane (Spokan), Squamish,

Steilacoom, Stockbridge, Sto:lo, Stoney, Suquamish, Suruwaha, Susquehannock, Swampy Cree, Swinomish,

- Tachi (Tache), Tagish, Tahltan, Taino, Takelma, Takla, Tanacross, Tanaina, Tanana, Tangipahoa, Tano, Taos, Taposá, Tarahumara, Tataviam, Tehachapi, Ten'a, Tenino, Tepehuano, Tequesta, Tesuque, Tewa, Thompson, Tigua, Tillamook, Timbisha, Timucua, Tinde, Tiwa, Tiwanaku, Tjekan, Tlahuica, Tlingit, Tohome, Tohono O'odham, Tolowa, Tongva, Tonkawa, Towa, Tsalagi (Tsa-la-gi), Tsilhqot'in, Tsimshian, Tsuu T'ina, Tualatin, Tubar (Tubare), Tulalip, Tunica, Tupi, Tuscarora, Tutchone, Tutelo, Tututni, Twana, Twatwa, Tygh,
- Uchi (Uche), Ukiah (Uki, Ukia), Umatilla, Unami, Unkechaug, Uru, Ute,
- Virginia Algonquian,
- Waco, Wahkiakum, Wailaki, Walapai, Walla Walla, Wampanoag, Wanapam, Wanki, Wappinger, Wappo, Warm Springs, Wasco-Wishram, Washo (Washoe), Wateree, Waxhaw,

- Wea, Wenatchee, Wendat, Weott, Wichita (Witchita), Willapa, Winnebago, Wintu (Wintun), Wishram, Wiyot, Wyandot (Wyandotte), Wynoochee,
- Yakama (Yakima), Yamasee, Yamel, Yanesha, Yaquina, Yavapai, Yaqui, Yellowknife, Yokuts (Yokut), Yoncalla, Yucatec Maya (Yucateco, Yucatan), Yuchi, Yuki, Yuma, Yupik (Yuit), Yurok,
 - Zapotec, Zia, Zoque, Zuni.³¹⁴

³¹⁴ <http://www.native-languages.org/languages.htm>

Circa 500 BHE: Cyprus, Aetokremnos:³¹⁵ evidence of humans using fire
– burned bones of megafauna including pygmy elephants and the
Cyprus Dwarf Hippopotamus.³¹⁶

Circa 400 BHE: Columbia, El Abra: Stone, bone and charcoal artifacts.³¹⁷

³¹⁵ <https://en.wikipedia.org/wiki/Aetokremnos>

³¹⁶ Tiffany Premack, and

https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

³¹⁷ https://en.wikipedia.org/wiki/List_of_countries_and_islands_by_first_human_settlement

Chapter Three 1 HE: BEGINNING OF THE HOLOCENE ERA

“Holocene” means “entirely recent”. The Holocene Era begins about 12,000 years before now, at the end of the Stone Age.³¹⁸

EMILIANI mathematically defined 10,000 BCE as year **1 HE**, so that **1 HE** matches 10,000 BCE.

Circa 1 HE: This is also a rough approximation of the start of the current geologic epoch, the Holocene Epoch, and approximates when human civilization (the first settlements and agriculture) arose.³¹⁹

³¹⁸ ISAAC ASIMOV: ASIMOV’S Chronology of the World

³¹⁹ https://en.wikipedia.org/wiki/Holocene_calendar

Circa 1 HE: The world-wide population of humans was approximately 5 million.³²⁰

Circa 1 HE: France: The Magdalenian Culture disappeared as the cool, near-glacial climate warmed at the end of the Fourth (Würm) Glacial Period, and herd animals became scarce.³²¹

Circa 500 HE: Southeast Turkey, Göbekli Tepe (pronounced [ˈɟøbekˈli teˈpe]) is Turkish for "Potbelly Hill". This is an archaeological site in the Southeastern Anatolia Region of Turkey, approximately 12 km (7 mi) northeast of the city of Şanlıurfa.³²²

³²⁰ <https://www.worldometers.info/world-population/>

³²¹ <https://www.britannica.com/topic/Magdalenian-culture>

³²² https://en.wikipedia.org/wiki/Gobekli_Tepe



Pre-Mediterranean Neolithic Ruins of Göbekli Tepe, photographer unknown.³²³

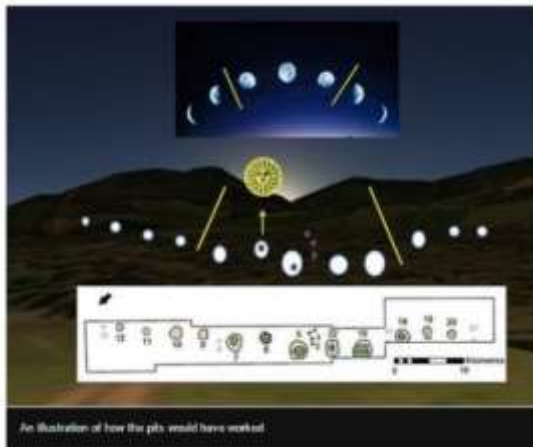
³²³ https://en.wikipedia.org/wiki/Gobekli_Tepe

Circa 1,301 HE: A copper pendant has been found in modern day Iraq that dates to **1,301 HE.**³²⁴

Circa 2,000 HE: Scotland, Warren Field, Aerial survey reveals Lunar Calendar.³²⁵

³²⁴ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

³²⁵ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>



An illustration of how the pits would have worked³²⁶

³²⁶ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>



Prof. VINCE GAFFNEY led the project to analyze the calendar pits at Warren Field.³²⁷

- ⇒ The Warren Field "calendar" is thousands of years older than previous known formal time-measuring monuments created in Mesopotamia. "The evidence suggests that hunter-gatherer societies in Scotland had both the need and sophistication to track time

³²⁷ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>

across the years, to correct for seasonal drift of the lunar year and that this occurred nearly 5,000 years before the first formal calendars known in the Near East. In doing so, this illustrates one important step towards the formal construction of time and therefore history itself" says DAVE COWLEY, RCAHMS.³²⁸

Circa 2,000 HE: Rivers are used for irrigation.³²⁹

Circa 2,000 HE: Xianren Cave, China.³³⁰

³²⁸ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>

³²⁹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

³³⁰ <http://science.sciencemag.org/content/336/6089/1696>



Xianren Cave, China, photographer and date unknown.³³¹

³³¹ https://en.wikipedia.org/wiki/Xianren_Cave



Photo of Chinese pottery storage/cooking vessel found in the Xianren cave, around 10,000 years old, photographer unknown.³³²

³³² https://en.wikipedia.org/wiki/Xianren_Cave

Circa 3,001 HE: China: The process of fermentation. The earliest archaeological evidence of the consumption of alcoholic beverages was discovered in Neolithic China dating from **3,001 HE**. Examination and analysis of ancient pottery jars from the Neolithic village of Jiahu in Henan province in northern China revealed residue left behind by the alcoholic beverages they once contained.³³³

Circa 3,001 HE – 8,501 HE: The Chinchorro preceramic culture³³⁴ inhabited what is now the Pacific coastal region of current northern Chile and southern Peru.³³⁵

³³³ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³³⁴ <https://www.youtube.com/watch?v=czgOWmtGVGs>

³³⁵ https://en.wikipedia.org/wiki/Chinchorro_culture



The funeral rite is shown as a human skull with funeral helmet and various items, collection of the Anker Nielsen museum in Iquique, Chile. The mummification practice is displayed in the Archaeology Museum of San Miguel de Azapa.³³⁶

³³⁶ https://en.wikipedia.org/wiki/Chinchorro_culture



Circa 4,951 HE Chinchorro Mummies at the museum in San Miguel de Azapa in Chile, photographer unknown.³³⁷

³³⁷ https://en.wikipedia.org/wiki/Chinchorro_mummies

Circa 3,001 HE: China: The first evidence of pottery urn comes from the early Jiahu site, where a total of 32 burial urns are found.³³⁸

Circa 3,001 HE: Baskets, pottery and textiles.³³⁹

Circa 4,001 HE: Linen cords used for nets, rafts invented, sickles invented.³⁴⁰

Circa 4,001 HE: China; Rowing oars have been used since the early Neolithic period; a canoe-shaped pottery and six wooden oars dating

³³⁸ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

³⁴⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

from the **4,001 HE** has been discovered in a Hemudu culture site at Yuyao, Zhejiang.³⁴¹

Circa 4,001 HE: The rise of Sumer or Sumeria, beginning of priest-kings and religion.³⁴²

Circa 4,301 HE – 5,501 HE: Vinca culture period Neolithic archaeological culture in present-day Serbia and smaller parts of Bulgaria and Romania (particularly Transylvania).³⁴³

³⁴¹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³⁴² ISAAC ASIMOV: ASIMOV'S Chronology of the World

³⁴³ https://en.wikipedia.org/wiki/Vinca_culture



Smelting evidence in Pločnik, Serbia. An anthropomorphic figurine with incised lines depicting clothing, photographer and location unknown.³⁴⁴

³⁴⁴ https://en.wikipedia.org/wiki/Vinca_culture



The "*Lady of Vinča*", an iconic terracotta anthropomorphic figurine excavated in **11,929 HE**, at the archaeological site of Vinča-Belo Brdo, in the municipality of Grocka, Belgrade. The figurine is housed in Belgrade's National Museum of Serbia, photographer unknown.³⁴⁵

³⁴⁵ https://en.wikipedia.org/wiki/Vinca_culture

5,001 HE: Author / Compiler's Note: This HE date “**5,001 HE**” is descriptive for me. “**5,001 HE**” equals the outdated calendar number 5000 BCE. But where that BCE number leaves a reader speculating or calculating – the number “**5,001 HE**” simply flows as it puts into perspective the “scale” of this huge timeline of human advancement and accomplishments. “**5,001 HE**” shows the reality of human development and advancement based on what came before them. It is both circa 5,000 years after the start of the Holocene Era and circa 7,000 years before our own time.

Circa 5,001 HE – c 6,501 HE: The Danube Valley; The Lost World of Old Europe: the Cucuteni-Trypillian culture.³⁴⁶

³⁴⁶ <http://isaw.nyu.edu/exhibitions/oldeurope/>



DID WOMEN RULE?



WHAT WAS HE THINKING?



WHY DID THEY BURN
DOWN THEIR HOUSES?



WHY DID THEY VANISH?



Art from the Cucuteni-Trypillian culture.³⁴⁷

³⁴⁷ <http://isaw.nyu.edu/exhibitions/oldeurope/>



Balta Popii, Romania, Pre-Cucuteni Clay Figures **circa 5,101 HE - 5,251 HE**, photographer unknown.³⁴⁸

Circa 5,001 HE: Scales for measurement developed, Irrigation used.³⁴⁹

³⁴⁸ https://en.wikipedia.org/wiki/Cucuteni-Trypillian_culture

³⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Circa 6,001 HE: Sundial invented ³⁵⁰; Greek name: gnomon: original sundial was a stick stuck into ground, so its shadow could be followed to give a rough estimate of time.³⁵¹

Circa 6,001 HE: Copper obtained from ore.³⁵²

⇒ Author / Compiler Note: Although a copper pendant was found in modern day Iraq that dates back to **1,301 HE**³⁵³ it was not until **6,001 HE** that (according to ISAAC ASIMOV) copper was obtained from ore. For that reason, we are including the description of the “Star Stuff” element copper at this point in the timeline.

³⁵⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

³⁵¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery p. 17

³⁵² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

³⁵³ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements



Photo is of Natural Copper nugget, 44 grams. Original size in cm: 1 x 2.5 x 3.5 “Star Stuff” Element Atomic Number 29, Copper, Cu, Copper is an abundant and quite inert metal with a golden-red color, which is useful for a lot of different things. It is known since ancient times and was the first metal used by humans. Together with tin, it is main ingredient of bronze. In an alloy together with zinc, it forms brass. Copper has a very high electrical conductivity, so it is used for most electrical lines (copper wire). Sometimes copper nuggets like this can be found, but most copper is won from ore. Copper also is a necessary trace element for most multicellular organisms.³⁵⁴ In the human body, Copper combines with proteins to

³⁵⁴ <http://images-of-elements.com/copper.php#a>

produce enzymes which act as catalysts for the release of energy from cells. Copper acts upon the transformation of melanin for skin pigmentation and the maintenance of connective tissues.³⁵⁵

Circa 6,001 HE: Japan, a rowing oar measuring 63.4 cm (2 ft) in length, dating from **6,001 HE**, has also been unearthed at Ishikawa Prefecture.³⁵⁶

Circa 6,001 HE: Polynesian colonization of South Pacific Islands.³⁵⁷

Circa 6,241 HE: The Ancient Hebrew culture epoch (reference date), 1 Tishrei AM 1.³⁵⁸

³⁵⁵ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

³⁵⁶ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery p.17

³⁵⁸ https://en.wikipedia.org/wiki/Hebrew_calendar



Map of Ancient Hebrew culture cosmology; Earth Quite Prominent – (but flat and under a dome). illustrated by George L. Robinson.³⁵⁹

³⁵⁹ SEAN CARROLL *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*

Chapter Four

THE BRONZE AGE:

Circa 6,401 HE - Circa 9,001 HE

(lasting circa 2,600 years)

The Bronze Age is when tools were made from the metal bronze. The Bronze Age ended with the emergence of iron working, lasting about 2,600 years.

Circa 6,401 HE: Bronze discovered, the wheel invented for use in making pottery, oars, plows³⁶⁰

³⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Circa 6,401 HE: Malta - Ġgantija (Maltese pronunciation: [dʒɡanˈtiːja], "Giants' Tower") is a megalithic temple complex from the Neolithic on the Mediterranean island of Gozo.³⁶¹



Entrance of the main temple of Ġgantija, photographer and date unknown³⁶²

³⁶¹ <https://en.wikipedia.org/wiki/Ggantija>

³⁶² <https://en.wikipedia.org/wiki/Ggantija>

Circa 6,501 HE: Wheeled carts invented – but not yet wheel barrows; river boats used, writing developed.³⁶³

Circa 6,501 HE: China; Triangular-shaped stone ploughshares are found at the sites of Majiabang culture around Lake Taihu.³⁶⁴



China, Ploughshares have also been discovered at the nearby Liangzhu and Maqiao sites.³⁶⁵

³⁶³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³⁶⁴ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³⁶⁵ <http://www.cultural-china.com/chinaWH/Kaleidoscope/en/10Kaleidoscope2912.html>

Circa 6,501 HE: The Fertile Crescent witnessed the spread of small settlements supported by agricultural surplus. Geometric tokens emerged to be used to manage stewardship of this surplus.³⁶⁶



Clay tokens, from Susa, Uruk period, circa **6,501 HE**. Department of Oriental Antiquities, Louvre.³⁶⁷

³⁶⁶ <https://en.wikipedia.org/wiki/Proto-Elamite>

³⁶⁷ <https://en.wikipedia.org/wiki/Proto-Elamite>

Circa 6,601 HE – 7,501 HE: Sumer or Sumeria develops in the area of the globe we now know as Iraq.

⇒ Because writing was invented in Sumer, - it triggered the beginning of written human history.³⁶⁸

⇒ The civilization of Sumeria: first medical writing. *“The Sumarian Clay Slab”* that lists 250 plants for preparing medicines.³⁶⁹

⇒ Record of one of the oldest stories ever written: *The Epic of Gilgamesh* or Bilgamesh was made in this area.³⁷⁰

³⁶⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 11

³⁶⁹ [Pharmacoplaetae.org/MedHistory.aspx](https://www.pharmacoplaetae.org/MedHistory.aspx)

³⁷⁰ <https://en.wikipedia.org/wiki/Gilgamesh>



Tablet V of the *Epic of Gilgamesh*. The Sulaymaniyah Museum, Iraq³⁷¹

³⁷¹ <https://en.wikipedia.org/wiki/Gilgamesh>

⇒ **Circa 6,601 HE- 7,501 HE:** The people of this Sumer, Uruk area AKA Proto-Elamite civilization were also known for development of technological innovations such as the plough (also see **Circa 6,501 HE:** China), sailing boats and copper metal working. Clay tablets with pictographic characters appeared in this period to record commercial transactions.³⁷²

Circa 6,701 HE – circa 8,901 HE: The ancient Cycladic culture flourished in the islands of the Aegean Sea from. Along with the Minoan civilization and Mycenaean Greece, the Cycladic people are counted among the three major Aegean cultures. Cycladic art therefore comprises one of the three main branches of Aegean art.³⁷³

³⁷² <https://en.wikipedia.org/wiki/Proto-Elamite>

³⁷³ https://en.wikipedia.org/wiki/Cycladic_art



Cycladic figurine Female Figure, c. **7,001 HE** Brooklyn Museum.³⁷⁴

³⁷⁴ https://en.wikipedia.org/wiki/Cycladic_art



Male harp player from Keros, National Archaeological Museum, Athens).³⁷⁵

³⁷⁵ https://en.wikipedia.org/wiki/Cycladic_art



Idol, Cycladic figurine, darker stone. Torso with a hole in the throat and dírkama thighs.³⁷⁶

³⁷⁶ https://en.wikipedia.org/wiki/Cycladic_art

Circa 6,800 HE: Scotland. Carved Stone Balls. Geometric balls carved of stone. Nearly all have been found in north-east Scotland, the majority in Aberdeenshire, the fertile land lying to the east of the Grampian Mountains.³⁷⁷



Three examples of Scottish Carved Stone Balls, in Kelvingrove Art Gallery and Museum, Glasgow, Scotland, photographer unknown.³⁷⁸

³⁷⁷ https://en.wikipedia.org/wiki/Carved_Stone_Balls

³⁷⁸ https://en.wikipedia.org/wiki/Carved_Stone_Balls

Circa 6,801 HE – Circa 7,301 HE: Stretching from Susa, Uruk in the west, to Tepe Yahya in the east, the Proto-Elamite writing system, (many still largely undeciphered), was used over a very large geographical area, and perhaps beyond. The known corpus of inscriptions consists of some 1600 tablets, the vast majority unearthed at Susa, Uruk.³⁷⁹

³⁷⁹ <https://en.wikipedia.org/wiki/Proto-Elamite>



Circa **6,801 HE** to **7,301 HE**: Tablet with numeric signs and script. From Tepe Sialk, Susa, Uruk period Department of Oriental Antiquities, Louvre.³⁸⁰

³⁸⁰ <https://en.wikipedia.org/wiki/Proto-Elamite>



Circa 6,801 HE to 7,301 HE: Economic tablet with numeric signs. Proto-Elamite script in clay, Susa, Uruk period. Department of Oriental Antiquities, Louvre.³⁸¹

³⁸¹ <https://en.wikipedia.org/wiki/Proto-Elamite>

Circa 6,801 HE – Circa 8,001 HE: Peru, The Norte Chico civilization (also Caral or Caral-Supe civilization).³⁸²



Remains of the two main Caral pyramids in the arid Supe Valley, date and photographer unknown.³⁸³

³⁸² https://en.wikipedia.org/wiki/Norte_Chico_civilization

³⁸³ https://en.wikipedia.org/wiki/Norte_Chico_civilization



Caral panorama, date and photographer unknown.³⁸⁴

³⁸⁴ https://en.wikipedia.org/wiki/Norte_Chico_civilization



Remains of platform mound structures at Caral.³⁸⁵

³⁸⁵ https://en.wikipedia.org/wiki/Norte_Chico_civilization

⇒ The Norte Chico civilization (also Caral or Caral-Supe civilization) was a complex pre-Columbian era society that included as many as 30 major population centers in what is now the Norte Chico region of north-central coastal Peru. The civilization flourished between circa **6,001 HE and 8,001 HE** with the formation of the first city generally dated to circa **6,501 HE**, at Huaricanga, in the Fortaleza area. It is from **6,501 HE** onward that large-scale human settlement and communal construction become clearly apparent, which lasted until a period of decline.³⁸⁶

Circa 6,801 HE: Newgrange, Ireland, *World Heritage Site*; The accuracy of Newgrange as a time-telling device is remarkable when one considers that it was built 500 years before the Great Pyramids, more

³⁸⁶ https://en.wikipedia.org/wiki/Norte_Chico_civilization

than 1,000 years before Stonehenge and more than 2000 years before Karnak.³⁸⁷



The entrance to Newgrange in the late **11,800 HEs**, when the mound had become largely overgrown³⁸⁸

³⁸⁷ <http://newgrange.com/>

³⁸⁸ <https://en.wikipedia.org/wiki/Newgrange>



The passage and chamber are aligned with the rising sun at the Winter Solstice, photographer and date unknown.³⁸⁹

³⁸⁹ <http://newgrange.com/>

Circa 6,821 HE – Circa 7,501 HE: Scotland; Europe's most complete Neolithic village: Skara Brae UNESCO World Heritage Site.³⁹⁰

- ⇒ UNESCO stands for United Nations Educational, Scientific and Cultural Organization.
- ⇒ Among much else, a primitive indoor, tree bark lined, two-channel, stone, fresh and wastewater system appears to have featured in the houses of in Skara Brae, along with a cell-like enclave in a number of houses, that it has been suggested may have functioned as an early indoor toilet.³⁹¹

³⁹⁰ https://en.wikipedia.org/wiki/Skara_Brae

³⁹¹ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation



Evidence of home furnishings at Skara Brae³⁹² including indoor water toilets, photographer unknown.³⁹³

³⁹² https://en.wikipedia.org/wiki/Skara_Brae

³⁹³ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation



Skara Brae, looking north, photographer unknown.³⁹⁴

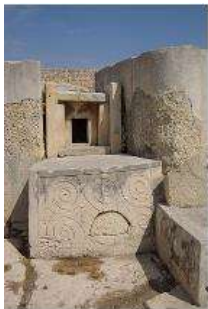
³⁹⁴ https://en.wikipedia.org/wiki/Skara_Brae



Excavated dwellings at Skara Brae, photographer unknown.³⁹⁵

³⁹⁵ https://en.wikipedia.org/wiki/Skara_Brae

Circa 6,851 HE: Malta, in the Mediterranean Sea, Tarxien Phase in Maltese prehistory; Traces of a lost Civilization.³⁹⁶



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.³⁹⁷

³⁹⁶ http://www.maltacultureguide.com/index.php?page=article&article_id=25

³⁹⁷ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.³⁹⁸

³⁹⁸ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.³⁹⁹

³⁹⁹ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁴⁰⁰

⁴⁰⁰ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁴⁰¹

Circa 6,887 HE - 10,250 HE: Mayan Culture, Yucatan Peninsula

⁴⁰¹ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



11,892 HE photograph of El Castillo at Chichen Itza, by Teoberto Maler.⁴⁰²

⁴⁰² https://en.wikipedia.org/wiki/Maya_civilization



El Castillo, at Chichen Itza.⁴⁰³ Photographer and more current date unknown.

⁴⁰³ https://en.wikipedia.org/wiki/Maya_civilization

- ⇒ Mayans had multiple calendars: Mayan “creation date:” **6,877 HE**; Mayan Round Calendar: 52 years; Mayan Tzolk’in calendar: 260 days; Mayan Haab calendar: 365 days; **12,012 HE**: end date of a 5,126 -year-long cycle in the Mesoamerican Mayan long count calendar.⁴⁰⁴
- ⇒ Mayan Civilization included: People, Society, Languages, Writing, Religion Mythology, Human Sacrifice, Cities, Architecture, Astronomy, Calendar, Stelae, Art, Textiles, Trade, Music, Dance, Medicine, Cuisine.⁴⁰⁵

⁴⁰⁴ https://en.wikipedia.org/wiki/Maya_calendar

⁴⁰⁵ https://en.wikipedia.org/wiki/Maya_civilization

0	1	2	3	4
5	6	7	8	9
10	11	12	13	14
15	16	17	18	19



400s			
20s			
1s			
	33	429	5125

Images of Mayan Numerals⁴⁰⁶

⁴⁰⁶ https://en.wikipedia.org/wiki/Maya_numerals

Circa 6,901 HE: The first “nation” united in Egypt⁴⁰⁷, called the First Dynasty of Egypt.⁴⁰⁸



Pottery jar with integral strainer, First Dynasty, Early Dynastic Period, Egypt. The Petrie Museum of Egyptian Archaeology, London.⁴⁰⁹

⁴⁰⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁴⁰⁸ https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt

⁴⁰⁹ https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt

⇒ Egyptian hieroglyphs were fully developed by then, and their shapes would be used with little change for more than three thousand years.⁴¹⁰ This early writing of hieroglyphs was called cuneiform and consisted of making specific marks in wet clay with a reed implement.⁴¹¹

Circa 7,001 HE: First evidence of candles being used for artificial lighting.⁴¹²

Circa 7,001 HE: Stonehenge, England, UNESCO World Heritage Site, is built.

⁴¹⁰ https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt

⁴¹¹ <https://www.ancient.eu/writing/>

⁴¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Farm carts near Stonehenge **circa 11,885 HE**, photographer unknown.⁴¹³

⁴¹³ <https://en.wikipedia.org/wiki/Stonehenge>



Post WWI Stonehenge aerial photograph, photographer unknown.⁴¹⁴

⁴¹⁴ <https://en.wikipedia.org/wiki/Stonehenge>



A contemporary newspaper depiction of the **11,920 HE** restoration of Stonehenge.⁴¹⁵

⁴¹⁵ <https://en.wikipedia.org/wiki/Stonehenge>



Stonehenge in **12,014 HE**, photographer unknown.⁴¹⁶

⁴¹⁶ <https://en.wikipedia.org/wiki/Stonehenge>

Circa 7,051 HE: IMHOTEP, Egyptian scholar, 2000 years after his death made into a god, architect of the first pyramid.⁴¹⁷



Late Period statue of IMHOTEP, Musée du Louvre.⁴¹⁸

⁴¹⁷ <https://en.wikipedia.org/wiki/Imhotep>

⁴¹⁸ https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt

Circa 7,401 HE: Sumer continues, (see **Circa 4,001 HE:** The rise of Sumeria) “Sumer had now developed into 28 cities over these hundreds of years. Uruk was one city in Sumer.”⁴¹⁹ “They call this place Uruk. We call it Iraq. It's a part of Mesopotamia, the land between the Tigris and the Euphrates rivers.”⁴²⁰



Dated to **Circa 7,401 HE — Circa 7,501 HE:** An image showing fragments of the *Instructions of Shurruk* Translation:

⁴¹⁹ <https://en.wikipedia.org/wiki/Sumer>

⁴²⁰ COSMOS, A Space Time Odyssey, by Ann Druyan, Episode 11

"Shurrapak gave instructions to his son: / Do not buy an ass which brays too much. / Do not commit rape upon a man's daughter, do not announce it to the courtyard. / Do not answer back against your father, do not raise a 'heavy eye.'" This exhibit is in the Museum of the Oriental Institute of Chicago.⁴²¹

Circa 7,401 HE – Circa 8,101 HE: What is now Pakistan: the Harappan Civilization Phase of the Indus Valley Civilization in the Indian Sub-continent.⁴²²

⁴²¹ Pharmacoplantae.org/MedHistory.aspx

⁴²² <https://en.wikipedia.org/wiki/Harappa>



Excavated ruins of Mohenjo-Daro, Sindh province, Pakistan, showing the Great Bath in the foreground. Mohenjo-Daro, on the right bank of the Indus River, is a UNESCO World Heritage Site, the first site in South Asia to be so declared.⁴²³

⁴²³ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⇒ From a room that appears to have been set aside for bathing, waste water was directed to covered drains, which lined the major streets.⁴²⁴



⇒ A large well and bathing platforms at Harappa, remains of the city's phase of occupation from **7,801 HE to 8,101 HE**.⁴²⁵

⁴²⁴ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⁴²⁵ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation

⇒ Although some houses were larger than others, Indus Civilization cities were remarkable for their apparent, if relative, egalitarianism. All the houses had access to water and drainage facilities. This gives the impression of a society with relatively low wealth concentration, though clear social levelling is seen in personal adornments. The prehistory of Indo-Iranian borderlands shows a steady increase over time in the number and density of settlements. The population increased in Indus plains because of hunting and gathering.⁴²⁶

⁴²⁶ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation



Dholavira Sophisticated Water Reservoir, evidence for hydraulic sewage systems in the ancient Indus Valley Civilization.⁴²⁷

⁴²⁷ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⇒ Toilets that used water were used in the Indus Valley Civilization. The cities of Harappa and Mohenjo-Daro had an early indoor toilet in almost every house, attached to a sophisticated sewage system.⁴²⁸



⇒ Indus Valley Pottery, photographer and location unknown.⁴²⁹

⁴²⁸ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⁴²⁹ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation



Indus valley seals with Bull, Elephant, and Rhinoceros, photographer and location unknown.⁴³⁰

⁴³⁰ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⇒ The Indus people, through over-irrigation had increased the salt content of their fields to such an extent that they could not grow crops enough to support themselves any longer.⁴³¹

Circa 7,401 HE – 8,901 HE: The Minoan Civilization, in Ancient Greece, was an Aegean Bronze Age civilization which flourished on the island of Crete and other Aegean islands. It preceded the Mycenaean civilization of Ancient Greece. The civilization was rediscovered at the beginning of the **19,000's HE** through the work of British archaeologist **ARTHUR EVANS**.^{432 433}

⇒ Minoan cities were connected by roads paved with blocks cut with bronze saws. Streets were drained, and water and sewage facilities were available to the upper class through clay pipes. Minoan

⁴³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁴³² https://en.wikipedia.org/wiki/Minoan_civilization

⁴³³ <https://www.youtube.com/watch?v=czgOWmtGVGs> en.wikipedia.org/wiki/Minoan_civilization

buildings often had flat, tiled roofs; plaster, wood or flagstone floors, and stood two to three stories high. Lower walls were typically constructed of stone and rubble, and the upper walls of mudbrick. Ceiling timbers held up the roofs.⁴³⁴



Restored model of a Minoan house found in Archanes, artist, photographer and location unknown.⁴³⁵

⁴³⁴ https://en.wikipedia.org/wiki/Minoan_civilization

⁴³⁵ https://en.wikipedia.org/wiki/Minoan_civilization



Map of Minoan Crete, artist and location unknown.⁴³⁶

⁴³⁶ https://en.wikipedia.org/wiki/Minoan_civilization#/media/File:Map_Minoan_Crete-en.svg



⇒ Ruins of the palace at Knossos, photographer and date unknown.⁴³⁷

⁴³⁷ https://en.wikipedia.org/wiki/Minoan_civilization



Sewers of the palace of Knossos⁴³⁸

⁴³⁸ https://en.wikipedia.org/wiki/Minoan_civilization



The partially-restored "campstool fresco" from Knossos, photographer unknown.⁴³⁹

⁴³⁹ https://en.wikipedia.org/wiki/Minoan_civilization



The Dolphin Mural from Knossos, photographer unknown.⁴⁴⁰



Palace complex at Phaistos, Minoan Civilization at Phaistos, Crete, photographer unknown.⁴⁴¹

⁴⁴¹ https://en.wikipedia.org/wiki/Phaistos_Disc



Circa 8,151 HE: The 15 cm or circa 5” Phaistos Disc (side A) is on display at the Heraklion Archaeological Museum, Crete. Its purpose and meaning, and even its original geographical place of manufacture, even authenticity, remain disputed.⁴⁴²

⁴⁴² https://en.wikipedia.org/wiki/Phaistos_Disc

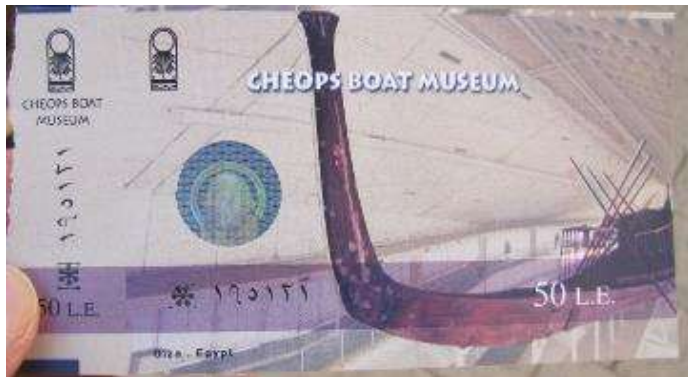
Circa **7,412 HE**: Fourth Dynasty of Egypt; "the Age of the Pyramids."⁴⁴³



Statue of “Khufu” (AKA Cheops, Suphis, Chnoubos and Sofe) in the Cairo Museum.⁴⁴⁴

⁴⁴³ https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt

⁴⁴⁴ https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt



Cairo, Egypt **12,009 HE** ticket to Cheops Boat Museum.⁴⁴⁵

⁴⁴⁵ From author family **12,010 HE** visit to Egypt



Cairo, Egypt; Boat excavation hole just to the side of the Cheops Pyramid.⁴⁴⁶

⁴⁴⁶ From author family **12,010 HE** visit to Egypt



Cairo, Egypt, Cheops Boat Museum; excavated **circa 4,605-year-old rope** used for Egyptian Cheops Boats (and ok, Author / Compiler, son and daughter).⁴⁴⁷

⁴⁴⁷ From author family **12,010 HE** visit to Egypt, photographer Paul Premack



Cairo, Egypt, Cheops Boat Museum; circa **4,605-year-old** boat excavated from above photo/hole just to the side of the Cheops Pyramid.⁴⁴⁸

⁴⁴⁸ From author family visit to Egypt



Cairo, Egypt, Cheops Boat Museum; view of circa 4,605-year-old paddles design from excavated boat.⁴⁴⁹

⁴⁴⁹ From author family visit to Egypt

Circa 7.421 HE: Construction of the Great Pyramid of Giza, Egypt.⁴⁵⁰



The Great Pyramid of Giza.⁴⁵¹

⁴⁵⁰ https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza

⁴⁵¹ https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza



Great Pyramid of Giza from a **11,800s HE** stereopticon card photo⁴⁵²

⁴⁵² https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza



Circa 7,441 HE: Egypt: The earliest archaeological evidence of papyrus was excavated in **12,012 HE and 12,013 HE** at Wadi al-Jarf, an ancient Egyptian harbor located on the Red Sea coast. These documents date from end of the reign of Khufu. The papyrus rolls describe the last years of building the Great Pyramid of Giza.⁴⁵³

- Author / Compiler note: I have run into some difficult time references researching this timeline. References that made a reader step out of context and be in an isolated moment. The resource of this next time reference actually said: “4200 years before 1950”⁴⁵⁴ Using the included HE conversion calculator to get to **11,950 HE** then subtracting 4,200 from it, was the

⁴⁵³ <https://en.wikipedia.org/wiki/Papyrus>

⁴⁵⁴ <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

calculation used to achieve the “**Circa 7,450 HE**” for dating this upcoming entry. Now you as the reader can relate **7,450 HE** and other HE dates to the flow of our history, rather than bleep over the reference: “4200 years before 1950” without having a big picture comparison. Yay CESARE EMILIANI’s HE timeline idea!

Circa 7,450 HE: The Meghalayan Age of the Holocene Epoch.⁴⁵⁵

- ⇒ The Meghalayan Age of the Holocene Epoch period started with a 200-year “mega-drought” that disrupted civilizations around the world. At this time, civilizations in Egypt, Greece, Syria, Palestine, Mesopotamia, the Indus Valley, and the Yangtze River Valley had started to settle down and use agricultural practices, according to a

⁴⁵⁵ <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

statement from Long Beach State University. After the onset of this 200-year climatic event, the societies were forced to migrate worldwide.⁴⁵⁶

Circa 7,501 HE: Glass used.⁴⁵⁷

Circa 7,501 HE: The civilization of Crete ends under the ashes of a volcanic explosion.⁴⁵⁸

Circa 7,501 HE – Circa 8,001 HE: Horses tamed.⁴⁵⁹ Some researchers do not consider an animal to be "domesticated" until it exhibits physical changes consistent with selective breeding, or at least having been

⁴⁵⁶ <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

⁴⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery PAGE 24

⁴⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁴⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

born and raised entirely in captivity. Until that point, they classify captive animals as merely "tamed".⁴⁶⁰ Those who hold to this theory of domestication point to a change in skeletal measurements was detected among horse bones recovered from middens dated about **7,501 HE** in eastern Hungary in Bell-Beaker sites, and in later Bronze Age sites in the Russian steppes, Spain, and eastern Europe.⁴⁶¹

Circa 7,661 HE: In the region that eventually became known as Assyria and over the territory to the east of the Tigris which was known as Elam: Sargon established the First Empire we know of by uniting Akkad and Sumeria: peoples with different languages and different cultures.⁴⁶²

⁴⁶⁰ https://en.wikipedia.org/wiki/Domestication_of_the_horse

⁴⁶¹ https://en.wikipedia.org/wiki/Domestication_of_the_horse

⁴⁶² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, pages 24-25

Circa 7,701 HE – Circa 8,401 HE: Central Europe; in what are now the Germany, Poland and Czech areas at the start of the Central European Bronze Age, lived the archaeological Únětice culture^[87] who created the Nebra Sky Disc. The Nebra Sky Disc was made of bronze and features the oldest tangible depiction of cosmic phenomena worldwide. It was buried along with two precious swords, two axes, two spiral arm-rings and one bronze chisel circa 3,600 years ago.

⇒ The Únětice culture bronze disc is considered to be one of the most important archaeological finds of the **11,900's HE**. It contains an extraordinary comprehension of astronomical phenomena that enable unique glimpses into the early knowledge of the skies.⁴⁶³

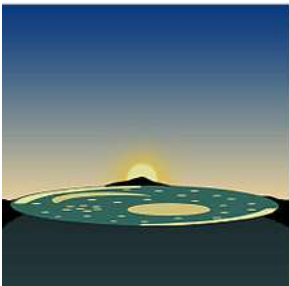
^[87] https://en.wikipedia.org/wiki/Unetice_culture

⁴⁶³ <http://www.unesco.org/new/en/communication-and-information/flagship-project-activities/memory-of-the-world/register/full-list-of-registered-heritage/registered-heritage-page-6/nebra-sky-disc/>



Únětice culture Nebra Sky Disk discovered in Saxony Anhalt, Germany, LDA Sachsen-Anhalt. Photo by J. Lipták.⁴⁶⁴

⁴⁶⁴ https://en.wikipedia.org/wiki/Unetice_culture



Unknown artist rendering of Nebra sky disk, position of the arcs at evening of summer solstice.⁴⁶⁵

⁴⁶⁵ https://en.wikipedia.org/wiki/Unetice_culture



Swords buried with the Únětice culture Nebra sky disk, location and photographer unknown.⁴⁶⁶

⁴⁶⁶ https://en.wikipedia.org/wiki/Unetice_culture

Circa 8,151 HE – Circa 8,201 HE: Egypt, the “Moscow or Golenishchev” Mathematical Papyrus’ format was divided into 25 problems. It is a well-known mathematical papyrus along with the Rhind Mathematical Papyrus. The Moscow Mathematical Papyrus is older than the Rhind Mathematical Papyrus, while the latter is the larger of the two.⁴⁶⁷



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A photo of a small section of the Length: 5.5 meters (18 ft) Width:

⁴⁶⁷ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

⁴⁶⁸ thematematicaltourist.wordpress.com

3.8 to 7.6 cm (1.5 to 3 in) *Moscow Mathematical Papyrus* at Pushkin State Museum of Fine Arts in Moscow⁴⁶⁹

⇒ Solutions by the Soviet Orientalist Vasily Vasilievich Struve in **11,930 HE**, exist.⁴⁷⁰

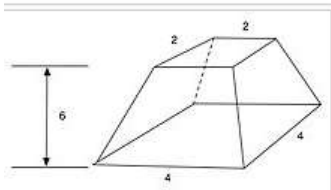
$$\text{Area} = \left(\frac{2 \times 8}{9}\right)^2 \times (\text{diameter})^2 = \frac{256}{81} (\text{diameter})^2$$

• The solution to the 10th problem means the scribe of the *Moscow Papyrus* could approximate pi $258/81 = 3.16049$.⁴⁷¹

⁴⁶⁹ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

⁴⁷⁰ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

⁴⁷¹ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus



$$V = \frac{1}{3}h(a^2 + ab + b^2).$$



The solution to this problem indicates that the Egyptians knew the correct formula for obtaining the volume of a truncated pyramid.⁴⁷²

⁴⁷² https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

Circa 8,201 HE: Egypt, uses of fermentation for drink or bread is further discovered (see **3,001 HE** in China); number system based on 60 developed; 7-day week devised; 5 planets and 12 constellations of zodiac named.⁴⁷³

Circa 8,201 HE: *The Kahun Gynecological Papyrus*⁴⁷⁴ (also *Petrie Medical Papyrus, Kahun Medical Papyrus, Lahun Medical Papyrus, or UC32057*); Egypt; it deals with women's health, contraception, gynecological diseases, fertility, pregnancy, etc.⁴⁷⁵

⁴⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁴⁷⁴ https://en.wikipedia.org/wiki/History_of_birth_control

⁴⁷⁵ https://en.wikipedia.org/wiki/Kahun_Gynaecological_Papyrus



Page 1 and part of page 2 of the *Kahun Gynecological Papyrus*, the Petrie Museum of Egyptian Archaeology of the University College London.⁴⁷⁶

⁴⁷⁶ https://en.wikipedia.org/wiki/Kahun_Gynaecological_Papyrus

⇒ *The Kahun Gynecological Papyrus* describes various contraceptive pessaries, including:

- acacia gum, which recent research has confirmed to have spermicidal qualities and is still used in contraceptive jellies.
- the application of gummy substances to cover the "mouth of the womb" (i.e. the cervix),
- a mixture of honey and sodium carbonate applied to the inside of the vagina, and
- a pessary made from crocodile dung.
- Lactation (breast-feeding) of up to three years was also used for birth control purposes in ancient Egypt.⁴⁷⁷

⁴⁷⁷ https://en.wikipedia.org/wiki/History_of_birth_control

Circa 8,247 HE: Babylonia; Mesopotamia.

- ⇒ The Babylonians knew math. They knew about the right-angled triangle, that the shorter sides were one unit long, and the hypotenuse is the square root of two – not a whole number but an irrational number.⁴⁷⁸
- ⇒ *Code of Hammurabi*, The Babylonians established the first surviving law code.⁴⁷⁹

⁴⁷⁸ Liz Strachan *A Slice of Pi*

⁴⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Code on clay tablets



Code on basalt stele



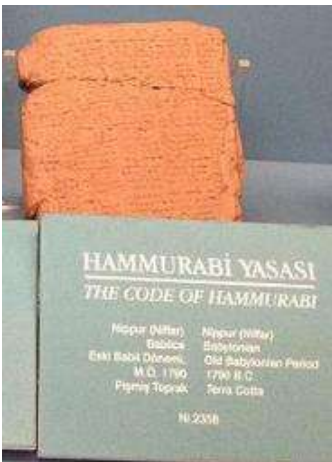
Two versions of the *Code of Hammurabi* at the Louvre Museum.⁴⁸⁰

⁴⁸⁰ https://en.wikipedia.org/wiki/Code_of_Hammurabi



Hammurabi stele at American Museum of Natural History, New York.⁴⁸¹

⁴⁸¹ https://en.wikipedia.org/wiki/Code_of_Hammurabi



A version of the code at the Istanbul Archaeological Museums.⁴⁸²

⁴⁸² https://en.wikipedia.org/wiki/Code_of_Hammurabi

⇒ Numbers as we know them still did not exist. Below are examples of early use of Babylonian numbers:

1	𐎶	11	𐎶𐎵	21	𐎶𐎵𐎶	31	𐎶𐎵𐎶𐎵	41	𐎶𐎵𐎶𐎵𐎶	51	𐎶𐎵𐎶𐎵𐎶𐎵
2	𐎶𐎶	12	𐎶𐎶𐎵	22	𐎶𐎶𐎶	32	𐎶𐎶𐎶𐎵	42	𐎶𐎶𐎶𐎵𐎶	52	𐎶𐎶𐎶𐎵𐎶𐎵
3	𐎶𐎶𐎶	13	𐎶𐎶𐎶𐎵	23	𐎶𐎶𐎶𐎶	33	𐎶𐎶𐎶𐎶𐎵	43	𐎶𐎶𐎶𐎶𐎵𐎶	53	𐎶𐎶𐎶𐎶𐎵𐎶𐎵
4	𐎶𐎶𐎶𐎶	14	𐎶𐎶𐎶𐎶𐎵	24	𐎶𐎶𐎶𐎶𐎶	34	𐎶𐎶𐎶𐎶𐎶𐎵	44	𐎶𐎶𐎶𐎶𐎶𐎵𐎶	54	𐎶𐎶𐎶𐎶𐎶𐎵𐎶𐎵
5	𐎶𐎶𐎶𐎶𐎶	15	𐎶𐎶𐎶𐎶𐎶𐎵	25	𐎶𐎶𐎶𐎶𐎶𐎶	35	𐎶𐎶𐎶𐎶𐎶𐎶𐎵	45	𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶	55	𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶𐎵
6	𐎶𐎶𐎶𐎶𐎶𐎶	16	𐎶𐎶𐎶𐎶𐎶𐎶𐎵	26	𐎶𐎶𐎶𐎶𐎶𐎶𐎶	36	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	46	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶	56	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶𐎵
7	𐎶𐎶𐎶𐎶𐎶𐎶𐎶	17	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	27	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	37	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	47	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶	57	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶𐎵
8	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	18	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	28	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	38	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	48	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	58	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶
9	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	19	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	29	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	39	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	49	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵	59	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎵𐎶
10	𐎶	20	𐎶𐎶	30	𐎶𐎶𐎶	40	𐎶𐎶𐎶𐎶	50	𐎶𐎶𐎶𐎶𐎶		

Babylonian Cuneiform Numerals.⁴⁸³

⁴⁸³ http://www-history.mcs.st-and.ac.uk/HistTopics/Babylonian_numerals.html

- ⇒ *Soap is invented!*- but not necessarily used to wash the body. The next recorded evidence of soap making are Babylonian clay cylinders. Inscriptions on the cylinders are the earliest known written soap recipe and they describe a process by which fats could be combined with wood ash and water to create a substance capable of cleaning. The product thus produced was not necessarily used to wash the body; it might have been used to clean textile fibers such as wool and cotton in preparation for weaving into cloth.⁴⁸⁴
- ⇒ **Circa 8,247 HE:** Babylonians first recorded oral hygiene by use of tooth cleaning sticks.⁴⁸⁵

⁴⁸⁴ <http://www.soaphistory.net/soap-history/first-soap/>

⁴⁸⁵ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>



A typical chew stick. This one is from the plant *Glycyrrhiza glabra* (licorice).⁴⁸⁶ (Author / Compiler sees two sticks in the picture. Maybe it is two halves of the same stick?)

⁴⁸⁶ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

Circa 8,301 HE – 8,801 HE: Ancient Egyptian Empire.⁴⁸⁷

⇒ **Circa 8,351 HE:** AHMES, Egyptian scribe who on papyrus scribed what others authored in the *Rhind Mathematical Papyrus* (mathematical treatise “Directions for Attaining Knowledge of all Dark Things”). It is now in the British Museum.⁴⁸⁸

⁴⁸⁷ ISAAC ASIMOV’S Chronology of the World

⁴⁸⁸ <https://www.britannica.com/biography/Ahmes>



Photo is of a portion of the *Rhind Mathematical Papyrus*, British Museum, London.⁴⁸⁹

⁴⁸⁹ https://en.wikipedia.org/wiki/Rhind_Mathematical_Papyrus

Circa 8,401 HE: First Egyptian medical text was on papyrus (named after the dealer, Edwin Smith, who bought it in **11,862 HE**).⁴⁹⁰



Plates vi & vii of the *Edwin Smith Papyrus* at the Rare Book Room, New York Academy of Medicine.⁴⁹¹

⁴⁹⁰ https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus

⁴⁹¹ https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus

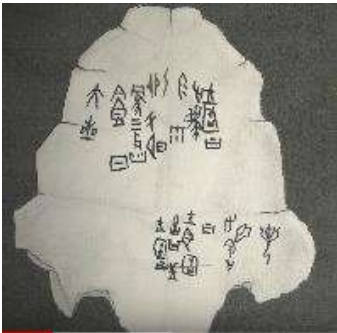
Circa 8,401 HE – 8,955 HE: China, Shang Dynasty, first Chinese early written records were on bone⁴⁹²



A Shang dynasty oracle bone from the Shanghai Museum⁴⁹³

⁴⁹² https://en.wikipedia.org/wiki/Oracle_bone

⁴⁹³ https://en.wikipedia.org/wiki/Oracle_bone



Unknown date: China, first record of a Solar Eclipse was found in Yin, China. It was carved on a tortoise shell. The pictures on the tortoise shell are translated to say: “Three flames ate the sun, big stars were seen.”⁴⁹⁴

⁴⁹⁴ PBS Skunk Bear How Eclipses changed History youtube video:
https://www.youtube.com/watch?v=tTxz_d2q7Js

Circa 8,401 HE – 8,801 HE: Tumulus Culture of Central Europe. In **11,902 HE**, PAUL REINECKE distinguished the Tumulus culture by distinguishing cultural horizons that showed the practice of burying the dead beneath burial mounds (tumuli or kurgans). Tumuli have been used elsewhere in Europe from the Stone Age to the Iron Age; the term "Tumulus culture" specifically refers to the South German variant of the Bronze Age.⁴⁹⁵

Circa 8,501 HE: The “Star Stuff” element Iron was first smelted by the Hittites of Asia Minor.⁴⁹⁶

⁴⁹⁵ https://en.wikipedia.org/wiki/Tumulus_culture

⁴⁹⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements



Photo is of fragments of an iron meteorite, about 92% iron. Original size of the single pieces in cm: 0.4 - 0.8 “Star Stuff” Element Atomic Number 26: Iron, Fe, is a silvery metal, which is very abundant and is used for multiple purposes. Commonly it is alloyed together with carbon and other elements, to become steel. The number of different steels is very high, their characters vary over a wide span. Sometimes pure iron occurs in nature, but most is found in ores. Meteorites, that hit Earth's ground and don't evaporate before, often are iron meteorites. Iron can be seen as an energetic ideal state of matter. Smaller atoms can set energy free by fusion, larger atoms by fission, but from iron no nuclear energy can be won. Iron 56 and 58 and nickel 62 have the highest binding energy

per nuclear particle. Very big stars form an iron core shortly before their final collapse and the following supernova. Iron is essential for mammals and makes our blood red. Iron is known to humanity since several millennia and has shaped our culture and civilization like no other element.⁴⁹⁷ Not just humans use the iron in the Earth's magnetic field as navigational aids. Birds and other creatures find their way across continents and oceans by sensing the direction of Earth's magnetic forces. Scientists have researched that birds can actually see Earth's magnetic field because their eyes evolved to contain molecules linked to the part of their brain that processes visual information.⁴⁹⁸

⁴⁹⁷ <http://images-of-elements.com/iron.php#a>

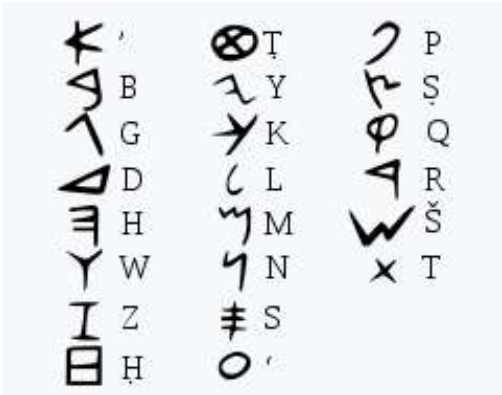
⁴⁹⁸ PAUL PARSONS & GAIL DIXON *The Periodic Table*

Circa 8,501 HE: The Alphabet from which all alphabets grew, was developed by some nameless Canaanite or Phoenician as they were called by the Greeks.⁴⁹⁹

⇒ There is no record of what the Phoenicians called themselves. It is only through their reference by others do we know of the Phoenicians.⁵⁰⁰

⁴⁹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁰⁰ Stuff you missed in history class podcast <https://www.missedinhistory.com/podcasts/the-phoenician-alphabet.htm>



Phoenician Alphabet, The Alphabet from which all alphabets grew

501

⇒ The Sarcophagus of Ahiiram is famed for its bas relief carvings, and its Phoenician language inscription. One of five known Byblian royal inscriptions, the inscription is considered to be the earliest known example of the fully developed Phoenician alphabet. The Sarcophagus of Ahiiram was found following a landslide in the cliffs surrounding Byblos (in now modern-day Lebanon) in late **11,923 HE**, which revealed a number of Phoenician royal tombs. The tomb of Ahiiram was ten meters deep.⁵⁰²

⁵⁰² https://en.wikipedia.org/wiki/Ahiiram_sarcophagus



The Sarcophagus of Ahirom in its current location at the National Museum of Beirut.⁵⁰³

⁵⁰³ https://en.wikipedia.org/wiki/Ahirom_sarcophagus

Circa 8,501 HE: The Ebers Papyrus,⁵⁰⁴ also known as **Papyrus Ebers**, is an Egyptian medical papyrus of herbal knowledge. Among the oldest and most important medical papyri of ancient Egypt, it was purchased at Luxor (Thebes) in the winter of **11,873 HE–11,874 HE** by Georg Ebers.⁵⁰⁵ Examples of remedies in the **Ebers Papyrus** include:

- For Cancer: Recounting a "tumor against the god Xenus", it recommends "do thou nothing there against;
- For Birth control: To prevent conception, smear a paste of dates, acacia, and honey to wool and apply as a pessary;
- For Diabetes mellitus: Drink a mixture including elderberry, asit plant fibers, milk, beer-swill, cucumber flowers and green dates;

⁵⁰⁴ https://en.wikipedia.org/wiki/History_of_birth_control AND HISTORY OF SOAP

⁵⁰⁵ https://en.wikipedia.org/wiki/Ebers_Papyrus

- For Guinea-worm disease: Wrap the emerging end of the worm around a stick and slowly pull it out. (3,500 years later, this remains the standard treatment.);
- For Medicinal use of ochre clays; one of the more common remedies described in the *Ebers Papyrus* is ochre, or medicinal clay. Ochre, or medicinal clay, is prescribed for intestinal and eye complaints. Yellow ochre is also described as a remedy for urological complaints.⁵⁰⁶
- During some eras and some cultures in history, abortion had none of the stigma which it has today, making birth control less important; abortion was in practice a means of birth control.⁵⁰⁷

⁵⁰⁶ https://en.wikipedia.org/wiki/Ebers_Papyrus

⁵⁰⁷ https://en.wikipedia.org/wiki/History_of_birth_control

The first recorded evidence of induced abortion is from the Egyptian *Ebers Papyrus*⁵⁰⁸

- ⇒ The *Ebers papyrus* refers to medicinal use of *soap*! These texts suggest that ancient Egyptians combined both animal and plant oils with alkaline salts to create a substance used for treating sores, skin ailments, as well as washing.⁵⁰⁹ SOAP and HYGENE! More detailed accounts of soap use came from Ancient Egypt, where soaps and aromatic oils were not only used for washing but also as an important medical cure for many skin and muscle diseases.⁵¹⁰

⁵⁰⁸ https://en.wikipedia.org/wiki/History_of_abortion

⁵⁰⁹ <http://www.soaphistory.net/soap-history/first-soap/>

⁵¹⁰ <http://www.soaphistory.net/soap-history/first-soap/>



A photo of a piece of The *Ebers Papyrus*, c. **8,501 HE** from Ancient Egypt. It is currently kept at the library of the University of Leipzig, in Germany.⁵¹¹

⁵¹¹ https://en.wikipedia.org/wiki/Ebers_Papyrus

Circa 8,601 HE to circa 8,650 HE: Egypt, Karnak, UNESCO World Heritage Site⁵¹²

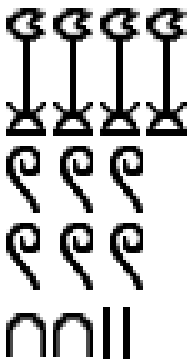
Value	1	10	100	1,000	10,000	100,000	1 million, or many
Hieroglyph		∩	ϩ	⌋	⌋	⌋	⌋

⇒

Numbers as we know them still did not exist. The image above shows the Ancient Hieroglyphs and matching current Hindu-Arabic number.⁵¹³

⁵¹² <http://www.karnak.org/>

⁵¹³ https://en.wikipedia.org/wiki/Egyptian_numerals



A drawing of a stone carving from Karnak (artist and date unknown) shows the number 4622.⁵¹⁴

⁵¹⁴ https://en.wikipedia.org/wiki/Egyptian_numerals



Karnak Gate built for Winter Solstice alignment.^{515 516}

⁵¹⁵ Tiffany Premack

- ⇒ **Circa 10,323 HE:** When Constantine the Great recognized the Christian religion, the Karnak complex was closed and abandoned.⁵¹⁷
- ⇒ After the fall of Egyptian civilization, the tradition of using soap for personal cleaning, for cleaning of living quarters, and for food hygiene was abandoned. This enabled spreading of many deadly diseases across Europe and shortened the average human lifespan.⁵¹⁸
- ⇒ In Asia hygiene remained respected and enforced by tradition.⁵¹⁹

Circa 8,651 HE – Circa 8,801 HE: *The Brugsch Papyrus (Pap. Berl. 3038)*, also known as *the Greater Berlin Papyrus*, or simply *Berlin*

⁵¹⁶ Photo from author **12,010 HE** family trip to Egypt

⁵¹⁷ https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re

⁵¹⁸ <http://www.soaphistory.net/soap-facts/soap-benefits/>

⁵¹⁹ <http://www.soaphistory.net/soap-facts/soap-benefits/>

Papyrus is an important ancient Egyptian medical papyrus. It was discovered by Giuseppe Passalacqua in Saqqara, Egypt. Friedrich Wilhelm IV of Prussia acquired it in **11,827 HE** for the Berlin Museum, where it is still housed. The style of writing is that of Egypt's 19th dynasty.⁵²⁰

⇒ It deals with:

- women's health,
- contraception,
- gynecological diseases,
- fertility tests, pregnancy, etc.⁵²¹

⇒ The papyrus was studied initially by HEINRICH KARL BRUGSCH, but was translated and published by WALTER WRESZINSKI in **11,909 HE**. Its only translation is in German.

⁵²⁰ https://en.wikipedia.org/wiki/Brugsch_Papyrus

⁵²¹ https://en.wikipedia.org/wiki/Brugsch_Papyrus

The papyrus contains twenty-four pages of writing. Much of it is parallel to the *Ebers Papyrus* (see: **Circa 8,501 HE**). Some historians believe that this papyrus was used by GALEN (see: **Circa 10,200 HE: AELIUS OR CLAUDIUS GALENUS**, Greek, GALEN of PERGAMON) in his writings.⁵²²

Circa 8,669 HE – circa 8,678 HE: The “Star Stuff” element Cobalt was highly prized in ancient China for pottery glazes, and in ancient Egypt where a glass object colored with Cobalt was found in the tomb of King Tutankhamen. Cobalt was not defined as an Element until circa **11,730s HE**. (See **11,730 HE GEORG BRANDT**).⁵²³

⁵²² https://en.wikipedia.org/wiki/Brugsch_Papyrus

⁵²³ PAUL PARSONS & GAIL DIXON *The Periodic Table*

Circa 8,701 HE: Map of Eastern Hemisphere Human Population groups.
At this time there were approximately 45,000,000 people.⁵²⁴



525

⁵²⁴ <http://www.worldometers.info/world-population/world-population-by-year/>

⁵²⁵ http://worldhistorymaps.info/images/East-Hem_1000bc.jpg Thomas Lessman

Circa 8,701 HE – 9,251 HE: The Urnfield culture was a late Bronze Age culture of central Europe, often divided into several local cultures within a broader Urnfield tradition. The name comes from the custom of cremating the dead and placing their ashes in urns which were then buried in fields. Over much of Europe, the Urnfield culture followed the Tumulus culture and was succeeded by the Hallstatt culture.⁵²⁶ Linguistic evidence and continuity with the following Hallstatt culture suggests that the people of this area spoke an early form of Celtic, perhaps originally proto-Celtic.^{527 528}

⁵²⁶ Chadwick and Corcoran, Nora and J.X.W.P. (11,970 HE). *The Celts. Penguin Books. pp. 28–29*

⁵²⁷ Kruta, Venceslas (11,991 HE). *The Celts* pp. 93–100.

⁵²⁸ Gimbutas, Marija (11,965 HE). Bronze age cultures in Central and Eastern Europe. pp. 274–298.



Drawing of urns in a burial site, artist and location unknown.⁵²⁹

Circa 8,719 HE: Tutankhamun's mummy was discovered by English Egyptologist Howard Carter and his team in **11,925 HE** in tomb KV62 of Egypt's Valley of the Kings. Tutankhamun was the 11th pharaoh of the 18th Dynasty of the New Kingdom of Egypt, making his mummy over 3,300 years old.



530



HOWARD CARTER and associates opening the shrine doors in the burial chamber (**11,924 HE** reenactment of the **11,923 HE** event)⁵³¹

Circa 8,801 HE: In both Egypt and China dyes resistant to sun & to water developed.⁵³²

Circa 8,801 HE: In India: The decimal Hindu-Arabic numeral system was invented.⁵³³ (Roman numerals still mostly in use.) (See **Circa 10,830**

⁵³¹ https://en.wikipedia.org/wiki/KV62#/media/File:The_Moment_Carter_Opens_the_Tomb.JPG

⁵³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵³³ https://en.wikipedia.org/wiki/Hindu%E2%80%93Arabic_numerals

HE: SIND IBN ALI, Baghdad and Circa 10,825 HE: AL-KHWARIZMI).

Circa 8,801 HE – circa 9,201 HE: Luristan (Western Iran).



Ancient bronze pin (“Swollen Pin”) has tapering round section ornamented with incised linear decoration. These types of pins were used during the Bronze Age for fastening cloaks or other garments. Length 5 inches (12.8 cm).⁵³⁴

⁵³⁴ <http://www.antiquesword101.com/pre-columbian.php#!/Ancient-Luristan-Bronze-Pin-12th-8th-century-BC/p/17351967>; a similar bronze pin is published in the book *“Iran in the Ancient East”* by Ernest E. Herzfeld. New York, 11,988 HE, page 153. Fig. 272

Circa 8,801 HE- circa 9,601 HE: Mexico - the Aztec name for these people was “Olmecatl” or modern name is “Olmec people.”⁵³⁵

⇒ Olmec People used science to extract latex from Panama rubber trees (*Castilla elastica*) growing in the region and mixed it with the juice of a local vine (*Ipomoea alba*, moonflower) to create rubber.⁵³⁶

⇒ Olmec People carved large items from stone.⁵³⁷

⁵³⁵ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

⁵³⁶ <https://www.britannica.com/topic/Olmec>

⁵³⁷ <https://www.britannica.com/topic/Olmec>



Olmec colossal basalt head in the Museo de la Venta, an outdoor museum near Villahermosa, Tabasco, Mexico. ranging in height from 1.47 to 3.4 meters (4.82 to 11.15 feet).⁵³⁸

⁵³⁸ <https://en.wikipedia.org/wiki/Olmec>



The Olmec people built Earth mounds such as this one, which was part of the **11,967 HE** excavations of the now famous Olmec site of San Lorenzo. As a then 26-year-old archaeology student, Dr. **RICHARD DIEHL** participated in the efforts.⁵³⁹

⁵³⁹ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>



Circa 8,801 HE – circa 9,601 HE: Olmec mask; Jadeite mask, Olmec culture, Mexico, now in the Metropolitan Museum of Art, New York City, bequest of Alice K. Bache, **11,977 HE.**⁵⁴⁰

⁵⁴⁰ <https://www.britannica.com/topic/Olmec>



Circa 8,801 HE – circa 9,601 HE: Olmec figure; ceramic, cinnabar, red ochre from Mexico. 34 × 31.8 × 14.6 cm. Photograph by Katie Chao. The Metropolitan Museum of Art, New York City, Michael C. Rockefeller Memorial Collection, bequest of Nelson A. Rockefeller in **11,979 HE**.⁵⁴¹

⁵⁴¹ <https://www.britannica.com/topic/Olmec>



Circa 9,401 HE: The major Formative Period (Pre-Classic Era) sites in present-day Mexico which show Olmec influences in the archaeological record.⁵⁴²

⁵⁴² <https://en.wikipedia.org/wiki/Olmec>

⇒ The ancient Mesoamerican tribes of Mexico, such as the Aztec and Olmec, practiced a sweat bath ceremony known as temazcal as a religious rite of penance and purification.⁵⁴³

Circa 8,801 HE – circa 9,201 HE: The Greek Dark Ages⁵⁴⁴ began because the Dorians used iron ore from meteorites to make their weapons and crushed the bronze weapon using Mycenaeans.⁵⁴⁵

⇒ Records show that the ancient Greeks seemed unsure about the status of zero as a number. Their thought experiments were along the line of “How can nothing be something?”⁵⁴⁶

⁵⁴³ https://en.wikipedia.org/wiki/Sweat_lodge

⁵⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁴⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁴⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Ancient	Value
Α	1
Β	2
Γ	3
Δ	4
Ε	5
Ϛ	6
Ζ	7
Η	8
Θ	9



Images of examples of Ancient Greek Numerals using the letters of the Greek alphabet.⁵⁴⁷

Circa 8,901 HE: The Phoenicians first developed sea routes around the entire Mediterranean. They used oars.⁵⁴⁸

⁵⁴⁷ https://en.wikipedia.org/wiki/Greek_numerals

⁵⁴⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Chapter Five

THE IRON AGE: CIRCA 9,001 HE- CIRCA 11,543 HE (lasting circa 2,760 years)

When tools were made from iron and steel. THE IRON AGE ended with the emergence of the Scientific Revolution. Some historians end the Iron Age in Roman times, but have trouble agreeing on labels for the following periods. This timeline could have spoken of the Dark Ages, the Renaissance, etc., but we decided to have the Iron Age chapter run until the beginning of the chapter of the Scientific Revolution.

Circa 9,001 HE: Iron age began, Steel was developed.⁵⁴⁹

⁵⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Circa 9,001 HE – Map of Eastern Hemisphere Human Population groups.
At this time approximately there were about 50,000,000 people.⁵⁵⁰



⁵⁵⁰ <http://www.worldometers.info/world-population/world-population-by-year/>

⁵⁵¹ http://worldhistorymaps.info/images/East-Hem_1000bc.jpg Thomas Lessman

Circa 9,001 HE: Bronze developed in China.



China, A bronze ritual bell, Zhou Dynasty, photographer and location unknown.⁵⁵²

⁵⁵² https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 9,051 HE - current: Africa, Berber Agricultural Calendar started, Tuareg people. (Starting from the **11,960s HE**, however, on the initiative of the Academie Berbere in Paris, some Berbers have begun computing the years starting from **9,051 HE**, the approximate date of the rising into power of the first Libyan Pharaoh in Egypt, Shosheng I, whom they identified as the first prominent Berber in history.)⁵⁵³

Circa 9,101 HE: Camels domesticated in the southern Levant (Israel / Jordan area) in conjunction with expanding copper mining.⁵⁵⁴

Circa 9,181 HE: AL-MAHAINI, Persia, conceived the idea of reducing geometrical problems such as doubling the cube to problems in the not yet named area of math now called Algebra.⁵⁵⁵

⁵⁵³ https://en.wikipedia.org/wiki/Berber_calendar

⁵⁵⁴ <https://www.sciencedaily.com/releases/2014/02/140203131518.htm>

⁵⁵⁵ https://en.wikipedia.org/wiki/Timeline_of_geometry

Circa 9,201 HE – Circa 10,600 HE: Ancient Greek birth control methods:

- ⇒ Plants commonly used for birth control in ancient Greece included:
- Queen Anne's lace (*Daucus carota*),
 - willow,
 - date palm,
 - pomegranate,
 - pennyroyal,
 - artemisia,
 - myrrh,
 - and rue.
-
- Some of these plants are toxic and ancient Greek documents specify safe dosages. Recent studies have confirmed the birth control properties of many of these plants, confirming for example that Queen Anne's lace has post coital anti-fertility

properties. Queen Anne's lace is still used today for birth control in India.⁵⁵⁶

- ⇒ The single most effective method of birth control known in antiquity was probably coitus interruptus.⁵⁵⁷
- ⇒ The ancient Greek philosopher ARISTOTLE (see Circa **9,617 HE** – **9,678 HE** ARISTOTLE) recommended applying cedar oil to the womb before intercourse. ARISTOTLE, and the humans of his time, had no knowledge of how conception worked, and he probably recommended this believing that the oil's smoothness would prevent conception. In reality, this method may have sometimes been effective because the oil may have gummed up the area which thereby reduced the mobility of the sperm, but

⁵⁵⁶ https://en.wikipedia.org/wiki/History_of_birth_control

⁵⁵⁷ https://en.wikipedia.org/wiki/History_of_birth_control

effectiveness would have been only occasional and highly variable.⁵⁵⁸

Circa 9,201 HE: BAUDHAYANA, India, mathematician of the 4 books of Dharmasūtra of Baudhayana Sulba *Sutra is a Vedic Sanskrit geometric text*, contains quadratic equations, and calculates the irrational number that is the square root of 2 correct to five decimal places, did work with what became known as the Pythagorean theorem, and circling the square.⁵⁵⁹ (The other 3 books, not the geometric text part of the Dharmasutra, sound like a bible /religious/ power over people... even written at different times....this was before the printing press.)

Circa 9,201 HE – 9,501 HE: Hallstatt Culture, named for a lakeside village in the Austrian Salzkammergut southeast of Salzburg where

⁵⁵⁸ https://en.wikipedia.org/wiki/History_of_birth_control

⁵⁵⁹ https://en.wikipedia.org/wiki/Baudhayana_sutras

there was a rich salt mine, and some 1,300 burials are known, many with fine artefacts, was the was the predominant Western and Central European culture of the time.⁵⁶⁰

⇒ The Hallstatt culture was based on farming, but metal-working was considerably advanced, and by the end of the period long-range trade within the area and with Mediterranean cultures was economically significant. Social distinctions became increasingly important, with emerging elite classes of chieftains and warriors, and perhaps those with other skills. Society was organized on a tribal basis, though very little is known about this. Only a few of the largest settlements, like Heuneburg in the south of Germany, were towns rather than villages by modern standards.⁵⁶¹

⁵⁶⁰ https://en.wikipedia.org/wiki/Hallstatt_culture

⁵⁶¹ https://en.wikipedia.org/wiki/Hallstatt_culture



Textile fragment recovered from the Hallstatt salt mine.⁵⁶²

⁵⁶² https://en.wikipedia.org/wiki/Hallstatt_Museum



Bronze container with stand, Hallstatt Ha C, photographer unknown.⁵⁶³

⁵⁶³ https://en.wikipedia.org/wiki/Hallstatt_Museum



Watercolor commissioned by JOHANN G. RAMSAUER documenting one of his cemetery digs at Hallstatt; unknown local artist.⁵⁶⁴

⁵⁶⁴ https://en.wikipedia.org/wiki/Hallstatt_culture



The Strettweg Cult Wagon, one of the most elaborate objects from the **Circa 9,201 HE – 9,501 HE** Hallstatt period. Location: Der Kultwagen von Strettweg im Archäologiemuseum in Graz, Österreich.⁵⁶⁵

⁵⁶⁵ https://en.wikipedia.org/wiki/Hallstatt_culture



Hallstatt Geographical Range was Europe, North of Current day Italy.⁵⁶⁶

⁵⁶⁶ https://en.wikipedia.org/wiki/Hallstatt_culture

Circa 9,206 HE: AL-BATANI, Turkey, Astronomer and mathematician⁵⁶⁷



A modern artist's impression of AL-BATANI holding an astrolabe.⁵⁶⁸

⁵⁶⁷ <https://en.wikipedia.org/wiki/Al-Battani>

⁵⁶⁸ <https://en.wikipedia.org/wiki/Al-Battani>

⇒ AL-BATANI Extended the Indian concepts of sine and cosine to other trigonometrical ratios, like tangent, secant and their inverse functions.⁵⁶⁹

Circa 9,225 HE - 10,394 HE: The first Olympic Games held among representatives of Archaic Greece city-states. They were held in honor of Zeus, and the Greeks gave them a mythological origin. The games were held every four years, or an *Olympiad*, which became a unit of time in historical chronologies. They continued to be celebrated when Greece came under Roman rule, until the emperor Theodosius I suppressed them in **10,394 HE** as part of the campaign to impose Christianity as the state religion of Rome.⁵⁷⁰

⁵⁶⁹ <https://en.wikipedia.org/wiki/Al-Battani>

⁵⁷⁰ https://en.wikipedia.org/wiki/Ancient_Olympic_Games

Circa 9,248 HE: Roman Calendar: AUC: “ab urbe condita” AUC or “anno urbis” AU; initiated by Roman scholar Marcus Terentius Varro; AKA Founding of City of Rome Calendar.⁵⁷¹

Circa 9,251 HE – Circa 10,080 HE: Etruscans built arches for the first time that could span a wider distance and hold more weight.⁵⁷²

⁵⁷¹ https://en.wikipedia.org/wiki/Ab_urbe_condita

⁵⁷² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery



This Etruscan arch is part of a massive set of walls which are 30 feet tall and 9,500 feet long made of travertine and set without mortar. It covers approximately a quarter of a square mile over three hills.⁵⁷³

⁵⁷³ https://en.wikipedia.org/wiki/Etruscan_Arch

Circa 9,251 HE – c 9,501 HE: During this time span, Greece was lifting from its dark ages into the Archaic Greek era.⁵⁷⁴

Circa 9,251 HE: Greece, Homer is credited with creation of the epic tales⁵⁷⁵ *Iliad* and *Odyssey*. These started as verbal accounts and were not written until many years later.⁵⁷⁶

Circa 9,301 HE: Assyria and Jerusalem built aqueducts.⁵⁷⁷ Egypt built Sundials.⁵⁷⁸

Circa 9,301 HE – 9,401 HE: MASTER TUNG-HSUAN, the Chinese physician, documented both coitus reservatus and coitus obstructus, which prevents the release of semen during intercourse. However, it

⁵⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁷⁶ <https://en.wikipedia.org/wiki/Homer>

⁵⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁷⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

is not known if these methods were used primarily as birth control methods or to preserve the man's yang. In the same century SUN SIMIAO documented the "*thousand of gold contraceptive prescription*" for women who no longer want to bear children. This prescription, which was supposed to induce sterility, was made of oil and quicksilver heated together for one day and taken orally.⁵⁷⁹ (Author / Compiler's note: evidently they did not know the toxic nature of quicksilver, i.e., the star-stuff element Mercury.)

Circa 9,301 HE: Mogador Island, Essaouira, Morocco.

⁵⁷⁹ Middleberg, Maurice I. (12,003 HE). *Promoting reproductive security in developing countries.* Springer. p. 4. ISBN 978-0-306-47449-1.



Phoenician plate with red slip; at Sidi Mohammed ben Abdallah Museum.⁵⁸⁰

⁵⁸⁰ http://www.digplanet.com/wiki/Sidi_Mohammed_ben_Abdallah_Museum

Circa 9,341 HE: Japan, as a nation came under its first emperor Jimmu Tenno.⁵⁸¹

Circa 9,361 HE: First libraries consisting of a few volumes started. “Books”, whether clay bricks covered with cuneiform or papyrus covered with hieroglyphics and rolled (the word *volume* comes from the Latin word to roll up)⁵⁸²

Circa 9,361 HE: Nineveh, the monarch: “Ashurbanipal” arranged to have every cuneiform document in his kingdom to be copied for his personal library.^{583 584}

⁵⁸¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵⁸² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵⁸³ <https://en.wikipedia.org/wiki/Ashurbanipal>

⁵⁸⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

Circa 9,361 HE: Bartering started to be replaced with the use of coins.⁵⁸⁵

Circa 9,401 HE: Ancient Greek bathing: Greeks original form of bathing consisted of nothing more than a quick plunge into icy water until the people of Laconica came upon the idea of a hot-air bath. The hot-air bath later came to be known as a laconica bath. The people of Laconica were from the Sparta area.⁵⁸⁶

Circa 9,401 HE: Asia Minor, city of Magnesia, legend said a shepherd discovered that a certain type of ore which attracted iron.⁵⁸⁷
Knowledge spread and...

⁵⁸⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁸⁶ https://en.wikipedia.org/wiki/Greek_Baths and Françoise de Bonneville's *The Book of the Bath*

⁵⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

- ⇒ ...THALES studied the fact in Circa **9,416 HE** (the dates are approximate) and knowledge spread and ... in China, unknown HE date, it was discovered that if a magnetic sliver was allowed to turn freely it would come to a resting point in a north – south position...⁵⁸⁸
- ⇒ ...eventually by Circa **11,800 HE**, English scholar ALEXANDER NECKAM was the first to refer to the directional ability of magnetism and Europeans put a magnetic needle on a card marked with directions and called it the magnetic compass (the French word for “to go around”).⁵⁸⁹

⁵⁸⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 80

⁵⁸⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 80

Circa 9,450 HE -9,522 HE: CONFUCIUS, Latinized version of the CHINESE NAME KUNG FU-TZU:⁵⁹⁰ CONFUCIUS wrote about ethical-sociopolitical teachings, core family, social harmony, and humanistic values”⁵⁹¹



A portrait of CONFUCIUS by the Tang dynasty artist Wu Daozi, artist and location unknown.⁵⁹²

⁵⁹⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵⁹¹ <https://en.wikipedia.org/wiki/Confucius>

⁵⁹² <https://en.wikipedia.org/wiki/Confucius>



Confucius Analects, artist and location unknown.⁵⁹³

⁵⁹³ <https://en.wikipedia.org/wiki/Analects>

Circa 9,451 HE: ALCMAEON OF CROTON, Greek, Natural philosopher of science and medical theorist was the first recorded European to take the chance of deliberately and carefully dissecting humans.⁵⁹⁴

⇒ ALCMAEON OF CROTON was the first to discover part of the ear connecting the ear and the throat.⁵⁹⁵ (see **11,552 HE BARTOLOMMEO EUSTATCHIO**)

Circa 9,455 HE: THALES, Greek Scientist, Mathematician, Astronomer, Philosopher was the first to ask, “What was the universe made of?” THALES thought in terms of “elements.”⁵⁹⁶ It was THALES who realized the workings of nature could be explained without invoking the supernatural.⁵⁹⁷

⁵⁹⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵⁹⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 112

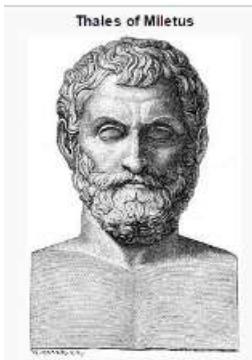
⁵⁹⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁵⁹⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

- ⇒ THALES studied the movements of the sun and the moon. THALES was one of the early astronomers who learned to predict when eclipses would take place. THALES made the first step toward defining eclipses as unavoidable and removed their ominous connotations.⁵⁹⁸
- ⇒ *Though none of the books THALES is said to have written survive*, THALES kindled a flame that still burns to this day: The very idea of cosmos out of chaos, a universe governed by the order of natural laws that we can figure out.⁵⁹⁹

⁵⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁹⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6



THALES, artist, date and location unknown.⁶⁰⁰



There was a moment when Humanity awakened to a new way of thinking and seeing. It happened about 2,500 years ago, on the Greek islands that lie between the empires of the east and west. But

⁶⁰⁰ <https://en.wikipedia.org/wiki/Thales>

the view of Ann Druyan (in COSMOS, A Space Time Odyssey, hosted by Neil de Grasse Tyson) is that the most revolutionary innovation of all to come to humanity from THALES ancient world was the idea that natural events were neither punishment nor reward from capricious gods.⁶⁰¹

Circa 9,455 HE – 10,400 HE: This map spans a millennium of prominent Greco-Roman mathematicians, from THALES of Miletus to HYPATIA of Alexandria. Their names are on the map under their cities of birth.⁶⁰²

⁶⁰¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

⁶⁰² <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



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Circa 9,481 HE: Athens was moving towards a democracy. Sparta was becoming more militaristic.⁶⁰⁴

Circa 9,481 HE: PYTHAGORAS, Greek mathematician, scientist; Best known for the Pythagorean Theorem. Studied propositional geometry and vibrating lyre strings.⁶⁰⁵



Bust of PYTHAGORAS of Samos in the Capitoline Museums, Rome.⁶⁰⁶

⁶⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶⁰⁶ <https://en.wikipedia.org/wiki/Pythagoras>

⇒ **PYTHAGORAS** was the first Greek to realize the bright planet that appeared in the western sky after sunset (which they called “Hesperos” – the Greek word for evening) was the same planet that appeared in the eastern sky before sunrise (which they called Phosphoros – the Greek word for “light-bringer”) were actually the same object. **PYTHAGORAS** actually named this single planet “Aphrodite” after the Greek goddess of love and beauty.⁶⁰⁷

Circa 9,481 HE: China may have had a population of over 20,000,000 people.⁶⁰⁸

Circa 9,481 HE: The Persian Empire may have had a population of over 15,000,000 people.⁶⁰⁹

⁶⁰⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁶⁰⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

⁶⁰⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

Circa 9,491 HE: ANAXAGORAS, Pre-Socratic Greek Philosopher described the world as a mixture of primary imperishable ingredients, where material variation was never caused by an absolute presence of a particular ingredient, but rather by its relative preponderance over the other ingredients. In his words, "each one is... most manifestly those things of which there are the most in it".⁶¹⁰

⇒ ANAXAGORAS also gave a number of novel scientific accounts of natural phenomena. ANAXAGORAS produced another correct explanation for eclipses and described the sun as a fiery mass larger than the Peloponnese, as well as attempting to explain rainbows and meteors.⁶¹¹

⁶¹⁰ <https://en.wikipedia.org/wiki/Anaxagoras>

⁶¹¹ <https://en.wikipedia.org/wiki/Anaxagoras>



ANAXAGORAS, part of a fresco in the portico of the National University of Athens.⁶¹²

⁶¹² <https://en.wikipedia.org/wiki/Anaxagoras>

Circa 9,491 HE: HECATAEUS OF MILETUS, Greek traveler⁶¹³ drew the first surviving map. However, it is said to have been improving a not surviving map by ANAXIMANDER. HECATAEUS OF MILETUS is the first known Greek historian and was one of the first classical writers to mention the Celtic people.

⇒ In his writings HECATAEUS OF MILETUS was probably the first of the logographers to attempt a serious prose history and to employ critical method to distinguish myth from historical fact. HECATAEUS OF MILETUS had skepticism for he recognized that oral history is untrustworthy.⁶¹⁴

⁶¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶¹⁴ https://en.wikipedia.org/wiki/Hecataeus_of_Miletus



Reconstruction of HECATAEUS's map, location unknown.⁶¹⁵

⁶¹⁵ https://en.wikipedia.org/wiki/Hecataeus_of_Miletus

Circa 9,494 HE – 9,561 HE: LU BAN, Chinese carpenter, engineer and inventor is credited with inventing: the saw, the square, the planer, the drill, the shovel, and an ink marking tool — to complete his many projects more quickly. His other inventions include a “Cloud ladder”, a mobile, counterweighted siege ladder, grappling hooks and ram—implements for naval warfare; and a Wooden bird—a non-powered, flying, wooden bird which could stay in the air for three days. It has been suggested to be a prototype of a kite.⁶¹⁶ The kite may have been the first form of Human-made aircraft.⁶¹⁷

⇒ LU BAN’s wife was also credited with inventing the umbrella in order to permit him to work in inclement weather.⁶¹⁸

⁶¹⁶ https://en.wikipedia.org/wiki/Lu_Ban

⁶¹⁷ https://en.wikipedia.org/wiki/History_of_aviation

⁶¹⁸ https://en.wikipedia.org/wiki/Lu_Ban

Circa 9,501 HE: Map of Eastern Hemisphere Human population groups.
At this time the human population was about 100,000,000 people.⁶¹⁹



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⁶¹⁹ <http://www.worldometers.info/world-population/world-population-by-year/>

⁶²⁰ <http://worldhistorymaps.info/>; Thomas Lessman

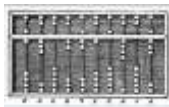
Circa 9,501 HE – 9,901 HE: Ancient Greece Olympia Bathhouse:

⇒ A Greek bathhouse of circa **9,501 HE** started off as nothing more than a single rectangular structure 20 meters long and four meters wide. A well was situated at one end of the room where the athletes could draw water. The bath was renovated upon several occasions. The first being around **9,601 HE** saw a smaller room added where small built tubs were put along the north and east side and an adjacent swimming pool. The third renovation took place around **9,901 HE** which saw an addition of a large apsidal room to the south along with a hypocaust system.⁶²¹

⁶²¹ https://en.wikipedia.org/wiki/Greek_Baths; and Françoise de Bonneville's *The Book of the Bath*

Circa 9,501 HE: The Abacus, Egypt, the first really important computing device worked out by humans.^{622 623}

⇒ The earliest known written documentation of the Chinese abacus dates to the **9,801 HE**.⁶²⁴



⇒ A Chinese abacus (suanpan) (the number represented in the picture is 6,302,715,408).⁶²⁵

⁶²² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶²³ <https://en.wikipedia.org/wiki/Abacus#Egyptian>

⁶²⁴ <https://en.wikipedia.org/wiki/Abacus#Chinese>

⁶²⁵ Encyclopædia Britannica - Article for "abacus", 9th edition Encyclopædia Britannica, volume 1 (11,875 HE); scanned and uploaded by Malcolm Farmer Transferred from en.wikipedia to Commons.

Circa 9,501 HE: HIPPOCRATES OF CHIOS, Ancient Greek mathematician, geometer, and astronomer was the first Greek to write a systematically organized geometry textbook, called *Elements* (Στοιχεῖα, Stoicheia), It included basic theorems, or building blocks of mathematical theory. HIPPOCRATES OF CHIOS attempted to square a circle. From then on, mathematicians from all over the ancient world could, at least in principle, build on a common framework of basic concepts, methods, and theorems, which stimulated the scientific progress of mathematics.⁶²⁶

Circa 9,501 HE: APASTAMBA, Ancient India, Editor of *Apastamba Vedic Sanskrit geometric text*, tries at squaring the circle and also calculates the square root of 2 correct to five decimal places.⁶²⁷

⁶²⁶ https://en.wikipedia.org/wiki/Hippocrates_of_Chios

⁶²⁷ https://en.wikipedia.org/wiki/Timeline_of_geometry

Circa 9,501 HE: PANINI, India, mathematician

⇒ PANINI's notations were similar to, (so may have launched?) modern mathematical notation, and PANINI used metarules, transformations, and recursion.^{628 629}

Circa 9,501 HE – circa 9,678 HE: 12 different Classical or Ancient Greek calendars based on regions were in use during this time.⁶³⁰

Circa 9,521 HE: The Greeks further felt that the universe ran according to laws of nature that could be understood by observation and reasoning

⁶²⁸ https://en.wikipedia.org/wiki/History_of_mathematics

⁶²⁹ Kadwany, John (2008-02-08). "Positional Value and Linguistic Recursion". Journal of Indian Philosophy

⁶³⁰ https://en.wikipedia.org/wiki/Hellenic_calendars

and did not require supernatural force or any force outside of or superior to the laws of nature.⁶³¹

Circa 9,531 HE – 9,610 HE: MOZI (Chinese: 墨子; pinyin: *Mòzǐ*; Wade–Giles: *Mo Tzu*, Lat. as Micius, original name Mo Di (墨翟, was a Chinese philosopher during the Hundred Schools of Thought period (early Warring States period).⁶³²

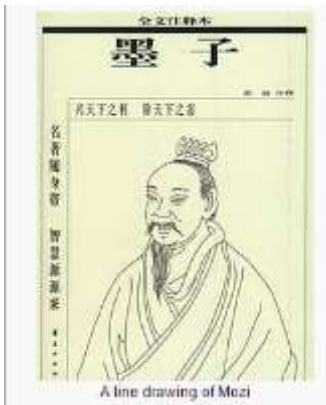
⇒ In MOZI's writings could be found early stirrings of the scientific approach.⁶³³ By MO TZE's time, the Chinese had already been recording their thoughts in books for at least a thousand years.⁶³⁴

⁶³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶³² <https://en.wikipedia.org/wiki/Mozi>

⁶³³ <http://web.newworldencyclopedia.org/entry/Mozi>

⁶³⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



HE date unknown: line drawing of MO TZE, artist and location unknown.⁶³⁵

⁶³⁵ <http://web.newworldencyclopedia.org/entry/Mozu>



A page from the Mozi, location unknown.⁶³⁶

⁶³⁶ <http://web.newworldencyclopedia.org/entry/Mozi>

⇒ Author / Compiler Note: See what happened to these works approximately 200 years later in the world's first book burning: Circa **9,741 HE** – **9,791 HE** by first emperor of China: Qin Shi Huang.⁶³⁷

Circa 9,541 HE: DEMOCRITUS: Greek, (/dɪ'mɒkrɪtəs/; Greek: Δημόκριτος, *Dēmókritos*, meaning "chosen of the people"⁶³⁸ was an influential Ancient Greek pre-Socratic philosopher primarily remembered today for his formulation of an atomic theory of the universe.⁶³⁹

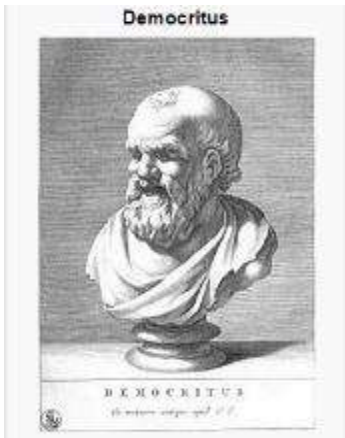
⁶³⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶³⁸ <https://en.wikipedia.org/wiki/Democritus>

⁶³⁹ <https://en.wikipedia.org/wiki/Democritus>

- ⇒ Neither DEMOCRITUS nor LEUCIPPUS had evidence for their atomistic views. They were only speculations, and the notions were rejected in their own time. It was to be circa 2,300 years before atomistic views began to gain ascendancy.⁶⁴⁰
- ⇒ (See among others: **11,627 HE – 11,691 HE**: ROBERT BOYLE and the work he did circa 2140 years after DEMOCRITUS predicted atoms; and see **11,893 HE – 11,916 HE**: the scientist ERNST MACH who, more than 200 years even after BOYLE, declared, after an **11,897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!" and then see **11,922 HE**: when NIELS HENRIK DAVID BOHR got the Nobel Prize for defining the structure of an atom circa 2,381 years after DEMOCRITUS' prediction.)

⁶⁴⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



DEMOCRITUS, artist and location unknown.⁶⁴¹

⁶⁴¹ <https://en.wikipedia.org/wiki/Democritus>



Rembrandt, The Young Rembrandt as
Democritus the Laughing Philosopher (1628-
29)



Rembrandt as Democritus, The Laughing Philosopher **11,628**
HE.⁶⁴²

⁶⁴² <https://en.wikipedia.org/wiki/Democritus>

Circa 9,567 HE: The Greek Historian HERODOTUS wrote of a Phoenician voyage, saying that he doubted people could live south of the Equator – actually feeling it was impossible- but that the Phoenicians reported during their voyage in the far south, the noonday sun was in the northern half of the sky.⁶⁴³

⇒ HERODOTUS was the first historian known to have broken from Homeric tradition to treat historical subjects as a method of investigation—specifically, by collecting his materials systematically and critically, and then arranging them into a historiographic narrative. *The Histories* is the only work which he is known to have produced.⁶⁴⁴

⇒ NOTE: HERODOTUS was not alone in doubting people could live south of the Equator. From the start of European people of that area

⁶⁴³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶⁴⁴ <https://en.wikipedia.org/wiki/Herodotus>

– **circa 9,851 HE**: A common European misconception of those thousands of years was that anyone living below the equator would melt into deformity from the horrible heat. This misbelief was updated when the Phoenicians mapped below the equator.⁶⁴⁵

Circa 9,569 HE: EUCTEMON AND METON⁶⁴⁶: Athenian astronomers⁶⁴⁷ who made records of the summer solstice of **9,569 HE** which they observed⁶⁴⁸ in an astronomical observatory that was most likely part of the Library of Alexandria. Their equipment would have been simple, most likely consisting of gnomons (sundials) and an armillary sphere.⁶⁴⁹ Chris Parkin presents an animated explanation of

⁶⁴⁵ Dava Sobel's book: *Longitude*

⁶⁴⁶ <https://en.wikipedia.org/wiki/Timocharis>

⁶⁴⁷ <https://en.wikipedia.org/wiki/Euctemon>

⁶⁴⁸ <https://en.wikipedia.org/wiki/Euctemon>

⁶⁴⁹ <https://en.wikipedia.org/wiki/Timocharis>

the Armillary Sphere from the Museum of the History of Science collection.⁶⁵⁰

⇒ METON's further observations⁶⁵¹ lead to the Metonic calendar which incorporates knowledge that 19 solar years and 235 lunar months are very near equal, thus lunar periods often, but not unconditionally, repeat on the same day of the year as 19 years previous.⁶⁵²

Circa 9,574 HE– 9,654 HE: PLATO, Greek philosopher who laid the very foundations of Western philosophy and science.⁶⁵³ Some 250 known manuscripts of PLATO survive.⁶⁵⁴

⁶⁵⁰ <https://www.youtube.com/watch?v=AaWuJHQL-bQ>

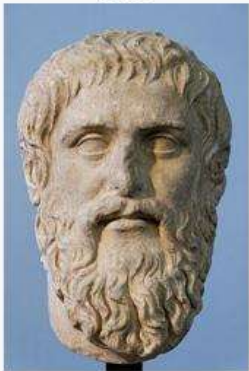
⁶⁵¹ https://en.wikipedia.org/wiki/Meton_of_Athens

⁶⁵² https://en.wikipedia.org/wiki/Meton_of_Athens

⁶⁵³ "Plato". Encyclopedia Britannica. 2002

⁶⁵⁴ <https://en.wikipedia.org/wiki/Plato>


Plato



Circa 9,631 HE Roman Copy of a portrait bust by Silanion.
Photographer and location unknown.⁶⁵⁵

⁶⁵⁵ <https://en.wikipedia.org/wiki/Plato>



Papyrus Oxyrhynchus, with fragment 
of Plato's *Republic*



Papyrus Oxythynchus, with fragment of PLATO's *Republic*.⁶⁵⁶
Photographer and location unknown.

⁶⁵⁶ <https://en.wikipedia.org/wiki/Plato>



PLATO'S CAVE⁶⁵⁷

⁶⁵⁷ LAWRENCE M. KRAUSE *The Greatest Story Ever Told: So Far*

⇒ Brief recount of “The Allegory of PLATO’s CAVE”: ...The people in the cave discovered the sun, which PLATO uses as an analogy for the fire that man cannot see behind them. Like the fire that cast light on the walls of the cave, in front of where they sat, the human condition is forever bound to the impressions that are received through the senses.⁶⁵⁸

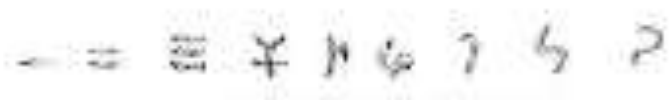
Circa 9,601 HE: Greeks developed trade routes in the Mediterranean using the length of the day, corrected for the time of the year, to estimate latitude.⁶⁵⁹

Circa 9,601 HE – 10,200 HE: Indian Sub-continent: Jain mathematicians in India wrote the “*Sthananga Sutra*”, which contains work on the theory of numbers, arithmetical operations, geometry, operations with

⁶⁵⁸ https://en.wikipedia.org/wiki/Allegory_of_the_Cave

⁶⁵⁹ https://en.wikipedia.org/wiki/Ocean_exploration

fractions, simple equations, cubic equations, quartic equations, and permutations and combinations.^{660 661}



⇒

Jain first numerals; no zero yet⁶⁶²

⇒ The math book the “*Sthananga Sutra*” also gives classifications of five types of infinities.⁶⁶³

⇒ The topics of mathematics, according to the Sthananga-sutra (sutra 747) are ten in numbers: Parikarma (four fundamental operations),

⁶⁶⁰ https://en.wikipedia.org/wiki/Sthananga_Sutra

⁶⁶¹ G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 11,991 HE)

⁶⁶² G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 11,991 HE)

⁶⁶³ https://en.wikipedia.org/wiki/Sthananga_Sutra

Vyavahara (subjects of treatment), Rajju (geometry), Rashi (mensuration of solid bodies), Kalasavarna (fractions), Yavat-tavat (simple equation), Varga (quadratic equation), Ghana (cubic equation), Varga-varga (biquadratic equation) and Vikalpa (permutation and combination).⁶⁶⁴

Circa 9,617 HE – 9,678 HE: ARISTOTLE, Greek philosopher who began studying at PLATO's Academy and who developed the method of identifying a question by gathering information from others and from self, and then developing ideas. ARISTOTLE developed the pre-cursor to the now used Scientific Method.⁶⁶⁵

⇒ Updated language by BBC Earth: ARISTOTLE said in his book "Again, our observations of the stars make it evident, not only that

⁶⁶⁴ https://en.wikipedia.org/wiki/Sthananga_Sutra

⁶⁶⁵ <https://en.wikipedia.org/wiki/Aristotle>

the Earth is circular, but also that it is a circle of no great size. For quite a small change of position to south or north causes a manifest alteration of the horizon."⁶⁶⁶

- ⇒ ARISTOTLE classified and arranged over 500 animal species into hierarchies.⁶⁶⁷

- ⇒ ARISTOTLE had an idea about time. It was different than ISAAC NEWTON's idea of time. It was ALBERT EINSTEIN who resolved the two differing opinions to define time as we now know it.⁶⁶⁸

⁶⁶⁶ <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

⁶⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

⁶⁶⁸ Carlo Rovelli's The Order of Time

- **ARISTOTLE (Circa 9,600 HE)** concluded that time is measured by the changing of things and that if nothing changes, there is no time.⁶⁶⁹
- **ISAAC NEWTON (see 11,642 HE– 11,727 HE)** concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.⁶⁷⁰
- **ALBERT EINSTEIN (see 11,879 HE – 11,955 HE)** concluded that both **ARISTOTLE** and **ISAAC NEWTON** were both correct when he combined mathematically space and time into “spacetime.” **ALBERT EINSTEIN** concluded that time varies depending on the observer’s frame of reference. Someone moving faster than someone else will experience time passing at

⁶⁶⁹ Carlo Roveli’s *The Order of Time*

⁶⁷⁰ Carlo Roveli’s *The Order of Time*

a different rate. Someone closer to a massive body (like a planet or like our sun) will experience time different than someone more distant to that massive body.⁶⁷¹

- ⇒ Some of ARISTOTLE 's zoological observations, such as on the hectocotyli (reproductive) arm of the octopus, were not confirmed or refuted until the **11,900's HE** (two thousand plus years later).⁶⁷²
- ⇒ Some of ARISTOTLE's works contain the earliest known formal study of logic, which was incorporated in the late **11,800's HE** into modern formal logic.⁶⁷³

⁶⁷¹ Carlo Roveli's *The Order of Time*

⁶⁷² <https://en.wikipedia.org/wiki/Aristotle>

⁶⁷³ <https://en.wikipedia.org/wiki/Aristotle>

- ⇒ Circa **9,663 HE**: ARISTOTLE began tutoring Alexander the Great.⁶⁷⁴
- ⇒ ARISTOTLE's school was called *Lyceum*. His lectures at the school were collected into nearly 150 volumes, representing a one-man encyclopedia of the knowledge of his times. *Some 50 of ARISTOTLE's volumes have survived through fortunate chance.* They were found in a pit in Asia Minor about **9,921 HE** by soldiers of the Roman general Lucius Cornelius Sulla and they were taken to Rome and copied.⁶⁷⁵
- ⇒ ARISTOTLE recorded the use of diving bells "...they enable the divers to respire equally well by letting down a cauldron, for this

⁶⁷⁴ <https://en.wikipedia.org/wiki/Aristotle>

⁶⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

does not fill with water, but retains the air, for it is forced straight down into the water."⁶⁷⁶



Roman copy in marble of a Greek bronze bust of ARISTOTLE by Lysippus **Circa 9,671 HE**. The alabaster mantle is modern.⁶⁷⁷

⁶⁷⁶ https://en.wikipedia.org/wiki/Timeline_of_diving_technology

⁶⁷⁷ <https://en.wikipedia.org/wiki/Aristotle>

Circa 9,631 HE – 9,701 HE: CALLIPPUS: Greek astronomer and mathematician⁶⁷⁸ who studied at the Academy of PLATO.

CALLIPPUS made careful measurements of the lengths of the seasons. CALLIPPUS also followed up on the work done by METON OF ATHENS to measure the length of the year and construct an accurate lunisolar calendar. The Callippic cycle of 76 years appears to be used in the Antikythera mechanism.⁶⁷⁹ (See **Circa 9,796 HE – 9,901 HE:** The Antikythera Mechanism.)

Circa 9,631 HE: HIPPOCRATES II of Kos, Greek, physician, was and is considered one of the most outstanding figures in the history of medicine. HIPPOCRATES II is referred to as the *“Father of Western*

⁶⁷⁸ https://en.wikipedia.org/wiki/Meton_of_Athens

⁶⁷⁹ <https://en.wikipedia.org/wiki/Callippus>

Medicine” in recognition of his lasting contributions to the field as the founder of the Hippocratic School of Medicine.⁶⁸⁰



A fragment of HIPPOCRATIES Oath on circa **9,631 HE** Papyrus Oxyrhynchus, location and photographer unknown.⁶⁸¹

⁶⁸⁰ <https://en.wikipedia.org/wiki/Hippocrates>

⁶⁸¹ https://en.wikipedia.org/wiki/Hippocratic_Oath

Circa 9,651 HE: EXDOXUS, Greek Mathematician was said to have drawn a better map of Earth than HECATAEUS and was the first Greek to attempt a map of the sky using longitude and latitude.⁶⁸²

Circa 9,678 HE – Circa 9,855 HE: Hellenistic Greek period.

Circa 9,681 HE: THEOPHRASTUS, Greek scholar who was the first Greek to write a systematic book on Botany, including 550 plant species from as far away as India.⁶⁸³

Circa 9,681 HE - 9,741 HE TIMOCHARIS⁶⁸⁴ was a Greek astronomer and philosopher and is regarded as the first astronomer to have made a recorded mention of the planet Mercury. He worked with

⁶⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

⁶⁸³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 47

⁶⁸⁴ <https://en.wikipedia.org/wiki/Hipparchus>

ARISTILLUS in an astronomical observatory that was most likely part of the Library of Alexandria. Their equipment would have been still the simple tools likely consisting of gnomons, sundials and an armillary sphere.⁶⁸⁵

Circa 9,681 HE - 9,741 HE: ARISTILLUS: Greek astronomer was among the earliest meridian-astronomy observers. Six of ARISTILLUS stellar declinations were preserved by CLAUDIUS PTOLEMY.⁶⁸⁶

Circa 9,689 HE: Appian Way: The first roman built road, it was 132 miles long between Rome and Capua.⁶⁸⁷

⁶⁸⁵ <https://en.wikipedia.org/wiki/Timocharis>

⁶⁸⁶ <https://en.wikipedia.org/wiki/Aristyllus>

⁶⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 48

Circa 9,689 HE: Another System of Chronology attempted; No political groupings among the ancients counted the years in the same way. Ancient dates are a bit hazy. Then in Greece, Alexander the Great's General Seleucus I started the SELEUCID ERA and the years were counted upwards with no regards to the succession of monarchs.⁶⁸⁸

Circa 9,691 HE - 9,771 HE: ARISTARCHUS OF SAMOS, ancient Greek astronomer and mathematician who presented the first known model that placed the Sun at the center of the known universe with the Earth revolving around it.^{689 690}

⇒ Like ANAXAGORAS before him, ARISTARCHUS OF SAMOS suspected and predicted that the stars were just other bodies like the

⁶⁸⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 54

⁶⁸⁹ https://en.wikipedia.org/wiki/Aristarchus_of_Samos

⁶⁹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 51

Sun, albeit further away from Earth. But did not have the math or tools to prove it.⁶⁹¹ (See **11,473 HE** - **11,543 HE: NICOLAUS COPERNICUS**)



ARISTARCHUS OF SAMOS Statue at the Aristotle University of Thessaloniki.⁶⁹²

⁶⁹¹ https://en.wikipedia.org/wiki/Aristarchus_of_Samos

⁶⁹² https://en.wikipedia.org/wiki/Aristarchus_of_Samos

Circa 9,696 HE: China, the world's earliest decimal multiplication table.⁶⁹³



The Tsinghua Bamboo Slips, containing the world's earliest decimal multiplication table, dated **9,696 HE** during the Warring States period.⁶⁹⁴

⁶⁹³ https://en.wikipedia.org/wiki/History_of_mathematics

⁶⁹⁴ https://en.wikipedia.org/wiki/History_of_mathematics

Circa 9,701 HE: Chankillo, AKA Chanquillo, Peru: Thirteen Towers Solar Observatory, a monthly sunset / sunrise complex built by still un-named culture of people in NW Peru.⁶⁹⁵



Thirteen Towers of Chankillo, viewed from the fortress, photographer and date unknown.⁶⁹⁶

⁶⁹⁵ <https://en.wikipedia.org/wiki/Chankillo>

⁶⁹⁶ <https://en.wikipedia.org/wiki/Chankillo>



Panorama of Chanquillo, photographer and date unknown.⁶⁹⁷

Circa 9,701 HE: The Morocco area: Essaouira.



Roman coins excavated in Essaouira.⁶⁹⁸

⁶⁹⁷ <https://en.wikipedia.org/wiki/Chankillo>

⁶⁹⁸ <https://en.wikipedia.org/wiki/Essaouira>

Circa 9,701 HE: PYTHIAS, Greek, observed the existence of true tides in the Atlantic Ocean and described them – and was disbelieved.⁶⁹⁹

Circa 9,701 HE: Ptolemy I, Aka Ptolemy I Soter Greek Egyptian Ruler⁷⁰⁰ ruled over Egypt after Alexander's death and he established his capital in Alexandria where he and his son Ptolemy II encouraged and funded scientists and thinkers to come together at their university called The Library of Alexandria or The Museum⁷⁰¹ or Museum of Alexandria, or Alexandrian Museum, or The Greek Mouseion (“Seat of the Muses”).

⇒ **Built Circa 9,721 HE:** it was the ancient centre of classical learning at Alexandria in Egypt. It was a research institute that was especially noted for its scientific and literary scholarship, the

⁶⁹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 49

⁷⁰⁰ Dava Sobel's book: *Longitude*

⁷⁰¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 49

Alexandrian Museum was built near the royal palace of Ptolemy I Soter (reigned Circa **9,678 HE** –**Circa 9,716 HE**).

- The best surviving description of the museum is by the Greek geographer and historian Strabo, who mentions that it was a large complex of buildings and gardens with richly decorated lecture and banquet halls linked by porticos, or colonnaded walks.⁷⁰²

⇒ The Fate of The Museum of Alexandria was two-fold:

- **Circa 9,953 HE:** The Royal Library was an unfortunate casualty of war. Authors of the time provided details of the destruction. Most explicit is by Plutarch, who, after a personal visit to

⁷⁰² <https://www.britannica.com/topic/Alexandrian-Museum>

Alexandria, explained that “Caesar was forced to repel the danger by using fire, which spread from the dockyards and destroyed the Great Library.”⁷⁰³

- The daughter library, protected by the Serapeum, subsisted another circa 438 years up to **Circa 10,391 HE**. Testimonies by contemporary eyewitnesses wrote of how when Christianity became the one and only religion acknowledged throughout the empire, Emperor Theodosius I in his zeal to wipe out all vestiges of paganism issued a decree in **10,391 HE** sanctioning the demolition of among other places, the Museum of Alexandria’s daughter library. Empowered by the imperial decree, Theophilus, bishop of Alexandria, led an attack on the Serapeum, and he himself gave the first blow. His frenzied

⁷⁰³ <https://www.britannica.com/topic/Library-of-Alexandria>

followers ran amok in the temple / daughter library, destroying and plundering. When the destruction was complete, Theophilus ordered a church to be built on the site.⁷⁰⁴



- Tetradrachm (Greek coin worth 4 drachmas) with portrait of Ptolemy I, in the British Museum, London.⁷⁰⁵

⁷⁰⁴ <https://www.britannica.com/topic/Library-of-Alexandria>

⁷⁰⁵ https://en.wikipedia.org/wiki/Ptolemy_I_Soter



Bust of PTOLEMY I in the Louvre Museum.⁷⁰⁶

⁷⁰⁶ https://en.wikipedia.org/wiki/Ptolemy_I_Soter

Circa 9,701 HE – 9,801 HE: PINGALA (Devanagari: पिङ्गल pingala) was an ancient sub-continent Indian mathematician who edited the *Chandahśāstra (also called Pingala-sutras)*, the earliest known treatise on Sanskrit prosody which presents the first known description of a binary numeral system in connection with the systematic enumeration of meters with fixed patterns of short and long syllables and which contains the Fibonacci numbers, called by PINGALA “mātrāmeru”.⁷⁰⁷ (See **Circa 11,170 HE – 11,250 HE:** LEONARDO BONACCI known as FIBONACCI.)

Circa 9,725 HE - 9,807 HE: ERATOSTHENES, Greek, mathematician, geographer, poet, astronomer, and music theorist.⁷⁰⁸

⁷⁰⁷ <https://en.wikipedia.org/wiki/Pingala>

⁷⁰⁸ MAX TEGMARK, Our Mathematical Universe

⇒ ERATOSTHENES correctly measured the Earth's circumference of 25,000 miles / 40,000 km in diameter.^{709 710}

- ERATOSTHENES discovered that at noon in the Egyptian city of Syene, the Sun was directly overhead on the summer solstice, whereas in Alexandria, 794 kilometers north, the Sun did not rise quite so high, 7.2 degrees south of straight overhead. Because ERATOSTHENES knew the distance between the two cities and measured how high in the sky the Sun rose to in each city at the same time, he did some trigonometry. His method was crude, but his answer was in the right ballpark. He showed how the Earth is round.

⁷⁰⁹ <https://en.wikipedia.org/wiki/Eratosthenes>

⁷¹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 99

⇒ The fact that Earth is round has been common knowledge, at least among the educated and powerful, ever since.^{711 712}



⇒

ERATOSTHENES, artist and location unknown.⁷¹³

⁷¹¹ <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

⁷¹² MAX TEGMARK, Our Mathematical Universe

⁷¹³ <https://en.wikipedia.org/wiki/Eratosthenes>

Circa 9,731 HE: EUCLID⁷¹⁴, Egypt Greek mathematician, often referred to as the "founder of geometry" or the "*father of geometry*". EUCLID wrote *The Elements* (Ancient Greek: Στοιχεῖα Stoicheia) which is a mathematical treatise consisting of 13 books. He was active in Alexandria during the reign of Ptolemy I.⁷¹⁵



“EUCLID”; **11,584 HE** colored woodcut- not his likeness because

⁷¹⁴ MAX TEGMARK, Our Mathematical Universe

⁷¹⁵ https://en.wikipedia.org/wiki/Euclid%27s_Elements

it was done circa 1,800 years after he lived. Artist and location unknown.⁷¹⁶



Photo is of a fragment of the: Published circa **9,701 HE**: A fragment of EUCLID'S *Elements* on part of the Oxyrhynchus papyri.⁷¹⁷

⁷¹⁶ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

⁷¹⁷ https://en.wikipedia.org/wiki/Euclid%27s_Elements

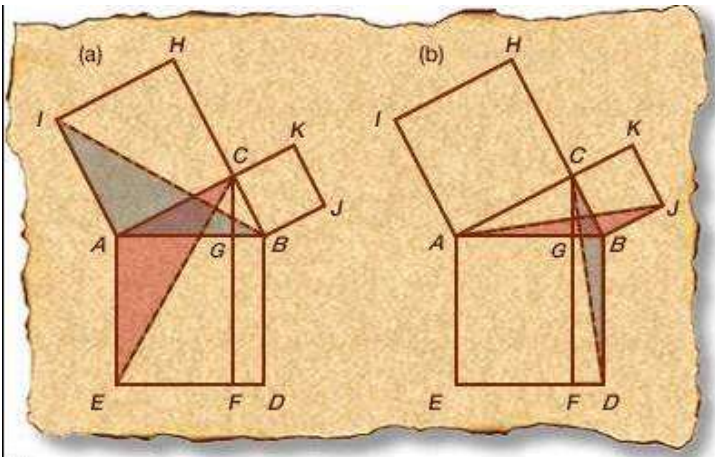
⇒ (Oxyrhynchus Papyri were written in Greek, Egyptian, Aramaic, Syrian and Pahlavi and are papyrus fragments the size of large cornflakes and are currently housed in institutions all over the world. A substantial number are housed in the Ashmolean Museum at Oxford University. There are estimated to be at least half a million papyri still remaining to be conserved, transcribed, deciphered and catalogued.⁷¹⁸)

⁷¹⁸ https://en.wikipedia.org/wiki/Oxyrhynchus_Papyri



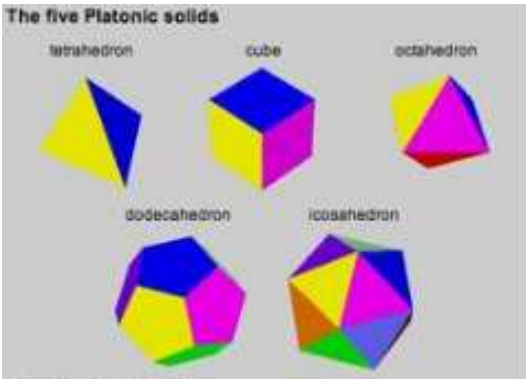
The frontispiece of Sir Henry Billingsley's first English version of EUCLID'S *Elements*, reprint **11,570 HE.**⁷¹⁹

⁷¹⁹ https://en.wikipedia.org/wiki/Euclid%27s_Elements



↪ **EUCLID's** Windmill proof.⁷²⁰

⁷²⁰ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



Current drawing of **EUCLID**'s five Platonic solids. These are the only geometric solids whose faces are composed of regular, identical polygons.⁷²¹

⁷²¹ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

Circa **9,731 HE**: CTESIBIUS, Greek inventor and mathematician invented the first water clock. Until CTESIBIUS's water clock was invented, for circa 3,730 years (See: **Circa 6,001 HE**: Sundial invented), humans had marked the passage of time using sundials and other crude measures such as the hour glass or candles that burned.⁷²²



CTESIBIUS's water clock, as visualized by the **11,600's HE** French architect Claude Perrault - dimensions unknown.⁷²³

⁷²² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 52

⁷²³ <https://en.wikipedia.org/wiki/Ctesibius>

Circa 9,741 HE: ARCHIMEDES, Syracuse, was an Ancient Greek mathematician, physicist, engineer, inventor, and astronomer.

⇒ ARCHIMEDES anticipated modern calculus and analysis by applying concepts of infinitesimals and the method of exhaustion to derive and rigorously prove a range of geometrical theorems, including the area of a circle, the surface area and volume of a sphere, and the area under a parabola. Other of his mathematical achievements include deriving an accurate approximation of pi, defining and investigating the spiral bearing his name, and creating a system using exponentiation for expressing very large numbers.⁷²⁴

⁷²⁴ <https://en.wikipedia.org/wiki/Archimedes>

- ⇒ ARCHIMEDES was also one of the first to apply mathematics to physical phenomena, founding hydrostatics and statics, including an explanation of the principle of the lever.⁷²⁵

- ⇒ ARCHIMEDES is credited with designing innovative machines, such as his screw pump, compound pulleys, and defensive war machines to protect his native Syracuse from invasion.⁷²⁶

- ⇒ ARCHIMEDES died during the Siege of Syracuse when he was killed by a Roman soldier despite orders that he should not be harmed.⁷²⁷

⁷²⁵ <https://en.wikipedia.org/wiki/Archimedes>

⁷²⁶ <https://en.wikipedia.org/wiki/Archimedes>

⁷²⁷ <https://en.wikipedia.org/wiki/Archimedes>



This bronze statue of ARCHIMEDES is at the Archenhold Observatory in Berlin. It was sculpted by Gerhard Thieme.⁷²⁸

⇒ ARCHIMEDES Legacies: GALILEO praised ARCHIMEDES many times and referred to him as a "superhuman". LEIBNIZ said, "He who understands ARCHIMEDES AND APOLLONIUS will

⁷²⁸https://upload.wikimedia.org/wikipedia/commons/2/25/Gerhard_Thieme_Archimedes.jpg

admire less the achievements of the foremost men of later times." There is a crater on the Moon named Archimedes (29.7° N, 4.0° W) in his honor, as well as a lunar mountain range, the Montes Archimedes (25.3° N, 4.6° W). The Fields Medal for outstanding achievement in mathematics carries a portrait of Archimedes, along with a carving illustrating his proof on the sphere and the cylinder. The inscription around the head of Archimedes is a quote attributed to him which reads in Latin: "Transire suum pectus mundoque potiri" (**Rise above oneself and grasp the world**). Archimedes has appeared on postage stamps issued by East Germany (**11,973 HE**), Greece (**11,983 HE**), Italy (**11,983 HE**), Nicaragua (**11,971 HE**), San Marino (**11,982 HE**), and Spain (**11,963 HE**). The exclamation of Eureka! attributed to Archimedes is the state motto of California. In this instance the word refers to the discovery of gold near

Sutter's Mill in **11,848 HE** which sparked the California Gold Rush.⁷²⁹

Circa 9,741 HE – 9,791 HE: Qin Shi Huang, first emperor of China. Most of us know Emperor Qin for the army of 7,000 terra cotta warriors that guard his tomb⁷³⁰ or as the leader behind the building of the Great Wall of China to keep the horses of the invading nomads from raiding the Chinese Peasants and taking their food or them for slaves.⁷³¹

⇒ However, Emperor Qin felt only his thoughts were important. He burned and destroyed the works of MO TZE (See Circa **9,531 HE** –

⁷²⁹ <https://en.wikipedia.org/wiki/Archimedes>

⁷³⁰ https://en.wikipedia.org/wiki/Qin_Shi_Huang

⁷³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 55

9,610 HE: MOZI) and CONFUCIUS (See Circa 9,450 HE -9,522 HE: CONFUCIUS).⁷³²

⇒ The works destroyed by him were victim of the world's first book burning.⁷³³

Circa 9,796 HE – 9,901 HE: The Antikythera Mechanism The world's oldest known astronomical calculator, the Antikythera Mechanism performs calculations based on both the Metonic and Callipic calendar cycles, with separate dials for each. (See **Circa 9,569 HE: METON** and **Circa 9,631 HE – 9,701 HE: CALLIPPUS:**)⁷³⁴

⁷³² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁷³³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁷³⁴ https://en.wikipedia.org/wiki/Meton_of_Athens



The Antikythera mechanism (Fragment A – front). National Archaeological Museum, Athens.⁷³⁵

⁷³⁵ https://en.wikipedia.org/wiki/Antikythera_mechanism



The Antikythera mechanism (Fragment A – back) National Archaeological Museum, Athens.⁷³⁶

⁷³⁶ https://en.wikipedia.org/wiki/Antikythera_mechanism

Circa 9,799 HE – 10,200 HE: China: Some of the earliest evidence of water wells dug for retrieval of fresh water deeper in the ground.⁷³⁷



Photo (location and photographer unknown) is of a Chinese ceramic model of a well with a water pulley system, excavated from a tomb of the Han Dynasty period.⁷³⁸

⁷³⁷ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation

⁷³⁸ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation

Circa 9,831 HE: In the small Hellenistic kingdom of Pergamum the ruler Eumemes II wanted to build a library to rival Alexandria. Egypt would not share papyrus, so Pergamum invented Parchment. The parchment skins could not be rolled into scrolls, they could only be cut into sheets and glued together into a Codex. This is the first form of printed books.⁷³⁹

Circa 9,851 HE: HIPPARCHUS: Ancient Greece, astronomer
HIPPARCHUS was the first to write careful tables relating angles to side ratios and is considered the founder of Trigonometry.⁷⁴⁰
HIPPARCHUS used the trigonometry he founded to calculate the distance from the Earth to the Moon.⁷⁴¹

⁷³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 56

⁷⁴⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57

⁷⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57

⇒ At its closest point (known as perigee) the Moon is only 363,104 km (225,622 miles) away. At its most distant point (called apogee) the Moon gets to a distance of 406,696 km (252,088 miles).⁷⁴²



⇒

Undated, unattributed drawing of HIPPARCHUS⁷⁴³

⁷⁴² <https://www.universetoday.com/103206/what-is-the-distance-to-the-moon/>

⁷⁴³ <https://en.wikipedia.org/wiki/Hipparchus>



Unattributed, HIPPARCHUS holding his celestial globe, in Raphael's The School of Athens (**circa 11,510 HE**)⁷⁴⁴

⁷⁴⁴ <https://en.wikipedia.org/wiki/Hipparchus>

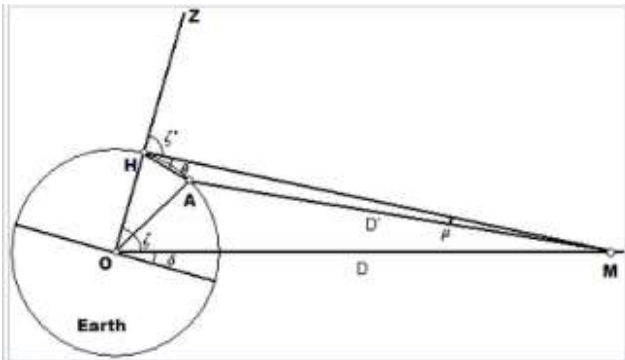


Diagram used in reconstructing one of HIPPARCHUS's methods of determining the distance to the moon. This represents the earth-moon system during a partial solar eclipse at A (Alexandria) and a total solar eclipse at H (Hellespont).⁷⁴⁵

⁷⁴⁵ <https://en.wikipedia.org/wiki/Hipparchus>

Circa 9,855 HE – Circa 10,529 HE: Antiquity Roman Greece Empire:

- ⇒ “Funny thing about the Romans. Even though they knew that contact with lead inevitably poisoned people, rendered them sterile and drove them mad, what metal did they use to make the pipes that carried the water through their legendary aqueducts? Druyan, through Neil deGrasse Tyson said “give you a hint”:⁷⁴⁶
- ⇒ What metal did the Romans use to line their famous baths? The word "plumbing" comes from the Latin word for lead, "plumbum". And how did the ancient Romans sweeten their wines when they were too sour? What did the ancient Romans use to line their vats and cooking pots? There are some historians who believe that the

⁷⁴⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

widespread use of lead was a major cause in the decline and fall of the Roman Empire.⁷⁴⁷

- ⇒ Why did the Romans continue to use lead long after they knew it was toxic? It was cheap, very malleable, easy to work with, and the ones who were exposed to it at its most lethal levels – “the miners and workers” who processed the lead were considered expendable. To the Roman leadership the workers didn't matter. They were slaves.⁷⁴⁸
- ⇒ See more about the “Star Stuff” element Lead: Scientist CLAIR CAMERON PATTERSON **11,922 HE – 11,995 HE.**

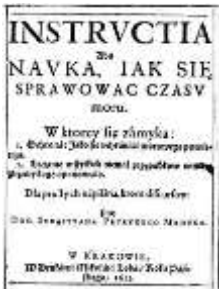
⁷⁴⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

⁷⁴⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

Beginning Circa 9,900 HE – through circa 11,800 HE: Human hygiene and lack thereof. Miasma: Bad Air Theory.

- ⇒ Author / Compiler found conflicting reports as to which people or whether people bathed whole body, only hands/face, not at all, or at what frequency during these years.
- ⇒ Miasma: (Latin; means nebula) (Ancient Greek means "pollution") Bad Air - was considered to be a poisonous vapor or mist filled with particles from decomposed matter (miasmata) that caused illnesses.⁷⁴⁹

⁷⁴⁹ https://en.wikipedia.org/wiki/Miasma_theory



11,613 HE: Book by SEBASTIAN PETRYCY (**11,554 HE–11,626 HE**) Polish practicing physician, published about prevention against Miasma (Bad Air): *De natura, causis, symptomatis morbi gallici eiusque curatione* which combined deductive reasoning with observation and experiment published in Kraków.⁷⁵⁰

⁷⁵⁰ https://en.wikipedia.org/wiki/Sebastian_Petrycy

- ⇒ **11,674 HE:** Air, during these years, was considered homogenous, empty and inactive. *Suspicious about the Hidden Realities of the Air* (Author / Compiler could find no image) is a book on alchemy by ROBERT BOYLE (See **11,627 HE – 11,691 HE: ROBERT BOYLE**).⁷⁵¹
- ⇒ **11,880 HE:** The Miasma -Bad Air- theory was eventually given up by scientists and physicians and replaced by the germ theory of disease: specific germs, not miasma, caused specific diseases. However, cultural beliefs about getting rid of odor made the clean-up of waste a high priority for cities.⁷⁵²

⁷⁵¹ https://en.wikipedia.org/wiki/Miasma_theory

⁷⁵² https://en.wikipedia.org/wiki/Miasma_theory

Circa 9,901 HE: Syria; Colored Glass blowing discovered. The art of producing clear glass was still not known.⁷⁵³

Circa 9,901 HE: China Hemp paper invented.⁷⁵⁴



Fragments of hemp wrapping paper dated to the reign of Emperor Wu of Han (Circa **9,860 HE – 9,914 HE**).⁷⁵⁵

⁷⁵³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁷⁵⁴ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁷⁵⁵ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 9,901 HE: India, the notion arose of having a leather loop suspended from the saddle for their horses. They invented the leather stirrup.⁷⁵⁶

Circa 9,902 HE – 9,946 HE: TITUS LUCRETIUS CARUS: Roman, poet and philosopher only known work is the epic philosophical book - poem: “*De rerum natura*” about the tenets and philosophy of Epicureanism, and which is usually translated into English as *On the Nature of Things*.⁷⁵⁷

⁷⁵⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 64

⁷⁵⁷ <https://en.wikipedia.org/wiki/Lucretius>



Bust of TITUS LUCRETIUS CARUS, artist, date and location unknown.⁷⁵⁸

⁷⁵⁸ <https://en.wikipedia.org/wiki/Lucretius>



Piece of Manuscript of *De Re Natura* in Cambridge University Library Collection.⁷⁵⁹

⁷⁵⁹ <https://en.wikipedia.org/wiki/Lucretius>

Circa 9,916 HE: Waterwheels were first mentioned in a poem: (ASIMOV didn't mention where or by whom). Humans had been using themselves and animals over the ages for power. Probably waterwheels were in use before this time, but this was the first time they were mentioned in writing.⁷⁶⁰

Circa 9,955 HE: Julian Calendar introduced.⁷⁶¹

Circa 10,001 HE: Maps of peoples around the world.⁷⁶²

⁷⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁷⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 60

⁷⁶² https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10,001 HE Map of Peoples in Northwest Hemisphere.⁷⁶³

⁷⁶³ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10,001 HE Map of Peoples in Southwest Hemisphere.⁷⁶⁴

⁷⁶⁴ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10,001 HE Map of Peoples African Continent.⁷⁶⁵

⁷⁶⁵ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10,001 HE Map of Peoples in Australia.⁷⁶⁷

⁷⁶⁷ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG

Circa 10,080 HE: The Roman Colosseum was built. For some time, Roman numerals are in use.

Symbol	I	V	X	L	C	D	M
Value	1	5	10	50	100	500	1,000



768

⇒ No one is sure when they started but the Colosseum Entrance to section LII (52) has Roman Numerals still visible.⁷⁶⁹

⁷⁶⁸ https://en.wikipedia.org/wiki/Roman_numerals

⁷⁶⁹ https://en.wikipedia.org/wiki/Roman_numerals



Colosseum Entrance to section LII (52) with numerals still visible, photographer unknown.⁷⁷⁰

⁷⁷⁰ https://en.wikipedia.org/wiki/Roman_numerals

Circa 10,050 HE: The first written mention of Japan is in Chinese written texts.⁷⁷¹

Circa 10,050 HE: PEDANIUS DIOSCORIDES, Greek physician, pharmacologist, botanist⁷⁷² who studied the medical applications of plants in the Mediterranean and in his book *De Materia Medica* PEDANIUS DIOSCORIDES described about 600 plants and nearly 1000 drugs.⁷⁷³

⁷⁷¹ <https://en.wikipedia.org/wiki/Japan>

⁷⁷² https://en.wikipedia.org/wiki/Pedanius_Dioscorides

⁷⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



Photo of a drawing from 550 years after DIOSCORIDES lived; it is from the **10,600 HE Greek Juliana Anicia Codex** DIOSCORIDES receives a mandrake root.⁷⁷⁴

⁷⁷⁴ https://en.wikipedia.org/wiki/Pedanius_Dioscorides



11,554 HE: Circa 1,500 years after being written, this photo is of the cover of a re-printed version of PEDANIUS DIOSCORIDES *De Materia Medica*, Lyon.⁷⁷⁵

⁷⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

Circa 10,050 HE: HERO of ALEXANDRIA, Greek engineer invented the steam engine; the modern sprinkler system works in precisely the same design – without the heat.⁷⁷⁶

⇒ Works known to have been written by HERO of ALEXANDRIA: *Pneumatica (Πνευματικά)*, a description of machines working on air, steam or water pressure, including the hydraulis or water organ; *Automata*, a description of machines which enable wonders in temples by mechanical or pneumatical means (e.g. automatic opening or closing of temple doors, statues that pour wine, etc.); See Automaton and Bernardino Baldi's translation; *Mechanica*, preserved only in Arabic, written for architects, containing means to lift heavy objects; *Metrica*, a description of how to calculate surfaces and volumes of diverse objects; On *the Dioptra*, a collection of methods to measure lengths, a work in which the odometer and the Dioptra, an apparatus which resembles the

⁷⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

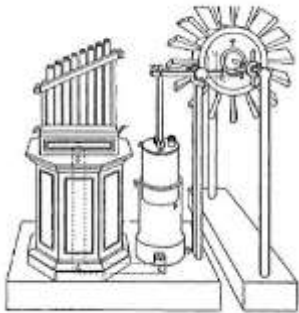
theodolite, are described; *Belopoeica*, a description of war machines; *Catoptrica*, about the progression of light, reflection and the use of mirrors.⁷⁷⁷

⁷⁷⁷ https://en.wikipedia.org/wiki/Hero_of_Alexandria



The book *About Automata* by HERO of ALEXANDRIA (11,589 HE edition).⁷⁷⁸

⁷⁷⁸ https://en.wikipedia.org/wiki/Hero_of_Alexandria



11,899 HE Drawing of HERO's wind-powered organ, the earliest recorded machine powered by a windwheel, artist W. Schmidt, location unknown.⁷⁷⁹

⁷⁷⁹ https://en.wikipedia.org/wiki/History_of_wind_power

Circa 10,090 HE: Northern Europe: Horse collar invented. The horse was converted into a farm animal. This increased food supply and thus population. Power began to shift from the Mediterranean area to the north.⁷⁸⁰

Circa 10,100 HE: Libya: Silphium, a species of giant fennel native to north Africa, may have been used as an oral contraceptive in ancient Greece and the ancient Near East. Possibly due to its supposed effectiveness and thus desirability, it had become so rare that it was worth more than its weight in silver and, by late antiquity, it was fully extinct.⁷⁸¹

⁷⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 73

⁷⁸¹ "*Herbal contraceptives and abortifacients*". In Bullough, Vern L. Encyclopedia of birth control. Santa Barbara, Calif.: ABC-CLIO. pp. 125–128. ISBN 978-1-57607-181-6. Archived from the original

on November 16, 12,016 HE; Laurence M. V. (12,009 HE). *Hippocratic Recipes: Oral and Written Transmission of Pharmacological Knowledge in Fifth- and Fourth-Century Greece; and*
https://en.wikipedia.org/wiki/History_of_birth_control



Cyrenian coin with an image of Silphium, a contraceptive plant, but could also have been an abortifacient.⁷⁸²

⁷⁸² https://en.wikipedia.org/wiki/History_of_abortion

Circa 10,100 HE - Circa 10,200 HE: SORANUS OF EPHESUS was an ancient Greek physician.⁷⁸³

- ⇒ **SORANUS OF EPHESUS** recommended abortion in cases involving health complications as well as emotional immaturity and provided detailed suggestions in his work *Gynecology*.⁷⁸⁴
- ⇒ **SORANUS OF EPHESUS**, prescribed diuretics, emmenagogues, enemas, fasting, and bloodletting as safe abortion methods, although he advised against the use of sharp instruments to induce miscarriage, due to the risk of organ perforation. He also advised women wishing to abort their pregnancies to engage in energetic walking, carrying heavy objects, riding animals, and jumping so that the woman's heels were to touch her buttocks with each jump,

⁷⁸³ https://en.wikipedia.org/wiki/Soranus_of_Ephesus

⁷⁸⁴ https://en.wikipedia.org/wiki/History_of_abortion

which he described as the "Lacedaemonian Leap". He also offered a number of recipes for herbal baths, rubs, and pessaries.⁷⁸⁵

⇒ Although abortion was accepted in Rome, attitudes changed with the spread of Christianity and around **10,211 HE** emperors Septimius Severus and Caracalla banned abortion as infringing on parental rights; temporary exile was the punishment.⁷⁸⁶

Circa 10,100 HE: NICOMACHUS: ancient Greek mathematician influenced by ARISTOTLE⁷⁸⁷ is best known for his works *Introduction to Arithmetic* and *Manual of Harmonics* in Greek.⁷⁸⁸

⁷⁸⁵ https://en.wikipedia.org/wiki/History_of_abortion#cite_note-Soranus-46

⁷⁸⁶ Jeffrey H. Reiman, *Abortion and the Ways We Value Life* (Rowman and Littlefield 1998 ISBN 978-0-8476-9208-8), p, 19

⁷⁸⁷ <https://en.wikipedia.org/wiki/Nicomachus>

⁷⁸⁸ <https://en.wikipedia.org/wiki/Nicomachus>

Circa 10,105 HE: TSAI LUN, China, invented *paper*: the smooth writing surface from cellulose. It took 1,000 years for knowledge of paper to reach Europe.⁷⁸⁹

Circa 10,105 HE: The Roman Empire may have had 40 million people.⁷⁹⁰

Circa 10,105 HE: The population of China may have been around 50 million people.⁷⁹¹

Circa 10,150 HE: CLAUDIUS PTOLEMY aka PTOLEMY; Egypt, Roman Empire Mathematician Geographer Astronomer Astrologer. The name Claudius is a Roman name; the fact that PTOLEMY bore it indicates he lived under the Roman rule of Egypt with the privileges

⁷⁸⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

⁷⁹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

⁷⁹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

and political rights of Roman citizenship.⁷⁹² CLAUDIUS PTOLEMY wrote the scientific Treatise: *Almagest*, a star catalog, and wrote the *Tetrabiblos* as *Almagest*'s astrological counterpart. CLAUDIUS PTOLEMY wrote the scientific Treatise *Geography*.⁷⁹³



Since no contemporary depictions or descriptions of CLAUDIUS

⁷⁹² <https://en.wikipedia.org/wiki/Ptolemy>

⁷⁹³ Dava Sobel's book: *Longitude*

PTOLEMY are known to have existed, later artist's impressions are unlikely to have reproduced his appearance accurately. This depiction of him is undated and unattributed.⁷⁹⁴



This **11,476 HE** depiction of CLAUDIUS PTOLEMY with an

⁷⁹⁴ <https://en.wikipedia.org/wiki/Ptolemy>

armillary sphere Earth centric model, by Joos van Ghent and Pedro Berruguete is at The Louvre, Paris.⁷⁹⁵

Circa 10,209 HE – Circa 10,200 HE: AELIUS OR CLAUDIUS

GALENUS, Greek, GALEN of PERGAMON (sometimes spelled Pergamum), when anglicized, Rome, Greek/Roman physician.⁷⁹⁶

GALEN was an accomplished medical researcher of antiquity, who influenced the development of various scientific disciplines, including anatomy, physiology, pathology, pharmacology, and neurology, as well as philosophy and logic.^{797 798}

⁷⁹⁵ <https://en.wikipedia.org/wiki/Ptolemy>

⁷⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

⁷⁹⁷ <https://en.wikipedia.org/wiki/Galen>

⁷⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

- ⇒ In his work *De Motu Musculorum*, GALEN explained the difference between motor and sensory nerves, discussed the concept of muscle tone, and explained the difference between agonists and antagonists.⁷⁹⁹
- ⇒ GALEN was a skilled surgeon, operating on human patients. Many of his procedures and techniques would not be used again for centuries, such as the procedures he performed on brains and eyes. To correct cataracts in patients, GALEN performed an operation similar to a modern one. Using a needle-shaped instrument, GALEN attempted to remove the cataract-affected lens of the eye. GALEN's surgical experiments included ligating the arteries of living animals.⁸⁰⁰

⁷⁹⁹ <https://en.wikipedia.org/wiki/Galen>

⁸⁰⁰ <https://en.wikipedia.org/wiki/Galen>



Modern statue of GALEN in his home town, Pergamon.⁸⁰¹

⁸⁰¹ <https://en.wikipedia.org/wiki/Galen>



11,529 HE: 1,300 years after it was written- reprint of GALEN's *De Curandi Ratione*.⁸⁰²

⁸⁰² <https://en.wikipedia.org/wiki/Galen>

Circa 10,200 HE: India: VATSYAYANA, wrote a classical text, which presented various contraceptive methods including coitus obstructus involving controlling the release of semen.⁸⁰³

Circa 10,200 HE: China used tea leaves to flavor boiled water.⁸⁰⁴

Circa 10,200 HE: Human population had reached approximately 190,000,000 people.⁸⁰⁵

Circa 10,250 HE: DIOPHANTUS, Greek mathematician. wrote an Algebra text.⁸⁰⁶ Author / Compiler Note: this is Circa 1,069 years

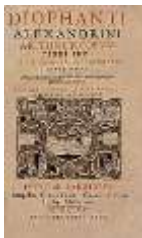
⁸⁰³ https://en.wikipedia.org/wiki/History_of_birth_control

⁸⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

⁸⁰⁵ <http://www.worldometers.info/world-population/world-population-by-year/>

⁸⁰⁶ <https://en.wikipedia.org/wiki/Diophantus>

after circa **9,181 HE**: when AL-MAHAINI, of Persia (see above) not yet named area of math we now call Algebra.⁸⁰⁷



Title page of the **11,621 HE** reprint edition **DIOPHANTUS'S** *Arithmetica*, translated into Latin by Claude Gaspard Bachet de Méziriac.⁸⁰⁸

⁸⁰⁷ https://en.wikipedia.org/wiki/Timeline_of_geometry

⁸⁰⁸ <https://en.wikipedia.org/wiki/Diophantus>

Circa 10,300 HE: China expanded on the **9,901 HE** India notion of the leather stirrup and made stirrups of metal.⁸⁰⁹

Circa 10,300 HE – 11,150 HE: The Tiwanaku (Spanish: Tiahuanaco or Tiahuanacu) state was a Pre-Columbian polity based in the city of Tiwanaku in western Bolivia that extended around Lake Titicaca and into present-day Peru and Chile.⁸¹⁰

Circa 10,323 HE: “Constantine the Great” recognized the Christian religion, and closed the Karnak complex, in Egypt.⁸¹¹

⁸⁰⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 64

⁸¹⁰ https://en.wikipedia.org/wiki/Tiwanaku_empire

⁸¹¹ https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re

Circa 10,335 HE - 10,405 HE: THEON of Alexandria, Greek of Alexandria, Egypt, mathematician⁸¹² edited and arranged: EUCLID's *Elements* and wrote commentaries on works by EUCLID and PTOLEMY. The editions ascribed to THEON are the only known version until Francois Peyrard discovered an older copy of the *Elements* in the Vatican Library in **11,808 HE**".⁸¹³

⇒ THEON made predictions and observances of solar and lunar eclipses in **10,364 HE** which show he was active at that time.⁸¹⁴

⇒ THEON was the father of the mathematician HYPATIA.

⁸¹² https://en.wikipedia.org/wiki/Theon_of_Alexandria

⁸¹³ Thomas Little Heath (11,921HE). "*A history of Greek mathematics*".

⁸¹⁴ https://en.wikipedia.org/wiki/Theon_of_Alexandria

Circa 10,350 HE: China, invents carving a wooden block with a raised reverse symbol that can then be used to print on paper.⁸¹⁵

Circa 10,370 HE - 10,415 HE: HYPATIA, Greek, of Alexandria, Egypt, then part of the Eastern Roman Empire; was a Hellenistic Neoplatonist philosopher, astronomer, and mathematician.⁸¹⁶

⇒ HYPATIA was the first female mathematician whose life is reasonably well recorded. She was renowned in her own lifetime as a great teacher and a wise counselor. She is known to have written a commentary on DIOPHANTUS's *thirteen-volume Arithmetica*, which may survive in part, having been interpolated into Diophantus's original text, and another commentary on Apollonius

⁸¹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

⁸¹⁶ Author 1st heard the name HYPATIA from Lake Hypatia in Alabama, USA; then Hypatia was mentioned in the <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos> map below; further information on HYPAYIA from <https://en.wikipedia.org/wiki/Hypatia>

of Perga's treatise on conic sections, which has not survived. Many modern scholars also believe that Hypatia may have edited the surviving text of PTOLEMY'S Almagest, based on the title of her father THEON'S commentary on Book III of the Almagest. HYPATIA is known to have constructed astrolabes and hydrometers, but did not invent either of these, which were both in use long before she was born.⁸¹⁷

⇒ HYPATIA who was killed by a Christian mob in **10,415 HE** during a period of religious and sectarian conflict.⁸¹⁸

Circa 10,370 HE – c 10,529 HE: The final phase of Antiquity Roman Greece Empire is the period of Christianization which closed the

⁸¹⁷ <https://en.wikipedia.org/wiki/Hypatia>

⁸¹⁸ https://en.wikipedia.org/wiki/Theon_of_Alexandria

physical Roman Empire with the closure of the Academy of Athens by Justinian.⁸¹⁹

- ⇒ ISAAC ASIMOV wondered what would have happened if Greek science had continued uncrushed by the weight of Roman lack of interest?⁸²⁰

- ⇒ Additionally, after the fall of Roman civilization the tradition of personal, living quarters and eating hygiene was abandoned...
 - ...except in Asia, where hygiene remained respected and enforced by tradition.

⁸¹⁹ https://en.wikipedia.org/wiki/Ancient_Greece

⁸²⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

- This enabled spreading of many deadly diseases across Europe and shortened the average length of human life to only 35 years.⁸²¹

Circa 10,370 HE - Circa 11,500 HE: European DARK AGES.

Circa 10,400 HE: China, wheelbarrows invented⁸²²

Circa 10,400 HE to 11,100 HE: Native Petroglyphs at Canyonlands National Park, Utah.⁸²³

⁸²¹ <http://www.soaphistory.net/soap-facts/soap-benefits/>

⁸²² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

⁸²³ <https://www.youtube.com/watch?v=CczH6P41nUs> (GoTraveler)



The Great Gallery has been dated by two rockfall events of which one exposed the rock face the panel was made and the second damaging part of the panel, photographer unknown.⁸²⁴

⁸²⁴ [https://en.wikipedia.org/wiki/Horseshoe_Canyon_\(Utah\)](https://en.wikipedia.org/wiki/Horseshoe_Canyon_(Utah))

Circa 10,450 HE: Polynesians reached Hawaii, they had been sailing over the vast Pacific without compasses and by following the stars and the currents and were settling island after island.⁸²⁵

Circa 10,476 HE – 10,550 HE: India, ARYABHATA aka ARYABHATA I aka ARYABHATTA.⁸²⁶ was the first of the major mathematician-astronomers from the classical age of Indian mathematics and Indian astronomy.

⇒ The fact that ARYABHATA correctly insisted that the earth rotates about its axis daily⁸²⁷ was lost in the dark ages of Europe - so much so that when COPERNICUS (See **11,473 HE - 11,543 HE:**

⁸²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

⁸²⁶ Robert Green Ingersoll's **11,869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation "*The gods and other lectures*"

⁸²⁷ <https://en.wikipedia.org/wiki/Aryabhata>

NICOLAUS COPERNICUS) finally revealed the fact, it was as if COPERNICUS was indeed the first human to prove it.⁸²⁸

⇒ ARYABHATA's works also include the *Arya-siddhanta* a lost work on astronomical computations, is known through the writings of ARYABHATA's contemporary, VARAHAMIHIRA, and later mathematicians and commentators, including BRAHMAGUPTA and BHASKARA I. This work appears to be based on the older Surya Siddhanta and uses the midnight-day reckoning, as opposed to sunrise in *Aryabhatiya*. It also contained a description of several astronomical instruments: the gnomon (shanku-yantra), a shadow instrument (chhAyA-yantra), possibly angle-measuring devices, semicircular and circular (dhanur-yantra / chakra-yantra), a cylindrical stick yasti-yantra, an umbrella-shaped device called the

⁸²⁸ Robert Green Ingersoll's **11,869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation *"The gods and other lectures"*

chhatra-yantra, and water clocks of at least two types, bow-shaped and cylindrical.⁸²⁹

- ⇒ A third text by ARYABHATA which survived in the Arabic translation, is *Al ntf or Al-nanf*. It claims that it is a translation by ARYABHATA, but the Sanskrit name of this work is not known, it is mentioned by the Persian scholar and chronicler of India, ABŪ RAYHĀN AL-BĪRŪNĪ⁸³⁰ (See Circa **11,148 HE: ABURAYHAN AL-BIRUNI**).⁸³¹
- ⇒ ARYABHATA's definitions of sine (jya), cosine (kojya), versine (utkrama-jya), and inverse sine (otkram jya) influenced the *birth of trigonometry*. He was also the first to specify sine and versine (1 –

⁸²⁹ <https://en.wikipedia.org/wiki/Aryabhata>

⁸³⁰ <https://en.wikipedia.org/wiki/Aryabhata>

⁸³¹ <https://en.wikipedia.org/wiki/Aryabhata>

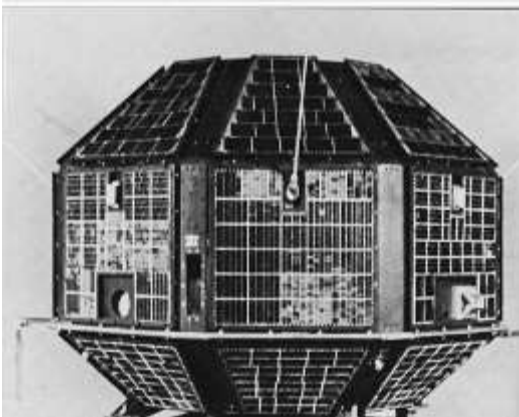
cos x) tables, in 3.75° intervals from 0° to 90° , to an accuracy of 4 decimal places. In fact, modern names "sine" and "cosine" are mis-transcriptions of the words *jya* and *kojya* as introduced by ARYABHATA.⁸³²



Statue of ARYABHATA on the grounds of IUCAA, Pune, India, photographer unknown.⁸³³

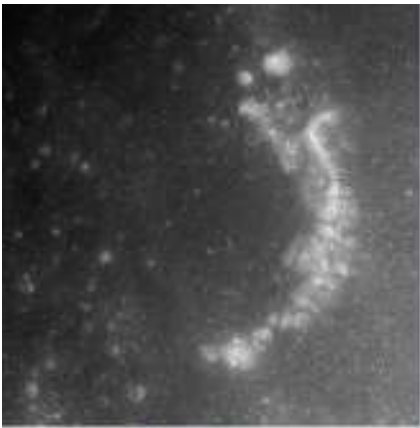
⁸³² <https://en.wikipedia.org/wiki/Aryabhata>

⁸³³ <https://en.wikipedia.org/wiki/Aryabhata>



India's first satellite named after ARYABHATA, photographer, date and location unknown.⁸³⁴

⁸³⁴ <https://en.wikipedia.org/wiki/Aryabhata>



This photo is an Apollo 15 image is the remnant of a lunar impact ARYABHATA crater located in the eastern Mare Tranquillitatis.⁸³⁵

⁸³⁵ [https://en.wikipedia.org/wiki/Aryabhata_\(crater\)](https://en.wikipedia.org/wiki/Aryabhata_(crater))



This photo was taken of the same lunar impact ARYABHATA crater from an oblique view from Apollo 8, facing west.⁸³⁶

⁸³⁶ [https://en.wikipedia.org/wiki/Aryabhata_\(crater\)](https://en.wikipedia.org/wiki/Aryabhata_(crater))

Circa 10,500 HE: Ancient Chumash Native American Tribe pictographs in Simi Valley, United States, photographer unknown.⁸³⁷



⁸³⁷ https://en.wikipedia.org/wiki/Chumash_people

Circa **10,500 HE – 10,570 HE**: YATIVRSABHA: Sub-Continent Indian mathematician and writer of the book *Tiloyapannatti* which gives various units for measuring distances and time and postulated different concepts about infinity.^{838 839}

Circa **10,505 HE –10, 587 HE**: VARAHAMIHIRA: (also called Vārāha or Mihira), was a Sub- Continent Indian astronomer, mathematician, and astrologer who lived in Ujjain.⁸⁴⁰ His contributions include: Trigonometry and improved the accuracy of the sine tables of ARYABHATA. VARAHAMIHIRA was among the first mathematicians to discover a version of what is now known as the PASCAL'S triangle which VARAHAMIHIRA used it to calculate the binomial coefficients. Among VARAHAMIHIRA's contributions to physics is his optics statement that “reflection is caused by the back-

⁸³⁸ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

⁸³⁹ <https://en.wikipedia.org/wiki/Yativrṣabha>

⁸⁴⁰ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

scattering of particles and refraction (the change of direction of a light ray as it moves from one medium into another) by the ability of the particles to penetrate inner spaces of the material, much like fluids that move through porous objects.” Also, "*the Pañca-siddhāntikā ("Five Treatises")*, a compendium of Greek, Egyptian, Roman and Indian astronomy. VARAHAMIHIRA's knowledge of Western astronomy was thorough. In 5 sections, his monumental work *the Pañca-siddhāntikā ("Five Treatises")* progresses through Sub-Continent Indian astronomy and culminates in 2 treatises on Western astronomy, showing calculations based on Greek and Alexandrian reckoning and even giving complete Ptolemaic mathematical charts and tables.^{841 842}

⁸⁴¹ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians and Encyclopedia Britannica (**12,007 HE**) s.v. Varahamihira 2. E. C. Sachau, Alberuni's India (11,910 HE), vol. I, p. 153

⁸⁴² <https://en.wikipedia.org/wiki/Varāhamihira>

10,598 HE – 10,668 HE: BRAHMAGUPTA: Sub-Continent Indian mathematician and astronomer⁸⁴³ was the Editor of two early works on mathematics and astronomy: *the Brāhmasphuṭasiddhānta* (BSS, "correctly established doctrine of Brahma", dated **10,628 HE**), a theoretical treatise, and *the Khandakhādyaka* ("edible bite", dated **10,665 HE**), a more practical text.⁸⁴⁴

⇒ BRAHMAGUPTA was the first to give rules to compute with zero. The texts composed by BRAHMAGUPTA were composed in elliptical verse in Sanskrit, as was common practice in Indian mathematics. As no proofs are given, it is not known how BRAHMAGUPTA's results were derived.⁸⁴⁵

⁸⁴³ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

⁸⁴⁴ <https://en.wikipedia.org/wiki/Brahmagupta>

⁸⁴⁵ <https://en.wikipedia.org/wiki/Brahmagupta>

- Author / Compiler note: as I am editing, I see that ASIMOV, as well as Wikipedia, reference Circa **10,810 HE** as the time when the concept of “0” / ZERO as a digit in the decimal place value notation was developed in India.⁸⁴⁶ ⁸⁴⁷ Author / Compiler wonders if circa **10,810 HE** is when proofs began to be given?

Circa 10,600 HE: The population of the world was approximately 200,000,000 people.⁸⁴⁸

Circa 10,600's HE – 10,900's: The first practical windmills were in use in Sistan, a region in Iran and bordering Afghanistan. These "Panemone windmills" were horizontal windmills, which had long vertical driveshafts with six to twelve rectangular sails covered in reed

⁸⁴⁶ <https://en.wikipedia.org/wiki/Zero>

⁸⁴⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 71

⁸⁴⁸ <http://www.worldometers.info/world-population/world-population-by-year/>

matting or cloth. These windmills were used to pump water, and in the gristmilling and sugarcane industries.⁸⁴⁹

Circa 10,622 HE: Many Islamic Calendars were in use: Prophet Muhammad and Islamic lunar Hijri calendar; The first year was the Islamic year during which the emigration of Muhammad from Mecca to Medina known as the Hijra occurred; **Circa 11,976 HE:** Shah Mohammad Reza Pahlavi changed the origin of the calendar, using the beginning of the reign of Cyrus the Great as the first day, rather than the Hijra of Mohammad. Overnight, the year changed from 1355 to 2535. **Circa 11,979 HE:** The change lasted till the Islamic Revolution in Iran, at which time the calendar was reverted to Solar Hijri. Islamic *Solar Hijri calendar*, Iran & Afghanistan calendar: The Solar Heiri; *Maybe AKA Solar Hijri algorithmic calendar*, Iranian Rule Based calendar; Jalali Rule Based calendar; Late Ottoman-era

⁸⁴⁹ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

solar Hijri calendar; Afghanistan Rule Based calendar; The Tabular Islamic Rule Based calendar.⁸⁵⁰

Circa 10,660 HE: The Slavs of Eastern Europe were supposed to have invented the moldboard plow with a knife on the end of it. As it slowly spread through eastern and northern Europe food production took a jump and population increased⁸⁵¹ to approximately 200,000,000 people.⁸⁵²

Circa 10,660 HE: China, Woodblock Printing.⁸⁵³

⁸⁵⁰ https://en.wikipedia.org/wiki/Islamic_calendar

⁸⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

⁸⁵² <http://www.worldometers.info/world-population/world-population-by-year/>

⁸⁵³ https://en.wikipedia.org/wiki/List_of_Chinese_inventions



10,618 HE–10,907 HE: Frontispiece of *The Diamond Sutra*, the oldest printed book, during the Tang Dynasty, photographer and location unknown.⁸⁵⁴

⁸⁵⁴ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 10,700 HE: Porcelain invented in China. As the shiny almost glassy, very hard, very white pottery that rang like a bell when struck, eventually reached Europe, the product was known as “China.”⁸⁵⁵

Circa 10,700 HE: The population of the world was approximately 210,000,000 people.⁸⁵⁶

Circa 10,700 HE: Persia, windmills use further developed in Middle East.⁸⁵⁷

Circa 10,700s HE: HALAYUDHA, Indian sub-continent mathematician wrote a commentary on PINGALA's *Chandahśāstra* and expanded it

⁸⁵⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69

⁸⁵⁶ <http://www.worldometers.info/world-population/world-population-by-year/>

⁸⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

and including a clear description of Pascal's triangle called meru-prastaara.^{858 859}

⇒ HALAYUDHA composed the following works: *Kavi-Rahasya*, a book on poetics; *Mrta-Sañjīvanī*, a commentary on PINGALA's *Chandah-sāstra* and *Abhidhana-ratna-mala*, a lexicon⁸⁶⁰ describing the vocabulary or language or branch of knowledge.⁸⁶¹

Circa 10,733 HE – 11,066 HE: Norse / Viking Age, Vikings explore and colonize Iceland, Greenland, Newfoundland.⁸⁶²

⁸⁵⁸ <https://en.wikipedia.org/wiki/Pingala>

⁸⁵⁹ <https://en.wikipedia.org/wiki/Halayudha>

⁸⁶⁰ <https://en.wikipedia.org/wiki/Halayudha>

⁸⁶¹ <https://en.wikipedia.org/wiki/Halayudha>

⁸⁶² https://en.wikipedia.org/wiki/History_of_Greenland

Circa 10,750 HE - Circa 11,300 HE: Arab world contributions to science & math, and the preservation of historical learning.

- ⇒ By this time on our *Holocene Era Timeline of Human Accomplishments, Advancements, Innovations and Understanding*, Greek learning had almost been forgotten in Europe.⁸⁶³
- ⇒ However, when the Arabs were exposed to Greek books, they loved them. The learned Arabs translated the great books of EUCLID, ARISTOTLE, PTOLEMY and others into Arabic. For centuries Arabs were the leading scientists of the Western world.⁸⁶⁴ Known as *The Islamic Golden Age*, in the history of Islam, during which much of the historically Islamic world was ruled by various

⁸⁶³ https://en.wikipedia.org/wiki/Islamic_Golden_Age

⁸⁶⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69

caliphates, and science, and economic development. Also, cultural works flourished.⁸⁶⁵



Circa 11,237 HE art of Scholars at an Abbasid library, from the Maqamat of al-Hariri by Yahya ibn Mahmud al-Wasiti, Baghdad⁸⁶⁶

⁸⁶⁵ https://en.wikipedia.org/wiki/Islamic_Golden_Age

⁸⁶⁶ https://en.wikipedia.org/wiki/Islamic_Golden_Age

Circa 10,750 HE: JABIR IBN HAYYAN aka GEBER, Persian chemist, polymath, pharmacist, physician⁸⁶⁷ who introduced the experimental method and controlled experiment in chemistry.⁸⁶⁸

⇒ Before JABIR IBN HAYYAN's time – the strongest known acid was vinegar. Acids bring about change without using heat. The acid he achieved was acetic acid which he got by distilling vinegar.⁸⁶⁹

⁸⁶⁷ https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan

⁸⁶⁸ <http://sciencetimeline.blogspot.com/2009/11/timeline-of-scientific-experiments.html>

⁸⁶⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69



Circa 11,600 HE European imagination portrait of "GEBER",

Codici Ashburnhamiani **11,166 HE**, Biblioteca Medicea
Laurenziana, Florence, Italy.⁸⁷⁰

Circa 10,770 HE: Iron horseshoes, but not yet harnesses, were coming
into use.⁸⁷¹

Circa 10,800 HE: China, (see **10,350 HE** for first step in using wooden
blocks for letters for printing) more highly invents carving wooden
blocks that have a whole page of raised reverse symbols that can then
be used to print on paper.⁸⁷²

⁸⁷⁰ https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan

⁸⁷¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 70

⁸⁷² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

Circa 10,825 HE: AL-KHWARIZMI, aka MUHAMMAD IBN MUSA AL-KHWARIZMI: Persian mathematician^{873 874} wrote the book *On the Calculation with Hindu Numerals* in Arabic.⁸⁷⁵

⇒ At the time Roman Numerals were still mostly used. It took these next couple of centuries for people to overcome the habit of sticking to something “inconvenient but customary” like the use of the cumbersome roman numerals, rather than adopting something new and begin using convenient Arabic numerals. Still, it was done in the end and because of AL-KHWARIZMI’s introduction, the transition to use of Arabic numerals democratized arithmetical computation, bringing it to within reach of everyone.⁸⁷⁶

⁸⁷³ https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi

⁸⁷⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 71

⁸⁷⁵ https://en.wikipedia.org/wiki/Hindu_Arabic_numeral_system

⁸⁷⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 71

⇒ **Circa 10,833 HE:** AL-KHWARIZMI treatise on Algebra: *The Compendious Book on Calculation by Completion and Balancing*, presented the first systematic solution of linear and quadratic equations. The term Algebra itself comes from the title of his book: specifically, the word AL-JABR: meaning "completion" or "rejoining".⁸⁷⁷

- Author / Compiler Note: this is Circa 1,069 years after circa **9,181 HE:** when AL-MAHAINI, of Persia (see above) who conceived the idea of reducing geometrical problems such as doubling a cube in problems in the not yet named area of math we now call Algebra.⁸⁷⁸ This is 583 years since see circa **10,250 HE** when DIOPHANTUS wrote an Algebra text.⁸⁷⁹

⁸⁷⁷ https://en.wikipedia.org/wiki/Hindu_Arabic_numerals

⁸⁷⁸ https://en.wikipedia.org/wiki/Timeline_of_geometry

⁸⁷⁹ <https://en.wikipedia.org/wiki/Diophantus>



AL-KHWARIZMI statue in Amir Kabir University, Tehran, date and artist unknown.⁸⁸⁰

⁸⁸⁰ https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi

⇒ **Circa 10,825 HE:** AL-KHWARIZMI & AL-KINDI works were principally responsible for the diffusion of the Indian-Arabic system of numeration in the Middle East and the West. AL-KINDI wrote 4 volumes *On the Use of Indian Numerals*.⁸⁸¹



⇒ Imagination Portrait of AL-KINDI; date, location, and artist unknown.⁸⁸²

⁸⁸¹ https://en.wikipedia.org/wiki/Arabic_numerals

⁸⁸² <https://en.wikipedia.org/wiki/Al-Kindi>

Circa 10,830 HE: SIND IBN ALI, Baghdad.⁸⁸³ He introduced the Indian decimal point notation, and also wrote the earliest treatise on Arabic numerals.⁸⁸⁴

⇒ SIND IBN ALI is known to have translated and modified the *Zij al-Sindhind*. The *Zij al-Sindhind* was the first astronomical table ever introduced in the muslim world.⁸⁸⁵

⇒ As a mathematician SIND IBN 'ALĪ worked closely with YAQUB INB TARIQ. Together they calculated the diameter of the Earth and other astronomical bodies. SIND IBN 'ALĪ also wrote a commentary on *Kitāb al-ğabr wa-l-muqābala* and helped prove the works of AL-KHWARIZMI.⁸⁸⁶

⁸⁸³ https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁸⁸⁴ https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁸⁸⁵ https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁸⁸⁶ https://en.wikipedia.org/wiki/Sind_ibn_Ali

Circa 10,850 HE: Southern Arabia: Coffee invented. The story goes that a goatherd noticed his goats got friskier after eating some berries. It was said that he tried them, liked the sensation and told others. They learned how to roast the berries and steep them in boiling water. It took hundreds of years for coffee to reach Europe.⁸⁸⁷

Circa 10,952 HE: ABU-HASAN-AL-UQLISDISI, Syrian mathematician wrote the treatise about Middle eastern mathematicians who extended the decimal numeral system to include fractions.⁸⁸⁸

⁸⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 72

⁸⁸⁸ https://en.wikipedia.org/wiki/Abu_Hasan_al-Uqlidisi

Circa 10,960 HE – Circa 11,279: China, Earliest example of extant print advertisement.



Song dynasty bronze plate advertising print for the Liu family needle shop at Jinan, photographer and location unknown.⁸⁸⁹

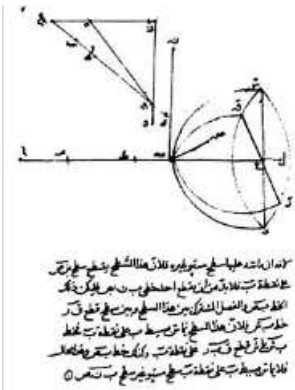
⁸⁸⁹ https://en.wikipedia.org/wiki/History_of_printing

Circa 10,986 HE: IBN SAHL was a Persian mathematician, physicist and optics engineer of the Islamic Golden Age associated with the Abbasid court of Baghdad.⁸⁹⁰ IBN SAHL's circa **10,986 HE** treatise *On Burning Mirrors and Lenses* sets out his understanding of how curved mirrors and lenses bend and focus light.

⇒ IBN SAHL is credited with first discovering the law of refraction, usually called Snell's law. IBN SAHL used the law of refraction to derive lens shapes that focus light with no geometric aberrations, known as anaclastic lenses.⁸⁹¹

⁸⁹⁰ https://en.wikipedia.org/wiki/Ibn_Sahl

⁸⁹¹ https://en.wikipedia.org/wiki/Ibn_Sahl



Reproduction of a page of IBN SAHL's manuscript showing his discovery of the law of refraction⁸⁹²

⁸⁹² https://en.wikipedia.org/wiki/Ibn_Sahl

Circa 10,900, HE – circa 11,000 HE: MUHAMMAD IBN ZAKARIYA AL-RAZI, Persian chemist and physician who introduced controlled experiment into the field of medicine and carried out the first medical experiment in order to find the most hygienic place to build a hospital.⁸⁹³

- ⇒ He also documented coitus interruptus, preventing ejaculation, and the use of pessaries to block the cervix as birth control methods. He described a number of pessaries, including elephant dung, cabbages and pitch, used alone or in combination.⁸⁹⁴

- ⇒ MUHAMMAD IBN ZAKARIYA AL-RAZI is said to be the first to produce acids such as sulfuric acid, writing up notes on diseases

⁸⁹³ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

⁸⁹⁴ Bullough, Vern L., ed. (12,001 HE). *Encyclopedia of Birth Control*. ABC-CLIO. p. 154. ISBN 978-1-57607-533-3.

such as smallpox and chickenpox, a pioneer in ophthalmology, editor of the first book on pediatrics, making leading contributions in inorganic and organic chemistry, also the editor of several philosophical works.⁸⁹⁵

⇒ EDWARD GRANVILLE BROWNE considers MUHAMMAD IBN ZAKARIYA AL-RAZI as "probably the greatest and most original of all the Muslim physicians, and one of the most prolific as an Editor".⁸⁹⁶

⁸⁹⁵ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

⁸⁹⁶ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi



Imagination portrait MUHAMMAD IBN ZAKARIYA AL-RAZI,
artist and location unknown.⁸⁹⁷

⁸⁹⁷ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi



Colophon of MUHAMMAD IBN ZAKARIYA AL-RAZI's **Book of Medicine**.⁸⁹⁸

⁸⁹⁸ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

Circa 10,900, HE – circa 11,000 HE: ALI IBN ABBAS AL-MAJUSI, Persia, documented the use of pessaries made of rock salt for women for whom pregnancy may be dangerous.⁸⁹⁹

Circa 10,900 HE: The population of the world was approximately 240,000,000 people.⁹⁰⁰

Circa 10,973 HE: ABURAYHAN AL-BIRUNI, Persian chronicler of India, Geodesy and Earth scientist; astronomer; conversant in 7 languages. He conducted the first elaborate experiments related to astronomical phenomena since the Greeks. He introduced the experimental method into mechanics. He was conversant in

⁸⁹⁹ "*Definition of Birth control*". MedicineNet.

⁹⁰⁰ <http://www.worldometers.info/world-population/world-population-by-year/>

Khwarezmian, Persian, Arabic, Sanskrit, and also knew Greek, Hebrew and Syriac.⁹⁰¹

⇒ ABURAYHAN AL-BIRUNI also made contributions to Earth sciences and is regarded as the "*father of geodesy*" for his important contributions to that field, along with his significant contributions to geography.⁹⁰²

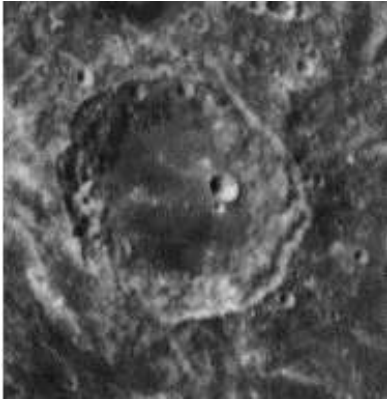
⁹⁰¹ <https://en.wikipedia.org/wiki/Al-Biruni>

⁹⁰² <https://en.wikipedia.org/wiki/Al-Biruni>



The statue of ABURAYHAN AL-BIRUNI in United Nations Office in Vienna as a part of Persian Scholars Pavilion donated by Iran ⁹⁰³

⁹⁰³ <https://en.wikipedia.org/wiki/Al-Biruni>



Lunar crater Al-Biruni, on the far side of the Moon, as seen by Apollo 14.⁹⁰⁴

⁹⁰⁴ <https://en.wikipedia.org/wiki/Al-Biruni>

Circa 10,990 HE – circa 10,051 HE: BI SHENG, Chinese artisan who invented movable type.⁹⁰⁵

Circa 11,006 HE: ALI IBN RIDWAN, Egyptian astronomer⁹⁰⁶ who observed and wrote about Supernova SN 1006.⁹⁰⁷



ALI IBN RIDWAN's artistic drawing.⁹⁰⁸

⁹⁰⁵ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁹⁰⁶ https://en.wikipedia.org/wiki/Ali_ibn_Ridwan

⁹⁰⁷ <https://en.wikipedia.org/wiki/Star>

⁹⁰⁸ https://en.wikipedia.org/wiki/Ali_ibn_Ridwan

Circa 11,020 HE – ABU ALI AL-HUSSAIN IBN ABDALLAH IBN SINA, known in Europe as AVICENNA IBN SINA; Persian polymath who introduced experimentation and quantification into the study of medicine and physiology, including the introduction of experimental medicine and clinical trials. AVICENNA IBN SINA also included a chapter on birth control in his medical encyclopedia *The Canon of Medicine*, listing 20 different methods of preventing conception.⁹⁰⁹

⁹⁰⁹ <https://en.wikipedia.org/wiki/Avicenna>



AVICENNA IBN SINA Conventional modern portrait (on a silver vase, Avicenna Mausoleum and Museum: Hamadan, Iran).⁹¹⁰

Circa 11,021 HE: At the research institutes of Baghdad, Cairo, and other Islamic capitols:⁹¹¹

- ⇒ Christians, Jews, Doubters, and Skeptics – all scholars were honored guests.⁹¹²
- ⇒ Instead of burning books, the Caliphs sent emissaries around the world in search of books.⁹¹³
- ⇒ The Caliphs lavishly funded projects to translate, study, and preserve the gathered books for future generations.⁹¹⁴
- ⇒ Much of the light of Ancient Greek science would have been permanently extinguished without their efforts.⁹¹⁵

⁹¹² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹¹³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹¹⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹¹⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

- ⇒ The reawakening to science that took place in Europe hundreds of years later was kindled by a flame that had been long tended by Islamic scholars and scientists.⁹¹⁶

- ⇒ In *Cosmos*, author Druyan reminds us that the Arabs also imported ideas from India to the West, including the so-called Arabic numerals that we all use today, and the concept of zero which they adapted from the Indians.⁹¹⁷

- ⇒ Arabic astronomy was so influential, that we still call most of the bright stars by their Arabic names.⁹¹⁸

⁹¹⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹¹⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹¹⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⇒ And the "al's" in algebra, algorithm, alchemy, and alcohol are just some of the traces left from the time when Arabic was the language of science.⁹¹⁹

Circa 11,021 HE: – IBN AL HAYTHAM, Cairo scientist, astronomer, mathematician. Abū ‘Alī al-Ḥasan ibn al-Ḥasan ibn al-Haytham (Arabic: *أبو علي، الحسن بن الحسن بن الهيثم*; Persian: *بو علی محمد بن حسن بن هيثم*) also known by the Latinization Alhazen or Alhacen.⁹²⁰

⇒ Circa 1,400 years after Emperor Qin (see Circa **9,741 HE – 9,791 HE:** Qin Shi Huang, first emperor of China) burned the optics works of MO TZE (See Circa **9,531 HE – 9,610 HE:** MOZI), and after the knowledge of the Ancient Greeks was lost and being rediscovered....

⁹¹⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹²⁰ https://en.wikipedia.org/wiki/Ibn_al-Haytham

- IBN AL-HAYTHAM made significant contributions to the principles of optics, astronomy, mathematics, visual perception, and the scientific method. IBN AL-HAYTHAM was the first to explain that vision occurs when light bounces on an object and then is directed to one's eyes.⁹²¹ IBN AL-HAYTHAM spent most of his life close to the court of the Fatimid Caliphate in Cairo and earned his living authoring various treatises.⁹²²

⇒ IBN AL-HAYTHAM is widely considered to be one of the first theoretical physicists, and an early proponent of the concept that a hypothesis must be proved by experiments based on confirmable

⁹²¹ Adamson, Peter (7 July 12,016 HE). Philosophy in the Islamic World: A History of Philosophy Without Any Gaps.

⁹²² https://en.wikipedia.org/wiki/Ibn_al-Haytham

procedures or mathematical evidence—hence understanding the scientific method 200 years before Renaissance scientists.⁹²³

- ⇒ IBN AL-HAYTHAM wrote of his optics research, and further pioneered the experimental scientific method and experimental physics in his *Book of Optics*.⁹²⁴
- ⇒ IBN AL-HAYTHAM devised the first scientific experiments on optics, including the first use of the camera obscura to prove that light travels in straight lines and the first experimental proof that visual perception is caused by light rays travelling to the eyes, which also marks the beginning of experimental psychology and

⁹²³ https://en.wikipedia.org/wiki/Ibn_al-Haytham

⁹²⁴ https://en.wikipedia.org/wiki/Ibn_al-Haytham

psychophysics. A camera obscura works best in bright light. The stars of the night sky are way too dim for this.⁹²⁵

- ⇒ IBN AL-HAYTHAM was the first person ever to set down the rules of science.⁹²⁶
- ⇒ IBN AL-HAYTHAM created an error-correcting mechanism, a systematic and relentless way to sift out misconceptions in our thinking.⁹²⁷
- ⇒ IBN AL-HAYTHAM said “Finding truth is difficult and the road to it is rough. IBN AL-HAYTHAM said: as seekers after truth, you will be wise to withhold judgment and not simply put your trust in the writings of the ancients; You must question and critically

⁹²⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹²⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁹²⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

examine those writings from every side; You must submit only to argument and experiment and not to the sayings of any person; For every human being is vulnerable to all kinds of imperfection; As seekers after truth, we must also suspect and question our own ideas as we perform our investigations, to avoid falling into prejudice or careless thinking. Take this course, and truth will be revealed to you. This is the method of science.”⁹²⁸

⁹²⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



IBN AL HAYTHAM; date, location, and artist unknown⁹²⁹

⁹²⁹ https://en.wikipedia.org/wiki/Ibn_al-Haytham



IBN AL-HAYTHAM *Book of Optics* reprint cover page Friedrich Risner, reprint publ. **11,572 HE** ⁹³⁰

⁹³⁰ Friedrich Risner, publ. 11,572 HE . Opticae Thesaurus: Alhazeni Arabis Libri Septem Nunc Primum Editi , Eiusdem Liber De Crepusculis Et Nubium Asensionibus .Item Vitellonis Thuringopoloni Libri X. See Sabra, the authorship of Liber de crepusculis

Circa 11,031 HE– circa 11,095 HE: SHEN KUO, China, was the first to describe the process of movable type printing, and both magnetic declination (in discerning true north) and the magnetic needle compass in his *Dream Pool Essays* of **11,088 HE**. SHEN KUO attributed the innovation of reusable fired clay characters to a little-known artisan named BI SHENG (see **Circa 10,990 HE–10,051 HE**).⁹³¹

Circa 11,071 HE: Prior to this time forks were not used as a tool for eating by most people. Historically people had been eating with their fingers, spoons and knives. Then, it was recorded that a Byzantine princess married a doge of Venice and brought her forks with her.⁹³²

⁹³¹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁹³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 78

Circa 11,080 HE: France expanded on EUCLID's and the Persian original windmill designs to mill grain and pump water.⁹³³ (see Circa **9,731 HE**, EUCLID's windmill design⁹³⁴ and Circa **10,700 HE:** Persia, earliest windmills developed in Middle East⁹³⁵)

Circa 11,100 HE: Human population worldwide had reached approximately 320,000,000 million people.⁹³⁶

Circa 11,111 HE: Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. From Al-Ghazali came the philosophy that *mathematics was the work of the devil*. That, combined with the codification of the entirety of what Islam was and would become,

⁹³³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

⁹³⁴ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

⁹³⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

⁹³⁶ <http://www.worldometers.info/world-population/world-population-by-year/>

collapsed the great age of enlightenment in the Islamic world. It has not recovered since.⁹³⁷

⇒ The end of the era of “Naming Rights” by the Arab scientific minds, the most extensive work in navigation, math, and astronomy, along with the most beautifully carved astrolabes – everything and all of it was traceable to the 300 years period, prior to this date, when the teachings of Al-Ghazali caused it all to be stopped.⁹³⁸

⁹³⁷ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⁹³⁸ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⇒ The darkness fell at this time in the Arab world, because Al-Ghazali enforced the false premise that revelation must replace investigation.⁹³⁹

Circa 11,119 HE: China, The Editor ZHU YU was the first to mention use of the compass specifically for navigation at sea in his book *Pingzhou Ketan* (萍洲可談; *Pingzhou Table Talks*).⁹⁴⁰

⁹³⁹ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⁹⁴⁰ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 11,137 HE: Gothic architecture – specifically flying Buttresses invented.⁹⁴¹ The defining, functional characteristic of a flying buttress is that it is not in contact with the wall it supports, like a traditional buttress, and so transmits the lateral forces across the span of intervening space between the wall and the pier. To provide lateral support, flying-buttress systems are composed of two parts: (i) a massive pier, a vertical block of masonry situated away from the building wall, and (ii) an arch that bridges the span between the pier and the wall — either a segmental arch or a quadrant arch — the flyer of the flying buttress.

⁹⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 78



A later example of flying buttresses at the Rotunda of Galerius in Thessaloniki, Greece. Artist and date unknown.⁹⁴²

⁹⁴² https://en.wikipedia.org/wiki/Flying_buttress

Circa 11,170 HE – 11,250 HE; LEONARDO BONACCI known as FIBONACCI (and Leonardo of Pisa, and Leonardo Pisano Bigollo) Italian, mathematician considered to be "the most talented Western mathematician of the Middle Ages."⁹⁴³

- ⇒ FIBONACCI popularized the Hindu–Arabic numeral system and positional notation to the Western World primarily through his composition in *11,202 HE of Liber Abaci (Book of Calculation)* where in it he also introduced to Europe the sequence of Fibonacci numbers.⁹⁴⁴

- ⇒ In mathematics, the Fibonacci numbers are the numbers in the following integer sequence, called the Fibonacci sequence, and characterized by the fact that, every number after the first two is the

⁹⁴³ <https://en.wikipedia.org/wiki/Fibonacci>

⁹⁴⁴ <https://en.wikipedia.org/wiki/Fibonacci>

sum of the two preceding ones. 1,1,2,3,5,8,13,21,34,55,89,144..., and often, especially in modern usage, the sequence is extended by one more initial term: 0,1,1,2,3,5,8,13,21,34,55,89,144...⁹⁴⁵

⇒ Fibonacci numbers appear unexpectedly often in mathematics, so much so that there is an entire journal dedicated to their study, the Fibonacci Quarterly.⁹⁴⁶

⁹⁴⁵ https://en.wikipedia.org/wiki/Fibonacci_number

⁹⁴⁶ <http://www.fq.math.ca/>



Statue of LEONARDO BONACCI known as FIBONACCI (**11,863 HE**) by Giovanni Paganucci in the Camposanto di Pisa ⁹⁴⁷

⁹⁴⁷ <https://en.wikipedia.org/wiki/Fibonacci>



A page of the LEONARDO BONACCI known as FIBONACCI's

Liber Abaci from the Biblioteca Nazionale di Firenze showing on the right the numbers of the Fibonacci Sequence ⁹⁴⁸

⇒ The wonderful youtube.com by VIHART shows how Fibonacci numbers also appear in biological settings. ⁹⁴⁹

Circa beginning in the 11,180s HE: The use of windmills became further widespread across the Middle East and Central Asia, and later spread to China and India. ⁹⁵⁰

Circa 11,185 HE: England: a windmill in England dates from **11,185 HE** in Weedley, Yorkshire. In medieval England, rights to waterpower

⁹⁴⁸ https://en.wikipedia.org/wiki/Liber_Abaci

⁹⁴⁹ ViHart–YouTubevideoFibonacci

<https://www.bing.com/videos/search?q=vi+heart+fibonacci&view=detail&mid=C1B0A8F3C1E4D08B5087C1B0A8F3C1E4D08B5087&FORM=VIRE>

⁹⁵⁰ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

sites were often confined to nobility and clergy, so wind power was an important resource to a new middle class. In addition, windmills, unlike water mills, were not rendered inoperable by the freezing of water in the winter.⁹⁵¹

Circa 11,200 HE: ABD-EL-LATIF-AL BAGHDADI, Bagdad, Iraq; physician, historian, Egyptologist, and traveler. During the famine of Egypt, ABD-EL-LATIF-AL BAGHDADI observed and examined a large number of skeletons, and he discovered that GALEN (See Circa **10,150 HE**) was incorrect regarding the formation of the bones of the lower jaw and sacrum.⁹⁵²

⇒ Of the numerous works (mostly on medicine) which are ascribed to ABD-EL-LATIF-AL BAGHDADI, one only, his graphic and

⁹⁵¹ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

⁹⁵² https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

detailed Account of Egypt (in two parts), appeared to be known in Europe.⁹⁵³ ABD-EL-LATIF-AL BAGHDADI's *Mukhtarat fi al-Tibb* was one of the earliest works on hirudotherapy. He introduced a more modern use for medicinal leech, stating that leech could be used for cleaning the tissues after surgical operations.⁹⁵⁴

Circa 11,200 HE: South Asian Indians used a variety of birth control methods since ancient times, including a potion made of powdered palm leaf and red chalk, as well as pessaries made of honey, ghee, rock salt or the seeds of the palasa tree. A variety of birth control prescriptions, mainly made up of herbs and other plants, are listed *Ratirahasya ("Secrets of Love")*,⁹⁵⁵

⁹⁵³ https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

⁹⁵⁴ https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

⁹⁵⁵ https://en.wikipedia.org/wiki/History_of_birth_control

Circa 11,215 HE –11,216 HE: China, Copperplate moveable type printing.



Copperplate printed 5000-cash Jin dynasty paper money with bronze movable type counterfeit markers, artist and location unknown.⁹⁵⁶

⁹⁵⁶ https://en.wikipedia.org/wiki/History_of_printing

Circa 11,223 HE: China, First documented use of a toothbrush. Dōgen Kigen, a Japanese Zen master traveling in China, documented in writing the use of the instrument to clean teeth, by Northern Chinese monks. The instrument which was most likely made from the coarse hairs of the cold-climate hog. Hogs living in Siberia and Northern China grew very stiff hair in response to the harsh climate, yielding a sturdy bristle material. Bristles were inserted into tiny holes made in bone or bamboo.⁹⁵⁷ (See **Circa 8,247 HE:** Babylonians first recorded oral hygiene by use of tooth cleaning sticks.)⁹⁵⁸

⁹⁵⁷ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

⁹⁵⁸ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

Circa 11,228 HE: China, then England, started to dig into the earth to mine coal.⁹⁵⁹

Circa 11,242 HE: IBN AL-NAFIS, Arab, physician carried out autopsies which lead him to the discovery of pulmonary circulation and the circulatory system. Earliest and best Eastern exploration of cardiac physiology.⁹⁶⁰ IBN AL-NAFIS wrote a book (Author / Compiler could not find its name) (not known unto the West until **11,924 HE**) in which IBN AL-NAFIS suggested the right and left ventricles of the heart were totally separate; explaining the double pump.⁹⁶¹ IBN AL-NAFIS wrote treatises on eye diseases and diet and commentaries on

⁹⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 82

⁹⁶⁰ https://en.wikipedia.org/wiki/Ibn_al-Nafis

⁹⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 139, 140

medical writings of HIPPOCRATES, AVICENNA, AND HUNAYN
IBN ISHĀQ.⁹⁶²



IBN AL-NAFIS (artist, date and location of bronze bust are unmentioned).⁹⁶³

⁹⁶² <https://www.britannica.com/biography/Ibn-an-Nafis>

⁹⁶³ https://en.wikipedia.org/wiki/Ibn_al-Nafis

Circa 11,249 HE: China and Europe both invent convex lenses used to help the aged who were becoming far sighted.⁹⁶⁴

⇒ Author / Compiler wonders if these convex lenses were of colored glass because according to ISAAC ASIMOV himself: **Circa 9,901 HE** in Syria the blowing and making of colored glass had been invented⁹⁶⁵; while clear glass was not invented until **11,291 HE** in Venice.⁹⁶⁶

⁹⁶⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 83

⁹⁶⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁹⁶⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 85

Circa 11,252 HE: Spain, Alfonso X of Castile sponsored updated Planetary Tables for nothing better than CLAUDIUS PTOLOMY's tables of planetary motion had been prepared in 11 centuries.⁹⁶⁷

⇒ Alfonso X of Castile and Leon assembled a team of scholars and created the Alfonsine Tables which provided data for computing the position of the Sun, the Moon and the planets relative to the fixed stars.⁹⁶⁸

⁹⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 84

⁹⁶⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 84

The image shows two pages from the Alfonsine Tables, a medieval astronomical work. The left page is titled "Tabulae astronomicae" and contains a table of astronomical data with columns for various celestial parameters. The right page is titled "Tabulae quibus demonstratur longitudo et latitudo in quibuslibet diebus" and contains a table of celestial coordinates for various days. Both pages feature dense Latin text and numerical data in columns.



Alfonsine Tables, photographer and location unknown.⁹⁶⁹

⁹⁶⁹ https://en.wikipedia.org/wiki/Alfonsine_tables

11,267 HE - 11,319 HE: KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI OR ABU HASAN MUHAMMAD IBN HASAN, Persian, scientist in optics and numbers theory.⁹⁷⁰

⇒ AL-FARISI rewrote after much studying AL HAYTHAM's *Treatise/Book of Optics* which became known as *Tanqih*.⁹⁷¹

⇒ AL-FARISI is known for giving the first mathematically satisfactory explanation of the rainbow, and an explication of the nature of colors that reformed the theory of IBN AL-HAYTHAM.⁹⁷²

⁹⁷⁰ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⁹⁷¹ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⁹⁷² https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⇒ AL-FARISI also "proposed a model where the ray of light from the sun was refracted twice by a water droplet, one or more reflections occurring between the two refractions." AL-FARISI verified this through extensive experimentation using a transparent sphere filled with water and a camera obscura.⁹⁷³



⇒ KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI (artist, date and location of bronze bust are unmentioned)⁹⁷⁴

⁹⁷³ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⁹⁷⁴ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

Circa 11,269 HE: PELERIN DE MARICOURT or PETRUS PEREGRINUS DE MARICOURT, France, Scholar experimented and defined “Magnetic Poles” and wrote to a friend a letter describing his scientific experimentation with Magnets.⁹⁷⁵

Circa 11,291 HE: Venice. Clear glass making invented 1,390 years after circa **9,901 HE** in Syria invented blowing and making of colored glass.⁹⁷⁶

⇒ Mirrors invented: Clear glass lead to invention of the first “something” besides water or polished metal for people to see their reflections.⁹⁷⁷

⁹⁷⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 84

⁹⁷⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

⁹⁷⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

Circa 11,292 HE: North America, United States, Ancient Puebloan culture. Ancient Puebloan is their more accurate name. “Anasazi People” was a derogatory name.⁹⁷⁸

- ⇒ In contemporary times, the people and their archaeological culture were referred to as Anasazi for historical purposes. The Navajo, who were not their descendants, called them by this term. Reflecting historic traditions, the term was used to mean "ancient enemies". Contemporary Puebloans do not want this term used.⁹⁷⁹
- ⇒ The Ancestral Puebloans possessed a complex network that stretched across the now Colorado Plateau, United States linking hundreds of communities and population centers. They held a

⁹⁷⁸ https://en.wikipedia.org/wiki/Ancestral_Puebloans

⁹⁷⁹ https://en.wikipedia.org/wiki/Ancestral_Puebloans

distinct knowledge of celestial sciences that found form in their architecture.⁹⁸⁰



Photo is of Mesa Verde National Park, Cliff Palace, Colorado, United States, photographer unknown.⁹⁸¹

⁹⁸⁰ https://en.wikipedia.org/wiki/Ancestral_Puebloans

⁹⁸¹ https://en.wikipedia.org/wiki/Ancestral_Puebloans



Photo is of Spruce Tree House, Colorado, United States, photographer unknown.⁹⁸²

⁹⁸² https://en.wikipedia.org/wiki/Ancestral_Puebloans

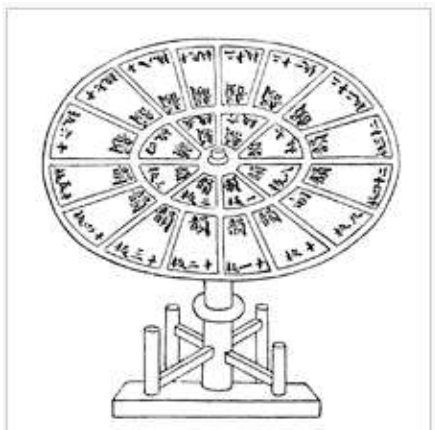
Circa 11,298 HE: The Spinning Wheel, invented in India, actual date unknown but, already had mechanized the work process of taking fiber and spinning it into yarn in India. This is the year the knowledge of the spinning wheel finally made it to Europe.⁹⁸³

Circa 11,300 HE: History now calls him the “false Gerber”, unknown location; discovered Sulfuric Acid (He referred to himself as Geber to be associated with the famous Arabic REAL GERBER) Sulfuric Acid is much stronger than Acetic acid and made possible discovery of many chemical changes.⁹⁸⁴

Circa 11,313 HE: China, revolving type case for wooden type.

⁹⁸³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 86

⁹⁸⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 87



A revolving type case for wooden type in China, from Wang Zhen's book.⁹⁸⁵

⁹⁸⁵ https://en.wikipedia.org/wiki/History_of_printing



Wooden movable type for Old Uyghur alphabet, dated to the **11,200's HE – 11,300's HE**. Discovered in the Mogao caves.⁹⁸⁶

⁹⁸⁶ https://en.wikipedia.org/wiki/History_of_printing

Circa 11,316 HE: MONDINO DE LUZZI, Italian anatomist MONDINO DE LUZZI taught at medical school of Bologna and did human cadaver dissection which lead to **11,316 HE** publication of book *Anathomia corporis humani*⁹⁸⁷ entirely dedicated to anatomy.⁹⁸⁸ MONDINO DE LUZZI's book *Anathomia corporis humani* remained the most widely-used anatomical text for 250 years because it clearly and concisely provided the important technical indications involved in the dissection process, including the steps involved and the reasoning behind the organization of these procedures.⁹⁸⁹

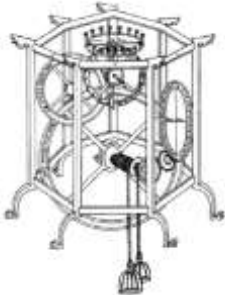
Circa 11,330 HE – 11,388 HE: GIOVANNI DE DONDI: Padua, Italy. Known for art design and construction, he built an astronomical clock which demonstrated an ambitious attempt to describe and model the

⁹⁸⁷ https://en.wikipedia.org/wiki/Mondino_de_Liuzzi

⁹⁸⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 89

⁹⁸⁹ https://en.wikipedia.org/wiki/Mondino_de_Liuzzi

planetary system with mathematical precision and technological sophistication.⁹⁹⁰



Built in **11,364 HE**: This tracing of an illustration from GIOVANNI DE DONDI'S **11,364 HE** treatise, *Il Tractatus*

⁹⁹⁰ https://en.wikipedia.org/wiki/Giovanni_Dondi_dell_Orologio

Astrarii is perhaps the earliest existing drawing of a balance wheel. The balance wheel (crown shape, top) had a beat of 2 seconds.⁹⁹¹

Circa 11,333 HE – 11,351 HE: By now, simple hygienic principles were lost, becoming unknown to European society.⁹⁹² The Black Death is estimated to have killed 30–60% of Europe's total population.⁹⁹³

Circa 11,335 HE: Milan, Italy; Mechanical Clocks invented; the first advance over the water clock (see **9,731 HE** - note it took circa 1,600 years for this advancement) was invented and used the downward gravitational pull of weights from the mechanical clock face. It struck the hour. For the first time citizens could know the approximate time

⁹⁹¹ https://en.wikipedia.org/wiki/Balance_wheel

⁹⁹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 90

⁹⁹³ https://en.wikipedia.org/wiki/Black_Death

by listening to the bell. the word “clock” is from the French word for “bell”.⁹⁹⁴

Circa 11,335 HE: Mexico City, then known as Tenochtitlan by the rising Aztec empire, was founded.⁹⁹⁵

Circa 11,352 HE – 11,354 HE: France, Strasbourg cathedral, an astronomical clock was erected, often falsely claimed to be the oldest such clock, it is considered the second oldest preserved automaton worldwide. The mechanism most certainly had an astrolabe dial and a calendar dial.⁹⁹⁶ (See **Circa 9,796 HE – 9,901 HE:** The Antikythera Mechanism.)

⁹⁹⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 89

⁹⁹⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 90

⁹⁹⁶ https://en.wikipedia.org/wiki/Strasbourg_astronomical_clock

Circa 11,400 HE: The population of the world was approximately 350,000,000 people.⁹⁹⁷

Circa starting: 11,400's HE: Netherlands; Use of wind mills to pump water from low lands polder, as a method for flood control. The wind-driven water pump has become one of the trademark tourist attractions of the Netherlands. The first drainage mills using a scoop wheel could raise water at most 1.5 m. By combining mills, the pumping height could be increased. Later mills were equipped with an Archimedes' screw which could raise water much higher.⁹⁹⁸

⁹⁹⁷ <http://www.worldometers.info/world-population/world-population-by-year/>

⁹⁹⁸ https://en.wikipedia.org/wiki/Flood_control_in_the_Netherlands



Current times **HE**: Pumping station in Zoetermeer, Netherlands. The polder lies lower than the surrounding water on the other side of the dike. The Archimedes' screws are clearly visible. Photographer unknown.⁹⁹⁹

⁹⁹⁹ https://en.wikipedia.org/wiki/Polder#Polders_and_the_Netherlands

Circa 11,400 HE – 11,468 HE: Germany, JOHANNES GUTENBERG gets historical credit for being the first European to use a Printing Press with moveable type.¹⁰⁰⁰

⇒ By **11,450 HE**, the press was in operation, and a German poem had been printed, possibly the first item to be printed.¹⁰⁰¹



⇒ JOHANNES GUTENBERG, date, artist and location unknown.¹⁰⁰²

¹⁰⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

¹⁰⁰¹ https://en.wikipedia.org/wiki/Johannes_Gutenberg

¹⁰⁰² https://en.wikipedia.org/wiki/Johannes_Gutenberg



A Gutenberg press replica at the Featherbed Alley Printshop Museum in Bermuda.¹⁰⁰³

¹⁰⁰³ https://en.wikipedia.org/wiki/Johannes_Gutenberg

Circa 11,403 HE: Venice. Again, by this time the use of soap for hygiene or cleaning was lost as religion replaced science. Society did not know how to control the resulting spread of disease. The Venetians invented the idea of “Quarantine” (from the French word for “forty”).¹⁰⁰⁴

⇒ “Quarantine” was what it was called when the rulers of Venice stopped allowing visitors into their land by making them wait for 40 days outside the city – quarantined from the citizens – to prove they had no disease; after which time they were allowed to enter. (Also mentioned was “isolation” for skin diseases such as leprosy, undoubtedly along with less drastic skin ailments, but no date is given.)¹⁰⁰⁵

¹⁰⁰⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

¹⁰⁰⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

Circa 11,436 HE: LEON BATTISTA ALBERTI, Italian artist, architect, published the first book on perspective, handling the matter in careful mathematical manner. This book and the ideas lead to “Projective Geometry” which was invented 400 years later.¹⁰⁰⁶

⇒ *De re aedificatoria* (English: *On the Art of Building*) is a classic architectural treatise written by LEON BATTISTA ALBERTI between **11,443 HE** and **11,452 HE**. Although largely dependent on *Vitruvius's De architectura*, it was the first theoretical book on the subject written in the Italian Renaissance, and in **11,485 HE** it became the first printed book on architecture.¹⁰⁰⁷

¹⁰⁰⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 94

¹⁰⁰⁷ https://en.wikipedia.org/wiki/De_Re_Aedificatoria



Title page of **11,550 HE** edition of *De re aedificatoria* (English:

On the Art of Building) is a classic architectural treatise,

Florence, photographer unknown.¹⁰⁰⁸

Circa 11,438 HE – circa 11,572 HE: The Inca civilization¹⁰⁰⁹ arose from the Andes Mountains in the highlands of Peru¹⁰¹⁰ and Ecuador.¹⁰¹¹

⇒ The Inca Civilization thrived despite supposed handicaps that they lacked many features associated with civilization in the Old World: In the words of one scholar, "The Incas lacked the use of wheeled vehicles. They lacked animals to ride and draft animals that could pull wagons and plows... lacked the knowledge of iron and steel... and they lacked a system of writing", they thrived.¹⁰¹²

¹⁰⁰⁸ https://en.wikipedia.org/wiki/De_Re_Aedificatoria

¹⁰⁰⁹ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁰¹⁰ https://en.wikipedia.org/wiki/Inca_Empire

¹⁰¹¹ <https://www.youtube.com/watch?v=NryISO45RT4>

¹⁰¹² https://en.wikipedia.org/wiki/Inca_Empire

⇒ Notable features of the Inca Empire include its monumental architecture, especially stonework, extensive road network reaching all corners of the empire, finely-woven textiles, use of knotted strings (quipu) for record keeping and communication, agricultural innovations in a difficult environment, and the organization and management fostered or imposed on its people and their labor. ¹⁰¹³

¹⁰¹³ https://en.wikipedia.org/wiki/Inca_Empire



Inca Civilization site, Ingapirca, Ecuador, photographer unknown.¹⁰¹⁴

¹⁰¹⁴ Cultura Cañari: Ingapirca



Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.¹⁰¹⁵

¹⁰¹⁵ <http://leoturismoecuador.blogspot.com/2015/12/ingapirca.html>



Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.¹⁰¹⁶

¹⁰¹⁶ <http://viajerosustentable.com/2012/05/08/ingapirca/>



Peru, Inca Civilization site: Machu Picchu was declared a Peruvian Historic Sanctuary and a UNESCO World Heritage Site, photographer unknown.¹⁰¹⁷

¹⁰¹⁷ https://en.wikipedia.org/wiki/Machu_Picchu



The Inca Empire at its greatest extent.¹⁰¹⁸

¹⁰¹⁸ https://en.wikipedia.org/wiki/Inca_Empire

⇒ **Circa 11,500 HE:** The Incas also committed ritual human sacrifices. Mummies known as The Children of Lulllaillaco (Spanish: [ju.jai'ja.ko]), also known as the Mummies of Lulllaillaco, are three rediscovered Inca child mummies DR. JOHAN REINHARD and his archaeological team near the summit of Lulllaillaco, 6,739 meters (22,110 ft) stratovolcano in the Andes mountains on the border between Chile and Argentina. The children were sacrifices in an Inca religious ritual. In this ritual, the three children were drugged and allowed to freeze on top of the mountain, and then they were placed inside a small chamber 1.5 meters (4.9 ft) beneath the ground, where they were left to die. According to DR. JOHAN REINHARD, the mummies "appear to be the best-preserved Inca mummies ever found", and other archaeologists have expressed the same opinion, calling them among the best-preserved mummies in the world.¹⁰¹⁹

¹⁰¹⁹ https://en.wikipedia.org/wiki/Children_of_Lulllaillaco



The mummy La Doncella on display at the Museum of High-Altitude Archaeology (es), a museum dedicated entirely to the display of the mummies, in Salta, Argentina, photographer unknown.¹⁰²⁰

¹⁰²⁰ https://en.wikipedia.org/wiki/Children_of_Llullaillaco



Mummy called El Niño, photographer unknown.¹⁰²¹

⇒ From **11,438 HE to 11,533 HE**, the Incas incorporated a large portion of western South America, centered on the Andean

¹⁰²¹ https://en.wikipedia.org/wiki/Children_of_Llullailaco

Mountains, using conquest and peaceful assimilation, among other methods.¹⁰²²

Circa 11,450 HE: China, (see **10,350 HE** for first step, and **10,800 HE** for earlier stages in printing development) invents carving wooden blocks that can be arranged in a configuration to print on paper.¹⁰²³

Circa 11,451 HE: NICHOLAS OF CUSA AKA NICOLAUS CUSANUS, German scholar, astronomer¹⁰²⁴ who suggested the use of concave glass for lenses to help those who were otherwise near sighted.¹⁰²⁵
(See **Circa 11,249 HE:** China and Europe both invent convex lenses used to help the aged who were becoming far sighted.¹⁰²⁶)

¹⁰²² https://en.wikipedia.org/wiki/Inca_Empire

¹⁰²³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

¹⁰²⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

¹⁰²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

¹⁰²⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 83

- ⇒ In medicine NICHOLAS OF CUSA / NICOLAUS CUSANUS introduced an improvement which in an altered form has continued in use to this day. This improvement was the counting of the pulse which up to his time had been felt and discussed in many ways but never counted. He proposed to compare the rate of pulses by weighing the quantity of water run out of a water clock while the pulse beat one hundred times.¹⁰²⁷
- ⇒ Most of NICOLAUS CUSANUS mathematical ideas can be found in his essays, *De Docta Ignorantia* (*Of Learned Ignorance*), *On Conjectures* and in his *mathematical treatises*.¹⁰²⁸
- ⇒ NICOLAUS CUSANUS has remained an influential figure. During the period **12,000 HE-12,001 HE**, his sixth centennial of his birth

¹⁰²⁷ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

¹⁰²⁸ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

was celebrated on four continents and commemorated by publications on his life and work.¹⁰²⁹ The lunar crater, “CUSANUS” was named after NICHOLAS.¹⁰³⁰

¹⁰²⁹ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

¹⁰³⁰ https://en.wikipedia.org/wiki/Nicholas_of_Cusa



NICHOLAS OF CUSA AKA NICOLAUS CUSANUS, unknown current location¹⁰³¹ by late Gothic German painter working ca. **11,463 HE** — **ca. 11,490 HE**, working in Cologne, one name known as the Master of Wilten.¹⁰³²

¹⁰³¹ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

¹⁰³² https://en.wikipedia.org/wiki/Master_of_the_Life_of_the_Virgin

11,452 HE– 11,519 HE: LEONARDO DA VINCI, Italian, polymath, born Leonardo di ser Piero da Vinci.¹⁰³³



LEONARDO DA VINCI Portrait by Francesco Melzi.¹⁰³⁴

¹⁰³³ https://en.wikipedia.org/wiki/Leonardo_da_Vinci

¹⁰³⁴ https://en.wikipedia.org/wiki/Leonardo_da_Vinci



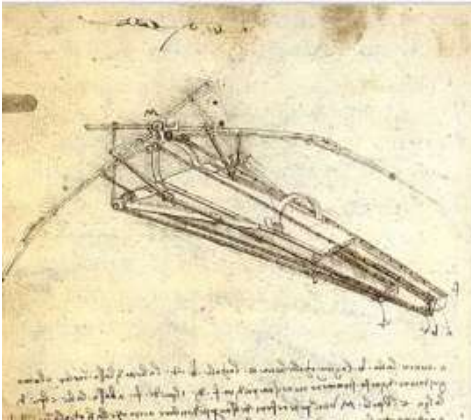
Profile bust "Leonardo da Vinci" created by LEONARDO DA VINCI.¹⁰³⁵

¹⁰³⁵ <http://self-portrait-leonardo.com/research/6>

- ⇒ Among other scientific ideas LEONARDO DA VINCI conceptualized a type of armored fighting vehicle, concentrated solar power, and a rudimentary theory of plate tectonics.¹⁰³⁶
- ⇒ Although unheralded in his own time, LEONARDO DA VINCI did create the automated bobbin winder and a machine for testing the tensile strength of wire.¹⁰³⁷

¹⁰³⁶ https://en.wikipedia.org/wiki/Leonardo_da_Vinci

¹⁰³⁷ https://en.wikipedia.org/wiki/Leonardo_da_Vinci



11,488 HE: LEONARDO DA VINCI conceptualization of a flying machine, Institut de France, Paris, photographer unknown¹⁰³⁸

¹⁰³⁸ https://en.wikipedia.org/wiki/Leonardo_da_Vinci



One of LEONARDO DA VINCI 's flying machine sketches,
photographer unknown.¹⁰³⁹

¹⁰³⁹ https://en.wikipedia.org/wiki/History_of_aviation

Circa 11,459 HE – 11,507 HE – MARTIN BEHAIM, German mariner, artist, cosmographer, astronomer, philosopher, geographer, and explorer.¹⁰⁴⁰ In **11,492 HE MARTIN BEHAIM**, made the first globe, The Erdapfel (German: *lit. earth apple*).¹⁰⁴¹

⇒ The Erdapfel only included three continents: Europe, Africa and Asia, and only the great world ocean in between. **MARTIN BEHAIM** had no clue that North and South America even existed.¹⁰⁴²

¹⁰⁴⁰ https://en.wikipedia.org/wiki/Martin_Behaim

¹⁰⁴¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13

¹⁰⁴² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13



MARTIN BEHAIM with his Erdapfel, artist, date and location unknown.¹⁰⁴³

¹⁰⁴³ <https://en.wikipedia.org/wiki/Erdapfel>



MARTIN BEHAIMs Erdapfel at the German National Museum.¹⁰⁴⁴

¹⁰⁴⁴ <https://en.wikipedia.org/wiki/Erdapfel>

Circa 11,470 HE: PETER HENLEIN, German locksmith who invented the pocket-sized watch. PETER HENLEIN realized the mainsprings of the clocks, with main springs, that 1) included a spiral spring that could be repeatedly wound tightly had 2) the tendency to unwind that tight main spring that 3) would then power the watch 4) that the springs and thus the clocks themselves could be made smaller 5) so small it could fit in a pocket. However, PETER HENLEIN's small winding mainspring pocket watches had only had hour hands on them and were not usually accurate.¹⁰⁴⁵

¹⁰⁴⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



Monument to PETER HENLEIN by Max Meisner, in Hefnersplatz,
Nuremberg.¹⁰⁴⁶

¹⁰⁴⁶ https://en.wikipedia.org/wiki/Peter_Henlein



An early "clock-watch", photographer and location unknown.
(*Taschenuhr*)¹⁰⁴⁷

¹⁰⁴⁷ https://en.wikipedia.org/wiki/Peter_Henlein

Circa 11,502 HE: MARTIN WALDSEEMULLER: German cartographer who published the first map with a continent between oceans and, separate from Europe and Asia, and named the new continent after Amerigo Vespucci Aka Americus Vespucius because was impressed that:¹⁰⁴⁸ Amerigo Vespucci Aka Americus Vespucius, Italian navigator derived that none of the lands he was seeing were the Asia lands described by Marco Polo or Christopher Columbus.¹⁰⁴⁹

¹⁰⁴⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102

¹⁰⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



MARTIN WALDSEEMULLER, artist, date and location unknown.¹⁰⁵⁰

¹⁰⁵⁰ https://en.wikipedia.org/wiki/Martin_Waldseemuller



Universalis Cosmographia, MARTIN WALDSEEMULLER's
11,507 HE world map which was the first to show the Americas
separate from Asia¹⁰⁵¹

¹⁰⁵¹ https://en.wikipedia.org/wiki/Martin_Waldseemuller



Detail of the map showing the name "America".¹⁰⁵²

¹⁰⁵² https://en.wikipedia.org/wiki/Waldseemuller_map



Detail of the map showing the names "Catigara" and "Mallaqua".¹⁰⁵³

¹⁰⁵³ https://en.wikipedia.org/wiki/Waldseemuller_map

Circa 11,523 HE: Circumnavigation of the Earth was completed. The Earth is round proved a different way. Financed by Spain, FERDINAND MAGELLAN started the expedition but died on route. The circumnavigation showed beyond a doubt, the circumference of the Earth was 25,000 miles confirming the scientific prediction of Earth's circumference calculations done by ERATOSTHENES in circa **9,761 HE**, (circa 1,762 years earlier).¹⁰⁵⁴

Circa 11,535 HE: This is the year when it became standard practice that Scientific discoveries do not belong to the discoverer – they belong to the world.¹⁰⁵⁵

¹⁰⁵⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 105

¹⁰⁵⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

- ⇒ The “first to publication” rule came to be and Science as we now know it exists.¹⁰⁵⁶
- ⇒ Because, the mathematician GERONIMO CARDANO wheedled and *without permission published* the privately held information mathematician NICOLLO TARTAGLIA had generally re-discovered how to do cubic equations. (But didn't know it was a re-discovery. See: **Circa 9,601 HE – 10,200 HE: Indian Sub-continent: Jain mathematicians in India wrote the “Sthananga Sutra”**, which contains among much else cubic equations) combinations) GERONIMO CARDANO usually gets recognized for TARTAGLIA'S work.¹⁰⁵⁷

¹⁰⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

¹⁰⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

Circa 11,538 HE: Comets, once thought as the bearers of bad fortunes, were no longer thought of as dangerous, were now viewed calmly by the people. *Two Books on comets were published that year:*¹⁰⁵⁸

⇒ Book One Published on Comets: by GIROLAMO FRACASTORO, **circa 11,478 HE – 11,553 HE**, Italian physician, poet, and scholar in mathematics, geography and astronomy: saying the comet's tail always pointed away from the sun.¹⁰⁵⁹

¹⁰⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

¹⁰⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



Portrait of GIROLAMO FRACASTORO by Titian, **circa 11,528 HE**; in the collection of the National Gallery since **11,924 HE**.¹⁰⁶⁰

¹⁰⁶⁰ https://en.wikipedia.org/wiki/Girolamo_Fracastoro



GIROLAMO FRACASTORO's *Hieronimi Fracastorii Poemata Omnia* (11,718 HE Reprint).¹⁰⁶¹

¹⁰⁶¹ https://en.wikipedia.org/wiki/Girolamo_Fracastoro

- ⇒ Circa **11,546 HE**: Non-Comet note: GIROLAMO FRACASTORO proposed that epidemic diseases are caused by transferable tiny particles or "spores" that could transmit infection by direct or indirect contact or even without contact over long distances. In his writing, the "spores" of diseases may refer to chemicals rather than to any living entities.¹⁰⁶²
- ⇒ **11,495 HE – 11,552 HE**: Book Two Published on Comets: by PETER BENNEWITZ; also known as PETER BIENEWITZ AND PETRUS APIANUS, German astronomer, humanist, cartographer who came to the same conclusions independently AND also included the first European scientific drawing of a comet.¹⁰⁶³

¹⁰⁶² https://en.wikipedia.org/wiki/Girolamo_Fracastoro

¹⁰⁶³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



PETRUS APIANUS c. **15,000 HE.** Engraving by Theodor de Bry.¹⁰⁶⁴

¹⁰⁶⁴ https://en.wikipedia.org/wiki/Petrus_Apianus



Non-Comet map by **PETRUS APIANUS 11,524 HE**: Cordiform projection in a map of the world which is another early map that shows America separate from Asia.¹⁰⁶⁵

¹⁰⁶⁵ https://en.wikipedia.org/wiki/Petrus_Apianus

- ⇒ See list of other Non-Comet works by PETER BENNEWITZ also known as PETER BIENEWITZ AND PETRUS APIANUS¹⁰⁶⁶
- ⇒ Author / Compiler note: see Circa **9,761 HE**, China, first surviving drawings of comets.

¹⁰⁶⁶ https://en.wikipedia.org/wiki/Historical_comet_observations_in_China

Chapter Six

THE SCIENTIFIC REVOLUTION: Circa 11,543 HE - Now (lasting, so far, less than 600 years)

The Scientific Revolution has lasted less than 600 years – beginning Circa **11,543 HE** and continuing to current times. The Scientific Revolution began with the printing of the two books *De Revolutionibus Coelestium (Concerning the Revolution of Heavenly Bodies)* by NICOLAUS COPERNICUS¹⁰⁶⁷ and *De humani corporis fabrica (Concerning the Structure of the Human Body)* by ANDREAS VESALIUS.¹⁰⁶⁸

“One Scientific Breakthrough often enables another.” – Max Tegmark¹⁰⁶⁹

¹⁰⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

¹⁰⁶⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

¹⁰⁶⁹ Max Tegmark, Our Mathematical Universe

11,473 HE - 11,543 HE: NICOLAUS COPERNICUS, Royal Prussian, Kingdom of Poland, Renaissance mathematician and astronomer, polyglot and polymath, law educated, physician, classics scholar, translator, governor, diplomat, and economist.¹⁰⁷⁰

⇒ **11,543 HE:** NICOLAUS COPERNICUS, with great reluctance and fear of what would be the reaction of the powers of the time-published – after being pushed by others – his book *De Revolutionibus Coelestium (Concerning the Revolution of Heavenly Bodies)* which mathematically defined the HELIOCENTRIC SYSTEM, against all information of the time, that the Sun is the center of the solar system, not the Earth.¹⁰⁷¹ The Earth and the other planets orbit the Sun.¹⁰⁷² COPERNICUS

¹⁰⁷⁰ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

¹⁰⁷¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

¹⁰⁷² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

elaborated on the **9,770 HE** predicted heliocentric theory of **ARISTARCHUS OF SAMOS**.¹⁰⁷³ **COPERNICUS** dedicated the book in a placatory gesture to the powers that he feared, and then died. The story is that **COPERNICUS** was given the very first copy of his book on the day of his death.¹⁰⁷⁴

- ⇒ **COPERNICUS** derived a quantity theory of money – a key concept in economics.¹⁰⁷⁵

- ⇒ **NICOLAUS COPERNICUS** figured out the size and shape of our Solar System using geometric ingenuity,¹⁰⁷⁶ and proposed, an infinitely vaster cosmos.¹⁰⁷⁷ However, the overall scale of

¹⁰⁷³ https://en.wikipedia.org/wiki/Aristarchus_of_Samos

¹⁰⁷⁴ **ISAAC ASIMOV: ASIMOV'S** Chronology of Science and Discovery page 109

¹⁰⁷⁵ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

¹⁰⁷⁶ Max Tegmark, Our Mathematical Universe

¹⁰⁷⁷ **COSMOS, A Space Time Odyssey**, by Ann Druyan Episode 1

COPERNICUS's Solar System was about 20 times smaller than reality. That's like confusing a real house with a doll house.¹⁰⁷⁸



NICOLAUS COPERNICUS The "Torun portrait", anonymous, circa **11,580 HE**, kept in Toruń town hall ¹⁰⁷⁹

¹⁰⁷⁸ Max Tegmark, Our Mathematical Universe

¹⁰⁷⁹ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

11,494 HE – 11,555 HE: GEORG BAUER, whose pen name was the Latinized GEORGIUS AGRICOLAE was a German Mineralogist.¹⁰⁸⁰ who also speculated on fossils.¹⁰⁸¹

⇒ **11,912 HE:** 350 years after BAUER wrote the book, the first English translation of *De Re Metallica* was privately published in London by subscription. The translators were HERBERT HOOVER, a multi lingual mining engineer (and later President of the United States), and his multi lingual wife, LOU HENRY HOOVER, a geologist and Latinist, and later First Lady of the United States.¹⁰⁸²

⇒ Author / Compiler found GEORG BAUER while researching the history of trains. The books written by GEORG BAUER

¹⁰⁸⁰ https://en.wikipedia.org/wiki/Georgius_Agricola

¹⁰⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

¹⁰⁸² https://en.wikipedia.org/wiki/De_re_metallica

encompass so much more than their information on the minecart and “What created the extraordinary value of the book are the many drawings and sketches AGRICOLAE used to illustrate it. He realized that technical descriptions in words alone are not enough to give a clear picture of the activity. Therefore, he provided clear images of all tools, installations, and constructions that he discussed. These numerous images have contributed immensely to the fame of the book. Additionally, it showed there were things beyond the classical writers which were worth knowing about and which became an example of accurate, independent research. Thereby it also helped establish a new kind of science.”¹⁰⁸³

¹⁰⁸³ <http://farlang.com/books/agricola-hoover-de-re-metallica>



GEORGIUS AGRICOLA AKA GEORG BAUER, date and artist unknown.¹⁰⁸⁴

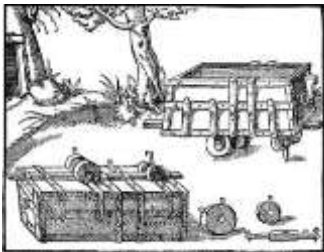
¹⁰⁸⁴ https://en.wikipedia.org/wiki/Georgius_Agricola



11,561 HE: Title page of one of GEORG BAUER's 12 books of *De Re Metallica*, Latin for: *On the Nature of Metals (Minerals)*.¹⁰⁸⁵ The work gives an overview of everything that has to do with the mining industry. BAUER covers not only metals, although he gives them the most attention, but he also discusses the

¹⁰⁸⁵ https://en.wikipedia.org/wiki/Georgius_Agricola

extraction and preparation of substances such as salt, saltpeter, sulfur and glass.¹⁰⁸⁶



1—MINECART WITH WHEELS IN FRONT. 2—ITS FRONT WHEELS. 3—MINECART. 4—WHEELS. 5—WHEELS. 6—WHEELS. 7—WHEELS. 8—WHEELS. 9—WHEELS. 10—WHEELS. 11—WHEELS. 12—WHEELS.

1087

Circa 11,556 HE: A drawing of GEORG BAUER's Minecart shown in one of the 12 books of *De Re Metallica*. The book

¹⁰⁸⁶ <http://farlang.com/books/agricola-hoover-de-re-metallica>

¹⁰⁸⁷ https://en.wikipedia.org/wiki/History_of_rail_transport

remained the authoritative text on mining for years after its publication. It was also an important chemistry text for the period and is significant in the history of chemistry.¹⁰⁸⁸

Circa 11,500 HE: A South Asian Indians book: *Ananga Ranga ("The Stage of the God of Love")*, said how Indians used a variety of birth control methods since ancient times, including a potion made of powdered palm leaf and red chalk, as well as pessaries made of honey, ghee, rock salt or the seeds of the palasa tree, and a variety of birth control prescriptions, mainly made up of herbs and other plants.¹⁰⁸⁹

11,515 HE: Cardinal Matthäus Lang wrote a description of the *Reisszug*, a funicular railway at the Hohensalzburg Castle in Austria. The line originally used wooden rails and a hemp haulage rope and was

¹⁰⁸⁸ https://en.wikipedia.org/wiki/De_re_metallica

¹⁰⁸⁹ https://en.wikipedia.org/wiki/History_of_birth_control

operated by human or animal power, through a treadwheel. The line still exists and is operational, although in updated form and is possibly the oldest operational railway.¹⁰⁹⁰



Reisszug, as it appears today.¹⁰⁹¹

¹⁰⁹⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁰⁹¹ https://en.wikipedia.org/wiki/History_of_rail_transport

11,527 HE -11,598 HE: ABRAHAM ORTELIUS, Flemish cartographer and geographer is conventionally recognized as the creator of the first modern atlas in **11,570 HE** called the *Theatrum Orbis Terrarum* (Theatre of the World). ABRAHAM ORTELIUS is also believed to be the first person to imagine that the continents were joined together before drifting to their present positions and based his world atlas reflecting on the discoveries of the previous 80 years-- the Golden Age of Exploration. Errors, of course, abound, both in general conceptions and in detail.¹⁰⁹² ABRAHAM ORTELIUS later wrote that the Americas were torn away from Europe and Africa by earthquakes and floods. He was proved wrong – but he was the first to consider the land on the earth moves. The thought opened the door to finding the correct answer. (See **11,880 HE** ALFRED WEGENER.)

¹⁰⁹² https://en.wikipedia.org/wiki/Abraham_Ortelius



ABRAHAM ORTELIUS by Peter Paul Rubens, date and location unknown.¹⁰⁹³

¹⁰⁹³ https://en.wikipedia.org/wiki/Abraham_Ortelius



In **11,570 HE** Gilles Coppens de Diest at Antwerp published 53 maps created by ABRAHAM ORTELIUS under the title *Theatrum*

Orbis Terrarum, considered the "first modern atlas". This is the world map from this atlas.¹⁰⁹⁴

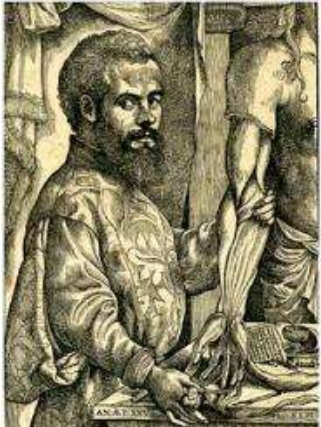
Circa 11,543 HE: ANDREAS VESALIUS, Flemish/ Netherlands, anatomist¹⁰⁹⁵ ANDREAS VESALIUS wrote *De humani corporis fabrica (Concerning the Structure of the Human Body)* in which he corrected, because he believed his eyes and was ready to update the knowledge of the Ancients; the over 200 errors of GALEN¹⁰⁹⁶ (See: Circa **10,200 HE:** AELIUS OR CLAUDIUS GALENUS, Greek, GALEN of PERGAMON). ANDREAS VESALIUS took advantage of printing to reproduce careful illustrations of anatomical facts by Flemish artist Jan Stephan van Calcar.¹⁰⁹⁷

¹⁰⁹⁴ https://en.wikipedia.org/wiki/Theatrum_Orbis_Terrarum

¹⁰⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

¹⁰⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

¹⁰⁹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109



Portrait of ANDREAS VESALIUS from *De humani corporis fabrica*.¹⁰⁹⁸

¹⁰⁹⁸ https://en.wikipedia.org/wiki/Andreas_Vesalius

Circa 11,545 HE: Negative numbers. ASIMOV does not say where... but until this time mathematicians thought there were no numbers less than nothing. However, debt was known – which at that time meant having less than no money. Debt and negative numbers, it was realized, followed the rules of mathematics.¹⁰⁹⁹

Circa 11,545 HE: AMBROISE PARE, French, considered the *father of rational surgery* who avoided the burning and cauterizing and dirty conditions of surgery up until this time, and instead brought about more cures with an infinitesimal amount of the pain.¹¹⁰⁰

¹⁰⁹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

¹¹⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110



The title page of AMBROISE PARE's *Oeuvres*.¹¹⁰¹ AMBROISE PARE 's writings further include the results of his methodical studies on the effects of violent death on internal organs. He also created and wrote, *Reports in Court* a procedure on the writing of

¹¹⁰¹ https://en.wikipedia.org/wiki/Ambroise_Pare

legal reports in relation to medicine. His writings and instructions *Oeuvres* are known to be the beginning of modern forensic pathology.¹¹⁰²

11,546 HE - 11,601 HE: TYCHO BRAHE, Danish astronomer who destroyed the previous notion of heavenly perfection and immutability. He recorded as he watched a new star change for 485 days. Prior to this effort, the Greeks had thought the heavens were unchangeable, they thought only the earth and the atmosphere changed. Circa **11,577 HE** TYCHO BRAHE with the help of the Danish king, established the first real astronomical observatory and further expanded knowledge by defining a comet to be beyond the moon.¹¹⁰³

¹¹⁰² https://en.wikipedia.org/wiki/Ambroise_Pare

¹¹⁰³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117



TYCHO BRAHE wearing the Order of the Elephant, artist, date and location unknown.¹¹⁰⁴

¹¹⁰⁴ https://en.wikipedia.org/wiki/Tycho_Brahe

- **Circa 9,851 HE:** HIPPARCHUS had defined parallax and TYCHO BRAHE tried to define the new star he saw distance using parallax but since he could not determine any parallax TYCHO BRAHE reasoned the new star must be beyond the moon / thus in the heavens.¹¹⁰⁵ TYCHO BRAHE published a small book detailing his observations on the new star called *De Nova Stella (Concerning the New Star)*. In modern times those stars that suddenly appear in the night sky are called Supernovas.¹¹⁰⁶

11,548 HE - 11,600 HE: GIORDANO BRUNO, Italian philosopher, mathematician, poet,¹¹⁰⁷ was burned at the stake by the Roman Inquisition because, among other reasons BRUNO insisted that the

¹¹⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

¹¹⁰⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

¹¹⁰⁷ https://en.wikipedia.org/wiki/Giordano_Bruno

universe - space - is in fact infinite and could have no celestial body at its "center".^{1108 1109}



GIORDANO BRUNO - Portrait from "Livre du recteur" made in **11,578 HE**, location and artist unknown.¹¹¹⁰

¹¹⁰⁸ Max Tegmark, Our Mathematical Universe

¹¹⁰⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode

¹¹¹⁰ https://en.wikipedia.org/wiki/Giordano_Bruno

11,550 HE – circa 11,758 HE: Introduced from Germany to England:
Wagon-ways made of wooden rails and horse-drawn traffic.¹¹¹¹

Circa 11,551 HE: GEORGE JOACHIM, German mathematician studied under NICOLAUS COPERNICUS and had been instrumental in persuading NICOLAUS COPERNICUS to publish. GEORGE JOACHIM expanded the knowledge of the Greeks and made *Trigonometric Tables* that related the ratios to the size of the angle (rather than to arcs of circles).¹¹¹² GEORGE JOACHIMs *Trigonometric Tables*, combined with NICOLAUS COPERNICUS's heliocentric view made it possible for computational astronomy to advance.¹¹¹³

¹¹¹¹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹¹¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

¹¹¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

Circa 11,551 HE: ERASMUS REINHOLD, German mathematician who improved, a small bit, on NICOLAUS COPERNICUS's mathematics and prepared *The Tabulae Prutencae (Prussian Tables) of Planetary Motion.* It was better than PTOLOMY's *Alfonsine Tables* but not much.¹¹¹⁴

Circa 11,552 HE: BARTOLOMMEO EUSTATCHIO, Italian anatomist described the tube that circa 2000 years earlier, see **Circa 9,451 HE** ALCMAEON OF CROTON first discovered: the part of the ear connecting the ear and the throat and BARTOLOMMEO EUSTATCHIO named it the Eustachian Tube.¹¹¹⁵

¹¹¹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

¹¹¹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 112

⇒ BARTOLOMMEO EUSTATCHIO was the first to describe the Adrenal Glands.¹¹¹⁶

Circa 11,553 HE: MIGUEL SERVETO aka MICHAEL SERVETUS, Spanish physician and heretic published a book dealing with the “lesser circulation” of the heart. MICHAEL SERVETUS also disputed theology with John Calvin, and when traveling to Spain was accused by Calvin, arrested, and burned at the stake for his scientific and non-religious views.¹¹¹⁷ (see **Circa 11,288 HE** IBN AL-NAFIS who was the first person to report on the “lesser circulation” of the heart.)¹¹¹⁸

¹¹¹⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 112

¹¹¹⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 140

¹¹¹⁸ https://en.wikipedia.org/wiki/Ibn_al-Nafis

⇒ John Calvin attempted to burn all copies of MIGUEL SERVETO aka MICHAEL SERVETUS's book and it was not until **11,694 HE** that some unburned copies were found.¹¹¹⁹

Circa 11,555 HE: PIERRE BELON, French, naturalist whose research encouraged evolutionary thought.¹¹²⁰ BELON had been sent to the Ottoman Empire from France, there he studied plant and animal life in the Eastern Mediterranean and published writings comparing it with the life in France. PIERRE BELON was the first to describe the basic similarities (homologies) in the skeletons of all vertebrates, from fish to humans. PIERRE BELON noted the number of bones in the limbs were remarkably consistent regardless of outer appearance.¹¹²¹

¹¹¹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

¹¹²⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113

¹¹²¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113



PIERRE BELON, artist, date and location unknown¹¹²²

¹¹²² https://en.wikipedia.org/wiki/Pierre_Belon

Circa 11,556 HE: Native Americans introduced tobacco to Europeans and thus the rest of the world.¹¹²³

Circa 11,559 HE: REALDO COLUMBO, Italian anatomist.¹¹²⁴ REALDO COLUMBO became the third person to understand and to describe the lesser circulation of the heart, and COLUMBO's work was the first to reach other practitioners of the medical profession.¹¹²⁵ (see **circa 11,288 HE IBN AL-NAFIS** and **circa 11,533 HE MIGUEL SERVETO** aka MICHAEL SERVETUS).

Circa 11,560 HE – 11,612 HE: SIR JOHN HARRINGTON, ALSO SPELLED HARRINGTON: Kelston, England. English courtier,

¹¹²³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

¹¹²⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

¹¹²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

author, translator and is known as the inventor of the flush toilet.¹¹²⁶
We call toilets “johns” after Sir John Harrington.¹¹²⁷

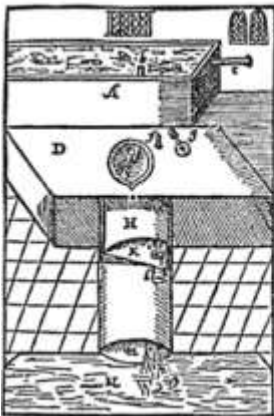


Circa 11,590 HE – 11,593 HE: Portrait of SIR JOHN HARINGTON by Hieronimo Custodis.¹¹²⁸

¹¹²⁶ [https://en.wikipedia.org/wiki/John_Harrington_\(writer\)](https://en.wikipedia.org/wiki/John_Harrington_(writer))

¹¹²⁷ <https://pintsofhistory.com/2014/09/17/how-queen-elizabeth-i-held-back-the-toilet/>

¹¹²⁸ [https://en.wikipedia.org/wiki/John_Harrington_\(writer\)](https://en.wikipedia.org/wiki/John_Harrington_(writer))



A privie in perfection

- A. the Cestene.
- B. the little washer.
- C. the waie pipe.
- D. the seate boord.
- E. the pipe that comes from the Cestene.
- F. the Screw.
- G. the Scallop shell to cover it when it is shut downe.
- H. the stoole pot.
- I. the troopie.
- K. the current.
- L. the sluice.

M.N. the vault into which it falls: alwayes remembers that () at noone and at night, emptye it, and leave it halfe a foote deepe in fayre water. And this being well done, and orderly kept, your worst privie may be as sweet as your best chamber. But to conclude all this in a few wordes, it is but a standing close stoole easilie emptied.

And by the like reason (other formes and proportions observed) all other places of your house may be kept sweet.

Drawing from **11,596 HE SIR JOHN HARINGTON**'s book: [A](#)

¹¹²⁹ <https://www.historytoday.com/richard-cavendish/death-sir-john-harington>

New Discourse of a Stale Subject, called the Metamorphosis of Ajax, described a forerunner to the modern flush toilet that was installed at his house at Kelston.¹¹³⁰

Circa 11,560 HE: GIAMBATTISTA DELLA PORTA, Italian physicist who founded the first Scientific Association designed particularly for the exchange of information and ideas. It was called THE ACADEMIA SECRETORUM NATURAE (ACADEMY OF THE MYSTERIES OF NATURE). It was shut down by the powers of the time / the Inquisition.¹¹³¹

¹¹³⁰ [https://en.wikipedia.org/wiki/John_Harington_\(writer\)](https://en.wikipedia.org/wiki/John_Harington_(writer))

¹¹³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115



GIAMBATTISTA DELLA PORTA, artist, date and location unknown¹¹³²

11,561 HE – 11,626 HE: FRANCIS BACON, English Philosopher.¹¹³³
“The Scientific Method” is further and again defined.¹¹³⁴ **Circa**
11,620 HE: Novum Organum’s skeptical methodology makes

¹¹³² https://en.wikipedia.org/wiki/Academia_Secretorum_Naturae

¹¹³³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

¹¹³⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

FRANCIS BACON *the Father of the Scientific Method*. This marked a new turn in the rhetorical and theoretical framework for science, the practical details of which are still central in debates about science and methodology today.¹¹³⁵

⇒ BACON had to re-invent the scientific method because:

- **See Circa 9,741 HE – 9,791 HE:** Emperor Qin of China burned the work of MO TZE and other scientists (SEE **Circa 9,531 HE – 9,610 HE: MOZI**);¹¹³⁶ and
- **See Circa 11,111 HE** Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. Al-Ghazali's destructive

¹¹³⁵ https://en.wikipedia.org/wiki/Francis_Bacon

¹¹³⁶ https://en.wikipedia.org/wiki/Qin_Shi_Huang

philosophy was that 1) “revelation replaced investigation”¹¹³⁷ and 2) that mathematics was the work of the devil. This destructive philosophy, combined with the codification of the entirety of what Islam was and would become, collapsed the forward momentum of the Persian scientific tradition, which has not recovered since.¹¹³⁸

⇒ It took circa 500 years until English Philosopher FRANCIS BACON organized his thoughts and published *Novum Ogranum*, (in latin) and by so writing supplied the theoretical backing for what we now know as *The Scientific Method*.¹¹³⁹

¹¹³⁷ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

¹¹³⁸ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

¹¹³⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136



The young FRANCIS BACON. Inscription around his head reads: Si tabula daretur digna animum mallet, Latin for "If one could but paint his mind". National Portrait Gallery, London.¹¹⁴⁰

¹¹⁴⁰ https://en.wikipedia.org/wiki/Francis_Bacon



11,617 HE: Portrait of BACON by Frans Pourbus, location unknown.¹¹⁴¹

¹¹⁴¹ https://en.wikipedia.org/wiki/Francis_Bacon

11,564 HE – 11,616 HE: William Shakespeare, British playwright. He was not a scientist like others in this HE timeline, but Author / Compiler wanted to include him so you can see when he fit into the HE timeline, because he was an inventor of words.

- ⇒ Bill Bryson says before Shakespeare, the English language was struggling to gain respectability. Latin was in use for serious works and official documents.
- ⇒ In **11,605 HE**, the Bodleian Library in Oxford, England, possessed almost 6,000 books. Of these, just 36 were in English.
- ⇒ Illiteracy was the usual condition in the **11,500's HE** in England. According to one estimate, in the upper social scale approximately only 60% of people could read and sign their names. In the illiterate lower classes, the approximate numbers were 70% of men and 90% of women couldn't even sign their names.

- ⇒ Among the English words first found in Shakespeare are antipathy, critical, frugal, dwindle, extract, horrid, vast, hereditary, excellent, eventful, barefaced, assassination, lonely, leapfrog, indistinguishable, well-read, zany, and countless others... including countless.
- ⇒ David Crystal points out, when it came to attaching “un” prefixes to existing words to make new words which no one had thought of before, Shakespeare was innovative – unmask, unhand, unlock, untie, unveil, and no fewer than 309 others... you can appreciate how much punch Shakespeare gave the English language.
- ⇒ Stanley Wells says that among the English language phrases first found in Shakespeare are: one fell swoop, vanish into thin air, bag and baggage, play fast and loose, go down the primrose path, be in a pickle, budge an inch, the milk of human kindness, flesh and blood, foul play, tower of strength, be cruel to be kind, blinking

idiot, with bated breath, pomp and circumstance, foregone conclusion, and many others.

⇒ Shakespeare's birth was recorded in Latin. His death was recorded in English.¹¹⁴²

11,564 HE - 11,642 HE: GALILEO, Italian¹¹⁴³ said, "If I move at a constant velocity, I do not know I am moving."¹¹⁴⁴ GALILEO was satisfied that all bodies fell at equal rates, provided that air resistance didn't complicate matters.¹¹⁴⁵ GALILEO proved PTOLEMY's observation that not all celestial objects orbit the sun.¹¹⁴⁶ GALILEO invented the brass telescope that fit over one's head to do closer

¹¹⁴² Bill Bryson *Shakespeare (The Illustrated and Updated Edition)*

¹¹⁴³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

¹¹⁴⁴ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

¹¹⁴⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

¹¹⁴⁶ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

research on four of the moons of Jupiter (Galilean moons)¹¹⁴⁷
Through his telescope, GALILEO viewed mountains and valleys on the surface of the moon, sunspots, the four largest moons of the planet Jupiter, and the phases of the planet Venus. His work on astronomy made him famous and he was appointed court mathematician in Florence.¹¹⁴⁸ In **11,589 HE GALILEO** given credit for *founding Experimental Science* with his experiments overriding observation on moving objects; and that if nothing stopped them, they would continue to move. He applied this knowledge to planets moving in orbit.¹¹⁴⁹ In **11,592 HE GALILEO** was the first person to invent a tool (later known as the thermometer) to attempt to measure the changes of the physical phenomenon by warming an empty tube into a container of water and measuring what happened.¹¹⁵⁰ Find more

¹¹⁴⁷ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

¹¹⁴⁸ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

¹¹⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 123

¹¹⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

information on GALILEO's other discoveries. He did so many Author / Compiler could not include the whole list.) In **11,612 HE**: GALILEO observed Saturn, saw its rings appear and disappear but because of scorn of those powers that be, he refused to look at it again.¹¹⁵¹

⇒ In **11,614 HE**, GALILEO was accused of heresy for his support of the Copernican theory that the sun was at the center of the solar system. This was revolutionary at a time when most people believed the Earth was in this central position. In **11,616 HE**, GALILEO was forbidden by the church from teaching or advocating these theories.¹¹⁵²

¹¹⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

¹¹⁵² http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⇒ In **11,632 HE**, GALILEO was again condemned for heresy after *his book 'Dialogue Concerning the Two Chief World Systems'* was (written in Italian, not Latin and thus made available to the masses – not just for scholars ¹¹⁵³) published. This set out the arguments for and against the Copernican theory in the form of a discussion between two men. GALILEO was summoned to appear before the Inquisition in Rome. GALILEO was convicted and sentenced to life imprisonment, later reduced to permanent house arrest at his villa in Arcetri, south of Florence. GALILEO was also forced to publicly withdraw his support for Copernican theory. Although he was now going blind GALILEO continued to write. In **11,638 HE**, *his 'Discourses Concerning Two New Sciences' was published with Galileo's ideas on the laws of motion and the principles of mechanics.*¹¹⁵⁴

¹¹⁵³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 141

¹¹⁵⁴ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml



GALILEO Portrait by Giusto Sustermans, location and date unknown¹¹⁵⁵

¹¹⁵⁵ https://en.wikipedia.org/wiki/Galileo_Galilei



GALILEO was the first to put a pair of lenses together and use the tool as a scientific instrument making observations of the solar system.¹¹⁵⁶ GALILEO was the first person to turn a telescope to the sky, artist, date and location unknown.¹¹⁵⁷

¹¹⁵⁶ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

¹¹⁵⁷ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

Circa 11,568 HE: GERHARD KREMER, aka GERARDUS MERCATOR, Flemish geographer¹¹⁵⁸ who perfected his world map using cylindrical projection. Although very inaccurate in size of land mass depiction the Mercator Projection helped launch modern geography.¹¹⁵⁹

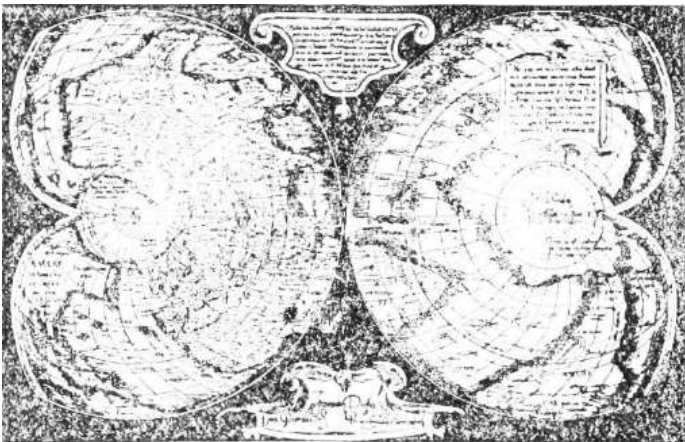


GERARDUS MERCATOR, artist, date, location unknown.¹¹⁶⁰

¹¹⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

¹¹⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

¹¹⁶⁰ https://en.wikipedia.org/wiki/Gerardus_Mercator



MERCATOR first map **11,538 HE**, location unknown.¹¹⁶¹

¹¹⁶¹ https://commons.wikimedia.org/wiki/File:PSM_V16_D518_Mercator_first_map_1538_ad.jpg

Circa 11,568 HE: Woodblock of current printing press process.



11,568 HE: In this woodblock, the printer at left is removing a page from the press while the one at right inks the text-blocks. Artist and location unknown.¹¹⁶²

¹¹⁶² https://en.wikipedia.org/wiki/History_of_printing

11,570 HE – 11,619 HE: HANS LIPPERSHEY, Dutch spectacle maker who in **11,608 HE** filed a patent, and is known for, the earliest written record of a refracting telescope.¹¹⁶³



HANS LIPPERSHEY, artist, location, date unknown.¹¹⁶⁴

¹¹⁶³ https://en.wikipedia.org/wiki/Hans_Lippershey

¹¹⁶⁴ https://en.wikipedia.org/wiki/Hans_Lippershey

Circa 11,571 HE – 11,630 HE: JOHANNES KEPLER, German astronomer was the assistant to TYCHO BRAHE. Based on the data of TYCHO BRAHE, JOHANNES KEPLER published in his book *Astronomia Nova (New Astronomy)* the information that the planets moved around the Sun in ellipses. Our present picture of our Solar System remains essentially that worked out by JOHANNES KEPLER.¹¹⁶⁵ (Early records from all over the world from the Americas to Scandinavia to India referred to the sun being eaten. People were so nervous. They thought a deity was angry or a king would die. Some kings were nervous enough they appointed people to study the sky. Freaking out about eclipses helped fuel the need for scientific study via astronomy.¹¹⁶⁶

¹¹⁶⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 131

¹¹⁶⁶ PBS Skunk Bear How Eclipses changed History youtube video:

https://www.youtube.com/watch?v=tTxz_d2q7Js



11,610 HE: Portrait of JOHANNES KEPLER by an unknown artist.¹¹⁶⁷

¹¹⁶⁷ https://en.wikipedia.org/wiki/Johannes_Kepler

⇒ Also in JOHANNES KEPLER's book *Astronomia Nova (New Astronomy)* were published JOHANNES KEPLER's 3 Laws of Planetary Motion: (1) The orbit of a planet is an ellipse with the Sun at one of the two foci.¹¹⁶⁸ (2) A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.¹¹⁶⁹ (3) The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.¹¹⁷⁰

¹¹⁶⁸ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

¹¹⁶⁹ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

¹¹⁷⁰ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

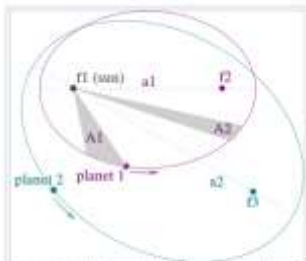


Figure 1: Illustration of Kepler's three laws with two \mathcal{S}^2 planetary orbits.

(1) The orbits are ellipses, with focal points f_1 and f_2 for the first planet and f_3 and f_4 for the second planet. The Sun is placed in focal point f_1 .

(2) The two shaded sectors A_1 and A_2 have the same surface area and the time for planet 1 to cover segment A_1 is equal to the time to cover segment A_2 .

(3) The total orbit times for planet 1 and planet 2 have a ratio $a_1^{3/2} : a_2^{3/2}$.



1171

⇒ MAX TEGMARK, in his **11,214 HE** book *Our Mathematical Universe* said: “to explain to an imaginary extraterrestrial mail carrier our cosmic address we would say we wanted our package delivered to the solar system with 8 planets whose orbits are 1.84, 2.51, 4.33, 12.7, 24.7 51.1 and 76.5 times larger than that of the innermost planet and that mail carrier would know our exact planet.”¹¹⁷²

11,572 HE – 11,633 HE: CORNELIS JACOBSZON DREBBEL (Dutch pronunciation: [kər'ne:lɪs 'ja:kəpsɔ:n 'drɛbəl]) Dutch engineer and inventor was the builder of the first navigable submarine in **11,620 HE** and an innovator who contributed to the development of measurement and control systems, optics and chemistry.¹¹⁷³

¹¹⁷² MAX TEGMARK, *Our Mathematical Universe*

¹¹⁷³ https://en.wikipedia.org/wiki/Cornelis_Drebbel



CORNELIS DREBBEL artist, date and location unknown.¹¹⁷⁴

¹¹⁷⁴ https://en.wikipedia.org/wiki/Cornelis_Drebbel



Reconstruction of the Drebbel: Richmond upon Thames. In **12,002 HE**, the British boatbuilder Mark Edwards built a wooden submarine based on the original version by Drebbel. It was shown in the BBC TV program *Building the Impossible* in **12,002 HE**.¹¹⁷⁵

¹¹⁷⁵ https://en.wikipedia.org/wiki/Cornelis_Drebbel

11,578 HE – 11,657 HE: WILLIAM HARVEY, English physician who was the first person to describe completely and in detail the systemic circulation and properties of blood being pumped to the brain and body by the heart.¹¹⁷⁶ (see Circa **11,288 HE** IBN AL-NAFIS and circa **11,533 HE** MIGUEL SERVETO aka MICHAEL SERVETUS and see circa **11,559 HE:** REALDO COLUMBO).^{1177 1178} **11,628 HE:** WILLIAM HARVEY had all the evidence he needed and published his book in the Netherlands with the title: *De Motu Cordis et Sanguinis (Concerning the Motions of the Heart and Blood)*. This book represents the beginning of modern physiology.¹¹⁷⁹

¹¹⁷⁶ https://en.wikipedia.org/wiki/William_Harvey

¹¹⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

¹¹⁷⁸ https://en.wikipedia.org/wiki/William_Harvey

¹¹⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140



WILLIAM HARVEY, artist, date and location unknown.¹¹⁸⁰

¹¹⁸⁰ https://en.wikipedia.org/wiki/William_Harvey

11,561 HE – 11,636 HE: SANTORIO SANTORIO, Italian Physician, constructed an elaborate weighing machine in which he sat while eating, drinking and eliminating wastes. His experiments became the beginning of the study of metabolism¹¹⁸¹ SANTORIO compared the weight of what he had eaten to that of his waste products, the latter being considerably smaller because for every eight pounds of food he ate, he excreted only 3 pounds of waste.¹¹⁸²

¹¹⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 134

¹¹⁸² https://en.wikipedia.org/wiki/Santorio_Santorio



Date, location, and artist unknown re: SANTORIO SANTORIO sitting in the balance that he made to calculate his net weight change over time after the intake and excretion of food stuffs and fluids.¹¹⁸³

¹¹⁸³ https://en.wikipedia.org/wiki/Santorio_Santorio

11,580 HE – 11,644 HE: JAN BAPTISTA VAN HELMONT, Flemish physician¹¹⁸⁴ and chemist is remembered today largely for his ideas on spontaneous generation, his 5-year tree experiment, his introduction of the word "gas" (from the Greek word chaos) into the vocabulary of scientists^{1185 1186} and that he identified Carbon Dioxide¹¹⁸⁷ VAN HELMONT also identified the “Star Stuff” element Magnesium.¹¹⁸⁸

¹¹⁸⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

¹¹⁸⁵ https://en.wikipedia.org/wiki/Jan_Baptist_van_Helmont

¹¹⁸⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

¹¹⁸⁷ www.britannica.com/biography/Jan-Baptista-van-Helmont

¹¹⁸⁸ https://en.wikipedia.org/wiki/Joseph_Black



11,648 HE: JAN BAPTISTA VAN HELMONT (left) and his son Franciscus-Mercurius from the *Ortus medicinae*, artist and location unknown.¹¹⁸⁹

¹¹⁸⁹ https://en.wikipedia.org/wiki/Jan_Baptist_van_Helmont



The photo is an ultrapure magnesium crystal from one side “Star Stuff” Element Atomic Number 12, Magnesium, Mg, is a very abundant, light and reactive element, which is essential to life. In nature, it is found in many minerals, like in talc. Elemental magnesium burns with a bright, white flame and a temperature of more than 3000 K. This once was used as flashlight for photography and is still used in underwater torches.¹¹⁹⁰

11,580 HE–11,650 HE: FRANZ KESSLER German portrait painter, scholar, inventor and alchemist who invented a harness for diving below water. KESSLER also wrote a book which had 5 chapters

¹¹⁹⁰ <http://images-of-elements.com/magnesium.php#a>

dealing with communicating via a crude Aldis lamp – the predecessor to Morse Code¹¹⁹¹



Drawing of FRANZ KESSLER'S invention: a harness for diving below water, artist, location, date unknown.¹¹⁹²

¹¹⁹¹ https://en.wikipedia.org/wiki/Franz_Kessler

¹¹⁹² https://en.wikipedia.org/wiki/Franz_Kessler

⇒ Author / Compiler did not find a book about his diving harness. But for a list of other of his books see the footnote.¹¹⁹³

Circa 11,582 HE: Gregorian calendar, introduced by Pope Gregory XIII, AKA Anno Domini / AD or Western or Christian “the year of our lord” calendar to keep their holidays from drifting.¹¹⁹⁴

Circa 11,583 HE: SIMON STEVIN, Dutch or Flemish mathematician showed that the pressure of a liquid on a given surface depends on the height of the liquid above the surface and upon the area of the surface - but does not depend on the shape of the vessel containing the liquid. This finding is considered to have founded the modern science of Hydrostatics.

¹¹⁹³ https://en.wikipedia.org/wiki/Franz_Kessler

¹¹⁹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

⇒ Circa **11,586** **HE SIMON STEVIN** was able to show how fractions could be made part of ordinary position number notation defining numeral position to the right of the decimal point. STEVIN devised that one position to the right is the tenths – two positions to the right is the hundredths....etc.: $2 \frac{1}{4}$ would be 2.25 and 2 and $\frac{7}{8}$ would be 2.875 and $2 \frac{1}{2}$ would be 2.5 etc. ¹¹⁹⁵



Statue of Simon Stevin
by Eugène Simons, on
the **Simon Stevinplein** (nl)
in Bruges

Statue of Stevin (detail)

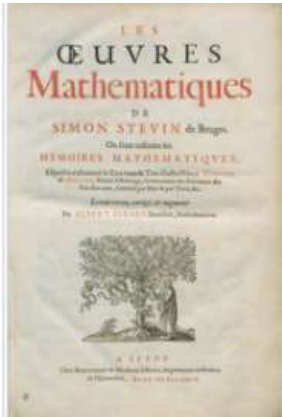
Statue (detail): Inclined
plane diagram

Statue (detail) showing
experiments on
hydrostatic equilibrium



Photos of monuments to **SIMON STEVIN**, date and locations unknown.¹¹⁹⁶

¹¹⁹⁶ https://en.wikipedia.org/wiki/Simon_Stevin



Cover of SIMON STEVIN's *Oeuvres mathématiques*, reprint in **11,634 HE.**¹¹⁹⁷

¹¹⁹⁷ https://en.wikipedia.org/wiki/Simon_Stevin

Circa 11,585 HE – 11,632 HE: ZARARIAS JANSSEN, Dutch spectacle maker who placed a convex lens at each end of a tube. The viewing magnification was not great, but the device was seen as the first microscope. Its descendants were to revolutionize biology.¹¹⁹⁸



ZARARIAS JANSSEN, artist, date, location unknown.¹¹⁹⁹

¹¹⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

¹¹⁹⁹ https://en.wikipedia.org/wiki/Zacharias_Janssen

11,563 HE – 11,614 HE: WILLIAM LEE, English. Circa **11,589 HE:** LEE invented the first replacement device for hand knitters to produce their knitted project. The Stocking Frame was a mechanical knitting machine. Although the Stocking Frame would be a great help to industry and the consumer – it would be a disadvantage to the employed hand knitters of the age if implemented on a large scale. Elizabeth I realized the implication of what is now understood as “technological unemployment” and refused to grant WILLIAM LEE the patent for the device. WILLIAM LEE therefore took his idea to France where it was granted a patent. LEE’s invention was not widely adopted but was a preview of what was to come later in the Industrial Revolution.¹²⁰⁰ (See circa **11,298 HE:** Spinning wheels themselves were only invented only about 500 years ago.)

¹²⁰⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 86



WILLIAM LEE's: The Stocking Frame at Ruddington Framework Knitters' Museum, photographer and date unknown.¹²⁰¹

¹²⁰¹ https://en.wikipedia.org/wiki/Stocking_frame

Circa 11,589 HE: FRANCOIS VIETE, French mathematician and lawyer whose work on what was then called “new algebra” was an important step towards modern algebra, due to his innovative use of letters as variables by symbolizing constants and unknown quantities or relationships by inventing the now familiar x 's or y 's of algebra.¹²⁰²



FRANCOIS VIETE, French mathematician, date, location, and artist unknown¹²⁰³

¹²⁰² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

¹²⁰³ https://en.wikipedia.org/wiki/Francois_Viete

Circa 11,592 HE: DOMINICO FONTANA, Italian engineer who began tunneling under a hill to establish an aqueduct and discovered the ruins of Pompeii and Herculaneum, near the base of Mt. Vesuvius. Although excavation for the deliberate purpose of studying the past did not begin for another century, subject matter was known to exist, and *the discovery may be viewed as the beginning of modern archeology.*¹²⁰⁴

Circa 11,592 HE: LUDOLF van CEULEN, German mathematician, by hand and by brain, obtained the value of PI to 20 decimal places. Later in life he got it to 35 decimal places.¹²⁰⁵

¹²⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 126

¹²⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127



LUDOLF van CEULEN, date, location, and artist unknown.¹²⁰⁶

¹²⁰⁶ https://en.wikipedia.org/wiki/Ludolph_van_Ceulen

Circa 11,597 HE: ANDREAS LIBAU, German alchemist¹²⁰⁷ who wrote a book called *Alchemia* in which he described the preparation of Hydrochloric Acid and gave clear directions for preparing other acids. With LIBAU's book, the stage was set for the birth of real chemistry 2/3 of a century later.¹²⁰⁸



ANDREAS LIBAU, date, location, and artist unknown.¹²⁰⁹

¹²⁰⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

¹²⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

¹²⁰⁹ https://en.wikipedia.org/wiki/Andreas_Libavius

Circa 11,600 HE: The population of the world was approximately 500,000,000 people.¹²¹⁰

Circa 11,600 HE: WILLIAM GILBERT, English physician, physicist, and astronomer who experimented with compasses. Up until his time no one knew why the compass pointed north. WILLIAM GILBERT wrote a book on his experiments *De Magnete (Concerning Magnets)* and showed that the Earth itself was a big magnet.¹²¹¹

¹²¹⁰ <http://www.worldometers.info/world-population/world-population-by-year/>

¹²¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 128



WILLIAM GILBERT, date, location, and artist unknown.¹²¹²

¹²¹² [https://en.wikipedia.org/wiki/William_Gilbert_\(astronomer\)](https://en.wikipedia.org/wiki/William_Gilbert_(astronomer))



WILLIAM GILBERT M.D. demonstrating his experiments before

Queen Elizabeth, painting by A. Auckland Hunt, date and location unknown.¹²¹³

11,607 HE – 11,665 HE: PIERRE DE FERMAT¹²¹⁴ (French: [pjɛːʁ də fɛʁma]) was a French lawyer at the Parlement of Toulouse, France, and mathematician. PIERRE DE FERMAT was one of the two leading mathematicians of the first half of the **11,600's HE**. According to Peter L. Bernstein, in his book *Against the Gods*, PIERRE DE FERMAT "was a mathematician of rare power. FERMAT was an independent inventor of analytic geometry, contributed to the early development of Calculus, did research on the weight of the Earth, and worked on light refraction and optics. In the course of what turned out to be an extended correspondence with BLAISE PASCAL (see **11,632 HE**), FERMAT made a significant contribution to the theory of probability. But FERMAT's crowning

¹²¹³ [https://en.wikipedia.org/wiki/William_Gilbert_\(astronomer\)](https://en.wikipedia.org/wiki/William_Gilbert_(astronomer))

¹²¹⁴ Liz Strachan *A Slice of Pi*

achievement was in the theory of numbers." Regarding FERMAT's work in analysis, circa **11,687 HE** ISAAC NEWTON wrote that his own early ideas about calculus came directly from "Fermat's way of drawing tangents". André Weil said of FERMAT the with his gift for number relations and his ability to find proofs for many of his theorems, FERMAT essentially created the modern theory of numbers.¹²¹⁵

⇒ PIERRE DE FERMAT's famous Last Theorem was first discovered by his son in the margin in his father's copy of an edition of DIOPHANTUS (see **circa 10,250 HE** when DIOPHANTUS wrote an Algebra text) and included the statement that the margin was too small to include the proof.¹²¹⁶ It took circa

¹²¹⁵ https://en.wikipedia.org/wiki/Pierre_de_Fermat

¹²¹⁶ https://en.wikipedia.org/wiki/Pierre_de_Fermat

370 years for his statement in that margin to be mathematically proven.¹²¹⁷ (See SIR ANDREW WILES **11,995 HE**).

¹²¹⁷ Liz Strachan *A Slice of Pi*



PIERRE DE FERMAT: Bust in the Salle des Illustres in Capitole de Toulouse, date unknown.¹²¹⁸

¹²¹⁸ https://en.wikipedia.org/wiki/Pierre_de_Fermat

Circa 11,614 HE: JOHN NAPIER, Scottish mathematician, physicist, and astronomer who spent years working out formulas for numbers calculated with appropriate exponents which he published using the term “Logarithms”.¹²¹⁹



JOHN NAPIER, artist, date, and location unknown.¹²²⁰

¹²¹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, page 134

¹²²⁰ https://en.wikipedia.org/wiki/John_Napier

11,616 HE – 11,703 HE: JOHN WALLIS, English mathematician who was the first to suggest “the law of conservation of motion”: that the total momentum of a closed system remains always unchanged. In **11,685 HE** WALLIS succeeded in making sense out of imaginary numbers, using a timeline scheme that proved enormously useful to mathematicians, scientists and engineers. WALLIS is credited with introducing the symbol ∞ for infinity and $1/\infty$ for an infinitesimal.¹²²¹



JOHN WALLIS, date, location, and artist unknown.¹²²²

¹²²¹ https://en.wikipedia.org/wiki/John_Wallis

¹²²² https://en.wikipedia.org/wiki/John_Wallis

Circa 11,620 HE: Stagecoaches came into use.¹²²³

11,620 HE – 11,682 HE: JEAN-FELIX PICARD, French astronomer who in **11,684 HE** published posthumously: although his observations were with telescopes, JEAN-FELIX PICARD correctly calculated the Earth's circumference as 24,876 miles and its diameter as 7,900 miles.¹²²⁴

⇒ Yes, Star Trek fans, Captain Jean-Luc Picard was named after this French astronomer!¹²²⁵

¹²²³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 136

¹²²⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 170

¹²²⁵ <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>



JEAN-FELIX PICARD, date, location, and artist unknown¹²²⁶

¹²²⁶ <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>

Circa 11,621 HE: WILLEBRORD SNEL VAN ROYAN or aka WILLEBRORD SNELIUS, Dutch mathematician known for “Snell’s Law”¹²²⁷ which was the law of refraction, which he *rediscovered* in **11,621 HE.**¹²²⁸

⇒ As you remember, the understanding of how curved mirrors and lenses bend and focus light was already defined by IBN SAHL in his **10,984 HE** treatise *On Burning Mirrors and Lenses*, which was lost when, in about **Circa 11,111 HE**, Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. It took approximately 637 years before SNELIUS rediscovered these ideas,¹²²⁹ and for that act got “naming rights.”¹²³⁰

¹²²⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

¹²²⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

¹²²⁹ https://en.wikipedia.org/wiki/Ibn_Sahl

¹²³⁰ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>



WILLEBRORD SNEL VAN ROYAN (SNELIUS), artist, date, and location unknown.¹²³¹

¹²³¹ https://en.wikipedia.org/wiki/Willebrord_Snellius

11,623 HE to 11,673 HE: MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, English aristocrat, philosopher, poet, scientist, fiction-writer, and playwright¹²³² wrote the utopian romance *The Blazing World*, and it is one of the earliest examples of science fiction.¹²³³

⇒ MARGARET LUCAS CAVENDISH published under her own name at a time when most women writers published anonymously. CAVENDISH's writing addressed a number of topics, including gender, power, manners, scientific method, and philosophy. She is singular in having published extensively in natural philosophy and early modern science. She published over a dozen original works;

¹²³² https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

¹²³³ Audible 7-22-16 Podcast "Get Smart"

inclusion of her revised works brings her total number of publications to twenty-one.¹²³⁴

- ⇒ Writings by MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, include *Bell in Campo* and *The Sociable Companions; Observations upon Experimental Philosophy; Paper Bodies; Sociable Letters; The Convent of Pleasure and Other Plays*.¹²³⁵
- ⇒ MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, was a “badass writer” according to Jennifer Sherman Roberts’s book *“Everyone, We Need to Talk About 17th-Century Badass Writer Margaret Cavendish”*.¹²³⁶

¹²³⁴ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

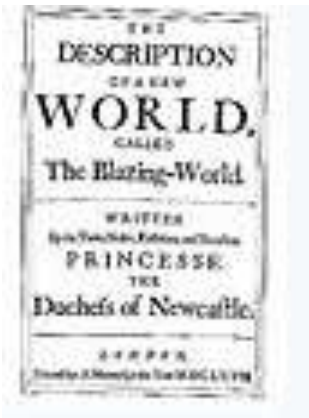
¹²³⁵ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

¹²³⁶ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne#Books



MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, unknown artist and date¹²³⁷

¹²³⁷ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne



11,666 HE Cover to earliest example of Science Fiction Book *The Blazing World*.¹²³⁸

¹²³⁸ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

11,625 HE – 11,712 HE: GIOVANNI DOMENICO CASSINI (CASSINI I) Italy & France, mathematician, astronomer, engineer, and astrologer who was the first of four “CASSINIs” referred to in the history of astronomical science. GIOVANNI DOMENICO CASSINI was first to observe the division in the rings of Saturn; CASSINI I created an important meridian, which helped settle the debate about whether the universe is geocentric; CASSINI I's method of determining longitude was used to measure the size of France accurately for the first time. Defined Cassini's Laws of the Moon: The Moon has a 1:1 spin-orbit resonance which means that the rotation orbit ratio of the Moon is such that the same side of it always faces the Earth. The Moon's rotational axis maintains a constant angle of inclination from the ecliptic plane. The Moon's rotational axis processes so as to trace out a cone that intersects the ecliptic plane as a circle. A plane formed

from a normal to the ecliptic plane and a normal to the Moon's orbital plane will contain the Moon's rotational axis.¹²³⁹

⇒ **Circa 11,665 HE: GIOVANNI DOMENICO CASSINI** also accurately measured the rotations of Mars and of Jupiter. **Circa 11,671 HE: GIOVANNI DOMENICO CASSINI** discovered a second satellite of Saturn (he named it “Iapetus” (who was the Titan brother of Saturn) and over the next 13 years discovered 3 more of Saturn’s satellites: “Rhea” “Dione” and “Tethys” (3 of Saturn’s sisters). **Circa 11,675 HE: GIOVANNI DOMENICO CASSINI** noted the dark line separating Saturn’s rings.¹²⁴⁰ **Circa 11,672 HE: GIOVANNI DOMENICO CASSINI** determined the distance to Mars at that time. 19 centuries earlier HIPPARCHUS had determined the distance to the moon – but until CASSINI I figured out how to use his telescope and parallax the distance to no

¹²³⁹ https://en.wikipedia.org/wiki/Giovanni_Domenico_Cassini

¹²⁴⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 165

other heavenly bodies had been accurately defined. Because of this correct calculation he was further able to calculate the distance to the Sun from Earth as 87 million miles which was off by 7% but for a first attempt, in our HE history, it was amazingly close. This led to the determination that the orbit of Saturn, the farthest known planet at that time was estimated at 1.6 billion miles across.¹²⁴¹

⇒ CASSINI I gave human beings their first exposure to how small they and their world were compared to the universe.¹²⁴²

¹²⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

¹²⁴² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

Giovanni Domenico Cassini



GIOVANNI DOMENICO CASSINI, CASSINI I, artist, location, and date unknown.¹²⁴³

11,626 HE – 11,697 HE: FRANCESCO REDI, Italian physician debunked the notion of spontaneous combustion.¹²⁴⁴

- ⇒ A rationalist of his time, FRANCESCO REDI was a critic of much. Knowing full well the fates of outspoken thinkers such as GIORDANO BRUNO and GALILEO, FRANCESCO REDI was careful to express his new views in a manner that would not contradict theological tradition of the powers of the time / the church; hence, REDI's interpretations were always based on biblical passages, such as his famous adage: *omne vivum ex vivo* "All life comes from life".¹²⁴⁵
- ⇒ **Circa 11,668 HE:** FRANCESCO REDI *set up the first clear case of using proper controls in an experiment* by using 8 flasks holding different types of meat and of which 4 he sealed and 4 he left open to the air.¹²⁴⁶

¹²⁴⁵ https://en.wikipedia.org/wiki/Francesco_Redi

¹²⁴⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

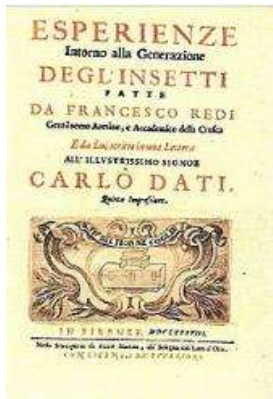
⇒ His most famous experiments are described in his magnum opus *Esperienze Intorno alla Generazione degl'Insetti (Experiments on the Generation of Insects)*, published in **11,668 HE**. REDI disproved that vipers drink wine and could break glasses, and that their venom was poisonous when ingested. He correctly observed that snake venoms were produced from the fangs, not the gallbladder, as was believed. REDI was also the first to recognize and correctly describe details of about 180 parasites, including *Fasciola hepatica* and *Ascaris lumbricoides*. He distinguished earthworms from helminths (like tapeworms, flukes, and roundworms). A collection of his poems first published in **11,685 HE** *Bacco in Toscana ("Bacchus in Tuscany")* is considered among the finest works of **11,600s HE** Italian poetry, and for which the Grand Duke Cosimo III gave him a medal of honor.¹²⁴⁷

¹²⁴⁷ https://en.wikipedia.org/wiki/Francesco_Redi



Statue of FRANCESCO REDI on the Uffizi Gallery (Piazzale degli Uffizi) in Florence. At his feet is a copy of *Bacco in Toscana*.¹²⁴⁸

¹²⁴⁸ https://en.wikipedia.org/wiki/Francesco_Redì



11,668 HE Esperienze Intorno alla Generazione degli Insetti front cover¹²⁴⁹

¹²⁴⁹ https://en.wikipedia.org/wiki/Francesco_Redi

⇒ FRANCESCO REDI honors: A crater on Mars was named after FRANCESCO REDI; The larval stage of parasitic fluke called "redia" is named after FRANCESCO REDI by another Italian zoologist, Filippo de Filippi, in **11,837 HE**; The Redi Award, the most prestigious award in toxicology, is given honor of FRANCESCO REDI by the International Society on Toxicology. The award is made at each World Congress of IST (generally held every three years) since **11,967 HE**; A scientific journal Redia, an Italian journal of zoology, is named in FRANCESCO REDI honor, which was first published in **11,903 HE**. A European viper subspecies, *Vipera aspis francisciredi* Laurenti, **11,768 HE**, is named after FRANCESCO REDI.¹²⁵⁰

¹²⁵⁰ https://en.wikipedia.org/wiki/Francesco_Redi

11,627 HE – 11,691 HE: ROBERT BOYLE - Irish born physicist and the chemist who said an element is a substance whose atoms all have the same number of protons: another way of saying this is that all of a particular element's atoms have the same atomic number. Elements are chemically the simplest substances and hence cannot be broken down using chemical reactions.¹²⁵¹

⇒ **Circa 11,662 HE ROBERT BOYLE** experimented with gas and mercury and a 17-foot glass tube and air and other gases were atomic in nature. BOYLE was able to experimentally prove what circa 2,121 years ago, DEMOCRITUS (**Circa 9,541 HE**) had conjectured about atomic theory.¹²⁵²

⇒ ROBERT BOYLE published *The Skeptical Chymist*, the book that symbolized turning the back on medievalism. BOYLE dropped the

¹²⁵¹ <https://www.chemicool.com/definition/element.html>

¹²⁵² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

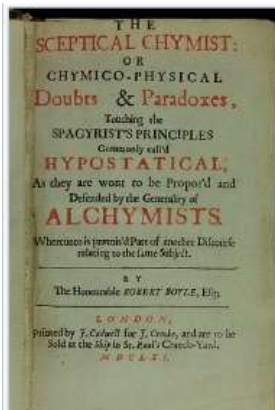
*prefix “al”, from the word alchemist, which in Arabic meant “the”. The very name was changed from alchemist to chemist in **The Skeptical Chymist**. He divorced chemistry from medicine making it a separate science. In **The Skeptical Chymist** BOYLE pushed for chemistry to be an experimental science. In **The Skeptical Chymist** he defined elements as being one of the simplest components on Earth – therefore saying anything that could not be made into something simpler was an “Element”.*¹²⁵³

¹²⁵³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 154



ROBERT BOYLE, date, location, and artist unknown.¹²⁵⁴

¹²⁵⁴ https://en.wikipedia.org/wiki/Robert_Boyle



Title page of *The Sceptical Chymist*, 11,661 HE, photographer unknown.¹²⁵⁵

¹²⁵⁵ https://en.wikipedia.org/wiki/Robert_Boyle

⇒ The “Star Stuff” Element Carbon was first discovered in prehistoric times as charcoal. It became recognized as an element after ROBERT BOYLE classified it as an Element as a substance that could not be decomposed into simpler substances.¹²⁵⁶



⇒ The photo is Ultrapure carbon as graphite. “Star Stuff” Carbon, C, the base of all life on Earth, the Element Atomic Number 6, has the most complex chemistry, which is called organic chemistry. Coal, which consists mostly of carbon, is known and used since prehistoric time. Mineral oil consists largely of hydrocarbons. The combustion of carbon produces carbon dioxide, CO₂. This is a

¹²⁵⁶ <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

greenhouse gas, which traps heat radiation.¹²⁵⁷ Compounds of carbon and another, more electropositive element are called carbides. Such with elements of the first three groups are salt-like and react with water. Of the others, some are extremely hard and durable, like silicon carbide and tungsten carbide.¹²⁵⁸ The natural, radioactive isotope C14, which has a half-life of 5730 years, is absorbed in small amounts by every organism. The abundance of this in old organic material allows a good specification of its age in a span between 300 and 50,000 years. This makes it an important tool for archaeology.¹²⁵⁹

- More about the “Star Stuff” Element Carbon: In **11,770 HE**, **CARL WILHELM SCHEELE** showed that graphite also burned

¹²⁵⁷ <http://images-of-elements.com/carbon.php#a>

¹²⁵⁸ <http://images-of-elements.com/carbon.php#a>

¹²⁵⁹ <http://images-of-elements.com/carbon.php#a>

to form carbon dioxide and thereby discovered another form of Carbon.

- In **11,985 HE** yet another form of carbon, Fullerene, was discovered by **ROBERT CURL, HARRY KROTO AND RICHARD SMALLEY**. Fullerene was also called "buckminsterfullerene," because its molecules resembled the geodesic domes designed by architect Buckminster Fuller for the **11,967 HE** World's Fair. In **12,004 HE** the most recently discovered form of Carbon is Graphene, which consists of a single layer of carbon atoms arranged in hexagons. Graphene was discovered by **KOSTYA NOVOSELOV and ANDRE GEIM**, who used adhesive tape to detach a single layer of atoms from graphite to produce this form of carbon.¹²⁶⁰

¹²⁶⁰ <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

11,627 HE – 11,705 HE: JOHN RAY, English naturalist who, circa **11,686 HE** when he had access to so much more of the world than the ancient Greeks, (see THEOPHRATUS circa **9,681 HE** who classified 550 different plants) published a painstaking three volume classification of 18,600 different plant species. In **11,691 HE** JOHN RAY started classifying animals on the basis of hooves, toes, and teeth, his system that persists to this day.¹²⁶¹ JOHN RAY's biographer Charles Raven commented that "Ray sweeps away the litter of mythology and fable... and always insists upon accuracy of observation and description and the testing of every new discovery"¹²⁶² ISAAC ASIMOV said classifications such as JOHN RAY's made the matter of biological evolution seem an overwhelming likelihood.¹²⁶³

¹²⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹²⁶² https://en.wikipedia.org/wiki/John_Ray

¹²⁶³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171



Wood cut of JOHN RAY, artist, date, and location unknown.¹²⁶⁴

¹²⁶⁴ https://en.wikipedia.org/wiki/John_Ray



Painting of JOHN RAY, artist, date, and location unknown.¹²⁶⁵

⇒ Including the various editions, *there are 172 works by JOHN RAY.*¹²⁶⁶

¹²⁶⁵ https://en.wikipedia.org/wiki/John_Ray

¹²⁶⁶ https://en.wikipedia.org/wiki/John_Ray

11,628 HE – 11,694 HE: MARCELLO MALPIGHI, Italian physiologist who further pioneered the field of microscopes.¹²⁶⁷ With the use of a more advanced microscope, MARCELLO MALPIGHI completed WILLIAM HARVEY's **11,628 HE** theory of how blood flows and defined "capillaries"¹²⁶⁸ MARCELLO MALPIGHI's treatise *De polypo cordis* (**11,666 HE**) was important for understanding blood composition, as well as how blood clots. In it, MALPIGHI described how the form of a blood clot differed in the right against the left sides of the heart. MARCELLO MALPIGHI discovered that invertebrates do not use lungs to breathe, but small holes in their skin called tracheae. MALPIGHI also studied the anatomy of the brain and concluded this organ is a gland. In terms of modern endocrinology, this deduction is correct because the hypothalamus of the brain has long been recognized for its hormone-secreting capacity. Because

¹²⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 153

¹²⁶⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 153

MARCELLO MALPIGHI had a wide knowledge of both plants and animals, he made contributions to the scientific study of both. *The Royal Society of London published two volumes of his botanical and zoological works in 11,675 HE and 11,679 HE. Another edition followed in 11,687 HE, and a supplementary volume in 11,697 HE.* In his autobiography, MALPIGHI speaks of his Anatome Plantarum, as "the most elegant format in the whole literate world."¹²⁶⁹

⇒ Several physiological features of the biological excretory system are named after MARCELLO MALPIGHI, such as the Malpighian corpuscles and Malpighian pyramids of the kidneys and the Malpighian tubule system of insects. The splenic lymphoid nodules are often called the "Malpighian bodies of the spleen" or

¹²⁶⁹ https://en.wikipedia.org/wiki/Marcello_Malpighi

Malpighian corpuscles. The botanical family Malpighiaceae is also named after him.¹²⁷⁰



MARCELLO MALPIGHI a lifetime portrait by Carlo Cignani, date and location unknown.¹²⁷¹

¹²⁷⁰ https://en.wikipedia.org/wiki/Marcello_Malpighi

¹²⁷¹ https://en.wikipedia.org/wiki/Marcello_Malpighi

Circa **11,629 HE – 11,695 HE**: CHRISTIAAN HUYGENS, Dutch astronomer¹²⁷² who invented the first clock accurate enough to tell time to the minute and was the first clock accurate enough to be used by scientists.¹²⁷³

⇒ HUYGENS along with Dutch philosopher and optician BENEDICT SPINOZA worked out a new and better method for grinding telescope lenses and did what in **11,612 HE**: GALILEO was unable to do: HUYGENS and BENEDICT SPINOZA observed Saturn, its rings, and also discovered Titan – one of its moons.¹²⁷⁴

¹²⁷² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

¹²⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

¹²⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

⇒ In **11,673** HE CHRISTIAAN HUYGENS published *Horologium Oscillatorium sive de motu pendulorum*, his major work on pendulums and horology.¹²⁷⁵



⇒ CHRISTIAAN HUYGENS, by Caspar Netscher, Museum Hofwijck, Voorburg¹²⁷⁶

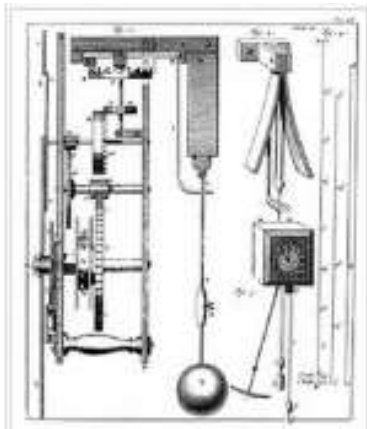
¹²⁷⁵ https://en.wikipedia.org/wiki/Christiaan_Huygens

¹²⁷⁶ https://en.wikipedia.org/wiki/Christiaan_Huygens



CHRISTIAAN HUYGENS clock, Rijksmuseum, Amsterdam¹²⁷⁷

¹²⁷⁷ https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology



Detail of illustration from *Horologium Oscillatorium* (11,658 HE),
by CHRISTIAAN HUYGENS¹²⁷⁸

¹²⁷⁸ https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology

11,630 HE – 11,702 HE: OLAUS RUDBECK aka OLOF RUDBECK the Elder, Swedish naturalist¹²⁷⁹ demonstrated another system in the body: The Lymphatic system.¹²⁸⁰



RUDBECK, painted in **11,696 HE** by Martin Mijtens the Elder, location unknown.¹²⁸¹

¹²⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

¹²⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

¹²⁸¹ https://en.wikipedia.org/wiki/Olaus_Rudbeck

11,632 HE – 11,662 HE: BLAISE PASCAL, French mathematician¹²⁸² physicist, inventor and writer.¹²⁸³ **Circa 11,648 HE** BLAISE PASCAL studied fluid pressures and his work is the basis for the hydraulic press.¹²⁸⁴ **Circa 11,648 HE** PASCAL sent his brother-in-law up some neighboring mountains with a couple of EVANGINELISTA TORRICELLI's barometers. PASCAL climbed about a mile and found the mercury in the columns had dropped from 30 to 27 inches. This showed to PASCAL that air became less dense with height and concluded that by 100 miles above the surface of the planet the air would be so thin it might as well be a vacuum.¹²⁸⁵

¹²⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

¹²⁸³ https://en.wikipedia.org/wiki/Blaise_Pascal

¹²⁸⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹²⁸⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

- ⇒ **Circa 11,654 HE PASCAL** and FERMAT worked out mathematical techniques for judging the likelihood of certain combinations, and in doing so laid out the almost inconceivably important theory of science known as *Probability*.¹²⁸⁶

- ⇒ PASCAL invented the first adding and subtracting machine. It had wheels that were marked 1 to 10 marked off along its circumference.¹²⁸⁷

- ⇒ Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL amounted to the discovery of Outer Space.¹²⁸⁸

¹²⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

¹²⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

¹²⁸⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148



BLAISE PASCAL only lived 39 years. This Painting of BLAISE PASCAL made by François II Quesnel for Gérard Edelinck in **11,691 HE** is posthumous.¹²⁸⁹

¹²⁸⁹ https://en.wikipedia.org/wiki/Blaise_Pascal

Circa 11,635 HE: HENRY GELLIBRAND, English astronomer, combined his experiments with notes from others, proving that although the earth was a magnet (see **11,600 HE:** WILLIAM GILBERT) that the north pole had shifted approximately 7 degrees in direction in the previous 50 years.¹²⁹⁰

11,635 HE: First surviving drawing of a kite; see **Circa 9,494 HE – 9,561 HE:** LU BAN, (Gongshu Ban).¹²⁹¹



First surviving woodcut print of a kite from John Bate's **11,635 HE** book *The Mysteryes of Nature and Art*.¹²⁹²

¹²⁹¹ https://en.wikipedia.org/wiki/History_of_aviation

¹²⁹² https://en.wikipedia.org/wiki/History_of_aviation

11,635 HE – 11,703 HE: ROBERT HOOKE, English physicist¹²⁹³ who designed an air pump that worked much better than **Circa 11,654 HE** OTTO von GUERICKE's. HOOKE made such a quality vacuum that he did the experiment that circa **11,612 HE** GALILEO tried but was unable to do: when a feather and a coin were dropped from the top of the vacuum jar they fell at the same speed.¹²⁹⁴

⇒ According to ISAAC ASIMOV, it was ROBERT BOYLE who hired ROBERT HOOKE to build the improved air pump.¹²⁹⁵

¹²⁹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

¹²⁹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

¹²⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

- ⇒ **Circa 11,654 HE** ROBERT HOOKE noted the large red oval marking on Jupiter and named it the Great Red Spot.¹²⁹⁶
- ⇒ ROBERT HOOKE argued for an attracting principle of gravitation in *Micrographia* of **11,665 HE**. HOOKE'S **11,666 HE** Royal Society lecture "*On gravity*" added two further principles – that all bodies move in straight lines till deflected by some force and that the attractive force is stronger for closer bodies.¹²⁹⁷
- ⇒ In **11,665 HE** ROBERT HOOKE's book *Micrographia*, he is also describing observations made with microscopes and telescopes, as well as some original work in biology. HOOKE *coined the term "cell"* for describing biological organisms, the term being

¹²⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

¹²⁹⁷ https://en.wikipedia.org/wiki/Robert_Hooke

suggested by the resemblance of plant cells to cells of a honeycomb.¹²⁹⁸



The hand-crafted, leather and gold-tooled microscope ROBERT HOOKE used to make the observations for his book *Micrographia*, originally constructed by Christopher White in London, is on

¹²⁹⁸ https://en.wikipedia.org/wiki/Robert_Hooke

display at the National Museum of Health and Medicine in Washington, DC.¹²⁹⁹

Circa 11,637 HE: RENE DESCARTES, French mathematician.¹³⁰⁰
DESCARTES published his book *Discours de la Methode*
(*Discussions on the Method*) which laid the course for calculus by combining algebra and geometry into Analytic Geometry.¹³⁰¹

¹²⁹⁹ https://en.wikipedia.org/wiki/Robert_Hooke

¹³⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142

¹³⁰¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142



RENE DESCARTES at work, date and artist unknown.¹³⁰²

11,637 HE – 11,680 HE: JAN SWAMMERDAM, Dutch naturalist.

11,658 HE: SWAMMERDAM used the improved microscope to study approximately 3,000 insects. **SWAMMERDAM** is considered the *father of modern entomology*. **SWAMMERDAM** used the improved microscope to discover the red blood corpuscle.¹³⁰³

¹³⁰² https://en.wikipedia.org/wiki/Rene_Descartes

¹³⁰³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152



JAN SWAMMERDAM, date, location and artist unknown.¹³⁰⁴

11,638 HE – 11,686 HE: NICHOLAS STENO, Danish Geologist was the first to maintain that fossils were the remains of creatures who had lived long ago, and whose remains had slowly converted to stone. ASIMOV notes this is the first scientifically recognized spectacular evidence of biological evolution.¹³⁰⁵ (See **11,556 HE:** GEORG

¹³⁰⁴ <http://janswammerdam.org/>

¹³⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

BAUER and how he speculated on fossils and **11,799 HE – 11,847 HE MARY ANNING.**)

⇒ **11,669 HE:** In NICHOLAS STENO's book *De solido intra solidum naturaliter contento* were the first accurate observations on a type of crystal. The principle in crystallography, known simply as Steno's law, or Steno's law of constant angles or the first law of crystallography, states that the angles between corresponding faces on crystals are the same for all specimens of the same mineral. STENO's seminal work paved the way for the law of the rationality of the crystallographic indices of French mineralogist RENÉ-JUST HAÜY in **11,801 HE**. This fundamental breakthrough formed the basis of all subsequent inquiries into crystal structure.¹³⁰⁶

¹³⁰⁶ https://en.wikipedia.org/wiki/Nicolas_Steno

⇒ **11,669 HE**: NICHOLAS STENO, in his *Dissertationis prodromus* is credited with four of the defining principles of the science of stratigraphy:

- The law of superposition: "... at the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore, at the time when the lower stratum was being formed, none of the upper strata existed";
- The principle of original horizontality: "Strata either perpendicular to the horizon or inclined to the horizon were at one time parallel to the horizon";
- The principle of lateral continuity: "Material forming any stratum were continuous over the surface of the Earth unless some other solid bodies stood in the way"; and

- The principle of cross-cutting relationships: "If a body or discontinuity cuts across a stratum, it must have formed after that stratum."
- NICHOLAS STENO's principles were applied and extended in **11,772 HE** by JEAN-BAPTISTE L. ROMÉ DE L'ISLE.
- STENO's ideas still form the basis of stratigraphy and were key in the development of JAMES HUTTON's. See **11,726 HE-11,797 HE**: JAMES HUTTON's theory of infinitely repeating cycles of seabed deposition, uplifting, erosion, and submersion.¹³⁰⁷
- Also see **11,910 HE– 11,994 HE**: DOROTHY MARY CROWFOOT HODGKIN OM FRS HonFRSC, British **11,964**

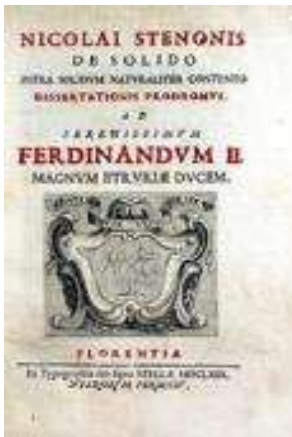
¹³⁰⁷ https://en.wikipedia.org/wiki/Nicolas_Steno

HE Nobel Prize winning chemist who invented / developed Protein Crystallography: the technique which shines light at proteins to expose their 3-dimensional structure.¹³⁰⁸



Portrait of NICHOLAS STENO Unsigned but attributed to court painter Justus Sustermans. (Uffizi Gallery, Florence, Italy)¹³⁰⁹

¹³⁰⁹ https://en.wikipedia.org/wiki/Nicolas_Steno



Cover of NICHOLAS STENO **11,669 HE** book "*De solido intra solidum naturaliter contento.*"¹³¹⁰

¹³¹⁰ https://en.wikipedia.org/wiki/Nicolas_Steno

11,641 HE – 11,712 HE: NEHEMIAH GREW, English Botanist, is known as the "*Father of Plant Anatomy*" because he showed that plants have sexuality, plants reproduce sexually, plants have sex organs, and that individual grains of pollen were the equivalent of the sperm cells in the animal world.¹³¹¹



NEHEMIAH GREW, date, location, and artist unknown.¹³¹²

¹³¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 168

¹³¹² https://en.wikipedia.org/wiki/Nehemiah_Grew

11,642 HE– 11,727 HE: SIR ISAAC NEWTON, English Physicist and Mathematician is widely recognized as one of the most influential scientists of all time. **11,666 HE:** ISAAC NEWTON conducted the experiments on defining the visible light spectrum.¹³¹³ Known for *Newton's Laws of Motion* using JOHANNES KEPLER's Laws of planetary motion NEWTON mathematically defined how the Heliocentric model of the solar system (how the earth knew the sun was there so it could go around it); how to account for the tides; how to account for trajectories of comets, and how to account for the precession of equinoxes. NEWTON scientifically began the explaining of optics and scientifically defined a rainbow.¹³¹⁴

⇒ LAWRENCE M. KRAUSS helps us understand more about the influence of the time period and from what NEWTON helped us to

¹³¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 158

¹³¹⁴ https://en.wikipedia.org/wiki/Isaac_Newton

gruelingly leave behind and points to the character of NEWTON himself saying:

- “...NEWTON devoted far more time, and far more ink, to writing about the occult, alchemy, and searching for hidden meanings and codes in the bible – focusing in particular on the book of revelation and mysteries associated with the ancient temple of Solomon- than he did to writing about physics.”¹³¹⁵

⇒ English Physicist and Mathematician: John Maynard Keyes said: “Newton was not the first of the Age of Reason, he was the last of the magicians...”¹³¹⁶

¹³¹⁵ LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

¹³¹⁶ LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

- ⇒ See **11,267 HE -11,319 HE**: KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI is known for giving the first mathematically satisfactory explanation of the rainbow.¹³¹⁷ Although because **Circa 11,111 HE**: Al-Ghazali pushed his philosophy that *mathematics was the work of the devil* the entirety of what Islam was and would become, collapsed the great age of enlightenment in the Islamic world. It has not recovered since.¹³¹⁸ So, NEWTON had to re-invent and thus get credit.
- ⇒ **11,687 HE** ISAAC NEWTON wrote the book: *Principia: 'Mathematical Principles of Natural Philosophy'* in Latin, but ROBERT HOOKE opposed the publication of it and the Royal Society hesitated to become involved.

¹³¹⁷ https://en.wikipedia.org/wiki/Kamal_al-Din_al-Farisi

¹³¹⁸ Neil deGrasse Tyson speech "How The Islamic Civilization Fell"
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

- ISAAC NEWTON thought of the alternative to refracting curved lens telescopes which were blurred by colored rings: NEWTON thought to use curved mirrors and focus the light by reflection. He built the first reflecting telescope.¹³¹⁹ **11,687 HE:** ISAAC NEWTON's *Philosophiæ Naturalis Principia Mathematica* ("*Mathematical Principles of Natural Philosophy*"), when first published, (in latin) laid the foundations for classical mechanics.¹³²⁰
- It was EDMOND HALLEY who privately paid for the publishing of *Principia*, what is thought to be the greatest science book of all time.¹³²¹

¹³¹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

¹³²⁰ <http://www.bbc.co.uk/timelines/zwwgcdn>

¹³²¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 172



- ⇒ ISAAC NEWTON concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.¹³²²
- ARISTOTLE (See Circa **9,617 HE** – **9,678 HE**) concluded that time is measured by the changing of things and that if nothing changes, there is no time.¹³²³
 - ALBERT EINSTEIN (See **11,879 HE** – **11,955 HE**) concluded that both ARISTOTLE and ISAAC NEWTON were both correct when he combined mathematically: space and time into “spacetime”. ALBERT EINSTEIN concluded that time varies depending on the observer’s frame of reference. Someone

¹³²² Carlo Roveli’s *The Order of Time*

¹³²³ Carlo Roveli’s *The Order of Time*

moving faster than someone else will experience time passing at a different rate. Someone closer to a massive body (like a planet or like our sun) will experience time different than someone more distant to that massive body.¹³²⁴

⇒ **11,687 HE**: ISAAC NEWTON further defined the spherical shape of the earth. (see ARISTOTLE and ERATOSTHENES and how in *Principia* ISAAC NEWTON refers to GIOVANNI DOMENICO CASSINI **circa 11,665 HE** sending French astronomer JEAN RICHER on the expedition to Cayenne, French Guiana, which in **circa 11,672 HE** RICHER helped determine the parallax of the planet Mars. While there, RICHER had also found that a pendulum beat more slowly in Cayenne than it did in Paris, so that a clock that would have been correct in Paris, lost 2.5 minutes a day in Cayenne. NEWTON considered among many other factors that if the pull of gravity was slightly weaker in Cayenne than in Paris,

¹³²⁴ Carlo Roveli's *The Order of Time*

including calculations, centrifugal force, spin, equatorial bulges seen in Jupiter and Saturn and determined that planet Earth's outline would be an elliptical oblate spheroid rather than circular orb (*not flat*) (Of course it was eventually confirmed by actual measurement).¹³²⁵



11,689 HE SIR ISAAC NEWTON portrait by Godfrey Kneller,
location unknown.¹³²⁶

¹³²⁶ https://en.wikipedia.org/wiki/Isaac_Newton

Circa 11,643 HE: EVANGINELISTA TORRICELLI, Italian physicist invented the first mercury column barometer by way of a vacuum.¹³²⁷ Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL (and BLAISE PASCAL's brother in law, See: **11,632 HE – 11,662 HE: BLAISE PASCAL**) amounted to the discovery of Outer Space.¹³²⁸



TORRICELLI, date, location, and artist unknown.¹³²⁹

¹³²⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 146

¹³²⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹³²⁹ https://en.wikipedia.org/wiki/Evangelista_Torricelli

11,644 HE – 11,710 HE: OLE ROEMER (RÓMER), Danish Astronomer, who first demonstrated that light travels at a finite speed using GALILEO's defining the moons of Jupiter. ROEMER also invented the first thermometer and suggested a temperature scale on which DANIEL FAHRENHEIT (See **11,686 HE – 11,736 HE:** FAHRENHEIT) relied as the basis for his temperature scale.¹³³⁰

¹³³⁰ https://en.wikipedia.org/wiki/ole_roemer

Ole Rømer



⇒ Ole Rømer, portrait by Jacob Coning from c.

11,700 HE OLE ROEMER (RØMER), by Jacob Coning, location unknown.¹³³¹

¹³³¹ https://en.wikipedia.org/wiki/ole_roemer

Circa 11,645 HE: OTTO von GUERICKE, German physicist, who after EVANGINELISTA TORRICELLI invented the vacuum, GUERICKE used the vacuum idea and invented the first practical air pump.¹³³²

⇒ **Circa 11,654 HE:** OTTO von GUERICKE took the air pump idea and expanded it to prove: air pressure. His work was published although it was not named.¹³³³

⇒ **Circa 11,660 HE:** OTTO von GUERICKE was the first to demonstrate static electricity by the use of a globe made of sulfur and a crank-turned shaft.¹³³⁴

¹³³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 147

¹³³³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

¹³³⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 154



OTTO von GUERICKE engraving after a portrait by Anselm van Hulle, date and location unknown.¹³³⁵

¹³³⁵ https://en.wikipedia.org/wiki/Otto_von_Guericke

11,646 HE – 11,716 HE: GOTTFRIED WILHELM LEIBNIZ, German mathematician who in **11,693 HE** devised a calculating machine that could not only add and subtract but could multiply by automatically repeating addition and divide by automatically repeating subtraction.

- ⇒ LEIBNIZ also invented a mechanical aid to the calculation of trigonometric and astronomical tables. LEIBNIZ worked on inventing Calculus at roughly the same time as ISAAC NEWTON.
- ⇒ **11,700 HE:** LEIBNIZ pointed out that although counting had been base 10, undoubtedly because we have 10 fingers and 10 toes, there was nothing magical about the base ten system. LEIBNIZ showed how base 8 or base 12 numbers had their uses.¹³³⁶

¹³³⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⇒ Most importantly, he defined the binary system using only the numbers 0 and 1 being needed. It is **GOTTFRIED WILHELM LEIBNIZ**'s binary system that has become so important to modern computers.¹³³⁷



⇒ **GOTTFRIED WILHELM LEIBNIZ**, Portrait by Christoph Bernhard Francke, date unknown.¹³³⁸

¹³³⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹³³⁸ https://en.wikipedia.org/wiki/Gottfried_Wilhelm_Leibniz

11,647 HE – 11,713 HE: DENIS PAPIN, French physicist, mathematician and inventor who in **11,679 HE** developed the pressure steam cooker with a safety valve.¹³³⁹



11,689 HE DENIS PAPIN, unknown artist and date.¹³⁴⁰

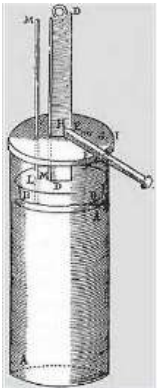
¹³³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹³⁴⁰ https://en.wikipedia.org/wiki/Denis_Papin



11,679 HE drawing of DENIS PAPIN's steam digester, artist and location unknown.¹³⁴¹

¹³⁴¹ https://en.wikipedia.org/wiki/Denis_Papin



11,690 HE drawing of DENIS PAPIN's first piston steam engine,¹³⁴² (also see **Circa 10,050 HE: HERO of ALEXANDRIA**).

¹³⁴² https://en.wikipedia.org/wiki/Denis_Papin

Circa 11,650 HE: Timekeeping was still quite crude.



Circa 10,050 years (see **6,001 HE**) after the first recorded ground sundial, this sundial was wall mounted, for use by the people of the

area to tell time, as an SSW facing, vertical declining sundial on Moot Hall, Aldeburgh, Suffolk, England.¹³⁴³

Circa **11,650 HE** – **11,715 HE**: THOMAS SAVERY, English, inventor¹³⁴⁴ created the first *European* steam engine, which he patented in **11,698 HE** for the very specific purpose of pumping water from coal mines.¹³⁴⁵ (See **10,500 HE**: HERO, Greece, invented the first steam engine; the modern sprinkler system works in precisely HERO's same design – without the heat. ISAAC ASIMOV said HERO's same design did not affect society at that time and wondered what would have happened if Greek science had continued uncrushed by the weight of Roman lack of interest?).¹³⁴⁶

¹³⁴³ <https://en.wikipedia.org/wiki/Sundial>

¹³⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹³⁴⁵ https://en.wikipedia.org/wiki/Thomas_Savery

¹³⁴⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



THOMAS SAVERY, date, location, and artist unknown¹³⁴⁷

¹³⁴⁷¹³⁴⁷ https://en.wikipedia.org/wiki/Thomas_Savery



The **11,698 HE** patented *Savery Steam Engine* ¹³⁴⁸

¹³⁴⁸ https://en.wikipedia.org/wiki/Thomas_Savery

Circa **11,651 HE**: GIAMBATTISTA RICCIOLI, Italian astronomer¹³⁴⁹ who ASIMOV said was the first to detect a double star: Mizar. The middle star of the Big Dipper is actually two stars that could not be seen as separate with the naked eye.¹³⁵⁰

- ⇒ In his **11,651 HE** *Almagestum Novum (New Almagest)* work GIAMBATTISTA RICCIOLI re-insisted on the sun centric model of our Solar System (100 years after COPERNICUS) and included a map of the Moon with names given to various craters, thus introducing the current scheme of lunar nomenclature.¹³⁵¹
- ⇒ One of GIAMBATTISTA RICCIOLI's most significant works was his **11,651 HE** *Almagestum Novum (New Almagest)*, an encyclopedic work consisting of over 1500 folio pages (38 cm x 25

¹³⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹³⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹³⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

cm) densely packed with text, tables, and illustrations. It became a standard technical reference book for astronomers all over Europe: JOHN FLAMSTEED (**11,646 HE –11,719 HE**), the first English astronomer royal, a Copernican, used it for his Gresham lectures; JÉRÔME LALANDE (**11,732 HE–11,807 HE**) of the Paris Observatory cited it extensively even though it was an old book at that point.¹³⁵²

⇒ People of the time still did not know the Earth rotated. RICCIOLI presented the common opinion that, if the Earth rotated, we ought to feel it, and since we do not, the Earth must be immobile. But RICCIOLI then said that mathematically there is no necessity for such a sensation. He likewise dismissed the ideas that buildings might be ruined, or birds left behind by Earth's motion—all may

¹³⁵² https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli

simply share the eastward rotational motion of Earth, which is now known as the "Coriolis Effect" Argument.¹³⁵³



GIAMBATTISTA RICCIOLI, date, location, and artist unknown¹³⁵⁴

¹³⁵³ https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli

¹³⁵⁴ https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli

11,656 HE – 11,742 HE: EDMOND HALLEY, British; Scientist and member of the Royal Society¹³⁵⁵ who, among so much else, privately paid for the publishing of NEWTON'S '*Mathematical Principles of Natural Philosophy*' (the *Principia*) what is thought to be the greatest science book of all time.¹³⁵⁶

- ⇒ On his own, HALLEY computed the orbit of Halley's Comet, thus further removing fear in the masses of the celestial events.¹³⁵⁷
HALLEY was the second Astronomer Royal in Britain, succeeding JOHN FLAMSTEED.¹³⁵⁸

¹³⁵⁵ https://en.wikipedia.org/wiki/Edmond_Halley

¹³⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹³⁵⁷ https://en.wikipedia.org/wiki/Edmond_Halley

¹³⁵⁸ https://en.wikipedia.org/wiki/Edmond_Halley

- ⇒ **11,676 HE:** HALLEY wrote a book on the subject of winds. He knew winds involved the rising of sun-heated air but did not understand the reason for the westward flow of tropical air.¹³⁵⁹
- ⇒ **Circa 11,678 HE:** Prior to this time, no systematic astronomical observations of the skies of the southern hemisphere existed. HALLEY changed that and spent two years under severely limited astronomical observations, published a catalogue of 321 stars.¹³⁶⁰
- ⇒ **11,693 HE:** It occurred to HALLEY to look at the fact of death by statistical evaluation and wrote the first Mortality Tables. Besides death being a result of age, careful Mortality tables show aspects of death that were not a result of age.¹³⁶¹

¹³⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹³⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 166

¹³⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

- ⇒ **11,698 HE – 11,790 HE:** EDMOND HALLEY commanded the first ocean voyage undertaken for the sole and specific purpose of scientific exploration. HALLEY's ship was the *Paramour Pink*. The voyage remained at sea for 2 years, measuring magnetic declinations all over the world and made the first map of the world showing the wiggling lines of equal declination. He also did his best to determine accurate latitudes and longitudes for the various ports at which he stopped.¹³⁶² His voyage, probably the first primarily scientific voyage to study the variation of the magnetic compass, sailing as far as 52 deg S. in the Atlantic Ocean.¹³⁶³
- ⇒ **11,715 HE:** It had been 23 centuries since THALES (see **Circa 9,455HE: THALES**) had predicted an eclipse. In order to prevent as much panic as possible among the masses (not among the astronomers who perfectly understood eclipses) before this **11,715**

¹³⁶² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 176

¹³⁶³ https://en.wikipedia.org/wiki/Edmond_Halley

HE eclipse of the sun, EDMOND HALLEY predicted there was going to be an eclipse of the sun and prepared and distributed maps that plotted out the path the eclipse would take. HALLEY did this well in advance, so that everyone knew when he or she was going to lose their light. He also organized, well in advance, large numbers of observers throughout Europe to watch and time this eclipse.¹³⁶⁴

¹³⁶⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 185

Edmond Halley



↪ Circa 11,722 HE Portrait by Richard Phillips¹³⁶⁵

¹³⁶⁵ https://en.wikipedia.org/wiki/Edmond_Halley

- Author / Compiler Note: The discoveries of EDMOND HALLEY rendered astrology moot. “Until the **11,600’s HE** astrology was considered a scholarly tradition, and it helped drive the development of astronomy. It was commonly accepted in political and cultural circles, and some of its concepts were used in other traditional studies, such as alchemy, meteorology, and medicine. By the end of the **11,600’s HE**, emerging scientific concepts in astronomy, such as heliocentrism, and HALLEY’s discovery of the movement of the stars over the years, undermined the theoretical basis of astrology which subsequently lost its academic standing and became regarded as a pseudoscience. Empirical scientific investigation has shown that predictions and recommendations based on astrology are not accurate.”¹³⁶⁶

¹³⁶⁶ https://en.wikipedia.org/wiki/History_of_astrology

- Author / Compiler asked: What returned the outdated astrology to public awareness? ...”In the **11,900’s HE**, astrology gained broader consumer popularity through the influence of regular mass media products, such as newspaper horoscopes.”¹³⁶⁷
- Eric Idle made a Netflix movie called “What About Dick?” that includes a parody of astrology with a song called “Asstrology”.¹³⁶⁸

11,660 HE: The Royal Society of London first met.¹³⁶⁹ The very first British ‘learned society’ meeting on 28 November **11,660 HE** followed a lecture at Gresham College by CHRISTOPHER WREN. Joined by other leading polymaths including ROBERT BOYLE and

¹³⁶⁷ https://en.wikipedia.org/wiki/History_of_astrology

¹³⁶⁸ <https://www.netflix.com/ca/title/80235999> entitled “What about Dick?”

¹³⁶⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 156

JOHN WILKINS, the group soon received royal approval¹³⁷⁰ ...and from **11,662 HE** it would be known as 'The Royal Society' of London for Improving Natural Knowledge when Charles II gave it legal charter.¹³⁷¹

⇒ The Royal Society's motto 'Nullius in verba' is taken to mean 'take nobody's word for it'. It is an expression of the determination of Fellows to withstand the domination of authority and to verify all statements by an appeal to facts determined by experiment.¹³⁷² (See **Circa 11,560 HE: GIAMBATTISTA DELLA PORTA**, Italian physicist who founded the first Scientific Association designed

¹³⁷⁰ <https://royalsociety.org/about-us/history/>

¹³⁷¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

¹³⁷² <https://royalsociety.org/about-us/history/>

particularly for the exchange of information and ideas was shut down by the powers of the time / the Inquisition.)¹³⁷³



The Royal Society met at Crane Court. It was a newly formed organization for men of learning to discuss their ideas. Artist, date and location unknown.¹³⁷⁴

¹³⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115

¹³⁷⁴ <https://royalsociety.org/about-us/history/>

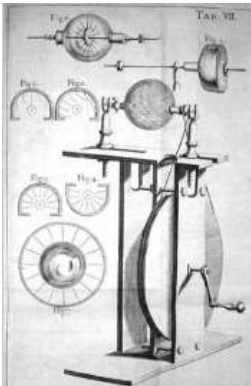
11,660 HE– 11,713 HE: FRANCIS HAWKS BEE¹³⁷⁵ aka Francis Hauksbee the Elder, is the English physicist scientist best known for his work on electricity and electrostatic repulsion.¹³⁷⁶

⇒ In **11,706 HE:** FRANCIS HAWKS BEE constructed a glass sphere turned by a crank, which, through friction could build up a more intensive electric charge. This in turn stimulated further experimentation with static electricity.¹³⁷⁷

¹³⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹³⁷⁶ https://en.wikipedia.org/wiki/Francis_Hauksbee

¹³⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Drawing of the Generator built by FRANCIS HAUKSBEE. From *Physico-Mechanical Experiments*, second Ed., London, posthumously published **11,719 HE.**¹³⁷⁸

¹³⁷⁸ https://en.wikipedia.org/wiki/Francis_Hauksbee

Circa 11,661 HE: FRANCISCUS SYLVIUS, (AKA FRANZ DELEBOE)
Dutch physician who suggested health depended on a balance of acids and bases in the body. *SYLVIUS* correctly suggested digestion was a chemical process of fermentation.¹³⁷⁹



FRANCISCUS SYLVIUS, date, location and artist unknown.¹³⁸⁰

¹³⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

¹³⁸⁰ https://en.wikipedia.org/wiki/Franciscus_Sylvius

11,663 HE – 11,705 HE: GUILLAUME AMONTONS,¹³⁸¹ French scientific instrument inventor and physicist was one of the pioneers in studying the problem of friction: that is the resistance to motion where bodies are in contact.¹³⁸²

⇒ In **11,699 HE**, AMONTONS *published his rediscovery of the laws of friction first put forward by Leonardo da Vinci.* Though they were received with some skepticism at the time, the laws were verified by CHARLES-AUGUSTIN DE COULOMB in **11,781 HE**.¹³⁸³

⇒ **11,669 HE** GUILLAUME AMONTONS devised an air thermometer that was different than GALILEO's for it measured temperature by the change in gas pressure rather than the change in

¹³⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

¹³⁸² https://en.wikipedia.org/wiki/Guillaume_Amontons

¹³⁸³ [https://en.wikipedia.org/wiki/Amontons_\(crater\)](https://en.wikipedia.org/wiki/Amontons_(crater))

gas volume. With it AMONTONS was able to prove that water always boiled at the same temperature. He also studied other gases and for each gas he studied, the volume change with temperature was the same for all gasses.¹³⁸⁴



GUILLAUME AMONTONS, Luxembourg Garden, date and artist unknown.¹³⁸⁵

¹³⁸⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

¹³⁸⁵ [https://en.wikipedia.org/wiki/Amontons_\(crater\)](https://en.wikipedia.org/wiki/Amontons_(crater))

Circa **11,665 HE**: FRANCISCO MARIA GRIMALDI, Italian physicist who did experiments that showed light was a wave and that light bent and labeled it “diffraction.” Controversy continued for 150 years with his work being mostly neglected.¹³⁸⁶ The crater Grimaldi on the Moon is named after him.¹³⁸⁷



GRIMALDI, artist, location, date unknown.¹³⁸⁸

¹³⁸⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

¹³⁸⁷ https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi

¹³⁸⁸ https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi

11,666 HE – 11,736 HE: STEPHEN GRAY, English experimenter¹³⁸⁹ who in **11,729 HE** was the first to systematically experiment with electrical conduction. Until his work, the emphasis had been on the simple generation of static charges and investigations of the static phenomena (electric shocks, plasma glows, etc.).

- ⇒ GRAY also first made the distinction between conduction and insulation and discovered the action-at-a-distance phenomenon of electrostatic induction.¹³⁹⁰
- ⇒ There is no monument to STEPHEN GRAY, and little recognition of what he achieved in his scientific discoveries. He is believed to

¹³⁸⁹ ISAAC ASIMOV'S *Chronology of Science and Discovery*

¹³⁹⁰ [https://en.wikipedia.org/wiki/Stephen_Gray_\(scientist\)](https://en.wikipedia.org/wiki/Stephen_Gray_(scientist))

be buried in a common grave in an old London cemetery, in an area reserved for pauper pensioners.¹³⁹¹

11,667 HE – 11,756 HE: JACQUES CASSINI (CASSINI II); French Astronomer was GIOVANNI DOMENICO CASSINI'S youngest son and succeeded CASSINI I as astronomer at Paris Observatory and geodesist under the name of CASSINI; CASSINI II Published the first *Tables of the Satellites of Saturn*;¹³⁹²

⇒ JACQUES CASSINI: CASSINI II defined the arc of meridian from Dunkirk to Perpignan – defining the radius of Earth.

¹³⁹¹ [https://en.wikipedia.org/wiki/Stephen_Gray_\(scientist\)](https://en.wikipedia.org/wiki/Stephen_Gray_(scientist))

¹³⁹² https://en.wikipedia.org/wiki/Jacques_Cassini

Jacques Cassini



JACQUES CASSINI: CASSINI II, date, location, and artist unknown¹³⁹³

11,669 HE: The year the “Star Stuff” element: Phosphorus was first isolated / made by HENNING BRANDT, German merchant and alchemist¹³⁹⁴ at Hamburg, Germany, when he evaporated urine and heated the residue until it was red hot, whereupon phosphorus vapor

¹³⁹³ https://en.wikipedia.org/wiki/Jacques_Cassini

¹³⁹⁴ https://en.wikipedia.org/wiki/Hennig_Brandt

distilled - which he collected by condensing it in water. BRANDT kept his discovery secret, thinking he had discovered the Philosopher's Stone that could turn base metals into gold.¹³⁹⁵



The photo is a piece of ultrapure purple phosphorus in a vial. Original size in cm: 0.5 x 2. The “Star Stuff” Element Atomic Number 15, Phosphorus, P, is a very common element, which is found in every life form on Earth, notably as the complex molecule adenosine triphosphate (ATP), which supplies the cells with energy. As an element it has four different allotropes, white, red, black and purple. The white phosphorus is infamous for its extreme

¹³⁹⁵ Phosphorus - Element information, properties and uses ... www.rsc.org/periodic-table/element/15/phosphorus

toxicity and dangerousness, it spontaneously burns in air. The other allotropes are more or less harmless. Phosphates, however, are a main ingredient of (conventional) fertilizers and as such are often a big ecological problem for waterbodies.¹³⁹⁶

11,669 HE: ISAAC ASIMOV notes two discoveries were made at this time, which took many additional years of general scientific advancement to be explained.¹³⁹⁷

⇒ First: ERASMUS BARTH, Danish physician, obtained a crystal that is now known as ‘Icelandic Spar.’ When objects are viewed through the crystal, they appear double (known now as “double refraction”). One remains fixed while the crystal is rotated, and the

¹³⁹⁶ <http://images-of-elements.com/phosphorus.php#a>

¹³⁹⁷ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 162

other image rotates around it. It took circa 150 years for enough to be known about light for an explanation to become possible;¹³⁹⁸ and

⇒ Second: RICHARD LOWER, English physician, noted that dark blood drawn from the veins turned bright red when in contact with air. It was circa 100 years before science had developed to understand the details.¹³⁹⁹

11,670 HE – 11,720 HE: MARIA MARGARETHE WINKELMANN KIRCH, German unpaid Astronomer¹⁴⁰⁰ was a famous astronomer of her period due to her writings on the conjunction of the sun with

¹³⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

¹³⁹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

¹⁴⁰⁰ Author / Compiler does not record where she first learned of KIRCH

Saturn, Venus, and Jupiter in **11,709 HE** and **11,712 HE** respectively.¹⁴⁰¹

⇒ On **April 21, 11,702 HE**, while making her regular nighttime observations, **MARIA KIRCH** discovered a previously unknown comet, the so-called "Comet of 1702" (C/1702 H1), becoming the first woman to record making such a discovery.¹⁴⁰²

¹⁴⁰¹ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

¹⁴⁰² https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

Verbesserte			Januarius.		Jenner.	
Sonnab.	1	Neu Jahr.	53	7. 7. 7.	Nachtag	
Sonntag	2	Chr. Ficht in nach N. J.	54	8. 8. 8.	pten. Matth. 2. der Kälte.	
Montag	3	Enoch	55	9. 9. 9.	windicht und	
Dienstag	4	Loth	56	10. 10. 10.	nicht alzuhefti-	
Mittwoch	5	Enoch	57	11. 11. 11.	tige Kälte.	
Donnerst.	6	N. J. König.	58	12. 12. 12.	Es wird früh	
Freitag	7	Adorus	59	13. 13. 13.	lichtbar.	
Sonnab.	8	Erhardus	60	14. 14. 14.	Es wisset.	
2.			Jesus 12. Ja		h. Luc. 2.	
Sonntag	9	Epiph.	61	15. 15. 15.	O. J. o. v. Frost.	
Montag	10	Paul Eins.	62	16. 16. 16.	und Schner.	
Dienstag	11	Hyginus	63	17. 17. 17.	Frost und	
Mittwoch	12	Reinhold	64	18. 18. 18.	Schnee / oder	
Donnerst.	13	Hilarius	65	19. 19. 19.	nur Regen.	
Freitag	14	Helix	66	20. 20. 20.	Regen oder	
Sonnab.	15	Maurus	67	21. 21. 21.	Schnee.	
3.			Hochzeit zu E		ana. Joh. 2.	
Tages-Länge		O Aufgang		O Untergang.		
5	7 36 m	8 11	12 m.	3 11	48 m.	
10	7 44	8 8		3	52	
15	7 58	8 1		3	59	



Circa 11,701 HE: The data collected by MARIA KIRCH and her husband, GOTTFRIED KIRCH were used to produce calendars and

almanacs and were also very useful in navigation. The academy in Berlin handled sales of their calendars.¹⁴⁰³

- ⇒ Details of January 1 -15 of the Chur-Brandenburgischer Calendar for **11,701 HE** pictured below: The first column lists the days in the week, the second column gives the name day, the third column predicts the zodiac in which the moon would stand that day, while the fourth column either contains astronomical information – “1th January conjunction of Saturn and Mars, 9th January new moon” – or vague weather predictions – “12th and 13th January snow or just rain”. At the bottom of the page the daylight hours, and the time the sun will rise and set is predicted for every fifth day.¹⁴⁰⁴

¹⁴⁰³ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

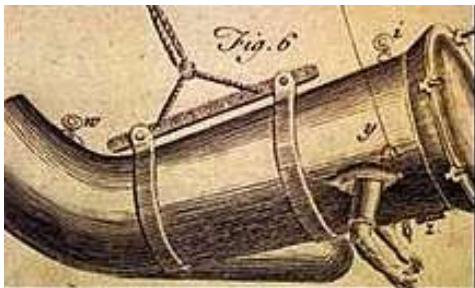
¹⁴⁰⁴ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

11,675 HE – 11,759 HE: JOHN LETHBRIDGE, English wool merchant based in Newton Abbot (Devon, England) who invented a diving barrel in **11,715 HE** and successfully salvaged valuables from wrecks.¹⁴⁰⁵

⇒ He said...”I go in with my feet foremost, and when my arms are got through the holes, then the head is put on, which is fastened with screws. It requires 500 weight to sink it and take but 15-pound weight from it and it will buoy upon the surface of the water. I lie straight upon my breast all the time I am in the engine, which hath many times been more than 6 hours, being frequently refreshed upon the surface by a pair of bellows. I can move it about 12-foot square at the bottom, where I have stayed many times 34 minutes. I

¹⁴⁰⁵ https://en.wikipedia.org/wiki/John_Lethbridge

have been 10 fathoms deep many a hundred times, and have been 12 fathoms, but with great difficulty.”¹⁴⁰⁶



JOHN LETHBRIDGE'S diving dress, artist, date and location not known.¹⁴⁰⁷

¹⁴⁰⁶ https://en.wikipedia.org/wiki/John_Lethbridge

¹⁴⁰⁷ https://en.wikipedia.org/wiki/John_Lethbridge



A replica of JOHN LETHBRIDGE'S diving machine at the Cité de la Mer (“City of the Sea”) in Cherbourg, France.¹⁴⁰⁸

¹⁴⁰⁸ https://en.wikipedia.org/wiki/John_Lethbridge

Circa 11,676 HE: ANTONI VAN LEEUWENHOEK, Dutch microscopist¹⁴⁰⁹ who ground small perfect lenses to see things 200 times smaller than had been previously viewed.

⇒ VAN LEEUWENHOEK used his microscopes and *was the first to see what science now calls microorganisms (he called them animalcules)* in pond water and he was the first to detect spermatozoa in semen.¹⁴¹⁰

⇒ ANTONI VAN LEEUWENHOEK was also the first to document microscopic observations of muscle fibers, bacteria, spermatozoa, red blood cells, crystals in gouty tophi, and blood flow in capillaries. Although van Leeuwenhoek did not write any books,

¹⁴⁰⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁴¹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

his discoveries came to light through correspondence with the Royal Society, which published his letters.¹⁴¹¹



A portrait of ANTONIE VAN LEEUWENHOEK by Jan Verkolje, date and location unknown.¹⁴¹²

¹⁴¹¹ https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek

¹⁴¹² https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek

11,677 HE– 11,761 HE: STEPHEN HALES, English, made major contributions to a range of scientific fields including botany, pneumatic chemistry, and physiology.¹⁴¹³

⇒ HALES was the first person to measure blood pressure. HALES also invented several devices, including a ventilator, a pneumatic trough, and surgical forceps for the removal of bladder stones.¹⁴¹⁴

⇒ STEPHEN HALES was the first person to collect gases by bubbling them through water and trapping them in an upside-down vessel.¹⁴¹⁵

¹⁴¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁴¹⁴ https://en.wikipedia.org/wiki/Stephen_Hales

¹⁴¹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⇒ STEPHEN HALES, in his capacity as a physiologist began experiments on plants. His most important suggestion was that air contributed to the nutrition of plants.¹⁴¹⁶



⇒

STEPHEN HALES, aged 82, by J. McArdell after T. Hudson, location unknown.¹⁴¹⁷

¹⁴¹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁴¹⁷ https://en.wikipedia.org/wiki/Stephen_Hales

11,678 HE – 11,761 HE: Dr. PIERRE FAUCHARD, French dentist who is considered the “*Father of Dentistry*”.¹⁴¹⁸

- ⇒ In **11,728 HE** FAUCHARD published the first book entirely devoted to dentistry: *Le Chirurgien Dentiste* (The Dental Surgeon). He discussed artificial dentures and crowns and described how to treat caries by cleaning out the decay and making use of metal fillings.¹⁴¹⁹
- ⇒ Dr. PIERRE FAUCHARD innovations in dentistry: he said the cause of dental caries was sugar, and people should limit it from their diet; he disproved theories of spontaneous tooth generation, arguing that the first teeth, which are called milk teeth, separate themselves from their roots. (Some dentists at FAUCHARD'S time believed teeth didn't have roots). He was one of the first physicians

¹⁴¹⁸ ISAAC ASIMOV'S *Chronology of Science and Discovery*

¹⁴¹⁹ ISAAC ASIMOV'S *Chronology of Science and Discovery*

to denounce medical malpractice in dentistry: he alleged to a tribunal that many dentists in France did not have a degree or experience; FAUCHARD introduced dental fillings as treatment for dental cavities, and he suggested amalgams like lead, tin, and sometimes gold.¹⁴²⁰

- Author / Compiler note: Lead? ...because information of the horrors of lead in humans was lost. (See: **Circa 9,855 HE** – **Circa 10,529 HE**: Antiquity Roman Empire and their roman slaves who died screaming after working with lead.)

⇒ FAUCHARD also said that teeth should be cleaned periodically by a dentist; FAUCHARD said that braces should be used to correct the position of teeth, and that children's teeth could be moved more easily and quickly than adults', a result of the size of the teeth roots; FAUCHARD was ahead of his time in medical practice and he

¹⁴²⁰ https://en.wikipedia.org/wiki/Pierre_Fauchard

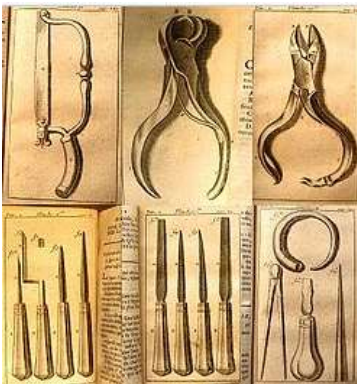
described the way the patient should be greeted by the doctor and the position in which the patient should sit. He recommended that the dentist should stand behind the patient to help them relax, and he introduced the concept of dentist's chair light.¹⁴²¹



FAUCHARD by J. Le. Bel, location and date unknown.¹⁴²²

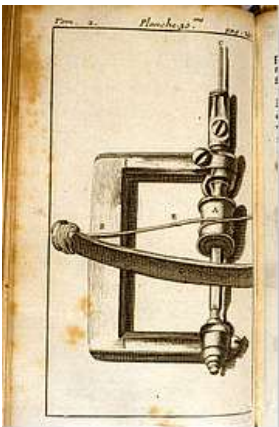
¹⁴²¹ https://en.wikipedia.org/wiki/Pierre_Fauchard

¹⁴²² https://en.wikipedia.org/wiki/Pierre_Fauchard



Drawings of Late 18th century HE surgical instruments made by Dr. PIERRE FAUCHARD during his research in oral surgery including a saw, two kinds of forceps, and a small drill (gimlet).¹⁴²³

¹⁴²³ https://en.wikipedia.org/wiki/Pierre_Fauchard



Drawing of Dr. PIERRE FAUCHARD's late **11,600's HE** bigger dentist's drill.¹⁴²⁴

¹⁴²⁴ https://en.wikipedia.org/wiki/Pierre_Fauchard

Circa 11,680 HE: GIOVANNI ALFONSO BORELLI, Italian Physiologist, and Physicist and Mathematician. BORELLI's book was posthumously published *De Motu Animalium* where he successfully explained muscular action on a mechanical system of levers basis.¹⁴²⁵



GIOVANNI ALFONSO BORELLI, date, location, and artist unknown.¹⁴²⁶

¹⁴²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 167

¹⁴²⁶ https://en.wikipedia.org/wiki/Giovanni_Alfonso_Borelli

Circa 11,681 HE: Disputably the first steam powered vehicle was invented by RP VERBIEST, missionary, who lived in China from **11,672 HE** to **11,686 HE**. VERBIEST created a very interesting vehicle to distract the Emperor of China and his court. The steam carriage in question is described in Latin in the book by father VERBIEST, *Astronomia Europae*. Historians do not agree on the exact date of the realization of the vehicle. Some locate it in **11,681 HE**. But, according to no less reliable Chinese texts, the test took place in **11,679 HE**.¹⁴²⁷

⇒ Reliable or not, the Chinese texts describe the machine as: two feet long (about 65 cm) and powered by an aeolipile heated by hot embers. The jet of steam hit a horizontal wheel with blades and meshing the front drive wheels. The cart was tried in the big court of the imperial palace of Peking. In the middle of the axis of the rear wheels, a very flexible drawbar was connected to a wheel of a

¹⁴²⁷ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

larger diameter easy to maneuver. The cart went around in the courtyard of the Palais Impérial to the great enthusiasm of the spectators.¹⁴²⁸



Modern depiction of the ancient disputed first steam powered vehicle, artist and date unknown.¹⁴²⁹

¹⁴²⁸ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

¹⁴²⁹ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

11,686 HE – 11,736 HE: DANIEL GABRIEL FAHRENHEIT:

Polish/Dutch physicist, engineer, and glass blower who is known for in **11,714 HE** inventing the mercury-in-glass thermometer, and for developing a temperature scale now named after him.¹⁴³⁰



FAHRENHEIT, artist, date and location unknown.¹⁴³¹

¹⁴³⁰ https://en.wikipedia.org/wiki/Daniel_Gabriel_Fahrenheit

¹⁴³¹ https://en.wikipedia.org/wiki/Daniel_Gabriel_Fahrenheit

Circa 11,688 HE: In France: Clear Plate Glass could by now be used in rooms to allow in light and keep out weather. No name mentioned as being the scientist who discovered how to make plate glass, but circa 4,187 years after the luxury item of clear glass was first *used* (see **7,501 HE**), the art or science of pressing or casting glass – by methods other than blowing – was developed. At first the sheets were quite small, but little by little they increased in size and larger sheets were being made for mirrors or coach windows. This meant that glass was becoming less expensive and more common.¹⁴³²

11,693 HE - 11,776 HE: JOHN HARRISON, British, carpenter and clockmaker¹⁴³³ who invented how to define Longitude and who was the first to make an accurate, portable timepiece that did not rely on a pendulum. It is said that the British Empire grew into the worldwide

¹⁴³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁴³³ Dava Sobel's book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*

power it became because it ruled the waves with the chronometer and the knowledge of Longitude. Measuring longitude accurately was not possible without an accurate timepiece.

⇒ **11,761 HE:** JOHN HARRISON awarded the prize from the Roayl Society Board of Longitude for HARRISON had defined Longitude at sea by creating the first independent movement clock: “H1”. He invented, designed and built the world's first successful marine chronometers and subsequently built “H2”, “H3”, “H4”, “H5” and “The Watch”.¹⁴³⁴

¹⁴³⁴ Dava Sobel's book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*



P.L. Tassaert's half-tone print of Thomas King's original **11,767 HE** portrait of JOHN HARRISON, located at the Science and Society Picture Library, England. Note his hand is open, but “The Watch” which was elsewhere during the sitting of the painting was not included in his open hand.¹⁴³⁵

¹⁴³⁵ https://en.wikipedia.org/wiki/John_Harrison



This painting is at the Royal Observatory in Greenwich, England. It includes less detail than the above half-tone print... but look closely... “The Watch” is painted in the right hand of John Harrison, date and artist unknown.¹⁴³⁶

¹⁴³⁶ <https://www.youtube.com/watch?v=T-g27KS0yiY>



Harrison's "The Watch" No.1 (H4), with winding crank, location and photographer unknown.¹⁴³⁷

¹⁴³⁷ https://en.wikipedia.org/wiki/John_Harrison



JOHN HARRISON's first sea clock (H1) at the Royal Observatory,
Greenwich¹⁴³⁸

¹⁴³⁸ https://en.wikipedia.org/wiki/John_Harrison



Harrison's Chronometer H5, (Collection of the Worshipful Company of Clockmakers), in the Science Museum, London.¹⁴³⁹

11,693 HE – 11,762 HE: JAMES BRADLEY¹⁴⁴⁰, FRS, English astronomer who served as Astronomer Royal from **11,742 HE**,

succeeding EDMOND HALLEY.¹⁴⁴¹ BRADLEY is best known for two fundamental discoveries in astronomy:

- ⇒ JAMES BRADLEY discovered *The Aberration of Light*¹⁴⁴² which ASIMOV says, “is a more accurate way of calculating the speed of light” (See **11,644 HE – 11,710 HE: OLE ROEMER**);

- ⇒ JAMES BRADLEY discovered the *Nutation of the Earth's Axis*, which is a phenomenon which causes the orientation of the axis of rotation of a spinning astronomical object (like our planet Earth) to vary over time.¹⁴⁴³

¹⁴³⁹ https://en.wikipedia.org/wiki/John_Harrison

¹⁴⁴⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 188

¹⁴⁴¹ https://en.wikipedia.org/wiki/James_Bradley

¹⁴⁴² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 188

¹⁴⁴³ https://en.wikipedia.org/wiki/Astronomical_nutation



JAMES BRADLEY, date, location, and artist unknown.¹⁴⁴⁴

11,703 HE – 11,771 HE: CHESTER MOOR HALL (MOOR may also be spelled MOORE), British lawyer and inventor who noticed what

¹⁴⁴⁴ https://en.wikipedia.org/wiki/James_Bradley

ISAAC NEWTON (see **11,642 HE– 11,727 HE: SIR ISAAC NEWTON**) had missed:

- That different kinds of glass produced different spectra of different widths.¹⁴⁴⁵ ¹⁴⁴⁶ **11,729 HE or 11,733 HE** (accounts differ). CHESTER MOOR HALL saw that Flint Glass, containing lead, produced a rather wider spectrum than ordinary crown or window glass. HALL made a convex lens out of the crown glass and a concave lens out of the Flint glass in a way that when the 2 were fit together they formed a biconvex lens. The end results were the achromatic lens which would have no color and magnify an object. HALL built the first refracting

¹⁴⁴⁵ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

¹⁴⁴⁶ https://en.wikipedia.org/wiki/Chester_Moore_Hall

telescope free from chromatic aberration (free from color distortion).^{1447 1448}

- **11,757 HE:** Since CHESTER MOOR HALL did not publicize his invention properly, and in **11,757 HE** JOHN DOLLOND did publicize his achromatic lens, DOLLOND got more credit. (SEE **Circa 11,021 HE, IBN AL-HAYTHAM.**)¹⁴⁴⁹

¹⁴⁴⁷ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

¹⁴⁴⁸ https://en.wikipedia.org/wiki/Chester_Moore_Hall

¹⁴⁴⁹ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

Chapter Seven **THE INDUSTRIAL REVOLUTION:**
Circa 11,760 HE - Now
(lasting, so far, less than 300 years,
part of the Scientific Revolution)

The Industrial Revolution encompasses the changes in economic and social organization on our planet which continues today, and which began around **11,760 HE** in Great Britain and later in other countries. Wikipedia places the Industrial Revolution as beginning in about **11,760 HE**, but many industrial inventions and processes were started much earlier. This period is characterized chiefly by the replacement of hand tools with power-driven machines such as the power loom,

the steam engine, and by the concentration of industry in large establishments.¹⁴⁵⁰

⇒ “World changing Inventions are the culminations of efforts of dozens or hundreds of people (over dozens or hundreds of years). The last person to come along usually gets all the credit – but they have all of history on their side as collaborators. A stroke of genius never happens in a vacuum. People who built something bigger or cooler than what came before them, were important, but they were standing on the shoulders of giants.”¹⁴⁵¹

¹⁴⁵⁰ https://en.wikipedia.org/wiki/Industrial_Age

¹⁴⁵¹ SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*

Circa 11,700 HE: The world population was approximately 610,000,000 people.¹⁴⁵²

11,704 HE – 11,764 HE: JOHN KAY, British machinist was the inventor of the flying shuttle, which was another key contribution to the Industrial Revolution.¹⁴⁵³ In July **11,733 HE**, JOHN KAY received a patent for his most revolutionary device: a "wheeled shuttle" for the hand weaving loom.¹⁴⁵⁴ (See **11,563 HE – 11,614 HE:** WILLIAM LEE and the first mechanical knitting machine.) But by September **11,733 HE** the Colchester weavers were so concerned for their livelihoods that they petitioned the King to stop Kay's inventions. JOHN KAY suffered violent treatment in England (fear of technological unemployment), but he did not leave the country on that

¹⁴⁵² <http://www.worldometers.info/world-population/world-population-by-year/>

¹⁴⁵³ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

¹⁴⁵⁴ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

account, but instead because of his inability to enforce (or profit from) his patent rights.¹⁴⁵⁵ **11,747 HE:** JOHN KAY left England, went to Paris, and negotiated with the French Government (in English) to sell them his hand weaving loom technology.¹⁴⁵⁶

⇒ **11,753 HE:** The beginning of mechanization in French textile production is traditionally dated to this year, with the widespread adoption of the flying shuttle there.¹⁴⁵⁷ **11,760 HE:** JOHN KAY'S son, ROBERT KAY, stayed in Britain and developed the "drop-box", which enabled looms to use multiple flying shuttles simultaneously, allowing multicolor wefts.¹⁴⁵⁸

¹⁴⁵⁵ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹⁴⁵⁶ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹⁴⁵⁷ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹⁴⁵⁸ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))



Portrait on the JOHN KAY Memorial.¹⁴⁵⁹

¹⁴⁵⁹ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))



Undated Flying shuttle showing metal capped ends, wheels, and a pirn of weft thread; photographer, location and date unknown.¹⁴⁶⁰

11,706 HE: Although he does not say where, or by whom, ISSAC ASIMOV says that it was this year when springs were added to carriages to make their jolting and uneven ride easier. To be sure, ISSAC ASIMOV says, this induced swaying, but springs were

¹⁴⁶⁰ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

undoubtedly preferable to the lurching and banging that existed prior to the use of springs in carriages.¹⁴⁶¹

11,706 HE - 11,749 HE: GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL, MARQUISE DU CHÂTELET,¹⁴⁶² French natural philosopher, mathematician, physicist, editor, and member of the Academy of Sciences of the Institute of Bologna.¹⁴⁶³ DU CHÂTELET introduced the idea of “Conservation of Energy” where “energy cannot be created or destroyed”.¹⁴⁶⁴ **11,737 HE:** DU CHÂTELET published a paper entitled *Dissertation sur la nature et la propagation du feu*, based upon her research into the science of fire, that predicted what is today known as infrared radiation and the nature of light.¹⁴⁶⁵ **11,740 HE:** DU CHÂTELET’s book *Institutions*

¹⁴⁶¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 180

¹⁴⁶² <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁴⁶³ <https://en.wikipedia.org> Emelie Du Chatelet

¹⁴⁶⁴ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁴⁶⁵ <https://en.wikipedia.org> Emelie Du Chatelet

de Physique (“Lessons in Physics”) was published. It was presented as a review of new ideas in science and philosophy to be studied by her 13-year-old son, but it incorporated and sought to reconcile complex ideas from the leading thinkers of the time. The book and subsequent debate contributed to her becoming a member of the Academy of Sciences of the Institute of Bologna in **11,746 HE**.¹⁴⁶⁶ DU CHÂTELET’s recognized achievement is her translation of and commentary on ISAAC NEWTON’s book *Principia*, (from its original writing in Latin, to French) containing basic laws of physics. DU CHÂTELET’s French translation, published posthumously in **11,759 HE**, is still considered the standard French translation today. Her commentary includes a profound contribution to Newtonian mechanics — the postulate of an additional conservation law for total energy, of which kinetic energy of motion is one element.¹⁴⁶⁷

¹⁴⁶⁶ <https://en.wikipedia.org> Emelie Du Chatelet

¹⁴⁶⁷ <https://en.wikipedia.org> Emelie Du Chatelet



MARQUISE DU CHÂTELET, Portrait by Maurice Quentin de La Tour, date and location unknown.¹⁴⁶⁸

¹⁴⁶⁸ <https://en.wikipedia.org> Emelie Du Chatelet



11,741 HE book entitled *Réponse de Madame la Marquise du Chastelet, a la lettre que M. de Mairan. Dortous de Mairan.* The secretary of the French Academy of Sciences had published a set of arguments addressed to her regarding the appropriate mathematical expression for forces vives. DU CHÂTELET presented a spirited point by point rebuttal of de Mairan's arguments causing him to withdraw from the controversy.¹⁴⁶⁹

¹⁴⁶⁹ <https://en.wikipedia.org> Emelie Du Chatelet



GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL,
MARQUISE DU CHÂTEL CHÂTELET's book: **Dissertation Sur
La Nature et La Propagation du feu**, 11,744 HE¹⁴⁷⁰

¹⁴⁷⁰ <https://en.wikipedia.org> Emelie Du Chatelet

11,706 HE – 11,790 HE: BENJAMIN FRANKLIN, American. A renowned polymath of his time, leading editor, printer, political theorist, politician, freemason, postmaster, scientist, inventor, civic activist, statesman, and diplomat.¹⁴⁷¹ As a scientist, BENJAMIN FRANKLIN was a major figure in the American Enlightenment and in the history of physics for his discoveries and theories regarding electricity. As an inventor, he is known for the lightning rod, bifocals, and the Franklin stove, among other inventions. He facilitated many civic organizations, including Philadelphia's fire department and a university. He wrote much in newspapers, published pamphlets, and books including the Farmer's Almanac and Marine Observations on improvements to ships, and about the Gulf Stream.¹⁴⁷²

¹⁴⁷¹ https://en.wikipedia.org/wiki/Benjamin_Franklin

¹⁴⁷² https://en.wikipedia.org/wiki/Benjamin_Franklin



BENJAMIN FRANKLIN, Sixth President of Pennsylvania and signer of the American Declaration of Independence, artist, date and location unknown.¹⁴⁷³

¹⁴⁷³ https://en.wikipedia.org/wiki/Benjamin_Franklin

11,707 HE: JOHN FLOYER, English physician who devised a *pulse watch*, which after winding would run for exactly one minute. JOHN FLOYER's *pulse watch* was the first precision instrument that could be used by physicians.¹⁴⁷⁴ (See Circa **11,451 HE:** when circa 256 years ago NICHOLAS OF CUSA devised a way to count pulses based on the drips of the then available technology of the water clock.)¹⁴⁷⁵

¹⁴⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 180

¹⁴⁷⁵ https://en.wikipedia.org/wiki/Nicholas_of_Cusa



JOHN FLOYER. Credit: Wellcome Library, date unknown.¹⁴⁷⁶

¹⁴⁷⁶ [https://en.wikipedia.org/wiki/John_Floyer_\(physician\)](https://en.wikipedia.org/wiki/John_Floyer_(physician))

11,707 HE – 11,788 HE: GEORGES-LOUIS LECLERC, COMTE de BUFFON, French Naturalist¹⁴⁷⁷ wrote *Histoire Naturelle, Générale et Particulière* (11,749 HE–11,788 HE) in 36 volumes; an additional volume based on his notes appeared in 11,789 HE. The *Histoire Naturelle* ended up focusing on the animal and mineral kingdoms.¹⁴⁷⁸

⇒ CHARLES DARWIN wrote in his *Origin of Species* from the fourth edition onwards, that "...the first author who in modern times has treated it [evolution] in a scientific spirit was Buffon..."¹⁴⁷⁹

¹⁴⁷⁷ Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*

¹⁴⁷⁸ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon

¹⁴⁷⁹ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon



GEORGES-LOUIS LECLERC, COMTE de BUFFON, date, location, and artist unknown.¹⁴⁸⁰

¹⁴⁸⁰ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon

11,709 HE: ABRAHAM DARBY THE ELDER, developed a method of producing pig iron in a blast furnace fueled by coke rather than charcoal. This was a major step forward in the production of iron as a raw material for the Industrial Revolution.^{1481 1482}

⇒ His method of casting pots in sand provided his successors with a viable business that operated for over two centuries. Smelting iron with coke ultimately released the iron industry from the limitation imposed by the speed of growth of trees. Coke-smelted cast iron went into steam engines, bridges, and many of the inventions of the **11,800's HE**. Only with coke smelting could there be produced the great quantities of iron made to meet the requirements of the Industrial Revolution.¹⁴⁸³

¹⁴⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 181

¹⁴⁸² https://en.wikipedia.org/wiki/Abraham_Darby_I

¹⁴⁸³ https://en.wikipedia.org/wiki/Abraham_Darby_I

Circa 11,712 HE: THOMAS NEWCOMEN, English inventor. Based on THOMAS SAVERY's patent, NEWCOMEN enhanced another Steam Engine for lifting water from mines.¹⁴⁸⁴ (See Circa **10,050 HE:** HERO of ALEXANDRIA.)



THOMAS NEWCOMEN, Memorial Steam Engine in Dartmouth. The Atmospheric Steam Engine kept failing. Photographer unknown.¹⁴⁸⁵

¹⁴⁸⁴ https://en.wikipedia.org/wiki/Thomas_Newcomen

¹⁴⁸⁵ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

11,713 HE: Smallpox was the dread disease of this time. This was the year that LADY MARY WORTLEY MONTAGU brought news from Turkey (her husband was British ambassador to Turkey) that they were inoculating people with pus from the people with mild cases of Smallpox. Those inoculations were like playing Russian Roulette because sometimes they worked and sometimes they didn't. Nevertheless, for 75 years people submitted to such inoculations.¹⁴⁸⁶



Circa 11,756 HE: LADY MONTAGU in Turkish dress by Jean-Étienne Liotard, Palace on the Water in Warsaw.¹⁴⁸⁷

¹⁴⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 183

¹⁴⁸⁷ https://en.wikipedia.org/wiki/Lady_Mary_Wortley_Montagu

11,714 HE – 11,784 HE: CÉSAR-FRANÇOIS CASSINI DE THURY,
(Cassini III), French Astronomer; was CASSINI II's second son.

- ⇒ He succeeded Cassini II as astronomer at Paris Observatory.
- ⇒ He continued the surveying operations started by Cassini I and Cassini II and began construction of one of the landmarks of historical cartography: the topographical map of France. Its 180 plates are known as the Cassini Map.¹⁴⁸⁸

¹⁴⁸⁸ https://en.wikipedia.org/wiki/C%C3%A9sar-Fran%C3%A7ois_Cassini_de_Thury



CÉSAR-FRANÇOIS CASSINI DE THURY, Cassini III, artist, date and location unknown.¹⁴⁸⁹

¹⁴⁸⁹ https://en.wikipedia.org/wiki/C%C3%A9sar-Fran%C3%A7ois_Cassini_de_Thury



Hand-drawn map of one side of the Valley of Vesdre by French geographers (led by the Cassini family) from **11,745 HE** to **11,748 HE**, location unknown.¹⁴⁹⁰

¹⁴⁹⁰ https://en.wikipedia.org/wiki/French_cartography#Cassini_maps

Circa 11,715 HE: THE CHEVALIER (SIR) PIERRE RÉMY DE BEAUVE, a French aristocrat who served as garde de la marine in Brest, built one of the oldest known diving dresses.

⇒ Different than JOHN LETHBRIDGES diving barrel (See **11,675 HE – 11,759 HE:** JOHN LETHBRIDGE), DE BEAUVE's dress was equipped with a metal helmet and two hoses, one of them air-supplied from the surface by a bellows and the other one for evacuation of the exhaled air.¹⁴⁹¹

¹⁴⁹¹ https://en.wikipedia.org/wiki/Timeline_of_diving_technology

11,718 HE – 11,799 HE: MARIA GAETANA AGNESI, Italy,
Mathematician was the first woman to write a mathematics handbook
Instituzioni analitiche ad uso della gioventù italiana (*Analytical
Institutions for the Use of Italian Youth*).

- ⇒ AGNESI was the first woman appointed as a Mathematics Professor at a university.

- ⇒ AGNESI could speak Italian, French, Greek, Hebrew, Spanish, German, and Latin by age 13.¹⁴⁹²

¹⁴⁹² Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*



MARIA GAETANA AGNESI, date, location, and artist
unknown¹⁴⁹³

¹⁴⁹³ https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi



11,748 HE: First page of MARIA GAETANA AGNESI's *Instituzioni analitiche*¹⁴⁹⁴

11,725 HE – 11,804 HE: NICOLAS-JOSEPH CUGNOT,¹⁴⁹⁵ French inventor who built disputably (see Circa **11,680 HE:** RP VERBIEST)

the first working self-propelled land-based mechanical vehicle: the world's first automobile¹⁴⁹⁶ fueled by hydrogen.¹⁴⁹⁷



NICOLAS-JOSEPH CUGNOT's **11,770 HE** fardier à vapeur, as preserved at the Musée des Arts et Métiers, Paris.¹⁴⁹⁸

¹⁴⁹⁴ https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi

¹⁴⁹⁵ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁴⁹⁶ https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot

¹⁴⁹⁷ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁴⁹⁸ https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot

Circa 11,725 HE – 11,798 HE: Giacomo Girolamo Casanova AKA “Casanova”, Europe (not a scientist, but as Author / Compiler is trying to report on the science of population and birth control methods through recorded history) was one of the first reported using "assurance caps" to prevent impregnating his mistresses.¹⁴⁹⁹ ¹⁵⁰⁰ Casanova was said to have inserted the rind of half a lemon into his lovers as a primitive cervical cap or diaphragm, also known as the “assurance cap”. Another of his inventions was a primitive condom designed out of the gut or bladder of sheep.¹⁵⁰¹

¹⁴⁹⁹ https://en.wikipedia.org/wiki/History_of_birth_control

¹⁵⁰⁰ https://en.wikipedia.org/wiki/Giacomo_Casanova; Fryer, Peter (11,965 HE). **The Birth Controllers**. London: Secker & Warburg and Dingwall EJ (11,953 HE). "**Early contraceptive sheaths**", and **A Brief history of condoms**". In Mindel, Adrian. *Condoms*. BMJ Books. ISBN 978-0-7279-1267-1. Br Med J. 1 (4800): 40–1. doi:10.1136/bmj.1.4800.40. PMC 2015111. PMID 12997834.

¹⁵⁰¹ <http://www.futurescopes.com/romance/love-and-sex/3245/10-unusual-contraceptive-methods-history>

11,726 HE- 11,797 HE: JAMES HUTTON, was a Scottish geologist, naturalist, experimental agriculturalist,¹⁵⁰² physician, and chemical manufacturer. HUTTON was a Fellow of the Royal Society of Edinburgh.¹⁵⁰³ HUTTON originated the theory of uniformitarianism — a fundamental principle of geology — that explains the features of the Earth's crust by means of natural processes over geologic time. Hutton's work established geology as a science, and as a result HUTTON is referred to as the "*Father of Modern Geology*".¹⁵⁰⁴

⇒ Through observation and carefully reasoned geological arguments, JAMES HUTTON came to believe that the Earth was perpetually being formed; he recognized that the history of Earth could be determined by understanding how processes such as erosion and

¹⁵⁰² BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁵⁰³ https://en.wikipedia.org/wiki/James_Hutton

¹⁵⁰⁴ https://en.wikipedia.org/wiki/James_Hutton

sedimentation work in the present day. HUTTON's theories of geology and geologic time, also called Deep Time, came to be included in theories which were called Plutonism and Uniformitarianism.¹⁵⁰⁵

⇒ JAMES HUTTON knew JAMES WATT (see **11,736 HE-11,819 HE: JAMES WATT**). JAMES WATT used heat to run steam engines, and HUTTON wondered if heat within the earth could be the engine that drives geological change. Scientists had seen volcanoes, but prior to HUTTON they thought they were small isolated fires. He theorized that the center of the planet was the heat source.¹⁵⁰⁶ See list of interesting works by JAMES HUTTON¹⁵⁰⁷

¹⁵⁰⁵ https://en.wikipedia.org/wiki/James_Hutton

¹⁵⁰⁶ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁵⁰⁷ https://en.wikipedia.org/wiki/James_Hutton



11,776 HE: JAMES HUTTON painted by Sir Henry Raeburn,
location unknown.¹⁵⁰⁸

¹⁵⁰⁸ https://en.wikipedia.org/wiki/James_Hutton

11,728 HE – 11,799 HE: JOSEPH BLACK, Scottish physician and chemist is known for his discoveries of latent heat (the theory of latent heat marks the beginning of thermodynamics), specific heat, and of Carbon Dioxide.¹⁵⁰⁹



JOSEPH BLACK by James Tassie. Hunterian Museum, Glasgow.¹⁵¹⁰

¹⁵⁰⁹ https://en.wikipedia.org/wiki/Joseph_Black

¹⁵¹⁰ https://en.wikipedia.org/wiki/Joseph_Black

11,730 HE: GEORG BRANDT, Swedish chemist, defined and named the “Star Stuff” element Cobalt.¹⁵¹¹



Photo is of fractions from a cobalt cathode. Original size in cm: 2 x 2. “Star Stuff” Element Atomic Number 27, Cobalt, Co, Cobalt is a ferromagnetic, ductile metal, which is very similar to iron, but is much rarer than iron. It is used for magnets and for many different alloys. Cobalt blue, CoAl_2O_4 , is one of the most important blue

¹⁵¹¹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

colorants for glass and ceramics. Also, Cobalt is part of the vitamin B12 and therefore is needed in small amounts in our food.¹⁵¹²

11,731 HE - 11,810 HE: HENRY CAVENDISH, British, natural philosopher, magnificently shy and retiring¹⁵¹³ scientist, and an important experimental, theoretical chemist and physicist¹⁵¹⁴ who turned his house in Clapham into a large laboratory where he could range undisturbed through every corner of the physical sciences- electricity, heat, gravity, gases and anything having to do with the composition of matter. **11,766 HE** CAVENDISH isolated the “Star Stuff” element Hydrogen.^{1515 1516} He made a string of signal discoveries- among which he was the first person to combine hydrogen and oxygen to make water. Bill Bryson says CAVENDISH

¹⁵¹² <http://images-of-elements.com/cobalt.php#a>

¹⁵¹³ Bill Bryson Short History of Nearly Everything ebook

¹⁵¹⁴ https://en.wikipedia.org/wiki/Henry_Cavendish

¹⁵¹⁵ https://en.wikipedia.org/wiki/Henry_Cavendish

¹⁵¹⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

conducted experiments in which he subjected himself to graduated jolts of electrical current and what he learned about electrical conductivity was a century ahead of its time. But almost nothing he did was entirely divorced from strangeness. CAVENDISH exasperated other scientists by not publishing his results. In his secretiveness, he exceeded NEWTON and the greater part of what he knew wasn't known until the late **11,800's HE** when the amazing JAMES CLERK MAXWELL took on the task of editing CAVENDISH's papers. MAXWELL discovered that CAVENDISH, prior to others had either discovered or anticipated "The Law of Conservation", "Ohm's Law", "Dalton's Law of Partial Pressures", "Richter's Law of Reciprocal Proportions", "Charles Law of Gasses", had left clues that led directly to the discovery of the group of elements known as the noble gases, and the principles of electrical conductivity.¹⁵¹⁷ Historian J.G. Crowther said CAVENDISH also foreshadowed "the work of KELVIN and G.H. Darwin on the effect

¹⁵¹⁷ Bill Bryson Short History of Nearly Everything ebook

of tidal friction on slowing the rotation of the Earth, and LARMOR'S discovery, published in **11,915 HE**, on the effect of local atmospheric cooling...the work of PICKERING on freezing mixtures, and some of the work of ROOSEBOOM on heterogeneous equilibria".¹⁵¹⁸

⇒ **11,797 HE:** HENRY CAVENDISH's last known experiment was to measure the density of the Earth which has come to be known as the *Cavendish Experiment*.¹⁵¹⁹

- Bryson say CAVENDISH had - evidently out of simple scientific respect - inherited crates of equipment from John Mitchell, which assembled looked nothing so much as a then late **11,700's HE** version of the late **12,004 HE** Nautilus weight training machine, incorporating weights, counterweights, pendulums, shafts and torsion wires at the heart of which were

¹⁵¹⁸ Bill Bryson Short History of Nearly Everything ebook

¹⁵¹⁹ https://en.wikipedia.org/wiki/Henry_Cavendish

two 350-pound lead balls, which were suspended beside two smaller spheresBryson skillfully talks about CAVENDISH trying to measure gravity at this extremely featherweight level. With experimental delicacy as a key word to accomplishing the detailed process, he announced the Earth weighed a little over 13,000,000,000,000 or six billion trillion metric tons. Bryson further says even the **12,004 HE** scientists using their equipment which can detect the weight of a single bacterium have not significantly improved on CAVENDISH's measurements of **11,797 HE**.¹⁵²⁰

¹⁵²⁰ Bill Bryson Short History of Nearly Everything ebook



Photo is Vial of glowing ultrapure hydrogen, H₂. “Star Stuff” Element Atomic Number 1, Hydrogen, H, is the lightest and simplest element and, with a ratio of 80%, is the main ingredient of the visible universe. 20% consist of helium, the ratio of the heavier elements (like you, me, and the Earth, and every living creature on the Earth, and everything else in the whole universe is below 1% ¹⁵²¹). Most stars, including our Sun, generate energy by fusing hydrogen to helium. Hydrogen is quite abundant on Earth too, opposite to helium, because it is a very reactive

¹⁵²¹ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

element and so is part of many different compounds. The most familiar of these is the one with oxygen, H₂O, water. But all the complex molecules of life contain hydrogen, too.¹⁵²²

⇒ Bill Bryson says “The second half of the eighteenth century was a time when people of a scientific bent (Author / Compiler note: and who had the means) grew intensely interested in asking real questions and seeking real answers about the physical properties of fundamental things, and seeing what they could do with them, often with more enthusiasm than sense.”¹⁵²³

¹⁵²² <http://images-of-elements.com/hydrogen.php#a>

¹⁵²³ Bill Bryson Short History of Nearly Everything ebook



H. Cavendish



HENRY CAVENDISH, date, location, and artist unknown.¹⁵²⁴

11,732 HE – 11,808 HE: JOSÉ CELESTINO MUTIS¹⁵²⁵ in Bogotá, now Columbia: Spanish personal physician to the Viceroy, botanist, and

mathematician was a significant scientific figure in the Spanish American Enlightenment.¹⁵²⁶



JOSÉ CELESTINO MUTIS, date, place, and artist unknown;¹⁵²⁷

¹⁵²⁴ https://en.wikipedia.org/wiki/Henry_Cavendish

¹⁵²⁵ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁵²⁶ https://en.wikipedia.org/wiki/José_Celestino_Mutis

¹⁵²⁷ https://en.wikipedia.org/wiki/José_Celestino_Mutis

- ⇒ MUTIS's likeness is well known to Spaniards, because his image was used on the first in a series of banknotes commemorating Spain in America. On the reverse was a drawing of the *Mutisia clematis* flower, named in his honor.¹⁵²⁸
- ⇒ NAMESAKES: José Celestino Mutis Botanical Gardens, a park and center of scientific investigation, is named in his honor in Bogotá. It includes climate-controlled exhibits of the flora in all climate zones of Colombia. An exhibit of 5,000 Colombian orchids, one of Colombia's most extensive; The official name of the town of Bahia Solano on Colombia's Pacific coast in the Department of Choco is Puerto Mutis. The airport there is Aeropuerto Jose Celestino Mutis. There is a Street named Celestino Mutis, in Cadiz, Spain.¹⁵²⁹

¹⁵²⁸ https://en.wikipedia.org/wiki/José_Celestino_Mutis

¹⁵²⁹ https://en.wikipedia.org/wiki/José_Celestino_Mutis

Circa 11,733 HE – 11,814 HE: ALEXHANDER CUMMING (sometimes CUMMINGS) FRSE: a Scottish watchmaker and instrument inventor, who was the first to patent a design of the indoor flush toilet, which had been pioneered earlier: see **Circa 11,560 HE – 11,612 HE: SIR JOHN HARRINGTON**, but without HARRINGTON solving the problem of foul smells.¹⁵³⁰

⇒ **11,775 HE:** The S-trap (or bend) was invented by CUMMING to retain water permanently within the bowl, thus preventing sewer gases (those foul smells) from entering buildings. It survives in today's plumbing modified as a U- or J-shaped pipe trap located below or within a plumbing fixture.¹⁵³¹

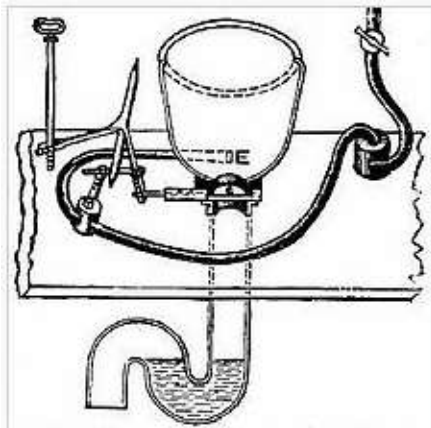
¹⁵³⁰ https://en.wikipedia.org/wiki/Alexander_Cumming

¹⁵³¹ https://en.wikipedia.org/wiki/Alexander_Cumming



Portrait of ALEXHANDER CUMMING; date, location, artist unknown.¹⁵³²

¹⁵³² https://en.wikipedia.org/wiki/Alexander_Cumming



11,775 HE: CUMMING's patent for the S-trap laid the foundations for the modern flush toilet.¹⁵³³

11,736 HE - 11,819 HE: JAMES WATT, Scottish Inventor, Fellow of the Royal Society of Edinburgh, Fellow of the Royal Society,¹⁵³⁴ Circa

11,781 HE JAMES WATT gets credit for inventing the steam engine because he took the steam engine designed first by (see circa **10,050 HE: HERO** of ALEXANDRIA and (see circa **11,698 HE THOMAS SAVERY**, and **Circa 11,712 HE THOMAS NEWCOMEN**) and added the separate condenser which made the device more energy efficient; enough for WATT and his partner Matthew Boulton to commercialize it and industrially speaking revolutionize the world. But steam engines predate WATT by circa 1,731 to 60 years.¹⁵³⁵

⇒ JAMES WATT developed the concept of horsepower, and the SI unit of power. The Watt (the power in a circuit in which a current of

¹⁵³³ https://en.wikipedia.org/wiki/Alexander_Cumming

¹⁵³⁴ https://en.wikipedia.org/wiki/James_Watt

¹⁵³⁵ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

one ampere flows across a potential difference of one volt) was named after him.¹⁵³⁶



JAMES WATT Portrait by Carl Frederik von Breda, date and location unknown.¹⁵³⁷

¹⁵³⁶ https://en.wikipedia.org/wiki/James_Watt

¹⁵³⁷ https://en.wikipedia.org/wiki/James_Watt

11,738 HE – 11,822 HE: WILLIAM HERSCHEL, British astronomer was the First President of the Royal Astronomical Society and discovered the planet Uranus and two of its moons: Tatiana & Oberon.

HERSCHEL discovered 2 moons of Saturn: Enceladus & Mimas; He calculated the rotation speed of Mars; He pioneered the use of spectrophotometry, using prisms & temperature measuring; He discovered infrared radiation.¹⁵³⁸

⇒ HERSCHEL was the first person to understand that a telescope is a time machine.¹⁵³⁹

¹⁵³⁸ https://en.wikipedia.org/wiki/William_Herschel

¹⁵³⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 4

William Herschel



11,785 HE WILLIAM HERSCHEL portrait by Lemuel Francis Abbott, location unknown.¹⁵⁴⁰

11,742 HE – 11,786 HE: CARL WILHELM SCHEELE was a Swedish Pomeranian and German pharmaceutical chemist.¹⁵⁴¹ ISAAC

ASIMOV called him "hard-luck Scheele" because CARL WILHELM SCHEELE made a number of chemical discoveries before others who are generally given the credit.¹⁵⁴²

⇒ For example, SCHEELE discovered the “Star Stuff” Element Oxygen (although JOSEPH PRIESTLEY, British, after whom the only riots known to be attributed to a scientist, *The Priestley Riots*, published his findings first¹⁵⁴³), SCHEELE identified the “Star Stuff” Element Molybdenum, the “Star Stuff” Element Tungsten, the “Star Stuff” Element Barium, the “Star Stuff” Element Hydrogen, and the “Star Stuff” Element Chlorine before HUMPHRY DAVY, among others. But did not received credit for

¹⁵⁴⁰ https://en.wikipedia.org/wiki/William_Herschel

¹⁵⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁵⁴² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁵⁴³ Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

his discoveries. SCHEELE discovered organic acids Tartaric Acid, Oxalic Acid, Uric Acid, Lactic Acid, and Citric Acid, as well as Hydrofluoric Acid, Hydrocyanic Acid, and Arsenic Acid.¹⁵⁴⁴ CARL WILHELM SCHEELE preferred speaking German to Swedish his whole life, as German was commonly spoken among Swedish pharmacists.¹⁵⁴⁵

¹⁵⁴⁴ Richard Myers, *The Basics of Chemistry* (12,003 HE)

¹⁵⁴⁵ Fors, Hjalmar 12,008 HE. Stepping through Science's Door: C. W. Scheele, from Pharmacist's Apprentice to Man of Science. *Ambix* 55: 29-49



CARL WILHELM SCHEELE, date, location, and artist unknown¹⁵⁴⁶

¹⁵⁴⁶ https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele

⇒ See the long list of books written by CARL WILHELM SCHEELE:¹⁵⁴⁷ (See: Circa **11,000 HE**: circa 786 years earlier when MUHAMMAD IBN ZAKARIYA AL-RAZI was the first to produce and write notes about acids such as sulfuric acid.¹⁵⁴⁸

¹⁵⁴⁷ https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele

¹⁵⁴⁸ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi



CARL WILHELM SCHEELE *Mémoires de chymie*, 11,785 HE, French translation by Mme. Claudine Picardet.¹⁵⁴⁹

- **11,777 HE:** Author / Compiler includes “Star Stuff” Element Arsenic (the deadly element known to humans since ancient

¹⁵⁴⁹ https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele

times) at this date because CARL WILHELM SCHEELE wrote *Arsenic and its Acid; Silica, Alumina, and Alum; Urinary Calculi;*



Metallic “Star Stuff” Element Arsenic: under argon, 1 - 2 grams. Original size of each piece in cm: 0.5 x 1. Element Atomic Number 33, Arsenic, As. The handling of arsenic is always very dangerous and needs special safety precautions. A deadly dose is about one tenth of a gram for a human.¹⁵⁵⁰

⇒ There is evidence that chickens benefit from ingesting low doses of Arsenic. Arsenic, which is known since ancient times, sometimes

¹⁵⁵⁰ <http://images-of-elements.com/arsenic.php#a>

natively occurs in nature as a grey metal. In its compounds it is one of the most toxic elements. Arsenic trioxide, As_2O_3 , was for many centuries the most popular poison for assassination. But arsenic also was and is still used as a pharmaceutical and was the main ingredient in the first chemotherapy. Today, it is mainly used in lead alloys and for special semiconductors.¹⁵⁵¹

⇒ Parsons and Dixon wrote that there was a 5,000-year-old ice mummy- named “Otzi” discovered in **11,991 HE** in the Tirolean Alps who had traces of Arsenic in his body – indicating he was possibly a copper smelter by trade. They further mention that Napoleon may have died because his wallpaper used “Paris Green Dye” – which included Arsenic in the green color.¹⁵⁵²

¹⁵⁵¹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁵⁵² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

11,743 HE -11,820 HE: SIR JOSEPH BANKS¹⁵⁵³ first Baronet, GCB, PRS; English naturalist, botanist, and patron of the natural sciences¹⁵⁵⁴ made his name on the **11,766 HE** natural history expedition to Newfoundland and Labrador. **BANKS** took part in Captain James Cook's first great voyage (**11,768 HE–11,771 HE**), visiting Brazil, Tahiti, and, after 6 months in New Zealand, Australia, returning to immediate fame. He held the position of President of the Royal Society for over 41 years. He advised King George III on the Royal Botanic Gardens, Kew, and by sending botanists around the world to collect plants, made Kew the world's leading botanical gardens.¹⁵⁵⁵ **SIR JOSEPH BANKS** advocated British settlement in New South Wales and colonization of Australia, as well as the establishment of Botany Bay as a place for the reception of convicts and advised the British government on all Australian matters.

¹⁵⁵³ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁵⁵⁴ https://en.wikipedia.org/wiki/Joseph_Banks

¹⁵⁵⁵ https://en.wikipedia.org/wiki/Joseph_Banks

BANKS is credited with introducing the eucalyptus, acacia, and the genus named after him, Banksia, to the Western world.

Approximately 80 species of plants bear his name. BANKS was the leading founder of the African Association and a member of the Society of Dilettanti which helped to establish the Royal Academy.¹⁵⁵⁶ SIR JOSEPH BANKS was a major supporter of the internationalist nature of science, being actively involved both in keeping open the lines of communication with continental scientists during the Napoleonic Wars, and in introducing the British people to the wonders of the wider world.¹⁵⁵⁷

¹⁵⁵⁶ https://en.wikipedia.org/wiki/Joseph_Banks

¹⁵⁵⁷ https://en.wikipedia.org/wiki/Joseph_Banks



SIR JOSEPH BANKS, as painted by Sir Joshua Reynolds in **11,773**
HE.¹⁵⁵⁸

⇒ Many places named after SIR JOSEPH BANKS: in the South Pacific: Banks Peninsula on the South Island, New Zealand; the Banks Islands in modern-day Vanuatu; the Banks Strait between Tasmania and the Furneaux Islands; Banks Island in the Northwest Territories, Canada; the Sir Joseph Banks Group in South Australia; The Canberra suburb of Banks, the electoral Division of Banks, and the Sydney suburbs of Bankstown, Banksia and Banksmeadow are all named after him. Situated in the Sydney suburb of Revesby, Sir Joseph Banks High School is an NSW Government school named after Banks. In Lincoln, England: The Sir Joseph Banks Conservatory is located at The Lawn, Lincoln adjacent to Lincoln Castle. Its tropical hot house has numerous plants related to Banks's voyages, with samples from across the world, including Australia. The Sir Joseph Banks Centre is located in Horncastle, Lincolnshire,

housed in a Grade II listed building which was recently restored by the Heritage Trust of Lincolnshire to celebrate Banks' life.¹⁵⁵⁹

11,743 HE – 11,817 HE: MARTIN HEINRICH KLAPROTH, German Chemist. Discovered the “Star Stuff” Elements: Uranium (**11,789 HE**), Zirconium (**11,789 HE**),¹⁵⁶⁰ and Titanium (**11,795 HE**).¹⁵⁶¹

⇒ See list of MARTIN HEINRICH KLAPROTH's papers, over 200 in number.¹⁵⁶²

¹⁵⁵⁹ https://en.wikipedia.org/wiki/Joseph_Banks

¹⁵⁶⁰ https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth

¹⁵⁶¹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁵⁶² https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth



MARTIN HEINRICH KLAPROTH, date, location and artist
unknown¹⁵⁶³

¹⁵⁶³ https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth



Photo is of depleted “Star Stuff” Element Uranium, Atomic Number 92 U; Uranium is a chemically very reactive, highly toxic, grey heavy metal. Like all actinoids it is radioactive, after thorium it is the second most stable of those. The most abundant natural isotope is ^{238}U with a half-life of 4.5 billion years. The basis for nuclear power plants is the fissile isotope ^{235}U . The fission products often are highly radioactive isotopes of lower elements, like cesium 137 and strontium 90. Uranium 235 is used for atomic bombs, too, like the one in Hiroshima. It has a natural abundance of only 0.7 % and has to be enriched in an extensive process. For power plants, at least 3 % are needed, for weapons much more. The waste material of this process, depleted uranium, sometimes is used in ammunition, sometimes is turned into plutonium in a breeder

reactor, most of it is waste. A secure repository concept for nuclear waste doesn't exist. Natural uranium decays to thorium.¹⁵⁶⁴

⇒ **11,789 HE:** “Star Stuff” Element Zirconium was discovered and named by KLAPROTH.¹⁵⁶⁵



- Photo is of ultrapure zirconium, together 2.5 grams. Original size in cm: 1 each Element Atomic Number 40, Zirconium, Zr, “Star Stuff” Element Zirconium is a hard, silvery grey metal. It is quite reactive, but forms a protective oxide layer in air, which

¹⁵⁶⁴ <http://images-of-elements.com/uranium.php#a>

¹⁵⁶⁵ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

makes it corrosion-resistant. Above all, it is used for special alloys. From cubic zirconia, ZrO_2 , artificial gemstones can be made, which look very similar to diamonds.¹⁵⁶⁶

⇒ **11,795 HE:** “Star Stuff Element: Titanium was discovered and named by KLAPROTH.”¹⁵⁶⁷



• The photo is Titanium crystal made with the van Arkel-de Boer process. 87 grams, original size in cm: 2.5 x 4. Element Atomic

¹⁵⁶⁶ <http://images-of-elements.com/zirconium.php#a>

¹⁵⁶⁷ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

Number 22, “Star Stuff” Element Titanium. Ti, is a grey, light, but very strong metal. It is quite frequent, but hard to extract, which makes the pure metal fairly expensive. It is used a lot for technical components and steels.¹⁵⁶⁸ Much better available than the element Titanium metal itself is titanium dioxide, TiO₂, the most widely used white pigment, which you can see on nearly every white painted wall. Titanium dioxide is one of the most enduring molecules and one of only a few that can be found in some stars.¹⁵⁶⁹

11,744 HE – 11,829 HE: JEAN-BAPTIST PIERRE ANTIONE DE MONET, CHEVALIER DE LAMARCK, often known as LAMARCK; a French naturalist. soldier, biologist, academic, and an early proponent of the idea that biological evolution occurred and

¹⁵⁶⁸ <http://images-of-elements.com/titanium.php#a>

¹⁵⁶⁹ <http://images-of-elements.com/titanium.php#a>

proceeded in accordance with natural laws.¹⁵⁷⁰ ¹⁵⁷¹ LAMARCK began as an essentialist who believed species were unchanging; however, after working on the mollusks of the Paris Basin, he grew convinced that transmutation or change in the nature of a species occurred over time.¹⁵⁷²

⇒ Of LAMARCK's published works, CHARLES DARWIN says that LAMARCK was the first man whose conclusion “on the transformation of species excited this much attention and upholds the doctrine that all species, including man, are descended from other species.”¹⁵⁷³ LAMARCK published *Système des animaux*

¹⁵⁷⁰ <https://www.perotmuseum.org>

¹⁵⁷¹ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹⁵⁷² https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹⁵⁷³ CHARLES DARWIN The Origin of Species

sans vertèbres, a major work on the classification of “invertebrates,” a term LAMARCK coined.¹⁵⁷⁴



LAMARCK by Charles Thévenin (**circa 11,802 HE**)¹⁵⁷⁵

¹⁵⁷⁴ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹⁵⁷⁵ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

⇒ See more on LAMARCK's publications.¹⁵⁷⁶

11,746 HE: ANDREAS SIGISMUND MARGGRAF, German Chemist, is credited with discovering the pure metallic “Star Stuff” Element Zinc.¹⁵⁷⁷



⇒

Photo is 30 grams Zinc. Original size in cm: 3. “Star Stuff” Element Atomic Number 30, Zinc, Zn, Zinc is a bluish silvery, brittle and hard metal, with which one often comes across. It is rather ignoble, but in air quickly forms an enduring protective

¹⁵⁷⁶ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹⁵⁷⁷ <https://en.wikipedia.org/wiki/Zinc>

layer. Therefore, it is used a lot as corrosion prevention. Many objects made of iron, which shall be weatherproof, are zinc-plated. This is also, because zinc is a quite cheap material. Brass, one of the most common alloys, is made of copper and zinc. Furthermore, zinc is an essential trace element, which above all is needed for the metabolism and which occurs in many foods.¹⁵⁷⁸

⇒ In the **11,860s HE** rolled Zinc sheeting became mandatory for roofing in Paris and this created the city's silvery patina.¹⁵⁷⁹

11,746 HE – 11,830 HE: JOHANN HELFRICH VON MÜLLER: an engineer in the Hessian army who conceived the difference engine in **11,786 HE** an idea that later evolved into modern computers. In **11,784 HE**, MÜLLER was responsible for an improved adding

¹⁵⁷⁸ <http://images-of-elements.com/zinc.php#a>

¹⁵⁷⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

machine based on principles of see **11,693 HE**: GOTTFRIED WILHELM LEIBNIZ'S stepped reckoner.¹⁵⁸⁰



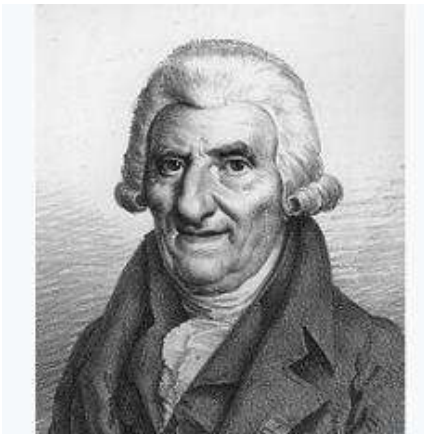
Adding machine by JOHANN HELFRICH VON MÜLLER, **11,784 HE**, in the Hessisches Landesmuseum Darmstadt.¹⁵⁸¹

¹⁵⁸⁰ https://en.wikipedia.org/wiki/Johann_Helfrich_von_Muller

¹⁵⁸¹ https://en.wikipedia.org/wiki/Johann_Helfrich_von_Müller

11,748 HE – 11,845 HE: JEAN-DOMINIQUE, COMTE DE CASSINI, (Cassini IV); French; JEAN-DOMINIQUE, COMTE DE CASSINI succeeded Cassini III as Director at Paris Observatory, but it had gone into decay. He was imprisoned in **11,794 HE** and released seven months later. He published an account of testing Pierre Le Roy's watches at sea called *the Voyage to America*. He proposed a trigonometric survey connecting the observatories of Paris and Greenwich for the purpose of determining latitude and longitude. For this purpose, he met with ADRIEN-MARIE LEGENDRE (French Mathematician) and WILLIAM HERSCHEL at Slough circa **11,791 HE**.¹⁵⁸²

¹⁵⁸² https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini



JEAN-DOMINIQUE, COMTE DE CASSINI, 11,820HE.
Lithograph by Julien-Léopold Boilly.¹⁵⁸³

¹⁵⁸³ https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini

11,749 HE – 11,819 HE: DANIEL RUTHERFORD, Scottish physician In first discovered and isolated the “Star Stuff” Element Nitrogen. Although CARL WILHELM SCHEELE and HENRY CAVENDISH had independently done so at about the same time, RUTHERFORD is generally accorded the credit because his work was published first.¹⁵⁸⁴



The photo is a Vial of glowing ultrapure nitrogen: Element Atomic Number 7, “Star Stuff” Nitrogen, N, is an enormously important element with a versatile chemistry. It is part of every protein. Our air consists to 78% of N₂. The chemical bond between the two

¹⁵⁸⁴ <https://en.wikipedia.org/wiki/Nitrogen>

atoms in the nitrogen molecule is the strongest bond between two atoms of the same element. This makes N₂ a very stable and inert gas.¹⁵⁸⁵ Ammonia, NH₃, which itself is toxic, is the most important base material for the nitrogen chemistry and is one of the most produced chemicals in the world. From this, for example artificial fertilizers (used for “Conventional farming”) and explosives are made.¹⁵⁸⁶ (See **11,868 HE – 11,934 HE: FRITZ HABER.**)

¹⁵⁸⁵ <http://images-of-elements.com/nitrogen.php#a>

¹⁵⁸⁶ <http://images-of-elements.com/nitrogen.php#a>



DANIEL RUTHERFORD, date, lithographer and location unknown.¹⁵⁸⁷

¹⁵⁸⁷ <https://en.wikipedia.org/wiki/Nitrogen>

Circa 11,750s HE: The introduction of steam engines for powering blast air to blast furnaces led to a large increase in British iron production.¹⁵⁸⁸

11,750 HE – 11,848 HE: CAROLINE LECRETIA HERSCHEL, German Astronomer working in England with her brother WILLIAM HERSCHEL.¹⁵⁸⁹ From **11,786 HE–11,797 HE** CAROLINE LECRETIA HERSCHEL discovered eight comets.¹⁵⁹⁰

⇒ In **11,787 HE**, CAROLINE LECRETIA HERSCHEL was granted an annual salary of £50 (equivalent to £5,700 in **12,017 HE**) by George III for her work as WILLIAM HERSCHEL's assistant. Her appointment made her the first woman in England with an official

¹⁵⁸⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁵⁸⁹ Podcast: Stuff You Missed in History Class

¹⁵⁹⁰ Podcast: Stuff You Missed in History Class

government position, and the first woman to be paid for her work in astronomy.^{1591 1592}

⇒ In **11,802 HE**, the Royal Society published CAROLINE LECRETIA HERSCHEL's catalogue in its Philosophical Transactions of the Royal Society A, under William's name. This listed around 500 new nebulae and clusters to the already known 2000. Toward the end of her life, she arranged two-and-a-half thousand nebulae and star clusters into zones of similar polar distances so that her nephew, JOHN HERSCHEL, could re-examine them systematically. The list was eventually enlarged and renamed the *New General Catalogue*. Many non-stellar objects are still identified by their NGC number.¹⁵⁹³

¹⁵⁹¹https://en.wikipedia.org/wiki/Caroline_Herschel

¹⁵⁹² Podcast: Stuff You Missed in History Class

¹⁵⁹³ https://en.wikipedia.org/wiki/Caroline_Herschel

⇒ CAROLINE LECRETIA HERSCHEL Honors: The gold medal from the Astronomical Society was awarded to her in **11,828 HE**. The Royal Astronomical Society elected her an Honorary Member in **11,835 HE**, along with MARY SOMERVILLE (see above); they were the first women members. She was also elected as an honorary member of the Royal Irish Academy in Dublin in **11,838 HE**. In **11,846 HE**, at the age of 96, she was awarded a Gold Medal for Science by the King of Prussia, conveyed to her by ALEXANDER VON HUMBOLDT "in recognition of the valuable services rendered to Astronomy by you, as the fellow-worker of your immortal brother, SIR WILLIAM HERSCHEL, by discoveries, observations, and laborious calculations".¹⁵⁹⁴

⇒ Asteroid 281 Lecretia is named in her honor.¹⁵⁹⁵

¹⁵⁹⁴ https://en.wikipedia.org/wiki/Caroline_Herschel

¹⁵⁹⁵ https://en.wikipedia.org/wiki/Caroline_Herschel



11,847 HE Lithograph of CAROLINE LECRETIA HERSCHEL,
artist and location unknown.¹⁵⁹⁶

¹⁵⁹⁶ https://en.wikipedia.org/wiki/Caroline_Herschel



A telescope that WILLIAM HERSCHEL made for CAROLINE HERSCHEL, **11,795 HE**, location unknown.¹⁵⁹⁷

¹⁵⁹⁷ https://en.wikipedia.org/wiki/Caroline_Herschel



The Herschel Museum of Astronomy at 19 New King Street, Bath, England, <https://herschelmuseum.org.uk/>, is a museum that was inaugurated in **11,981 HE**. It is located in a preserved town house that was formerly the home of **WILLIAM HERSCHEL** and **CAROLINE HERSCHEL**.¹⁵⁹⁸

¹⁵⁹⁸ https://en.wikipedia.org/wiki/Herschel_Museum_of_Astronomy

11,751 HE: AXEL FREDRIK, Swedish Chemist discovered/defined “Star Stuff” Element Nickel. It took 4 years for his discovery to be recognized.¹⁵⁹⁹



Photo is of pure Nickel button, obtained by electrolysis, about 20 grams. Original size in cm: 2 x 2. “Star Stuff” Element Atomic Number 28, Nickel, Ni. Nickel is a quite inert metal, which often is used for plating, but frequently causes allergic reactions on the skins of many people. Its main use is in alloys, especially in steel.

¹⁵⁹⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

Nickel is ferromagnetic and, together with iron, forms the inner core of the Earth, which is a big magnet. The rather rare Ni⁶² is the most stable isotope, the one with the highest binding energy.¹⁶⁰⁰ Nickel is one of the world's most recycled metals. Nickel is essential for some species and human daily intake of 150 micrograms, which you can get from one cup of tea, is considered to be more than sufficient.¹⁶⁰¹

11,752 HE – 11,828 HE: FRANÇOIS ISAAC DE RIVAZ, ¹⁶⁰² Paris, was an inventor and a politician who invented a hydrogen-powered internal combustion engine with electric ignition and described it in a French patent published in **11,807 HE**. In **11,808 HE**, he fitted it into

¹⁶⁰⁰ <http://images-of-elements.com/nickel.php#a>

¹⁶⁰¹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁶⁰² https://en.wikipedia.org/wiki/History_of_the_automobile

a primitive working vehicle – "the world's first internal combustion powered automobile".¹⁶⁰³

- ⇒ Few of his contemporaries took his work seriously.
- ⇒ The French Academy of Sciences argued that the internal combustion engine would never rival the performance of the steam engine.¹⁶⁰⁴

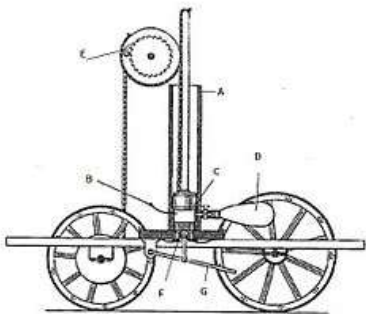
¹⁶⁰³ https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz

¹⁶⁰⁴ https://en.wikipedia.org/wiki/De_Rivaz_engine



ISAAC DE RIVAZ, date, location, and artist unknown.¹⁶⁰⁵

¹⁶⁰⁵ https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz



The **11,807 HE** Charette of de Rivaz. A = Cylinder, B = Spark ignition, C = Piston, D = Balloon containing hydrogen fuel, E = Ratchet, F = Opposed piston with air in and exhaust out valves, G = Handle for working opposed piston.¹⁶⁰⁶

¹⁶⁰⁶ https://en.wikipedia.org/wiki/De_Rivaz_engine

Circa 11,760 HE: England: The Coalbrookdale Company began to fix plates of cast iron to the upper surface of wooden wagon rails, which increased their durability and load-bearing ability.¹⁶⁰⁷

11,763 HE – 11,829 HE: LOUIS NICOLAS VAUQUELIN: French pharmacist and chemist¹⁶⁰⁸ who discovered the “star stuff” element Beryllium by extracting it from an emerald (a beryl variety)¹⁶⁰⁹ and discovered the “Star Stuff” element Chromium in a red lead ore from Siberia.¹⁶¹⁰ Working with asparagus, LOUIS NICOLAS VAUQUELIN and PIERRE JEAN ROBIQUET (future discoverer of the famous red dye alizarin, then a young chemist and his assistant) isolated the amino acid asparagine, the first one to be discovered.¹⁶¹¹ VAUQUELIN also discovered pectin and malic acid in apples, and

¹⁶⁰⁷ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁶⁰⁸ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁶⁰⁹ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

¹⁶¹⁰ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

¹⁶¹¹ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

isolated camphoric acid and quinic acid. He also managed to get liquid ammonia at atmospheric pressure. He included the study of hens fed a known amount of mineral. "Having calculated all the lime in oats fed to a hen, found still more in the shells of its eggs. Therefore, there is a creation of matter. In that way, no one knows."¹⁶¹²

¹⁶¹² https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin



LOUIS NICOLAS VAUQUELIN, artist, date and location unknown.¹⁶¹³

¹⁶¹³ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin



This is a photo of a piece of pure chromium, about 20 grams. Original size in cm: 2 x 2 “Star Stuff” Element Atomic Number 24: Chromium, Cr; Chromium is a very hard and shiny silvery metal and has many colorful compounds. A lot of these are quite toxic. Chromium e.g. as CrO_3 is a very dangerous environmental toxin. Elemental chromium is widely used for plating for optical reasons and corrosion protection. Chromium is added to steel, to make it stainless.¹⁶¹⁴

¹⁶¹⁴ <http://images-of-elements.com/chromium.php#a>



Photo is a bead of the “Star Stuff” Element Atomic Number 4, Beryllium, Be. Beryllium is a relatively inert, hard, medium grey metal, which is very light. It is nearly transparent to X-rays. Beryllium is not often used, as it is quite expensive and very toxic, in its elemental form as in many of its compounds. However, it is an important ingredient in many valuable gemstones, like beryl, aquamarine and emerald. Clear beryl was used for optical lenses in former times.¹⁶¹⁵

¹⁶¹⁵ <http://images-of-elements.com/beryllium.php#a>

11,764 HE: The first railway in America was built in Lewiston, New York.¹⁶¹⁶

11,765 HE – 11,850 HE: ROBERT FULTON, United States Engineer¹⁶¹⁷ who designed the *Nautilus* while living in the French First Republic. The *Nautilus* is often considered to be the first practical submarine.¹⁶¹⁸ FULTON and ROBERT R. LIVINGSTON¹⁶¹⁹ built the first commercially successful steamboat, North River Steamboat later known as the Clermont.¹⁶²⁰

¹⁶¹⁶ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁶¹⁷ https://en.wikipedia.org/wiki/Robert_Fulton

¹⁶¹⁸ [https://en.wikipedia.org/wiki/Nautilus_\(1800_submarine\)](https://en.wikipedia.org/wiki/Nautilus_(1800_submarine))

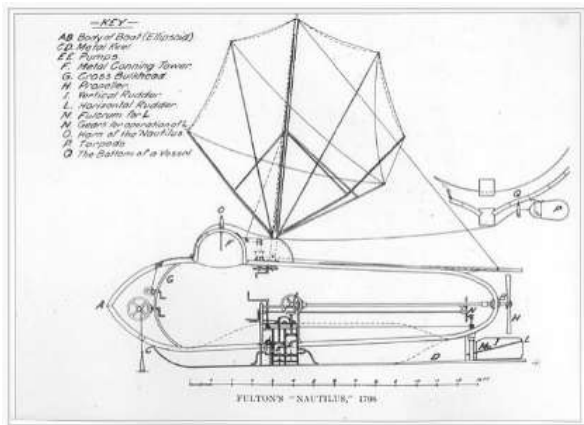
¹⁶¹⁹ [https://en.wikipedia.org/wiki/Robert_R._Livingston_\(chancellor\)](https://en.wikipedia.org/wiki/Robert_R._Livingston_(chancellor))

¹⁶²⁰ https://en.wikipedia.org/wiki/Robert_Fulton



11,803 HE: ROBERT FULTON, bust by Jean-Antoine Houdon,
location unknown.¹⁶²¹

¹⁶²¹ https://en.wikipedia.org/wiki/Robert_Fulton



● **11,798 HE:** FULTON's design for the submarine Nautilus, location unknown.¹⁶²²

¹⁶²² https://en.wikipedia.org/wiki/Robert_Fulton



● Full-sized section model for the submarine *Nautilus* at Cité de la Mer, Cherbourg, France.¹⁶²³

¹⁶²³ <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



FIG. 44.—The "Clermont," 1807.



11,807 HE: Drawing is of ROBERT FULTON's and ROBERT R. LIVINGSTON's Steamboat called the "Clermont".¹⁶²⁴

⇒ Yes, Jules Verne fans! Jules Verne based the name of his iconic incarnation upon the **11,800 HE**, ROBERT FULTON submarine invention the *Nautilus*.¹⁶²⁵

¹⁶²⁴ <https://www.bing.com/images/search?q=image+robert+fulton+steamship+clermont&id=53777F7C39EAB1D702595BB3893B874A34363B47&FORM=IQFRBA>

¹⁶²⁵ <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



The **11,878 HE** – **11,883 HE** marble statue by Howard Roberts in Statuary Hall of the United States Capitol.¹⁶²⁶

¹⁶²⁶ https://en.wikipedia.org/wiki/Robert_Fulton



11,896 HE: ROBERT FULTON (with SAMUEL F. B. MORSE (see: **11,791 HE**– **11,872 HE:** SAMUEL FINLEY BREESE MORSE) depicted on the reverse of the \$2 Silver Certificate from the United States Treasury.¹⁶²⁷

⇒ Some of the Places in the United States named for ROBERT FULTON, including: Fulton Township, Lancaster County,

¹⁶²⁷ https://en.wikipedia.org/wiki/Robert_Fulton

Pennsylvania; Fulton Elementary School, Fulton Township, Lancaster County, Pennsylvania; Fulton Steamboat Inn, hotel in Lancaster County, Pennsylvania; Robert Fulton School, Philadelphia; Fulton Elementary School, Dubuque, Iowa; Robert Fulton Fire Company, Fulton Township, Lancaster County, Pennsylvania; Robert Fulton Highway, Lancaster County, Pennsylvania; Fulton Opera House, Lancaster, Pennsylvania; Robert Fulton Drive in Columbia, Howard County, Maryland; Robert Fulton Drive in Reston, Virginia; Fulton Avenue in Sacramento, California; Fulton Neighborhood in Minneapolis, Minnesota; Fulton-Randolph Market District; Fulton Street in Brooklyn, New York; BMT Fulton Street Line subway line; IND Fulton Street Line subway line; Fulton Street (IND Crosstown Line); Fulton Street in Manhattan; Fulton Center in Manhattan; Fulton Street (New York City Subway) subway station; Fulton Fish Market New York City; Fulton Street in Massapequa Park, New York; Fulton Street in New Orleans, Louisiana; Fulton Street in

Alcoa, Tennessee; Fulton Street in San Francisco, California; Fulton Street in Anaheim, California; Fulton County, Ohio; Fulton County, Indiana; Fulton County, Kentucky; Fulton County, Illinois; Fulton County, Pennsylvania; Fulton County, New York; Fulton County, Georgia, partially home to the state capital, Atlanta; Fulton, Mississippi; Fulton, Missouri; Fulton, Arkansas; Fulton, Oswego County, New York; Fulton, Schoharie County, New York; Fulton Chain Lakes, New York; Fultonham, Ohio; Fultonville, New York; Fulton Hall, State Quad, University at Albany, (State University of New York at Albany); Fulton Park, New York City.

⇒ The Guatemalan government erected a bust of ROBERT FULTON in one of the parks of Guatemala City.¹⁶²⁸

¹⁶²⁸ https://en.wikipedia.org/wiki/Robert_Fulton



11,909 HE: Hudson-Fulton Celebration commemorative stamp.



11,965 HE: 200th Anniversary ROBERT FULTON commemorative stamp, based on the Houdon bust.¹⁶²⁹

¹⁶²⁹ https://en.wikipedia.org/wiki/Robert_Fulton

11,766 HE -11,828 HE: WILLIAM HYDE WOLLASTON, English chemist and physicist¹⁶³⁰ who did a similar experiment to ISAAC NEWTON, using a prism to break white light into its rainbow of visible colors but WOLLASTON's sunbeam had to pass through a narrow slit before it hit his prism.

- ⇒ The spectrum that emerged from WOLLASTON's prism was built up as a series of narrow strips of different wavelengths. The strips of colored light smeared into each other to make a spectrum but, scattered along the spectrum he saw dark lines in particular places.
- ⇒ The lines were later measured and systematically catalogued by JOSEPH VON FRAUNHOFER (SEE **11,787 HE – 11,826 HE:** FRAUNHOFER) to have specific fingerprints, or bar codes, which

¹⁶³⁰ RICHARD DAWKINS *Unweaving the Rainbow*

is specific to the chemical nature of the substance through which the light passed.¹⁶³¹

⇒ WILLIAM HYDE WOLLASTON is famous for discovering the chemical “star stuff” elements Palladium and Rhodium. He also developed a way to process Platinum ore into ingots.¹⁶³²

¹⁶³¹ RICHARD DAWKINS, *Unweaving the Rainbow*

¹⁶³² https://en.wikipedia.org/wiki/William_Hyde_Wollaston



Painting of WILLIAM HYDE WOLLASTON, artist, date and location unknown.¹⁶³³

¹⁶³³ https://en.wikipedia.org/wiki/William_Hyde_Wollaston



Photo is a crystal of “Star Stuff” Element Atomic Number 46, Palladium, Pd, The noble metal Palladium is very similar to Platinum and like this is often used for catalysts and for jewelry. It is more reactive and cheaper than platinum. Palladium can very well absorb, store and then release hydrogen.¹⁶³⁴



Photo of bead of pure “Star Stuff” Element Atomic Number 45,

¹⁶³⁴ <http://images-of-elements.com/palladium.php#a>

Rhodium, Rh. The platinum group metal rhodium is the rarest and most valuable stable metal on earth. It is needed in many chemical applications as a catalyst, like for example in the industrial production of acetic acid. Therefore, rhodium is very expensive, and its price fluctuates strongly. In catalytic converters, it reduces the amount of toxic material that arises from the combustion. Rhodium is furthermore used for plating high-grade mirrors and jewelry. Rhodium is very hard, ductile and noble.¹⁶³⁵

¹⁶³⁵ <http://images-of-elements.com/rhodium.php#a>

11,769 HE - 11,859 HE: ALEXANDER VON HUMBOLDT, born in Prussian/Germany ¹⁶³⁶ but as his knowledge increased others considered him a citizen of all countries, and he thought of himself as “half an American”.¹⁶³⁷

⇒ Already in **11,807 HE**, HUMBOLDT wrote: “I thought that if my *Naturgemälde* were capable of suggesting unexpected analogies to those who study its details, it would be capable of speaking to the imagination and providing the pleasure that comes from contemplating a beneficial as well as majestic nature.” He believed in the power of learning and wrote many books that were aimed at a general audience.¹⁶³⁸

¹⁶³⁶ Author/Compiler’s son Benjamin Premack actually introduced author to knowledge of
ALEXANDER VON HUMBOLDT

¹⁶³⁷ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt’s New World*

¹⁶³⁸ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt’s New World*

- ⇒ HUMBOLDT said: “With knowledge comes thought,” and “with thought comes power”. One of HUMBOLDT’s greatest achievements was to make science accessible and popular. He did so by using a simple and non–scientific language as well as through infographics. Everybody learned from him: farmers and craftsmen, schoolboys and teachers, artists and musicians, scientists and politicians.¹⁶³⁹
- ⇒ ALEXANDER VON HUMBOLDT was the first person who defined aspects of nature in different lands, different climates with scientific elucidations and applied the knowledge globally.¹⁶⁴⁰
- ⇒ HUMBOLDT resurrected the use of the word *cosmos* from the ancient Greek and assigned it to his **Multi-Volume Treatise:**

¹⁶³⁹ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁶⁴⁰ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

Kosmos, in which he sought to unify diverse branches of scientific knowledge and culture.¹⁶⁴¹

- ⇒ HUMBOLDT was the first person who specifically highlighted the human threat to nature.¹⁶⁴²
- ⇒ HUMBOLDT has strong abolitionist feelings which reflect how he truly believed that race did not influence intellect or ability.^{1643 1644}
- ⇒ HUMBOLDT's quantitative work on botanical geography laid the foundation for the field of biogeography.

¹⁶⁴¹ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

¹⁶⁴² Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁶⁴³ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁶⁴⁴ Eleanor Jones Harvey

- ⇒ HUMBOLDT's advocacy of long-term systematic geophysical measurement laid the foundation for modern geomagnetic and meteorological monitoring.¹⁶⁴⁵

- ⇒ Author / Compiler NOTE: The Biography of ALEXANDER VON HUMBOLDT by Andrea Wulf called: *The Invention of Nature: Alexander von Humboldt's New World* is a fantastic read or listen.

- ⇒ ALEXANDER VON HUMBOLDT wrote & published more than 30 other scientific works¹⁶⁴⁶ including: *Personal Narrative, Views of Nature, or, Contemplations on the sublime phenomena of*

¹⁶⁴⁵ Love, J.J. (12,008 HE). "Magnetic monitoring of Earth and space" (PDF). Physics Today. February: 31–37. doi:10.1063/1.2883907. Retrieved 29 June 12,015 HE; Jump Up; Thomson, A., "Von Humboldt and the establishment of geomagnetic observatories", IAEA-INI

¹⁶⁴⁶ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

creation: with scientific illustrations ¹⁶⁴⁷ Essay on the Geography
of Plants. ¹⁶⁴⁸ ¹⁶⁴⁹



1650

HUMBOLDT'S Multi-Volume Treatise: Kosmos also motivated a holistic perception of the universe as one interacting entity. ¹⁶⁵¹

¹⁶⁴⁷ Smile.amazon.com list of books

¹⁶⁴⁸ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁶⁴⁹ Andrea Wulf, lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁵⁰ Andrea Wulf, lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁵¹ Walls, L.D. "Introducing Humboldt's Cosmos". *Minding Nature*. August 2009: 3–15.

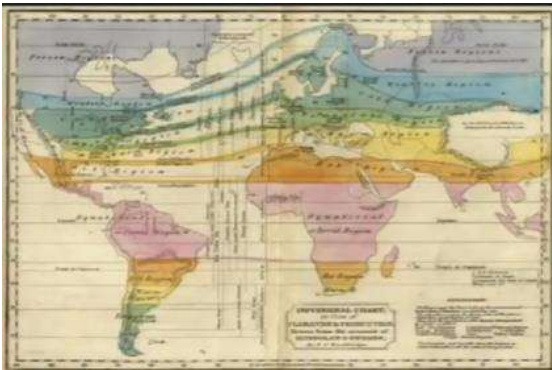


ALEXANDER VON HUMBOLT's three-foot by two-foot ***Naturgemälde*** depicted Chimborazo, a volcano in Ecuador that he climbed, in cross-section and on it, HUMBOLDT showed plants distributed according to their altitudes.¹⁶⁵² To the left and right of the mountain he placed several columns that provided related

¹⁶⁵² Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

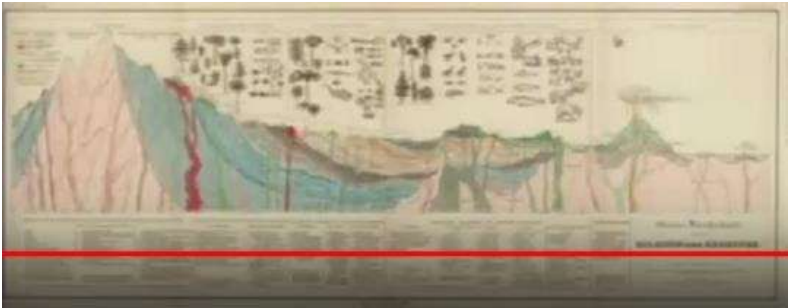
details and information, ranging from temperature, gravity, and humidity to the blueness of the sky – again all related to the height of the mountain. The variety but also the simplicity of the scientific information was unprecedented. HUMBOLDT showed the relationship between the elevation and the distribution of plants – and throughout his life, he used this kind of ‘infographics’.¹⁶⁵³

¹⁶⁵³ Andrea Wulf, lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



Still in use today - ALEXANDER VON HUMBOLDT's map of Isotherms and Endotherms in the world-wide geographical regions.¹⁶⁵⁴

¹⁶⁵⁴ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



⇒ ALEXANDER VON HUMBOLT's map. Before anyone knew of tectonic plates, he shows how volcanos and earthquakes are somehow related.¹⁶⁵⁵

¹⁶⁵⁵ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



11,799 HE – 11,804 HE - ALEXANDER VON HUMBOLDT's 5-year journey across the Americas.¹⁶⁵⁶

¹⁶⁵⁶ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- ⇒ On 14 September **11,869 HE**: One hundred years after his birth, ALEXANDER VON HUMBOLDT'S centennial was celebrated across the world: "There is not a text–book of geography or a school atlas in the hands of our children today, which does not bear... the imprint of his great mind", said the scientist LOUIS AGASSIZ in **11,869 HE** in Boston¹⁶⁵⁷
- ⇒ During the centennial celebrations of Humboldt's birth: There were parties in Europe, Africa and Australia as well as the Americas. In Melbourne and Adelaide people came together to listen to speeches in honor of Humboldt, as did groups in Buenos Aires and Mexico City.

¹⁶⁵⁷ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- There were festivities in Moscow where Humboldt was called the “Shakespeare of sciences”, and In Alexandria in Egypt where guests partied under a sky illuminated with fireworks.
- The greatest commemorations were in the United States, where from San Francisco to Philadelphia, and from Chicago to Charleston, the nation saw street parades, sumptuous dinners, and concerts. In Cleveland some 8,000 people took to the streets and in Syracuse another 15,000 joined a march that was more than a mile long. President Ulysses Grant (The same president who unfortunately signed the Comstock Acts: see **11,776 HE - 11,870s HE**: In the United States) attended the Humboldt celebrations in Pittsburgh together with 10,000 revelers who brought the city to a standstill.
- In New York City the cobbled streets were lined with flags. City Hall was veiled in banners, and entire houses had vanished

behind huge posters bearing Humboldt's face. Even the ships sailing by, out on the Hudson River, were garlanded in colorful bunting. In the morning thousands of people followed ten music bands, marching from the Bowery and along Broadway to Central Park to honor a man 'whose fame no nation can claim' as the New York Times's front page reported. By early afternoon, 25,000 onlookers had assembled in Central Park to listen to the speeches as a large bronze bust of Humboldt was unveiled. In the evening as darkness settled, a torchlight procession of 15,000 people set out along the streets, walking beneath colorful Chinese lanterns.¹⁶⁵⁸

⇒ Places named after ALEXANDER VON HUMBOLDT:¹⁶⁵⁹

¹⁶⁵⁸ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁶⁵⁹ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

- Hacienda Humboldt, Chihuahua, Mexico, Humboldt, South Dakota, United States, Humboldt, Nebraska, United States, Humboldt, Illinois, United States, Humboldt, Iowa, United States, Humboldt, Tennessee, United States, Humboldt, Kansas, United States, Humboldt, Minnesota, United States, Humboldt, Arizona, United States, Humboldt County, California, United States, Fort Humboldt State Historic Park, Eureka, California, United States, Humboldt County, Nevada, United States, Humboldt County, Iowa,
- United States, Humboldt, Saskatchewan, Canada, Humboldt Park, Chicago, Illinois, United States, Alejandro de Humboldt National Park, Cuba, Alexander von Humboldt National Forest, Peru, Humboldt-Toiyabe National Forest, Nevada & California, United States, Humboldt Bay — Bay in Northern California, United States, Humboldt Current - off the west coast of South America, Humboldt Glacier - in North West Greenland,

Humboldt River - River in Nevada, United States, Humboldt Peak (Colorado) - 4,287 m mountain in Custer County, Colorado, United States, Pico Humboldt - 4,940 m mountain in Mérida, Venezuela, Humboldt Sink - Dry lake bed in Nevada, United States, East and West Humboldt Range in Nevada, United States, Sima Humboldt - sinkhole in Venezuela, "Monumento Nacional Alejandro de Humboldt" at Caripe, Venezuela, Mount Humboldt - 1,617 m (5,308 ft), New Caledonia, Humboldt Mountains, Antarctic mountains discovered and mapped by the Third German Antarctic Expedition (**11,938 HE–11,939 HE**), Humboldt Range - Mountain Range in Fiordland National Park, New Zealand, Humboldt Falls - 275 m Water fall in Lower Hollyford Valley, Fiordland National Park, New Zealand, Humboldt Redwoods State Park - in northern California, United States.¹⁶⁶⁰

¹⁶⁶⁰ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

⇒ People who were personally influenced by HUMBOLDT:



- United States President THOMAS JEFFERSON¹⁶⁶¹
- In a **11,883 HE** letter from President Jefferson to ALEXANDER VON HUMBOLDT, JEFFERSON said: “MY DEAR FRIEND AND BARON, ...History, I believe, furnishes no example of a

¹⁶⁶¹ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>

priest-ridden people maintaining a free civil government. This marks the lowest grade of ignorance, of which their civil as well as religious leaders will always avail themselves for their own purposes."¹⁶⁶²

- For more on the amazing interactions between President THOMAS JEFFERSON and ALEXANDER VON HUMBOLDT, and all the people listed below: see the YouTube lecture or read Wulf's book.^{1663 1664}

¹⁶⁶² <http://www.let.rug.nl/usa/presidents/thomas-jefferson/letters-of-thomas-jefferson/jefl224.php>

¹⁶⁶³ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁶⁶⁴ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>



● JAMES SMITHSON¹⁶⁶⁵; English chemist and mineralogist, who had no family, met ALEXANDER VON HUMBOLDT at a cocktail party in Paris. Eleanor Jones Harvey is lead to believe that the idea for the Museums of the Smithsonian Institute in Washington, DC can be circled back to ALEXANDER VON HUMBOLDT¹⁶⁶⁶ because Smithson's Will stipulated that: "his estate be used "to found in Washington, under the name of the

¹⁶⁶⁵ James Smithson by Henri-Joseph Johns, 11,816 HE

¹⁶⁶⁶ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

Smithsonian Institution, an establishment for the increase and diffusion of knowledge among men." JAMES SMITHSON became the patron of the Smithsonian Institution in Washington, D.C. despite having never visited the United States.¹⁶⁶⁷



• United States President James Madison¹⁶⁶⁸

¹⁶⁶⁷ https://en.wikipedia.org/wiki/James_Smithson

¹⁶⁶⁸ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



Goethe¹⁶⁶⁹



Simon Bolivar¹⁶⁷⁰

¹⁶⁶⁹ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁷⁰ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>



- CHARLES DARWIN¹⁶⁷¹



- Henry David Thoreau¹⁶⁷²

¹⁶⁷¹ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁷² Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>



- Ernst Haeckel¹⁶⁷³



- JOHN MUIR; and among all his important work with nature at some point declared “oh how I long to be a HUMBOLDT”.¹⁶⁷⁴

¹⁶⁷³ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁷⁴ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>



● GEORGE PERKINS MARSH¹⁶⁷⁵



● Charles Willson Peale based his whole museum on
ALEXANDER VON HUMBOLDT's "Web of Life".¹⁶⁷⁶

¹⁶⁷⁵ Andrea Wulf as part of the Lecture at Washington College:

<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁷⁶ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



John Fremont (A)



John Fremont (B);

- (A): Fremont took ALEXANDER VON HUMBOLDT's ideas of the "Web of Life" west in the United States, and named, among other places: the Humboldt River, the Humboldt Mountains, and the Humboldt Desert, and (B) John Fremont adopted the Humboldtian Mantle when he ran for president and lost to James Buchanan.¹⁶⁷⁷

¹⁶⁷⁷ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

- STEPHEN LONG, who mapped the middle of the United States continent with Titian Ramsey Peale as the artist¹⁶⁷⁸



- Albert Galatian wrote the ethnography of the Indians of the United States due to ALEXANDER VON HUMBOLT'S urging.¹⁶⁷⁹

¹⁶⁷⁸ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁷⁹ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



ALEXANDER VON HUMBOLT funded JOHANN CARL BODMER's trip across the United States with Prince Maximilian to paint American Indians¹⁶⁸⁰

¹⁶⁸⁰ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



Ralph Waldo Emerson¹⁶⁸¹



Walt Whitman¹⁶⁸²

¹⁶⁸¹ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

¹⁶⁸² Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- ALEXANDER VON HUMBOLT's letters about his Abolitionist feelings were published by Wendell Phillips Garrison in "*The Liberator*".¹⁶⁸³

¹⁶⁸³ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



Frederick Douglass: ALEXANDER VON HUMBOLT's letters in *The Liberator* are read by Frederick Douglass and become the basis for American Abolitionism.¹⁶⁸⁴

¹⁶⁸⁴ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



HUMBOLDT got JEAN LOUIS RODOLPHE AGASSIZ, (see 11,807 HE – 11,873 HE) his job at Harvard.¹⁶⁸⁵

¹⁶⁸⁵ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- John Wesley Powell, head of Bureau of Ethnography of the Smithsonian Institute and the first white man to raft the length of the Colorado River, and organizer of the Cosmos Club at the Smithsonian Institute as it brings together all the thinkers of the different disciplines, because he was influenced by HUMBOLDT.¹⁶⁸⁶

¹⁶⁸⁶ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- CLARENCE KING was influenced by HUMBOLDT as he did his **11,838 HE- 11,842 HE** surveys reports.¹⁶⁸⁷

¹⁶⁸⁷ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



● Photo by Timothy O'Sullivan. ALEXANDER VON HUMBOLDT influenced all 4 western surveys of the United States.¹⁶⁸⁸

¹⁶⁸⁸ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- **11,903 HE** United States President Teddy Roosevelt, had declared the problem with America's educational system is that we are putting out specialists and not thinkers like **HUMBOLT**.¹⁶⁸⁹

¹⁶⁸⁹ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

⇒ The college courses influenced by ALEXANDER VON HUMBOLDT: Anthropology, Botany, Geography, Geophysics, Oceanography, Physiology, Zoology, Geography involving volcanic formation, the magnetic equator, Climatology, Meteorology, and Cartography.¹⁶⁹⁰

¹⁶⁹⁰ Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



11,843 HE ALEXANDER VON HUMBOLDT portrait by Joseph Stieler, location unknown¹⁶⁹¹

¹⁶⁹¹ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

11,773 HE – 11,857 HE: SIR GEORGE CAYLEY, 6th Baronet, English engineer, inventor, and aviator who had even re-invented the wheel, devising the tension-spoked wheel in which all compression loads are carried by the rim, allowing a lightweight undercarriage and was called the "*father of the aeroplane*".¹⁶⁹²

- ⇒ CAYLEY had begun the first rigorous study of the physics of flight and would later design the first modern heavier-than-air craft. Among his most important contributions to aeronautics: Clarifying our ideas and laying down the principles of heavier-than-air flight; Reaching a scientific understanding of the principles of bird flight; Conducting scientific aerodynamic experiments demonstrating drag and streamlining, movement of the center of pressure, and the increase in lift from curving the wing surface; Defining the modern aeroplane configuration comprising a fixed wing, fuselage and tail assembly; Demonstrations of manned, gliding flight; Setting out the

¹⁶⁹² https://en.wikipedia.org/wiki/History_of_aviation

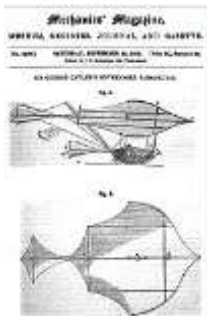
principles of power-to-weight ratio in sustaining flight; CAYLEY's first innovation was to study the basic science of lift by adopting the whirling arm test rig for use in aircraft research and using simple aerodynamic models on the arm, rather than attempting to fly a model of a complete design.¹⁶⁹³

⇒ In **11,848 HE SIR GEORGE CAYLEY** had progressed far enough to construct a glider in the form of a triplane large and safe enough to carry a child. A local boy was chosen but his name is not known.¹⁶⁹⁴ In **11,852 HE SIR GEORGE CAYLEY** went on to publish in the design for a full-size manned glider or "governable parachute" to be launched from a balloon and then to construct a

¹⁶⁹³ https://en.wikipedia.org/wiki/History_of_aviation

¹⁶⁹⁴ https://en.wikipedia.org/wiki/History_of_aviation

version capable of launching from the top of a hill, which carried the first adult aviator (name unknown) across Brompton Dale.¹⁶⁹⁵



11,852 HE: Drawing of SIR GEORGE CAYLEY's "Governable parachute".

¹⁶⁹⁵ https://en.wikipedia.org/wiki/History_of_aviation



SIR GEORGE CAYLEY, 6th Baronet, location, date and artist unknown¹⁶⁹⁶

11,774 HE: Pure Manganese was discovered by JOHAN GOTTLIEB GAHN, Swedish scientist.¹⁶⁹⁷



JOHAN GOTTLIEB GAHN, artist and location unknown.¹⁶⁹⁸

¹⁶⁹⁸ https://en.wikipedia.org/wiki/Johan_Gottlieb_Gahn



This photo is of an ultrapure manganese chip. Original size in cm: 3 x 3. “Star Stuff” Element Atomic Number 25: Manganese, Mn.

- Manganese is a very common metal and is often used in alloys. It is an important ingredient in many steels. It can be found in nature in large quantities in many minerals. It is probably most famous compound is the strong oxidizing agent potassium permanganate. Every life form needs small amounts of Manganese.¹⁶⁹⁹ Exposure to large amounts or certain forms of Manganese can be hazardous.¹⁷⁰⁰

¹⁶⁹⁹ <http://images-of-elements.com/manganese.php#a>

¹⁷⁰⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

11,775 HE - 11,800 HE: ANTOINE-LAURENT LAVOISIER; French chemist¹⁷⁰¹ ¹⁷⁰² ANTOINE-LAURENT LAVOISIER one of the founders of modern chemistry.¹⁷⁰³ He defined the “Law of the Conservation of Mass.”¹⁷⁰⁴ The “Star Stuff” Element: Carbon was named by LAVOISIER as he carried out a variety of experiments to reveal its properties. In one of his experiments. LAVOISIER used a magnifying glass to focus the sun's rays on a diamond and saw the diamond burn and disappear. He noticed the diamond combined with oxygen to form carbon dioxide which led him to conclude that diamond and charcoal were both made from carbon.¹⁷⁰⁵ **11,777 HE:** ANTOINE-LAURENT LAVOISIER also coined the name for the “Star Stuff” element: Oxygen. **11,777 HE:** The “Star Stuff” element

¹⁷⁰¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁷⁰² https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

¹⁷⁰³ https://en.wikipedia.org/wiki/Antoine_Lavoisier

¹⁷⁰⁴ Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

¹⁷⁰⁵ <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

Sulfur was discovered and known since ancient times. However, it was officially isolated and recognized as an element by ANTOINE-LAURENT LAVOISIER.¹⁷⁰⁶



Line engraving of ANTOINE-LAURENT LAVOISIER by Louis Jean Desire Delaistre, after a design by Julien Leopold Boilly,

¹⁷⁰⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

location and date unknown.¹⁷⁰⁷ A French aristocrat, LAVOSIER was arrested and beheaded during the French Revolution.¹⁷⁰⁸



The photo is a vial of glowing ultrapure oxygen. “Star Stuff” Element Atomic Number 8, Oxygen, O, is a very reactive gas and is the most abundant element on Earth. It is part of very many natural compounds, in minerals as in organic material and of course in water, H₂O. Combustion usually is a reaction of a material with oxygen. Elemental oxygen in the form of O₂ is to 21% part of our air and is used by humans and animals for respiration. It is produced by plants doing photosynthesis, most

¹⁷⁰⁷ https://en.wikipedia.org/wiki/Antoine_Lavoisier

¹⁷⁰⁸ Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

of it by algae in the sea and by forests on land. ¹⁷⁰⁹O₃ is ozone, a poisonous gas, which in a high atmospheric layer blocks otherwise deadly UV rays from the Sun. ¹⁷¹⁰



• The photo is a chunk of pure sulfur. “Star Stuff” Element Atomic Number 16. Sulfur, S. Sulfur sometimes naturally occurs in its elemental form and as such often is emitted in volcanic eruptions. Sulfur has a complex chemistry and is essential to life. On the other hand, it has some very toxic and environmentally hazardous compounds. Notable here are hydrogen sulfide, which gives rotten eggs their smell and sulfur

¹⁷⁰⁹ <http://images-of-elements.com/oxygen.php#a>

¹⁷¹⁰ <http://images-of-elements.com/oxygen.php#a>

dioxide and trioxide, which, when dissolved in water, give sulfurous acid and sulfuric acid.¹⁷¹¹

11,776 HE – 11,831 HE: MARIE-SOPHIE GERMAIN, French, Mathematician, physicist, and philosopher¹⁷¹² was one of the pioneers of Elasticity Theory. GERMAIN won the grand prize from the Paris Academy of Sciences for her essay on elasticity theory. Her work on Fermat's Last Theorem provided a foundation for mathematicians exploring the subject for hundreds of years after. Because of prejudice against her sex, she was unable to make a career out of mathematics, but she worked independently throughout her life. Before her death Gauss (see **11,777 HE – 11,855 HE:** KARL FRIEDRICH GAUSS) had recommended that GERMAIN be awarded an honorary degree,

¹⁷¹¹ <http://images-of-elements.com/sulfur.php#a>

¹⁷¹² Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*

but that never occurred. At the centenary of her life, a street and a girl's school were named after her. The French Academy of Sciences established the Sophie Germain Prize in her honor.¹⁷¹³

¹⁷¹³ https://en.wikipedia.org/wiki/Sophie_Germain



MARIE-SOPHIE GERMAIN, artist, date and location unknown.¹⁷¹⁴

¹⁷¹⁴ https://en.wikipedia.org/wiki/Sophie_Germain

11,777 HE – 11,851 HE: HANS CHRISTIAN ØRSTED was a Danish physicist and chemist.¹⁷¹⁵ ØRSTED discovered that electric currents create magnetic fields, which was the first connection found between electricity and magnetism. He is still known today for Oersted's Law.¹⁷¹⁶ ØRSTED was the first modern thinker to explicitly describe and name the “thought experiment”.¹⁷¹⁷ **In 11,825 HE,** HANS CHRISTIAN ØRSTED made a significant contribution to chemistry by producing aluminium for the first time. While an aluminium-iron alloy had previously been developed by British scientist and inventor HUMPHRY DAVY, HANS CHRISTIAN ØRSTED was the first to isolate the element via a reduction of aluminium chloride.¹⁷¹⁸

¹⁷¹⁵ HANS CHRISTIAN ØRSTED was 1st introduced to Author / Compiler by Wulf, Andrea: ***The Invention of Nature: Alexander von Humboldt's New World***

¹⁷¹⁶ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁷¹⁷ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁷¹⁸ https://en.wikipedia.org/wiki/Hans_Christian_Orsted



HANS CHRISTIAN ØRSTED, date, location and artist unknown.¹⁷¹⁹

¹⁷¹⁹ https://en.wikipedia.org/wiki/Hans_Christian_Orsted



Der Geist in der Natur, v.1 (re-print 11,854 HE)^{1720 1721}

¹⁷²⁰ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁷²¹ This book: *Der Geist in der Natur*, was 1st introduced by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

⇒ Named for HANS CHRISTIAN ØRSTED: The centimeter-gram-second system (CGS) unit of magnetic induction (oersted) is named for his contributions to the field of electromagnetism. The Ørsted Park in Copenhagen was named after HANS CHRISTIAN ØRSTED in **11,879 HE**. The streets H.C. Ørsteds Vej in Frederiksberg and H. C. Ørsteds Allé in Galten are also named after ØRSTED. The buildings that are home to the Department of Chemistry and the Institute for Mathematical Sciences at the University of Copenhagen's North Campus are named the H.C. Ørsted Institute, after him. A dormitory named H. C. Ørsted Kollegiet is located in Odense. The first Danish satellite, launched **11,999 HE**, was named after HANS CHRISTIAN ØRSTED.¹⁷²²Monuments and memorials re HANS CHRISTIAN ØRSTED: Statue of Ørsted in Ørstedsparken, in Copenhagen. A statue of HANS CHRISTIAN ØRSTED was installed in the Ørsted Park in **11,880 HE**. A commemorative plaque is located above the

¹⁷²² https://en.wikipedia.org/wiki/Hans_Christian_Orsted

gate on the building in Studiestræde where he lived and worked. The 100 danske kroner note issued from **11,950 HE to 11,970 HE** carried an engraving of HANS CHRISTIAN ØRSTED.¹⁷²³ The OERSTED (symbol Oe) is the unit of the auxiliary magnetic field H in the centimeter–gram–second system of units (CGS). It is equivalent to 1 dyne per MAXWELL. It is named after ØRSTED.¹⁷²⁴



- The photo is a chunk of aluminium, 2.6 grams, 1 x 2 cm. “Star Stuff” Element Atomic Number 13, Aluminum, Al, is very abundant and is used in pure form for a lot of different things,

¹⁷²³ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁷²⁴ <https://en.wikipedia.org/wiki/Oersted>

like kitchen foil, mirrors, coins and industrial components. It is light, soft and malleable, which makes it a material ideal to work with. At very high temperatures it can burn and emit a lot of energy. So, the production of aluminum from its compounds in earth's minerals like bauxite takes a lot of energy, much more than recycling used aluminum. The latter is more environmentally friendly and also cheaper.¹⁷²⁵

11,777 HE – 11,855 HE: KARL FRIEDRICH GAUSS, German mathematician, made his first ground-breaking mathematical discoveries while still a teenager. GAUSS completed *Disquisitiones Arithmeticae*, his magnum opus, in **11,798 HE** at the age of 21, although it was not published until **11,801 HE**. GAUSS contributed significantly to many fields, including number theory, algebra, statistics, analysis, differential geometry, geodesy, geophysics,

¹⁷²⁵ <http://images-of-elements.com/aluminium.php#a>

mechanics, electrostatics, magnetic fields, astronomy, matrix theory,
and optics.¹⁷²⁶

¹⁷²⁶ https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss



KARL FRIEDRICH GAUSS, painted by Christian Albrecht Jensen, date and location unknown.¹⁷²⁷

¹⁷²⁷ https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss

11,778 HE – 11,850 HE: JOSEPH LOUIS GAY-LUSSAC,¹⁷²⁸ French chemist and physicist. He is known among other work, for his discovery that water is made of two parts hydrogen and one part oxygen (with ALEXANDER VON HUMBOLDT), for his research using hot air balloons, for his two laws related to gases, as a co-discoverer of the Star Stuff element Boron, and for his work on alcohol-water mixtures.¹⁷²⁹

⇒ If you took the Earth, and shrank it to the size of an apple, GAY-LUSSAC's research was the first to prove Earth's breathable atmosphere is the thickness of the fragile and delicate skin of that apple.¹⁷³⁰

¹⁷²⁸ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁷²⁹ https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac

¹⁷³⁰ Sam Kean, *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

⇒ In Paris, a street and a hotel near the Sorbonne are named after GAY-LUSSAC as is a square. His name is one of the 72 names inscribed on the Eiffel Tower.



⇒ GAY-LUSSAC and BIOT ascend in a hot air balloon, **11,804 HE.**
Illustration from the late **11,800's HE.**¹⁷³¹

¹⁷³¹ https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac



JOSEPH LOUIS GAY-LUSSAC, date, location and artist unknown.¹⁷³²

¹⁷³² https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac

11,778 HE – 11,829 HE: SIR HUMPHRY DAVY, BT, Cornish
chemist.¹⁷³³ “Maybe more than anybody else, HUMPHRY DAVY lived what ALEXANDER VON HUMBOLDT was preaching because he was a poet and a chemist. In his notebooks, for example, DAVY filled one side with the objective accounts of his experiments while on the other page he wrote his personal reactions and emotional responses.... Like HUMBOLDT, DAVY believed that imagination and reason were necessary to perfect the philosophic mind – they were the ‘creative source of discovery’.”¹⁷³⁴ In **11,808 HE SIR HUMPHRY DAVY** invented the first lightbulb which was called an arc lamp – but it burned through quickly and was too bright.¹⁷³⁵ **SIR HUMPHRY DAVY** also invented the Davy Lamp and a very early

¹⁷³³ https://en.wikipedia.org/wiki/Humphry_Davy

¹⁷³⁴ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁷³⁵ https://en.wikipedia.org/wiki/Humphry_Davy

form of incandescent light bulb.¹⁷³⁶ In **11,808 HE SIR HUMPHRY DAVY** also isolated for the first time the “star stuff” elements Potassium and Sodium¹⁷³⁷ as well as discovering the elemental nature of chlorine and iodine. DAVY also studied the forces involved in these separations, inventing the new field of electrochemistry. BERZELIUS called Davy's **11,806 HE Bakerian Lecture On Some Chemical Agencies of Electricity** “one of the best memoirs which has ever enriched the theory of chemistry.” In **11,809 HE DAVY** isolated / defined the “Star Stuff” elements Calcium, Strontium, Barium, Magnesium (discovery also credited to JOSEPH BLACK¹⁷³⁸), and Boron.¹⁷³⁹

¹⁷³⁶ https://en.wikipedia.org/wiki/Humphry_Davy

¹⁷³⁷ https://en.wikipedia.org/wiki/Humphry_Davy

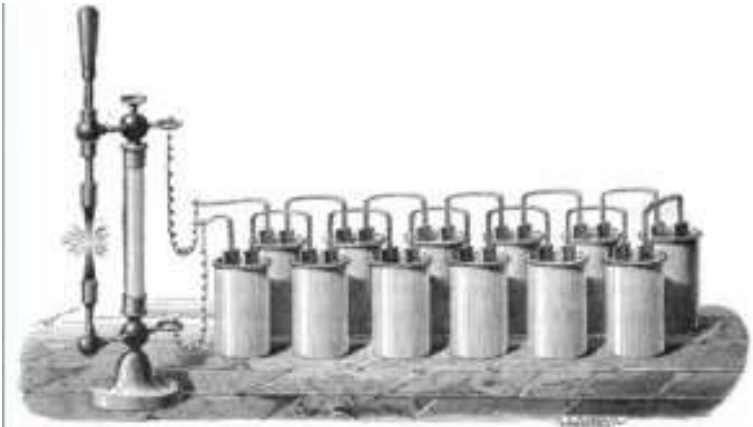
¹⁷³⁸ https://en.wikipedia.org/wiki/Joseph_Black

¹⁷³⁹ https://en.wikipedia.org/wiki/Humphry_Davy



SIR HUMPHRY DAVY, BT, by Thomas Phillips; National Portrait Gallery, London.¹⁷⁴⁰

¹⁷⁴⁰ https://en.wikipedia.org/wiki/Humphry_Davy



First lightbulb, artist, date and location unknown.¹⁷⁴¹

¹⁷⁴¹ SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*
<https://www.youtube.com/watch?v=g-KuigAQFp4>



● In the photo of this vial is contained Potassium pearls under paraffin oil. Original size of the largest pearl in cm: 0.5. The abundant “Star Stuff” Element Atomic Number 19, Potassium, K. In Potassium’s pure form it is a silvery white, light metal and is very reactive. It explosively reacts with water. When dealing with elemental potassium, painstaking precaution is inevitable.¹⁷⁴² In compounds, Potassium is essential to animals and plants, and several natural minerals contain it.¹⁷⁴³ The rare natural isotope potassium 40, a beta emitter, has a half-life of

¹⁷⁴² <http://images-of-elements.com/potassium.php#a>

¹⁷⁴³ <http://images-of-elements.com/potassium.php#a>

1.25 billion years. It is responsible for the largest part of the normal radioactive exposure.¹⁷⁴⁴



- A photo of sodium. “Star Stuff” Element Atomic Number 11, Sodium, Na. Sodium is a very abundant element, that can be found in compounds everywhere on earth, most notably in sea water. Sodium chloride, NaCl, is table salt. Sodium is essential to all animals, but only to a few plants. Elemental sodium is a silvery white, very soft and light metal, which reacts fast and fiercely with many substances (e.g. water), but not with dry air.¹⁷⁴⁵ The element Sodium glows in a very specific yellow. A

¹⁷⁴⁴ <http://images-of-elements.com/potassium.php#a>

¹⁷⁴⁵ <http://images-of-elements.com/sodium.php#a>

common application for this is sodium vapor lamps, which are often used as street lights. Those spend relatively little energy, give a good contrast and are better for nocturnal insects.¹⁷⁴⁶



- The photo is an ultrapure magnesium crystal from one side “Star Stuff” Element Atomic Number 12, Magnesium, Mg. Magnesium is a very abundant, light and reactive element, which is essential to life. In nature, it is found in many minerals, like in talc. Elemental magnesium burns with a bright, white flame and a temperature of more than 3000 K. This once was

¹⁷⁴⁶ <http://images-of-elements.com/sodium.php#a>

used as flashlight for photography and is still used in underwater torches.¹⁷⁴⁷



- The photo is 0.5 grams calcium pieces. Original size per piece in cm: 0.1. “Star Stuff” Element Atomic Number 20, Calcium, Ca, Calcium is a very abundant element, Elemental calcium is a grey metal, that slowly reacts with air and fiercely reacts with water.¹⁷⁴⁸ Elemental Calcium which in nature above all occurs as calcium carbonate (CaCO_3 , lime) and calcium sulfate (CaSO_4 , gypsum). For humans and animals, it is first of all important,

¹⁷⁴⁷ <http://images-of-elements.com/magnesium.php#a>

¹⁷⁴⁸ <http://images-of-elements.com/calcium.php#a>

because bones, teeth and exoskeletons to a large part consist of calcium compounds like tricalcium phosphate and calcium carbonate.¹⁷⁴⁹



A seashell is largely made of CaCO_3 .¹⁷⁵⁰

¹⁷⁴⁹ <http://images-of-elements.com/calcium.php#a>

¹⁷⁵⁰ <http://images-of-elements.com/calcium.php#a>



- The photo is 0.4 grams strontium with a dark layer of strontium nitride (Sr_3N_2), stored under paraffin oil. Original size of the largest piece in cm: 0.5. The “Star Stuff” Element Strontium is very similar to calcium, but it is heavier and more reactive. For this metal and its compounds, only very few and special applications exist. Strontium salts are used to make red fireworks. Strontium is notorious for the radioactive ^{90}Sr , which is produced in nuclear power plants as well as in atomic explosions like that in Chernobyl and from atomic bombs. This has a half-life of 29 years. It is built into bones like calcium and there causes cancer.¹⁷⁵¹

¹⁷⁵¹ <http://images-of-elements.com/strontium.php>



• The photo is 1.5 grams “Star Stuff” Element Barium with a grey oxide layer under argon. Original size in cm: 0.7 x 1 Barium is a very reactive, silvery metal, which quickly oxidizes in air and easily starts to burn. Therefore, elementary barium is hardly used except as a getter material, which binds unwanted rest gases in vacuum tubes. Barium compounds are scarcely used, too, water soluble compounds of it are toxic. The non-water-soluble barium sulfate, known as barium meal, is used as a radiographic contrast medium. Barium has a green flame color; barium salts make fireworks green.¹⁷⁵²

¹⁷⁵² <http://images-of-elements.com/barium.php>



● The stripe of yellow-green gas in the photo is of the “Star Stuff” Element Atomic Number 17, Chlorine, Cl, which at normal conditions is a yellow-green Cl₂ gas, is a very caustic substance. Elemental chlorine corrodes nearly every metal and is toxic for every creature.¹⁷⁵³ In nature, Chlorine always occurs in compounds, the most famous of those is sodium chloride, NaCl, which is table salt. Chloride is a vital part of the body. The compound of hydrogen and chlorine, HCl, dissolved in water, gives hydrochloric acid. Chlorine also is part of the very common plastic PVC.¹⁷⁵⁴

¹⁷⁵³ <http://images-of-elements.com/chlorine.php#a>

¹⁷⁵⁴ <http://images-of-elements.com/chlorine.php#a>

11,779 HE – 11,848 HE: BARON JÖNS JACOB BERZELIUS¹⁷⁵⁵ who was known as JACOB BERZELIUS, was a Swedish physician and chemist¹⁷⁵⁶ and is considered, along with ROBERT BOYLE, JOHN DALTON, and ANTOINE LAVOISIER, and SIR HUMPHRY DAVY¹⁷⁵⁷ to be one of the founders of modern chemistry. BERZELIUS discovered the “Star Stuff” elements: Silicon, Selenium, Thorium, Cerium; and his laboratory discovered “Star Stuff” Elements: Lithium (see also **11,792 HE -11,1841 HE** JOHAN AUGUST ARFWEDSON, Swedish chemist) and Vanadium.¹⁷⁵⁸

¹⁷⁵⁵ BARON JÖNS JACOB BERZELIUS 1st introduced by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

¹⁷⁵⁶ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

¹⁷⁵⁷ https://en.wikipedia.org/wiki/Humphry_Davy

¹⁷⁵⁸ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius



Daguerreotype of JACOB BERZELIUS date, location, and artist unknown.¹⁷⁵⁹

¹⁷⁵⁹ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius



Photo of the statue of **JACOB BERZELIUS** in the center of Berzelii Park, Stockholm.¹⁷⁶⁰

⇒ Named after **BERZELIUS**: Berzeliuskolan, a school situated next to his alma mater, Katedralskolan, is named for **BARON JÖNS**

¹⁷⁶⁰ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

JACOB BERZELIUS. In **11,939 HE** BERZELIUS's portrait appeared on a series of postage stamps commemorating the bicentenary of the founding of the Swedish Academy of Sciences.¹⁷⁶¹



- The photo is of an ultrapure silicon chunk. Original size in cm: 2 x 2. The metalloid “Star Stuff” Element Atomic Number 14, Silicon, Si. Silicon is a very abundant element. Much of the earth's crust is made out of silicates and silica (SiO₂). The latter is the chief ingredient of quartz and sand and is used as raw material for glass since ages. Elemental silicon is an important industrial material, where it is used in huge amounts for

¹⁷⁶¹ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

semiconductors, computer chips, in electronics, for solar energy and photovoltaics.¹⁷⁶²



- Photo is of “Star Stuff” Element Atomic Number 34, Selenium, Se. Selenium is a metalloid, which has more nonmetallic than metallic properties. Chemically it resembles sulfur but is less reactive than this. Nonetheless it very rarely occurs in nature in its pure form. Hydrogen selenide and many other selenium compounds smell terrible, worse than the accordant sulfur compounds. Every life form on earth needs selenium in small amounts for different proteins and amino acids. However, if the

¹⁷⁶² <http://images-of-elements.com/silicon.php#a>

dose is too high, Selenium quickly becomes poisonous.¹⁷⁶³
(Author / Compiler note: I was not aware that the “Star Stuff” Selenium could be poisonous and when I started losing my hair my doctor realized it was because between the vitamins and supplements I was taking – adding together the total mcg of Selenium - there was a toxic dose. Adjusted those supplements and hair regained some density. Not back to original thickness – but that was due to other causes.)

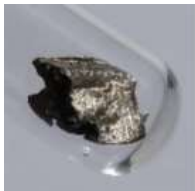


- Photo is of glass vial containing a square of “Star Stuff” Element Atomic Number 90 Thorium.¹⁷⁶⁴ Thorium by far is the

¹⁷⁶³ <http://images-of-elements.com/selenium.php#a>

¹⁷⁶⁴ <https://en.wikipedia.org/wiki/Thorium>

most stable and frequent actinoid, the half-life of ^{232}Th is 14 billion years. The soft, in pure form silvery, metal is chemically reactive and lightly toxic. However, its weak radioactivity can become dangerous, if it is inhaled. Therefore, it is no longer much used for mantles in gas lights, which it was for a long time. It is used for some special alloys and in good camera lenses (as ThO_2). Thorium decays to radium.¹⁷⁶⁵



● Photo of this “Star Stuff” Element Atomic Number 58 Cerium. Cerium is the most frequent of the lanthanoids, most of it occurs

¹⁷⁶⁵ <http://images-of-elements.com/thorium.php#a>

mixed with other lanthanoids. Often it is used as mischmetal, which contains a natural lanthanoid mixture and is cheaper than the separated lanthanoids. This typically consists of 50% cerium, 20% lanthanum and neodymium, 5% praseodymium and the other lanthanoids in fewer amounts as well as iron and other elements. Iron and cerium are the only elements, where by hard and fast friction sparks can be produced.¹⁷⁶⁶



• The photo is 2.3 grams pure Vanadium pieces with a colored oxide layer. Size of the largest piece in cm: 0.7 x 0.7. “Star Stuff” Element Atomic Number 23, Vanadium, V. Vanadium is

¹⁷⁶⁶ <http://images-of-elements.com/cerium.php#a>

a soft, malleable metal, which, when exposed to air, forms a hard, protective oxide layer. It is mainly used in steel alloys. A common product, which many people have at home, is a chrome vanadium steel screwdriver. In nature, vanadium appears in different, often colorful minerals, but only rarely in high concentration.¹⁷⁶⁷

11,780 HE – 11,872 HE: MARY FAIRFAX SOMERVILLE, Scottish scientist, science writer and polymath¹⁷⁶⁸ was nominated to be jointly the first female member of the Royal Astronomical Society at the same time as **CAROLINE HERSCHEL**.¹⁷⁶⁹ SOMERVILLE's first husband did not think much of women's capacity to pursue academic interests. Indeed, he/Greig "possessed in full the prejudice against learned women which was common at that time". He, however, died,

¹⁷⁶⁷ <http://images-of-elements.com/vanadium.php#a>

¹⁷⁶⁸ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

¹⁷⁶⁹ https://en.wikipedia.org/wiki/Mary_Somerville

and she continued her studies upon returning to her childhood home. Later, she married again. Her second husband, Dr William Somerville (11,771 HE – 11,860 HE) inspector of the Army Medical Board. He encouraged, and greatly aided her studies of sciences.¹⁷⁷⁰ Back in Scotland, MARY FAIRFAX SOMERVILLE resumed her mathematical studies. By that time, she had studied plane and spherical trigonometry, conic sections and JAMES FERGUSON'S *Astronomy*. At this time, SOMERVILLE first read ISAAC NEWTON'S *Principia*, which she continued to study. Her inheritance from Greig gave MARY the freedom to pursue intellectual interests. John Playfair, professor of natural philosophy at University of Edinburgh, encouraged her studies, and through him she began a correspondence with William Wallace, with whom she discussed mathematical problems. SOMERVILLE started to solve mathematical problems posed in the mathematical journal of the Military College at Marlow and she eventually made a name for herself when solving a

¹⁷⁷⁰ https://en.wikipedia.org/wiki/Mary_Somerville

diophantine problem for which she was awarded a silver medal in **11,811 HE**. Wallace suggested that she should study the writings of the French mathematician PIERRE-SIMON LAPLACE, which summarized the theory of gravity and collected the mathematical results that had been established in the 50 years since *Principia* had been published. SOMERVILLE said that studying LAPLACE's work gave her the confidence to persevere in her mathematical studies.¹⁷⁷¹ MARY FAIRFAX SOMERVILLE extended her studies into astronomy, chemistry, geography, microscopy, electricity and magnetism. At the age of 33 she purchased for herself a library of scientific books, including: LOUIS-BENJAMIN *Françœur's Elements of Mechanics*, SYLVESTRE FRANÇOIS LACROIX' *Algebra and Calculus Treatise*, JEAN-BAPTISTE BIOT'S *Analytical Geometry and Astronomy*, SIMÉON DENIS POISSON'S *Treatise on Mechanics*, JOSEPH-LOUIS LAGRANGE'S *Theory of Analytical Functions*, LEONHARD EULER'S *Elements of Algebra*

¹⁷⁷¹ https://en.wikipedia.org/wiki/Mary_Somerville

and Isoperimetrical Problems, ALEXIS CLAIRAUT'S Figure of the Earth, GASPARD MONGE'S Application of Analysis to Geometry, and FRANÇOIS CALLET'S Logarithmus.¹⁷⁷²

- ⇒ When John Stuart Mill, the philosopher and economist, organized a massive petition to Parliament to give women the right to vote, he had MARY FAIRFAX SOMERVILLE put her signature first on the petition.¹⁷⁷³
- ⇒ MARY FAIRFAX SOMERVILLE and her oldest brother Sam Fairfax would refuse to take sugar in their tea, in protest against the institution of slavery.¹⁷⁷⁴

¹⁷⁷² https://en.wikipedia.org/wiki/Mary_Somerville

¹⁷⁷³ https://en.wikipedia.org/wiki/Mary_Somerville

¹⁷⁷⁴ https://en.wikipedia.org/wiki/Mary_Somerville



MARY FAIRFAX SOMERVILLE, date, location and artist unknown.¹⁷⁷⁵

¹⁷⁷⁵ https://en.wikipedia.org/wiki/Mary_Somerville



Royal Bank of Scotland plans to depict pioneering astronomer MARY FAIRFAX SOMERVILLE on £10 polymer note¹⁷⁷⁶

Circa 11,780 HE: England: A system was introduced in which unflanged wheels ran on L-shaped metal plates – these became known as plateways.¹⁷⁷⁷



Photo is of a replica of a "Little Eaton Tramway" wagon. The tracks are plateways.¹⁷⁷⁸

11,780 HE – 11,849 HE: JOHANN WOLFGANG DÖBEREINER was the German chemist¹⁷⁷⁹ who invented a portable lighter, known as

¹⁷⁷⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁷⁷⁹ The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 HE book by science reporter Sam Kean.

Döbereiner's lamp. It was the first portable held-in-your-pocket lighter.¹⁷⁸⁰

⇒ DÖBEREINER is best known for work that foreshadowed the periodic law, where he grouped together elements into triads according to their weight.¹⁷⁸¹

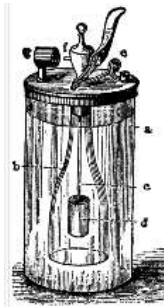
¹⁷⁸⁰ [https://en.wikipedia.org/wiki/Döbereiner's lamp](https://en.wikipedia.org/wiki/D%C3%B6bereiner%27s_lamp) [https://en.wikipedia.org/wiki/Johann_Wolfgang_Döbereiner](https://en.wikipedia.org/wiki/Johann_Wolfgang_D%C3%B6bereiner)

¹⁷⁸¹ The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 2010 HE book by science reporter Sam Kean.



JOHANN WOLFGANG DÖBEREINER, artist and location
unknown¹⁷⁸²

¹⁷⁸² <https://en.wikipedia.org/wiki/> https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner



● DÖBEREINER's Lamp.¹⁷⁸³ By **11,828 HE** hundreds of thousands of these lighters had been mass produced by the German manufacturer Gottfried Piegler in Schleiz.^{1784 1785}

¹⁷⁸³ [https://en.wikipedia.org/wiki/](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner) https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner

¹⁷⁸⁴ The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 HE book by science reporter Sam Kean.

¹⁷⁸⁵ [https://en.wikipedia.org/wiki/](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner) https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner

11,781 HE – 11,832 HE: HENRI CASSINI; French Botanist. Author / Compiler includes him because he is a great-great-grandson of CASSINI I, the astronomer, who studied our solar system and the stars. Editor thought it interesting that this CASSINI specialized in the sunflower family and researched and named circa 17 genera.¹⁷⁸⁶

11,781 HE: WILLIAM ADDIS, English merchant who is credited with inventing the modern western toothbrush while in jail and having a foul-tasting mouth and being inspired by a broom in his cell. After release from jail, he started a business making toothbrushes named “Wisdom Toothbrushes”. “Wisdom Toothbrushes” stayed in family ownership for 215 years until **11,996 HE** and continues as of **12,018 HE**.¹⁷⁸⁷

¹⁷⁸⁶ https://en.wikipedia.org/wiki/Henri_Cassini

¹⁷⁸⁷ [https://en.wikipedia.org/wiki/William_Addis_\(entrepreneur\)](https://en.wikipedia.org/wiki/William_Addis_(entrepreneur))

Circa 11,787 HE: England: JOHN CURR, a Sheffield colliery manager, invented the flanged rail for wagons / early train cars.¹⁷⁸⁸

11,787 HE – 11,826 HE: JOSEPH VON FRAUNHOFER, German physicist and lens expert is known for making excellent optical glass and achromatic telescope objectives.¹⁷⁸⁹

⇒ JOSEPH VON FRAUNHOFER invented the spectroscope to measure properties of light over a specific portion of the electromagnetic spectrum, typically used in spectroscopic analysis to identify elements and materials.¹⁷⁹⁰

¹⁷⁸⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁷⁸⁹ https://en.wikipedia.org/wiki/Joseph_von_Fraunhofer

¹⁷⁹⁰ https://en.wikipedia.org/wiki/Optical_spectrometer

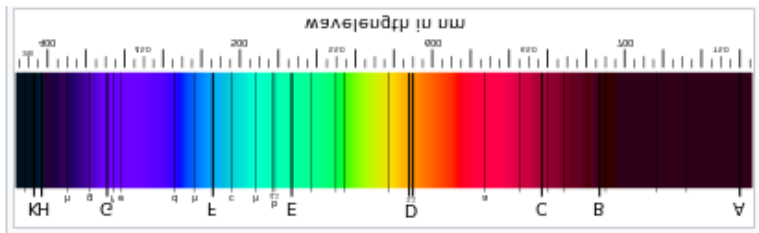
Joseph von Fraunhofer



JOSEPH VON FRAUNHOFER unknown date; unknown artist¹⁷⁹¹

¹⁷⁹¹ https://en.wikipedia.org/wiki/Joseph_von_Fraunhofer

⇒ Author / Compiler includes the following entries in JOSEPH VON FRAUNHOFER's section to display how his spectroscope is now used. In physics and optics, the **Fraunhofer lines** are a set of spectral lines named after the German physicist JOSEPH VON FRAUNHOFER. The lines were originally observed as dark features (absorption lines) in the optical spectrum of the Sun.¹⁷⁹²



Solar spectrum with Fraunhofer lines as it appears visually.¹⁷⁹³

¹⁷⁹² https://en.wikipedia.org/wiki/Fraunhofer_lines

¹⁷⁹³ https://en.wikipedia.org/wiki/Fraunhofer_lines

⇒ A spectral line may be observed either as an **emission line** or an **absorption line**. Which type of line is observed depends on the type of material and its temperature relative to another emission source.

- An absorption line is produced when photons from a hot, broad spectrum source pass through a cold material. The intensity of light, over a narrow frequency range, is reduced due to absorption by the material and re-emission in random directions.
- By contrast, a bright, emission line is produced when photons from a hot material are detected in the presence of a broad spectrum from a cold source. The intensity of light, over a

narrow frequency range, is increased due to emission by the material.¹⁷⁹⁴



Continuous spectrum¹⁷⁹⁵



Example of Emission lines.¹⁷⁹⁶

¹⁷⁹⁴ https://en.wikipedia.org/wiki/Spectral_line

¹⁷⁹⁵ https://en.wikipedia.org/wiki/Spectral_line

¹⁷⁹⁶ https://en.wikipedia.org/wiki/Spectral_line



● Example of Absorption lines.¹⁷⁹⁷

Circa **11,789 HE**: England: WILLIAM JESSOP had introduced a form of all-iron edge rail for wagons / early train cars and flanged wheels for an extension to the Charnwood Forest Canal at Nanpantan, Loughborough, Leicestershire.¹⁷⁹⁸ In **11,790 HE**: JESSOP and his partner OUTRAM began to manufacture edge-rails.¹⁷⁹⁹

¹⁷⁹⁷ https://en.wikipedia.org/wiki/Spectral_line

¹⁷⁹⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁷⁹⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

11,791 HE – 11,867 HE: MICHAEL FARADAY,¹⁸⁰⁰ British scientist who by experimentation showed unification of electricity and magnetism, showed that a changing electric field produced magnetism and a changing magnetic field produces electricity, and introduced the idea of electromagnetic fields.¹⁸⁰¹

⇒ In doing so, FARADAY had solved the mystery that baffled ISAAC NEWTON. FARADAY showed how the Sun told the planets how to move without touching them. FARADAY showed how the Sun does touch the planets with its gravitational field, and Earth's gravitational field tells the apples how to fall. If MICHAEL FARADAY had never lived, we might still be living as our ancestors did in **11,700 HE.**¹⁸⁰²

¹⁸⁰⁰ BRIAN COX, BBC show The Science of Dr. Who

¹⁸⁰¹ https://en.wikipedia.org/wiki/Michael_Faraday

¹⁸⁰² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

⇒ By showing that an electromagnetic force could manipulate light, FARADAY had discovered a deeper unity of nature. FARADAY opened a door for ALBERT EINSTEIN and all the physicists who came after him to glimpse the interplay of hidden, primal forces in the universe. FARADAY knew that electric current turns a wire into a magnet, so he expected to find related patterns in iron filings around a wire carrying electricity. But where others saw merely lovely shapes, FARADAY saw something profound. The patterns were not simply a quirk of iron filings; they existed in the space around a magnet or an electric current, even in the absence of iron filings. FARADAY saw the patterns in the iron filings were the traces, the footprints of invisible fields of force, that reached out into the space around anything magnetic. He saw the compass needle that people wondered at for a thousand years was not reacting to some far away magnetic North Pole. But instead, he saw it was detecting a continuous force field that stretched all the way to the North Pole.

- ⇒ FARADAY saw Earth itself is a giant magnet. He saw that like any other magnet, its lines of force extend far out into the space surrounding it. They're everywhere, all around us. They've always been. But nobody had ever noticed them before FARADAY.¹⁸⁰³
- ⇒ Unfortunately, what he showed disagreed with the prevailing view among his fellow scientists. They admired his inventiveness and his genius for experimentation, but they regarded his invisible "lines of force" and his ideas about light and gravity as hand-waving, meaning there was nothing solid to back it up. Scientists of the day openly ridiculed FARADAY'S theories. They needed to see his ideas expressed in the language of modern physics, precise equations. This was the one area where FARADAY's childhood poverty and lack of formal education held him back. FARADAY

¹⁸⁰³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

couldn't do the math to prove his discoveries/theories. He had finally hit a wall that he could not overcome.¹⁸⁰⁴

⇒ But later, **11,831 HE – 11,879 HE: JAMES CLERK MAXWELL** was able to do the maths to bring mathematical proofs to FARADAYs efforts.¹⁸⁰⁵

¹⁸⁰⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

¹⁸⁰⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10



11,842 HE: MICHAEL FARADAY portrait by Thomas Phillips, location unknown.¹⁸⁰⁶

11,791 HE – 11,871 HE: CHARLES BABBAGE¹⁸⁰⁷ English polymath: A mathematician, philosopher, inventor, and mechanical engineer.¹⁸⁰⁸

The notion of a mechanical calculator for mathematical functions can be traced back to the Antikythera mechanism; **11,819 HE – 11,822 HE** CHARLES BABBAGE originated the concept of a digital programmable computer by way of his “Difference Engines” the first of which he built in these years.¹⁸⁰⁹

⇒ **11,833 HE:** Lady Byron (See **11,815 HE – 11,852 HE:** ADA LOVELACE aka AUGUSTA ADA BYRON KING-NOEL, COUNTESS OF LOVELACE) described seeing the working prototype:

¹⁸⁰⁶ https://en.wikipedia.org/wiki/Michael_Faraday

¹⁸⁰⁷ Paul Premack suggested including

¹⁸⁰⁸ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁸⁰⁹ https://en.wikipedia.org/wiki/Charles_Babbage

- "We both went to see the thinking machine (for so it seems) last Monday. It raised several Nos. to the second and third powers and extracted the root of a Quadratic equation."¹⁸¹⁰

⇒ LEGACIES: Due to his association with the town Babbage was chosen in **12,007 HE** to appear on the 5 pound note. An image of BABBAGE features in the British cultural icons section of the newly designed British passport in **12,015 HE**.¹⁸¹¹

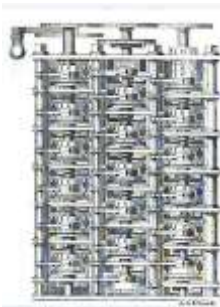
⇒ Half of BABBAGE's brain is preserved at the Hunterian Museum in the Royal College of Surgeons in London.¹⁸¹²

¹⁸¹⁰ https://en.wikipedia.org/wiki/Difference_engine

¹⁸¹¹ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁸¹² https://en.wikipedia.org/wiki/Charles_Babbage

⇒ The other half of BABBAGE's brain is on display in the Science Museum, London.¹⁸¹³



⇒ A portion of the Difference Engine, artist CHARLES BABBAGE, date and location unknown.¹⁸¹⁴

¹⁸¹³ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁸¹⁴ https://en.wikipedia.org/wiki/Charles_Babbage



CHARLES BABBAGE, circa **11,850 HE**, photographer and location unknown.¹⁸¹⁵

¹⁸¹⁵ https://en.wikipedia.org/wiki/Charles_Babbage

- ⇒ Locations, institutions and other things named after CHARLES BABBAGE include: The Moon crater Babbage; The Charles Babbage Institute, an information technology archive and research center at the University of Minnesota; British Rail named a locomotive after him; The Babbage Building at the University of Plymouth, where the university's school of computing is based; The Babbage programming language for GEC 4000 series minicomputers; "Babbage", The Economist's Science and Technology blog.
- ⇒ The former chain retail computer and video-games store "Babbage's" (now GameStop) was named after him.¹⁸¹⁶

¹⁸¹⁶ https://en.wikipedia.org/wiki/Charles_Babbage

⇒ List of Publications by BABBAGE, CHARLES can be seen online.¹⁸¹⁷

11,791 HE– 11,872 HE: SAMUEL FINLEY BREESE MORSE was a United States painter and inventor.¹⁸¹⁸ After having established his reputation as a portrait painter, in his middle age SAMUEL MORSE contributed to the invention of a single-wire telegraph system based on European telegraphs. MORSE was a co-developer of the Morse code and helped to develop the commercial use of telegraphy.¹⁸¹⁹ (See **11,580 HE–11,650 HE:** FRANZ KESSLER **11,616 HE:** The first five chapters of this FRANZ KESSLER book deal with

¹⁸¹⁷ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁸¹⁸ https://en.wikipedia.org/wiki/Samuel_Morse

¹⁸¹⁹ https://en.wikipedia.org/wiki/Samuel_Morse

communicating via a crude Aldis lamp – the predecessor to Morse Code).¹⁸²⁰



11,840 HE SAMUEL FINLEY BREESE MORSE, artist and location unknown,¹⁸²¹

¹⁸²⁰ https://en.wikipedia.org/wiki/Franz_Kessler

¹⁸²¹ https://en.wikipedia.org/wiki/Samuel_Morse



Chart of the Morse code letters and numerals, artist and location unknown.¹⁸²²

11,792 HE -11,1841 HE: JOHAN AUGUST ARFWEDSON, Swedish chemist discovered the element Lithium in by isolating it as a salt.¹⁸²³



● Photo of 0.5 grams Lithium under argon. The “Star Stuff” Element Atomic Number 3, Lithium, Li. Lithium is the lightest of all metals, with only half the weight of water. Like many other elements, it reacts with air, but opposite to most of those hardly with oxygen, but preferably with nitrogen. Thereby it quickly forms lithium nitride, Li_3N , which makes a dark layer on the otherwise light silver metal. Lithium is often used in disposable and rechargeable batteries; lithium salts are used in medicine as treatment for mental disorders.¹⁸²⁴

¹⁸²⁴ <http://images-of-elements.com/lithium.php#a>



JOHAN AUGUST ARFWEDSON, date, location, and artist unknown.¹⁸²⁵

¹⁸²⁵ https://en.wikipedia.org/wiki/Johan_August_Arfwedson

Circa **11,793 HE**: ELI WHITNEY: United States Inventor who applied for the patent for his cotton gin but did not exactly invent the cotton gin. As part of a massive engineering push sponsored by the state of Georgia, Whitney was commissioned to improve the rollers on the existing cotton gin. He replaced the solid rollers with wire teeth.¹⁸²⁶



11,822 HE: ELI WHITNEY, by Samuel F. B. Morse, Yale University Art Gallery.¹⁸²⁷

¹⁸²⁶ SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*

¹⁸²⁷ https://en.wikipedia.org/wiki/Eli_Whitney

11,796 HE: Wakefield, West Yorkshire England: The first public edgeway, thus also *The First Public Railway*, was an early narrow gauge railway¹⁸²⁸ called the *Lake Lock Rail Road*. Although the primary purpose of the line was to carry coal, it also carried passengers.¹⁸²⁹

11,796 HE: Lithography (from Ancient Greek lithos, meaning 'stone', and graphein, meaning 'to write') was invented by German author and actor ALOIS SENEFELDER as a cheap method of publishing theatrical works. It is method of printing originally based on the immiscibility of oil and water. The printing is from a stone or a metal plate with a smooth surface.¹⁸³⁰

¹⁸²⁸ https://en.wikipedia.org/wiki/Lake_Lock_Rail_Road

¹⁸²⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸³⁰ <https://en.wikipedia.org/wiki/Lithography>

11,796 HE: L'Intrépide is the oldest existing flying device, in the Heeresgeschichtliches Museum, Vienna.¹⁸³¹



●

L'Intrépide, location, date, and photographer unknown.¹⁸³²

¹⁸³¹ https://en.wikipedia.org/wiki/History_of_aviation

¹⁸³² https://en.wikipedia.org/wiki/History_of_aviation

11,797 HE – 11,875 HE: SIR CHARLES LYELL, first BARONET, British, foremost geologist of his day and a British Lawyer¹⁸³³ ¹⁸³⁴ is best known as the Editor of ***Principles of Geology***, which popularized the idea that the Earth was shaped by the same processes still in operation today.¹⁸³⁵

⇒ LYELL's scientific contributions included an explanation of earthquakes, the theory of gradual "backed up-building" of volcanoes, and in stratigraphy the division of the Tertiary Period into the Pliocene, Miocene, and Eocene. LYELL, also coined the

¹⁸³³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

¹⁸³⁴ https://en.wikipedia.org/wiki/Charles_Lyell

¹⁸³⁵ https://en.wikipedia.org/wiki/Charles_Lyell

currently-used names for geological eras, Paleozoic, Mesozoic and Cenozoic.¹⁸³⁶

- ⇒ LYELL was one of the first to believe that the world is older than 300 million years, on the basis of its geological anomalies.¹⁸³⁷
- ⇒ LYELL was a close friend of CHARLES DARWIN and contributed significantly to DARWIN's thinking on the processes involved in evolution. LYELL helped to arrange the simultaneous publication in **11,858 HE** of papers by CHARLES DARWIN and ALFRED RUSSEL WALLACE on natural selection, despite his personal religious qualms about the theory. LYELL later published evidence from geology of the time man had existed on Earth.¹⁸³⁸

¹⁸³⁶ https://en.wikipedia.org/wiki/Charles_Lyell

¹⁸³⁷ https://en.wikipedia.org/wiki/Charles_Lyell

¹⁸³⁸ https://en.wikipedia.org/wiki/Charles_Lyell



SIR CHARLES LYELL, BT, date, location, and artist unknown.¹⁸³⁹

¹⁸³⁹ https://en.wikipedia.org/wiki/Charles_Lyell

Circa 11,799 HE: Bloodletting (or blood-letting) is the withdrawal of blood from a patient to prevent or cure illness and disease.

Bloodletting, whether by a physician or by leeches, was based on an ancient system of medicine in which blood and other bodily fluids were regarded as "humours" that had to remain in proper balance to maintain health. It is claimed to have been the most common medical practice performed by surgeons from antiquity until the late **11,800's HE**, a span of almost 2,000 years.¹⁸⁴⁰

¹⁸⁴⁰ <https://en.wikipedia.org/wiki/Bloodletting>



11,790s HE “The Many-Bladed Fleam” was a tool having several different sized blades for opening a vein for bloodletting in various parts of the body¹⁸⁴¹ This photo from the Fort Ticonderoga museum says it was like the one used on George Washington.¹⁸⁴²

¹⁸⁴¹ Photo by Tiffany Premack during a family trip to the Ft. Ticonderoga museum in upstate New York, USA

¹⁸⁴² <https://www.pbs.org/newshour/show/bloodletting-blisters-solving-medical-mystery-george-washingtons-death>



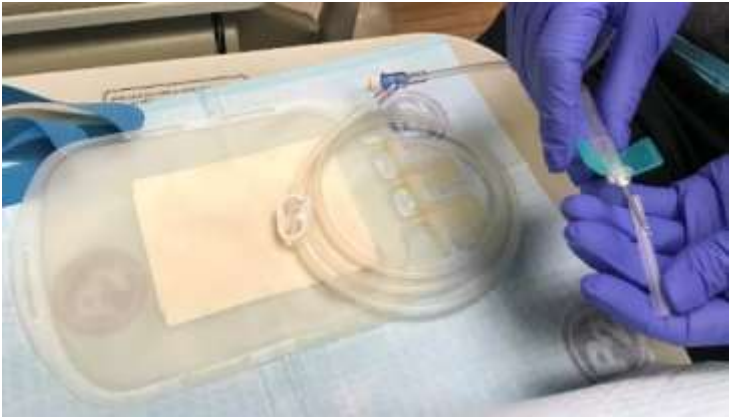
Author / Compiler chose this date to include this entry because history reports that George Washington died of bloodletting in **11,797 HE**. Painting is of his deathbed and those with him. Artist and location unknown.¹⁸⁴³

¹⁸⁴³ <https://www.bing.com/images/search; practicallyhistorical.files.wordpress.com>



Bloodletting-Set of a Barber Surgeon, beginning of the **11,800's**
HE, Märkisches Museum Berlin.¹⁸⁴⁴

¹⁸⁴⁴ <https://en.wikipedia.org/wiki/Bloodletting>



12,018 HE: current technology for bloodletting (phlebotomy).¹⁸⁴⁵

11,799 HE – 11,847 HE – MARY ANNING, Great Britain¹⁸⁴⁶ fossil collector, dealer, and renowned paleontologist¹⁸⁴⁷ who as a woman, was an outsider to the scientific community. At the time in Britain, women were not allowed to vote, hold public office, or attend university. The newly formed, but increasingly influential Geological Society of London did not allow women to become members, or even to attend meetings as guests. The only occupations generally open to working-class women were farm labor, domestic service, and work in the newly opening factories.¹⁸⁴⁸

⇒ The king's physician and aide, Carl Gustav Carus, wrote in his journal: “We had alighted from the carriage and were proceeding on foot, when we fell in with MARY ANNING’s shop in which the

¹⁸⁴⁶ https://en.wikipedia.org/wiki/Louis_Agassiz

¹⁸⁴⁷ https://en.wikipedia.org/wiki/Mary_Anning

¹⁸⁴⁸ https://en.wikipedia.org/wiki/Mary_Anning

most remarkable petrifications and fossil remains—the head of an Ichthyosaurus—beautiful ammonites, etc. were exhibited in the window. We entered and found the small shop and adjoining chamber completely filled with fossil productions of the coast ... I found in the shop a large slab of blackish clay, in which a perfect Ichthyosaurus of at least six feet, was embedded. This specimen would have been a great acquisition for many of the cabinets of natural history on the Continent, and I consider the price demanded, £15 sterling, as very moderate.”¹⁸⁴⁹

- ⇒ Lady Harriet Silvester, the widow of the former Recorder of the City of London, visited Lyme in **11,824 HE** and described MARY ANNING in her diary: “The extraordinary thing in this young woman is that she has made herself so thoroughly acquainted with the science that the moment she finds any bones she knows to what tribe they belong. She fixes the bones on a frame with cement and

¹⁸⁴⁹ https://en.wikipedia.org/wiki/Mary_Anning

then makes drawings and has them engraved... by reading and application she has arrived to that degree of knowledge as to be in the habit of writing and talking with professors and other clever men on the subject, and they all acknowledge that she understands more of the science than anyone else in this kingdom”¹⁸⁵⁰ (See Circa 250 years ago when in **11,556 HE: GEORG BAUER AKA GEORGIUS AGRICOLA** began to speculate on fossils.¹⁸⁵¹)

⇒ In the early **11,840s HE: JEAN LOUIS RODOLPHE AGASSIZ** named two fossil fish species after **MARY ANNING** —*Acrodus anningiae*, and *Belenostomus anningiae*.¹⁸⁵²

¹⁸⁵⁰ https://en.wikipedia.org/wiki/Mary_Annings

¹⁸⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

¹⁸⁵² https://en.wikipedia.org/wiki/Louis_Agassiz



MARY ANNING with her dog, Tray, painted before **11,842 HE**; the Golden Cap outcrop can be seen in the background, artist and location unknown.¹⁸⁵³

¹⁸⁵³ https://en.wikipedia.org/wiki/Mary_Anning



Letter and drawing from MARY ANNING announcing the discovery of a fossil animal now known as *Plesiosaurus dolichodeirus*, 26 December **11,823 HE.**¹⁸⁵⁴

¹⁸⁵⁴ https://en.wikipedia.org/wiki/Mary_Anning

11,799 HE – 11,868 HE: PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE¹⁸⁵⁵ was a German-Swiss chemist who is best known for inventing the fuel cell in **11,838 HE.**¹⁸⁵⁶



PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE, date, location, and artist unknown.¹⁸⁵⁷

¹⁸⁵⁵ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁸⁵⁶ https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein

¹⁸⁵⁷ https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein

Circa 11,800 HE: English scholar ALEXANDER NECKAM was the first to refer to the directional ability of magnetism and Europeans putting a magnetic needle on a card marked with directions and calling it the magnetic compass (the French word for “to go around”).¹⁸⁵⁸ (See **9,401 HE** for more.)

Circa 11,800 HE: The population of the world was approximately 1,000,000,000 people.¹⁸⁵⁹

11,800 HE – 11,895 HE: The battery electric car owes its beginnings to ÁNYOS ISTVÁN JEDLIK, Hungarian (AKA in older texts and publications by the Latin name STEPHANUS ANIANUS JEDLIK.) He was an inventor, engineer, physicist, and benedictine priest.¹⁸⁶⁰

¹⁸⁵⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 80

¹⁸⁵⁹ <http://www.worldometers.info/world-population/world-population-by-year/>

¹⁸⁶⁰ https://en.wikipedia.org/wiki/History_of_the_automobile



JEDLIK'S "lightning-magnetic self-rotor" **11,827 HE**; the world's first electric motor.¹⁸⁶¹

¹⁸⁶¹ https://en.wikipedia.org/wiki/Anyos_Jedlik



JEDLIK'S tubular voltage generator, which was successfully displayed at the Vienna World Exposition in **11,873 HE** is probably the earliest impulse generator¹⁸⁶²

¹⁸⁶² https://en.wikipedia.org/wiki/Anyos_Jedlik



ÁNYOS ISTVÁN JEDLIK, date and photographer unknown¹⁸⁶³

¹⁸⁶³ https://en.wikipedia.org/wiki/Anyos_Jedlik

Circa 11,804 HE: RICHARD TREVITHICK, British Engineer, built the first full-scale working railway steam locomotive. The world's first steam-powered railway journey in the world took place when TREVITHICK's unnamed steam locomotive hauled a train along the tramway of the Penydarren ironworks in South Wales.¹⁸⁶⁴



Photo is of a replica of TREVITHICK's engine at the National Waterfront Museum, Swansea, photographer unknown.¹⁸⁶⁵

¹⁸⁶⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁶⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

11,806 HE: In London, the song “Twinkle Twinkle Little Star” with English lyrics saying they “wondered what stars are?” were first written as a poem by Jane Taylor (**11,783 HE –11,824 HE**) and published with the title "*The Star*" by Jane Taylor.¹⁸⁶⁶

⇒ Author / Compiler note: From earliest star gazers until these last 100 years, humanity did not know what was or what made a star.

⇒ The entire poem by Taylor is:

- Twinkle, twinkle, little star, How I wonder what you are!
- Up above the world so high, Like a diamond in the sky.

¹⁸⁶⁶ https://en.wikipedia.org/wiki/Twinkle,_Twinkle,_Little_Star

- When this blazing sun is gone, when he nothing shines upon, then you show your little light, Twinkle, twinkle, through the night.
- Then the traveler in the dark, Thanks you for your tiny spark; He could not see where to go, If you did not twinkle so.
- In the dark blue sky you keep, And often through my curtains peep, For you never shut your eye Till the sun is in the sky.
- As your bright and tiny spark Lights the traveler in the dark, Though I know not what you are, Twinkle, twinkle, little star.”¹⁸⁶⁷

⇒ Author / Compiler note: Maybe the poem should be updated? We now know what those stars are and thus perpetuating the idea of

¹⁸⁶⁷ https://en.wikipedia.org/wiki/Twinkle,_Twinkle,_Little_Star

“How I wonder what you are!” is maybe a disservice to those hearing the song in our educated time over 200 years after the poem was published?

- Think about it – for tens of thousands of years our ancestors looked up into the sky and were un-informed as to what they were seeing. Now we are informed. It’s just in the last couple of hundreds of years humanity has started defining our view of our night skies. At the same time humanity is defining what we see, with light pollution, humanity is stealing from ourselves the view of the stars.
- Maybe the updated version of children’s song should reflect our knowledge and the damage done by light pollution? The update could be something like:

- “Twinkle, twinkle, little stars, we now realize what you are!
- Up above the world so high, hidden diamonds in our skies.
- When our blazing sun has set, round the sphere of earth it went, you used to show your little lights, twinkle, twinkle, through the nights.
- Now the traveler in the nights, rarely sees your tiny lights, wasted light hides most of you, light pollution through and through.
- Behind light pollut’d skies you hide, no more through urban curtains shine, light pollution with its haze, causes wasted light to blaze.

- So your bright and tiny spark, is'denied the traveler in the dark. Wish we could see you where you are, hidden twink'ling, little stars.”¹⁸⁶⁸

11,807 HE: Operating independently of ISAAC DE RIVAZ the French brothers NICÉPHORE AND CLAUDE NIÉPCE built an internal combustion engine called the “Pyreolophore” which they used to power a boat by the reaction from a pulsed water jet.¹⁸⁶⁹

11,807 HE – 11,840 HE: “Star Stuff” Element Ruthenium, Atomic Number 44, is discovered over time.

¹⁸⁶⁸ The updated sad version of the poem was written by Ruthie S. Premack.

¹⁸⁶⁹ https://en.wikipedia.org/wiki/De_Rivaz_engine

- The first effort was by JĘDRZEJ ŚNIADECKI¹⁸⁷⁰ (**11,768 HE – 11,838 HE**). ŚNIADECKI, a Polish writer, physician, chemist, and biologist tried to isolate Ruthenium but could not. He did create the modern Polish terminology in the field of chemistry.¹⁸⁷¹
- The second effort was by Swedish physician and chemist BARON JÖNS JACOB BERZELIUS (**11,779 HE – 11,848 HE**), who tried to isolate Ruthenium but didn't.
- The third effort was by German Scientist GOTTFRIED WILHELM OSANN¹⁸⁷² (**11,796 HE– 11,866 HE**), chemist and physicist. OSANN was known for his work on the chemistry of

¹⁸⁷⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁸⁷¹ https://en.wikipedia.org/wiki/Jędrzej_Śniadecki

¹⁸⁷² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

platinum metals.¹⁸⁷³ In **11,825 HE** OSANN worked on isolating Ruthenium and failed, but he did name it.

- Finally, KARL ERNST CLAUS (also Karl Klaus or Carl Claus) (**11,796 HE – 11,864 HE**), a Baltic German chemist and naturalist, isolated the Star Stuff chemical element Ruthenium in **11,840 HE**. CLAUS, *realizing he was standing on the shoulders of those who came before him*, then kept the name given to it by OSANN. CLAUS is also known as one of the first scientists who applied quantitative methods in botany.¹⁸⁷⁴
- Author / Compiler note: I celebrate the name of this Element! It relates my name to science, and I am beginning to understand

¹⁸⁷³ https://en.wikipedia.org/wiki/Gottfried_Osann

¹⁸⁷⁴ https://en.wikipedia.org/wiki/Gottfried_Osann

that science is one of the greatest achievements of our human species!



11,843 HE painting of JĘDRZEJ ŚNIADECKI by Aleksander Sleńdziński, location unknown.¹⁸⁷⁵

¹⁸⁷⁵ https://en.wikipedia.org/wiki/Jędrzej_Śniadecki



●

Portrait is of GOTTFRIED WILHELM OSANN, date, location, artist unknown.¹⁸⁷⁶

¹⁸⁷⁶ https://en.wikipedia.org/wiki/Gottfried_Osann



Photo is of KARL ERNST CLAUS, date, location and photographer unknown.¹⁸⁷⁷

¹⁸⁷⁷ https://en.wikipedia.org/wiki/Karl_Ernst_Claus



• The photo is a crystal of “Star Stuff” atomic Element 44: Ru Ruthenium, 0.6 grams, 0.6 x 1.3 cm size. Ruthenium crystallizes hexagonally, is one of the rarest metals found on earth and is the first of the platinum group of metals. Hard and brittle it is commonly used in superalloys and as a catalyst. Like with Osmium, its tetroxide is very toxic, but Ruthenium is less reactive.¹⁸⁷⁸ It is an effective hardener for Platinum and Palladium. It has been added to Titanium deep-water pipes to improve their resistance to corrosion.¹⁸⁷⁹

¹⁸⁷⁸ <http://images-of-elements.com/ruthenium.php#a>

¹⁸⁷⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

11,807 HE – 11,873 HE: JEAN LOUIS RODOLPHE AGASSIZ, United States scientist¹⁸⁸⁰ who made extensive contributions to ichthyological classification (including of extinct species) and to the study of geological history (including to the founding of glaciology) and has become broadly known through study of his thorough regimen of observational data gathering and analysis. He made vast institutional and scientific contributions to zoology, geology, and related areas—including many multi-volume research series running to thousands of pages.¹⁸⁸¹

⇒ In **11,837 HE** AGASSIZ was the first to scientifically propose that the Earth had been subject to a past ice age, when he proposed to the Helvetic Society that ancient glaciers had not only flowed outward from the Alps, but that even larger glaciers had

¹⁸⁸⁰ BBC Men of Rock 3 of 3 12,010HE BBC TV show “The Big Freeze”

¹⁸⁸¹ https://en.wikipedia.org/wiki/Louis_Agassiz

simultaneously encroached southward on the plains and mountains of Europe, Asia and North America, smothering the entire northern hemisphere in a prolonged Ice Age.¹⁸⁸² In **11,840 HE** AGASSIZ confirmed glaciation outside the Alps, in Scotland, with parallel lines at Glen Roy caused by a glacial lake changing depth and carving different shorelines over time.¹⁸⁸³

⇒ AGASSIZ's resistance to Darwinian evolution, and the scientific racism evident in his writings on human polygenism, tarnished his reputation and led to controversies over his legacy.¹⁸⁸⁴

¹⁸⁸² https://en.wikipedia.org/wiki/Louis_Agassiz

¹⁸⁸³ BBC Men of Rock 3 of 3 12,010HE BBC TV show "The Big Freeze"

¹⁸⁸⁴ https://en.wikipedia.org/wiki/Louis_Agassiz



JEAN LOUIS RODOLPHE AGASSIZ, date, location, and artist unknown.¹⁸⁸⁵

⇒ Some things named after AGASSIZ: An ancient glacial lake in the Great Lakes region of North America, Lake Agassiz; Mount Agassiz in California's Palisades; Mount Agassiz, in the Uinta

¹⁸⁸⁵ https://en.wikipedia.org/wiki/Louis_Agassiz

Mountains; Agassiz Peak in Arizona; In Switzerland, the Agassiz horn in the Bernese Alps; Agassiz Glacier (Montana); Agassiz Creek in Glacier National Park; Agassiz Glacier (Alaska) in Saint Elias Mountains; Mount Agassiz in New Hampshire's White Mountains; A crater on Mars (Crater Agassiz); A promontory on the Moon; A headland situated in Palmer Land, Antarctica, Cape Agassiz; A main-belt asteroid named 2267 Agassiz. The elementary school north of Harvard University was named in his honor and the surrounding neighborhood became known as "Agassiz" as a result. The school's name was changed to the Maria L. Baldwin School on May 21, **12,002 HE**, due to concerns about Agassiz's racism, and to honor Maria Louise Baldwin the African-American principal of the school who served from **11,889 HE** until **11,922 HE**. The neighborhood, however, continues to be known as Agassiz.¹⁸⁸⁶

¹⁸⁸⁶ https://en.wikipedia.org/wiki/Louis_Agassiz

Chapter Eight THE MODERN SCIENTIFIC ERA: Circa 11,859 HE (Lasting, so far, less than 175 years)

Evolution, Atomic and Quantum Physics, Astrophysics, Technology, and the Information Age.

11,809 HE – 11,882 HE: CHARLES DARWIN, British scientist who is best known for developing, defining, and proving the concepts of natural selection and evolution. DARWIN sailed on the HMS BEAGLE, collecting specimens. From his collecting, DARWIN established that all species of life have descended over time from common ancestors.¹⁸⁸⁷

¹⁸⁸⁷ https://en.wikipedia.org/wiki/Charles_Darwin

Charles Darwin



Photo of CHARLES DARWIN, date and location unknown¹⁸⁸⁸

¹⁸⁸⁸ https://en.wikipedia.org/wiki/Charles_Darwin



The title page of the 1859 edition

⇒ **11,859 HE:** DARWIN's title page for *The Origin of Species* draft.¹⁸⁸⁹ In the Sixth Edition of *The Origin of Species*, DARWIN references lists and published works of others who before him, or contemporaneously with him, referenced or speculated about natural selection.¹⁸⁹⁰

¹⁸⁸⁹ <http://darwin-online.org.uk/content/search-results?freetext=origin%20of%20species>

¹⁸⁹⁰ CHARLES DARWIN *The Origin of Species*

11,811 HE – 11,861 HE: ELISHA OTIS, Vermont and New York, United States inventor of power lifting devices with electricity or steam rather than people pulling on ropes. Prior elevators still used ropes, which tended to break. OTIS invented the safety break which made elevators practical. Human Powered Lifting devices date back to antiquity. The Greeks and Romans documented using them.¹⁸⁹¹



ELISHA OTIS, photographer, date, location unknown.¹⁸⁹²

¹⁸⁹¹ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

¹⁸⁹² https://en.wikipedia.org/wiki/Elisha_Otis



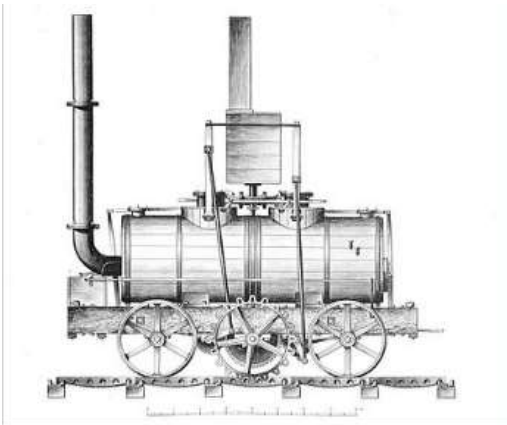
11,854 HE *Otis Free-fall safety demonstration elevator*, artist and location unknown. OTIS received no patent for his safety break elevators which made skyscrapers possible. ¹⁸⁹³

Circa 11,812 HE: MATTHEW MURRAY designed the first commercially successful steam rack locomotive *Salamanca*, built for the Middleton Railway in Leeds, England. This twin-cylinder locomotive was not heavy enough to break the edge-rails track and solved the problem of adhesion by a cog-wheel using teeth cast on the side of one of the rails. Thus, it was also the first rack railway.¹⁸⁹⁴

⇒ As of **12,018 HE**, these countries have cog and rack railways: Angola, Argentina, Australia, Austria, Bolivia, Brazil, Chile, Czech Republic, France, Germany, Greece, Hungary, Indonesia, India, Italy, Japan, Lebanon, Mexico, Panama, Portugal, Romania, Slovakia, South Africa, Spain, Switzerland, United Kingdom, United States, and Vietnam.¹⁸⁹⁵

¹⁸⁹⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁹⁵ https://en.wikipedia.org/wiki/Rack_railway



11,812 HE: Drawing (unknown artist and location) of MATTHEW MURRAY's rack locomotive *Salamanca*.¹⁸⁹⁶

¹⁸⁹⁶ https://en.wikipedia.org/wiki/History_of_rail_transport



Photo is an example of a rack system (also rack-and-pinion railway, cog railway, or cogwheel railway) which is a steep grade railway with a toothed rack rail, usually between the running rails. The trains are fitted with one or more cog wheels or pinions that mesh with this rack rail. This allows the trains to operate on steep grades above around 7 to 10%, which is the maximum for friction-based rail.¹⁸⁹⁷

¹⁸⁹⁷ https://en.wikipedia.org/wiki/Rack_railway

11,813 HE – 11,858 HE: JOHN SNOW English physician and a leader in the adoption of anesthesia and medical hygiene¹⁸⁹⁸ was a skeptic of the then, still dominant miasma theory that stated that diseases such as cholera and bubonic plague were caused by pollution or a noxious form of "bad air".¹⁸⁹⁹

⇒ The germ theory of disease had not yet been developed, so Snow was skeptical and did not understand the mechanism by which the disease was transmitted. His observation of the evidence led him to discount the theory of foul air. He first publicized his theory in an **11,849 HE** essay *On the Mode of Communication of Cholera*, followed in **11,855 HE** by a more detailed treatise incorporating the results of his investigation of the role of the water supply in the Soho epidemic of **11,854 HE**. By talking to local residents, (with the help of Reverend Henry Whitehead) SNOW identified the

¹⁸⁹⁸ Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

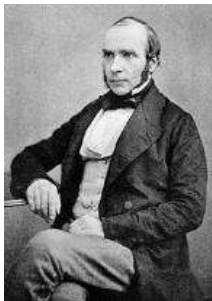
¹⁸⁹⁹ https://en.wikipedia.org/wiki/John_Snow

source of the outbreak as the public water pump on Broad Street (now Broadwick Street). Although SNOW's chemical and microscope examination of a water sample from the Broad Street pump did not conclusively prove its danger, his studies of the pattern of the disease were convincing enough to persuade the local council to disable the well pump by removing its handle (force rod).¹⁹⁰⁰

⇒ JOHN SNOW later used a dot map to illustrate the cluster of cholera cases around the pump. SNOW also used statistics to illustrate the connection between the quality of the water source and cholera cases. He showed that the Southwark and Vauxhall Waterworks Company was taking water from sewage-polluted sections of the Thames and delivering the water to homes, leading to an increased incidence of cholera. SNOW's study was a major

¹⁹⁰⁰ https://en.wikipedia.org/wiki/John_Snow

event in the history of public health and geography. It is regarded as the founding event of the science of epidemiology.¹⁹⁰¹



JOHN SNOW, date, location and photographer unknown.¹⁹⁰²

¹⁹⁰¹ https://en.wikipedia.org/wiki/John_Snow

¹⁹⁰² https://en.wikipedia.org/wiki/John_Snow

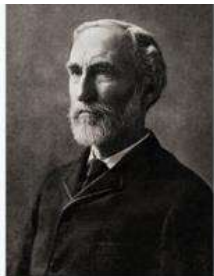
11,813 HE – 11,903 HE: JOSIAH WILLARD GIBBS; United States, physics, chemistry and mathematics. He is known for “Chemical thermodynamics; Chemical potential; Statistical mechanics; Statistical ensemble; Gibbs entropy; Phase space; Physical optics; Gibbs free energy; Phase rule; Gibbs paradox; Gibbs invented Vector Calculus; Cross product; Gibbs phenomenon; Gibbs–Helmholtz equation; Gibbs–Duhem equation; Gibbs algorithm; Gibbs measure; Gibbs state; Gibbs–Thomson effect; Gibbs isotherm; Gibbs–Donnan effect; Gibbs–Marangoni effect; Gibbs lemma; Gibbs' inequality; and the Gibbs distribution.”¹⁹⁰³

⇒ Henry Adams called JOSIAH WILLARD GIBBS “the greatest of Americans, judged by his rank in science.”¹⁹⁰⁴

¹⁹⁰³ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

¹⁹⁰⁴ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

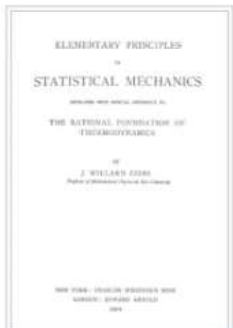
⇒ GIBBS application of thermodynamics to physical processes led him to develop the science of statistical mechanics; his treatment of it was so general that it was later found to apply to quantum mechanics.¹⁹⁰⁵



⇒ JOSIAH WILLARD GIBBS, date, artist, and location unknown.¹⁹⁰⁶

¹⁹⁰⁵ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

¹⁹⁰⁶ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs



Published in **11,902 HE**: Title page of JOSIAH WILLARD GIBBS's *Elementary Principles in Statistical Mechanics*, one of the founding documents of that discipline.¹⁹⁰⁷

¹⁹⁰⁷ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

11,815 HE – 11,852 HE: ADA LOVELACE¹⁹⁰⁸ aka AUGUSTA ADA BYRON KING-NOEL, COUNTESS OF LOVELACE. English mathematician - the enchantress of numbers – who wrote the first computer program to calculate Bernoulli numbers and consulted on the invention of CHARLES BABBAGE'S “Difference Engine”.¹⁹⁰⁹

⇒ ADA LOVELACE is chiefly known for her work on CHARLES BABBAGE'S proposed mechanical general-purpose computer, the Analytical Engine. LOVELACE was the first to recognize that the machine had applications beyond pure calculation and published the first algorithm intended to be carried out by such a machine. As a result, she is sometimes regarded as the first to recognize the full

¹⁹⁰⁸ Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

¹⁹⁰⁹ <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

potential of a "computing machine" and so was the first computer programmer.¹⁹¹⁰



ADA LOVELACE, Countess of Lovelace, **11,840 HE** artist and location unknown.¹⁹¹¹

¹⁹¹⁰ https://en.wikipedia.org/wiki/Ada_Lovelace

¹⁹¹¹ https://en.wikipedia.org/wiki/Ada_Lovelace



ADA LOVELACE, aged seven, by Alfred d'Orsay, **11,822 HE.**
Painting is displayed at Somerville College, Oxford.¹⁹¹²

¹⁹¹² https://en.wikipedia.org/wiki/Ada_Lovelace

11,819 HE – 11,868 HE: JEAN BERNARD LÉON FOUCAULT. French physicist who:

- ⇒ In **11,850 HE** did an experiment using the Fizeau–Foucault apparatus to measure the speed of light; it came to be known as the Foucault–Fizeau experiment and was viewed as "driving the last nail in the coffin" of ISAAC NEWTON'S particle theory of light when it showed that light travels more slowly through water than through air.¹⁹¹³ (EINSTEIN and others took the concept farther, showing that light has dual properties of both particles and waves depending on the experiment being conducted¹⁹¹⁴.)
- ⇒ In **11,851 HE** invented the FOUCAULT pendulum which was the first direct demonstration of the Earth's rotation. That Earth rotated

¹⁹¹³ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁹¹⁴ https://www.sciencedaily.com/terms/wave-particle_duality.htm

was doubted by a few at that time, but not yet demonstrated at an experimental level.¹⁹¹⁵

- ⇒ In **11,855 HE** discovered that the force required for the rotation of a copper disc becomes greater when it is made to rotate with its rim between the poles of a magnet, the disc at the same time becoming heated by the eddy current or "Foucault currents" induced in the metal. As a result, in **11,857 HE** FOUCAULT invented the polarizer which bears his name.¹⁹¹⁶
- ⇒ In **11,858 HE** devised a method of testing the mirror of a reflecting telescope to determine its shape. The so-called "Foucault knife-

¹⁹¹⁵ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁹¹⁶ https://en.wikipedia.org/wiki/Leon_Foucault

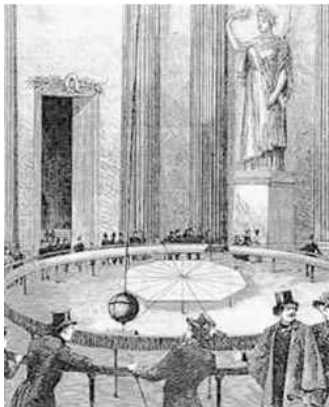
edge test" allows the worker to tell if the mirror is perfectly spherical or has non-spherical deviation in its figure.¹⁹¹⁷



JEAN BERNARD LÉON FOUCAULT, photographer, date, and location unknown.¹⁹¹⁸

¹⁹¹⁷ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁹¹⁸ https://en.wikipedia.org/wiki/Leon_Foucault



11,851 HE: Display of FOUCAULT's Pendulum in Paris for Napoleon III.¹⁹¹⁹

¹⁹¹⁹ http://www.cecs.cl/pendulo/index.php?option=com_content&view=article&id=48&Itemid=2&lang=en

Circa 11,820 HE: JOHN BIRKINSHAW, British railway engineer, recognized that wood and cast iron were not satisfactory materials for rails because they could only be up to 3 ft lengths and either were brittle or broke under heavy loads. BIRKINSHAW invented wrought iron, which could be made into 15 ft lengths. Wrought iron (usually simply referred to as "iron") was a ductile material that could undergo considerable deformation before breaking, making it more suitable for iron rails.¹⁹²⁰ ¹⁹²¹

11,820 HE -11,893 HE: JOHN TYNDALL, British scientist and inventor who explained the heat in the Earth's atmosphere known as infrared radiation and proved the Earth's atmosphere had a Greenhouse Effect.

¹⁹²⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁹²¹ https://en.wikipedia.org/wiki/John_Birkinshaw

He devised demonstrations that advanced the question of how radiant heat is absorbed and emitted at the molecular level.¹⁹²²

⇒ **11,862 HE:** JOHN TYNDALL invented a system for measuring the amount of carbon dioxide in a sample of exhaled human breath. The basics of TYNDALL's system is in daily use in hospitals today for monitoring patients under anesthesia. TYNDALL researched and what became “Tyndallization” was historically the earliest known effective way to destroy bacterial spores. At the time, it affirmed the “germ theory” against a number of critics whose experimental results had been defective.¹⁹²³

⇒ **11,864 HE:** JOHN TYNDALL appears to be the first person to have demonstrated experimentally that emission of heat in chemical

¹⁹²² https://en.wikipedia.org/wiki/John_Tyndall

¹⁹²³ https://en.wikipedia.org/wiki/John_Tyndall

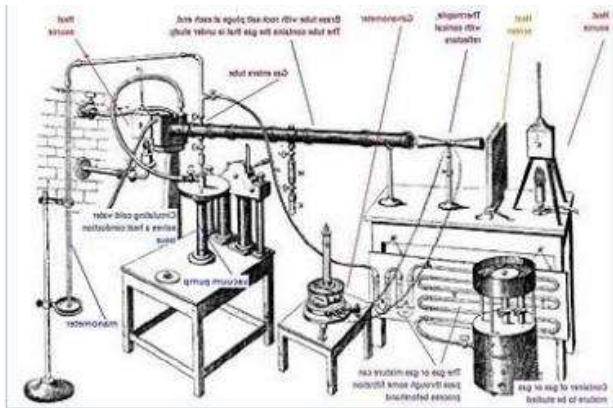
reactions has its physical origination within the newly defined molecules.¹⁹²⁴

- ⇒ During the mid-**11,870s** **HE LOUIS PASTEUR** and **JOHN TYNDALL** were in frequent communication. **TYNDALL** was a member of a group of scientists that vocally supported **DARWIN's** theory of evolution and sought to strengthen the barrier, or separation, between religion and science.¹⁹²⁵
- ⇒ **JOHN TYNDALL** was a well-attended lecturer and said that “religious sentiment should not be permitted to intrude on the region of *knowledge*, over which it holds no command”.¹⁹²⁶

¹⁹²⁴ https://en.wikipedia.org/wiki/John_Tyndall

¹⁹²⁵ https://en.wikipedia.org/wiki/John_Tyndall

¹⁹²⁶ https://en.wikipedia.org/wiki/John_Tyndall



JOHN TYNDALL 's mechanism for measuring the radiant heat absorption of gases ¹⁹²⁷



JOHN TYNDALL circa **11,930 HE**, photographer and location unknown.¹⁹²⁸

¹⁹²⁸ https://en.wikipedia.org/wiki/John_Tyndall

Circa 11,821 HE: England: JOHN BIRKINSHAW's wrought iron rails were taken up by George Stephenson for the proposed Stockton and Darlington Railway, and it was this railway that effectively launched the rail era.¹⁹²⁹

11,821 HE– 11,910 HE: DR. ELIZABETH BLACKWELL, British-born physician who attended medical college in Geneva, NY – and graduated in two years. First female doctor **11,849 HE.**^{1930 1931}

⇒ DR. ELIZABETH BLACKWELL was the first woman on the British¹⁹³² Medical Register of the General Medical Council. BLACKWELL was the first woman to graduate from a medical

¹⁹²⁹ https://en.wikipedia.org/wiki/John_Birkinshaw

¹⁹³⁰ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁹³¹ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

¹⁹³² https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

school, she was a pioneer in promoting the education of women in medicine in the United States, and she was a social and moral reformer in both the United States and the United Kingdom.¹⁹³³

- ⇒ DR. ELIZABETH BLACKWELL played an active part in the organization of women's nursing during the American civil war. One outcome of this work was the establishment of a medical school for women in which Miss Blackwell, who, in her visits to England, had come under the influence of Florence Nightingale, held the Chair of Hygiene.¹⁹³⁴

- ⇒ Due to her contribution to the world of medicine, DR. ELIZABETH BLACKWELL now has a US national Day of Recognition dedicated to her on February third (her birth date) to

¹⁹³³ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

¹⁹³⁴ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

celebrate her innovative work in medicine called National Women Physicians Day.¹⁹³⁵ From her obituary: “There are two points never to be forgotten in speaking of DR. ELIZABETH BLACKWELL: one is that, although much of her life was passed in America, she did not go there until she was 11 years old, and always regarded herself as English. The second is that, although never married, she was, and ever remained, one of the most womanly of women. It was, indeed, her womanly character, coupled with her intense earnestness, which mainly enabled her to overcome the difficulties in her path, and won for her personally, if not for her ambitions in respect of women as a whole, the esteem and good wishes of all possible opponents. Although she appears to have turned to medicine with some reluctance in the first place, she soon acquired a belief that she had a definite ‘call,’ and retained this belief to the

¹⁹³⁵ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

end.”¹⁹³⁶ Her sister, DR. EMILY BLACKWELL, was the third woman to get a medical degree in the US.¹⁹³⁷



ELIZABETH BLACKWELL, M.D.¹⁹³⁸

¹⁹³⁶ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

¹⁹³⁷ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

¹⁹³⁸ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

11,821 HE – 11,890 HE: JAMES CROLL, FRS, Scottish wheelwright, then tea merchant, then hotel manager, then insurance agent, then janitor who self-educated to become a highly respected Scientist.¹⁹³⁹

⇒ JAMES CROLL developed a theory of climate change based on changes in the Earth's orbit. CROLL's other theory, that ice ages result from earth's orbit around the sun and tilt of axis changing over time, is as important to climate science as the origin of the species is to biology.¹⁹⁴⁰

⇒ JAMES CROLL published a number of books and papers which "were at the forefront of contemporary science."¹⁹⁴¹

¹⁹³⁹ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁹⁴⁰ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁹⁴¹ https://en.wikipedia.org/wiki/James_Croll



JAMES CROLL, date, location, and photographer unknown.¹⁹⁴²

¹⁹⁴² https://en.wikipedia.org/wiki/James_Croll

11,822 HE – 11,884 HE: GREGOR JOHANN MENDEL,¹⁹⁴³ from the Silesian part of the Austrian Empire, today's Czech Republic. He conducted pea plant experiments which established many of the rules of heredity, now referred to as the *Laws of Mendelian Inheritance* although farmers had known for millennia that crossbreeding of animals and plants could favor certain desirable traits.¹⁹⁴⁴

- ⇒ GREGOR MENDEL began his studies on heredity using mice. He was at St. Thomas's Abbey, but his bishop did not like one of his friars studying animal sex, so MENDEL switched to plants.¹⁹⁴⁵

- ⇒ GREGOR MENDEL worked with seven characteristics of pea plants: plant height, pod shape and color, seed shape and color, and flower position and color. Taking seed color as an example, he

¹⁹⁴³ https://en.wikipedia.org/wiki/Barbara_McClintock

¹⁹⁴⁴ https://en.wikipedia.org/wiki/Gregor_Mendel

¹⁹⁴⁵ Henig 2000, pp. 15–17 and https://en.wikipedia.org/wiki/Gregor_Mendel

showed that when a true-breeding yellow pea and a true-breeding green pea were cross-bred their offspring always produced yellow seeds. However, in the next generation, the green peas reappeared at a ratio of 1 green to 3 yellow. To explain this phenomenon, GREGOR MENDEL *coined the terms “recessive” and “dominant”* in reference to certain traits.¹⁹⁴⁶ When MENDEL's paper was published in **11,866 HE** in *Verhandlungen des Naturforschenden Vereines in Brünn*, *it was seen as essentially about hybridization rather than inheritance, had little impact, and was only cited about three times over the next thirty-five years. His paper was criticized at the time but is now considered a seminal work.* Notably, CHARLES DARWIN (See **11,809 HE – 11,882 HE: CHARLES DARWIN**) was *not aware* of MENDEL's paper.¹⁹⁴⁷ **11,866 HE:** GREGOR MENDEL published his work, resulting from his research, demonstrating the actions of invisible “factors”—now

¹⁹⁴⁶ https://en.wikipedia.org/wiki/Gregor_Mendel

¹⁹⁴⁷ https://en.wikipedia.org/wiki/Gregor_Mendel

called genes—in predictably determining the traits of an organism. MENDEL gained posthumous recognition as the *founder of the modern science of genetics*.¹⁹⁴⁸



GREGOR MENDEL, date, location, & photographer unknown.¹⁹⁴⁹

¹⁹⁴⁸ https://en.wikipedia.org/wiki/Gregor_Mendel

¹⁹⁴⁹ https://en.wikipedia.org/wiki/Gregor_Mendel

11,822 HE – 11,895 HE: LOUIS PASTEUR; French biologist, microbiologist, and chemist is renowned for his discoveries of the principles of vaccination, microbial fermentation, and pasteurization. He is best known to the general public for his invention of the technique of treating milk and wine to stop bacterial contamination, a process now called pasteurization. LOUIS PASTEUR is regarded as the "*father of microbiology*".¹⁹⁵⁰

⇒ PASTEUR reduced mortality from puerperal fever and created the first vaccines for rabies and anthrax. These concepts were remarkable breakthroughs in the causes and prevention of diseases. His discoveries have saved many lives ever since. LOUIS PASTEUR medical discoveries provided direct support for the

¹⁹⁵⁰ https://en.wikipedia.org/wiki/Louis_Pasteur

germ theory of disease and its application in clinical medicine.¹⁹⁵¹

LOUIS PASTEUR

- By **11,870 HE** human life expectancy reached about 40 years, due to PASTEUR and other scientific and medical advancements. CARL SAGAN, in discussing human life expectancy, stated that circa **39,000 BHE** (that is circa 50,870 years ago in hunter-gatherer pre-agricultural times) the human life expectancy was about 20-30 years.¹⁹⁵²

¹⁹⁵¹ https://en.wikipedia.org/wiki/Louis_Pasteur

¹⁹⁵² CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10



LOUIS PASTEUR 11,857 HE (about 13 years before his research started extending human life spans).¹⁹⁵³

¹⁹⁵³ https://en.wikipedia.org/wiki/Louis_Pasteur



LOUIS PASTEUR, artist and location unknown **11,885 HE** (about 15 years after his research started extending human life spans).¹⁹⁵⁴

¹⁹⁵⁴ https://en.wikipedia.org/wiki/Louis_Pasteur

11,823 HE – 11,913 HE: ALFRED RUSSEL WALLACE; British naturalist, explorer, geographer, anthropologist, and biologist is best known for independently conceiving the theory of evolution through natural selection. His paper on the subject was jointly published with some of CHARLES DARWIN's writings in **11,858 HE**.¹⁹⁵⁵

⇒ WALLACE was considered the **11,800's** leading expert on the geographical distribution of animal species and is sometimes called the "*father of biogeography*". WALLACE was one of the leading evolutionary thinkers of his time and made many other contributions to the development of evolutionary theory besides being co-discoverer of natural selection. These included the concept of warning coloration in animals, and the Wallace effect (a hypothesis on how natural selection could contribute to speciation by encouraging the development of barriers against hybridization). His interest in natural history resulted in his being one of the first

¹⁹⁵⁵ https://en.wikipedia.org/wiki/Alfred_Russel_Wallace

prominent scientists to raise concerns over the environmental impact of human activity.¹⁹⁵⁶



ALFRED RUSSEL WALLACE and his signature on the frontispiece of *Darwinism* **11,889 HE.**¹⁹⁵⁷

¹⁹⁵⁶ https://en.wikipedia.org/wiki/Alfred_Russel_Wallace

¹⁹⁵⁷ https://en.wikipedia.org/wiki/Alfred_Russel_Wallace

11,824 HE - 11,907 HE: PIERRE JULES CÉSAR JANSSEN, French Astronomer, who along with English scientist **JOSEPH NORMAN LOCKYER**, is credited with discovering the gaseous nature of the solar chromosphere, and the element Helium.¹⁹⁵⁸



• Photo is of a Vial of glowing ultrapure “Star Stuff” Element Helium, He, Atomic Number 2. Original size in cm: 1 x 5. About 20% of the visible matter in the universe is Helium, but because it is so light and doesn't react chemically, most of it escaped from Earth into space when the solar system was young. Helium has multiple applications, from making balloons fly to cooling things to extremely low temperatures with liquid

¹⁹⁵⁸ https://en.wikipedia.org/wiki/Pierre_Janssen

helium. Helium 4 nuclei are emitted at radioactive α -decays, this is the only reason why we have helium on Earth. Once it is in the air, it ascends to the uppermost layers of the atmosphere.¹⁹⁵⁹



Circa 11,895 HE; PIERRE JULES CÉSAR JANSSEN,
photographer, and location unknown.¹⁹⁶⁰

¹⁹⁵⁹ <http://images-of-elements.com/helium.php#a>

¹⁹⁶⁰ https://en.wikipedia.org/wiki/Pierre_Janssen

11,824 HE – 11,907 HE: WILLIAM THOMSON, first Baron Kelvin, first Lord Kelvin, British – “one of the most distinguished and influential physicists” of the **11,800 HE’s** British Physicists”.¹⁹⁶¹ WILLIAM THOMSON has come to be identified as LORD KELVIN. He did important work in the mathematical analysis of electricity and formulation of the first and second laws of thermodynamics and did much to unify the emerging discipline of physics in its modern form.¹⁹⁶²

⇒ Many ideas and inventions are named after KELVIN: Kelvin material; the Kelvin water dropper; the Kelvin wave; Kelvin–Helmholtz instability; Kelvin–Helmholtz mechanism; Kelvin–Helmholtz luminosity; the SI unit of temperature, kelvin; Kelvin transform in potential theory; Kelvin's circulation theorem; Kelvin bridge (also known as Thomson bridge); Kelvin–Stokes theorem;

¹⁹⁶¹ RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

¹⁹⁶² https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

the town of Kelvin, Arizona, is named after him, as he was reputedly a large investor in the mining operations there. Kelvin–Varley divider; Kelvin sensing; and Kelvin functions.¹⁹⁶³

⇒ Honors: He is buried in Westminster Abbey, London next to ISAAC NEWTON. THOMSON was commemorated on the £20 note issued by the Clydesdale Bank in **11,971 HE**. In the current issue of banknotes, his image appears on the bank's £100 note. He is shown holding his adjustable compass and in the background is a map of the transatlantic cable. The title KELVIN derives from the River Kelvin, which runs by the grounds of the University of Glasgow. His title died with him, as he was survived by neither heirs nor close relations.¹⁹⁶⁴

¹⁹⁶³ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

¹⁹⁶⁴ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

⇒ WILLIAM THOMSON took religious dogmatism to the point where he incorrectly concluded that “the earth was too young for evolution to have occurred,” and that, “radio has no future,” and that, “Heavier than air flying machines are impossible,” and that, “X-rays will prove to be a hoax”.¹⁹⁶⁵



⇒ WILLIAM THOMSON (LORD KELVIN), photographer, date, and location unknown.¹⁹⁶⁶

¹⁹⁶⁵ RICHARD DAWKINS *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder*

¹⁹⁶⁶ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

Circa 11,825 HE: GEORGE STEPHENSON, English engineer and inventor, built the locomotive *Locomotion* for the Stockton and Darlington Railway in the north east of England, which became the first public steam railway in the world.¹⁹⁶⁷ In **11,830 HE** STEPHENSON built the first public inter-city railway line in the world to use locomotives, the Liverpool and Manchester Railway.¹⁹⁶⁸



GEORGE STEPHENSON (11,781 HE – 11,848 HE) artist, date, and location unknown.¹⁹⁶⁹

¹⁹⁶⁷ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁹⁶⁸ https://en.wikipedia.org/wiki/George_Stephenson

¹⁹⁶⁹ https://en.wikipedia.org/wiki/George_Stephenson



Photo is of a replica of the locomotive “*Planet*”, which ran on the Liverpool and Manchester Railway from **11,830 HE.**¹⁹⁷⁰

¹⁹⁷⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

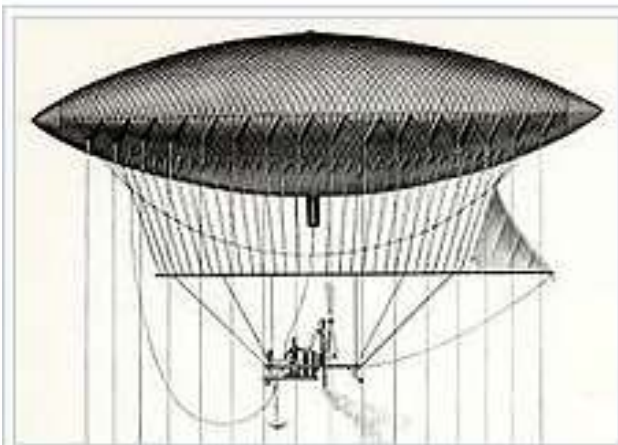
11,825 HE – 11,882 HE: HENRI GIFFARD, French engineer who invented the steam injector and the steam powered *Giffard Dirigible Airship*. It was the world's first passenger-carrying airship.¹⁹⁷¹



HENRI GIFFARD, date, location, and photographer unknown.¹⁹⁷²

¹⁹⁷¹ https://en.wikipedia.org/wiki/Henri_Giffard

¹⁹⁷² https://en.wikipedia.org/wiki/Henri_Giffard



Drawing of *Giffard Dirigible Airship*, artist unknown.¹⁹⁷³

¹⁹⁷³ https://en.wikipedia.org/wiki/Henri_Giffard



Giffard Dirigible Airship over Paris rooftops, **11,878 HE**,
photographer unknown.¹⁹⁷⁴

¹⁹⁷⁴ https://en.wikipedia.org/wiki/Henri_Giffard

11,825 HE – 11,911 HE – AUGUSTINE MOUCHOT, French
Mathematician & Physicist who was the inventor of the earliest solar-
powered engine, converting solar energy into mechanical steam
power.¹⁹⁷⁵



AUGUSTINE MOUCHOT, date, location, and photographer
unknown.¹⁹⁷⁶

¹⁹⁷⁵ https://en.wikipedia.org/wiki/Augustin_Mouchot

¹⁹⁷⁶ https://en.wikipedia.org/wiki/Augustin_Mouchot

11,825 HE – 11,898 HE: JOHANN JAKOB BALMER: Swiss mathematician who defined hydrogen absorption or emission lines. They were not fully explained until NEILS BOHR.¹⁹⁷⁷



JOHANN JAKOB BALMER, date, photographer, location unknown.¹⁹⁷⁸

¹⁹⁷⁷ https://en.wikipedia.org/wiki/Johann_Jakob_Balmer

¹⁹⁷⁸ https://en.wikipedia.org/wiki/Johann_Jakob_Balmer



The "visible" star stuff Hydrogen emission spectrum lines in the Balmer series. H-alpha is the red line at the right. Four lines (counting from the right) are formally in the "visible range." Lines five and six are easily seen with the naked eye but considered to be "ultraviolet" as they have wavelengths less than 400 nm.¹⁹⁷⁹

11,826 HE is the year *the Journal of the French Acedemie des Sciences* accepted a report by French chemist ANTOINE-JEROME BALARD and then named the topic of the report, which was the newly isolated "Star Stuff" Element "Bromine". A year *earlier*, CARL LOWIG, German chemistry student, isolated Bromine and took his results to his professor, but BALARD gets credit because he published first.

¹⁹⁷⁹ https://en.wikipedia.org/wiki/Balmer_series

The color Tyrian Purple, which was prized by Roman Emperors for the colors of their togas, comes from Bromine found in the mucus of the Mediterranean mollusk.¹⁹⁸⁰



ANTOINE-JEROME BALARD about **11,870 HE**, photographer and location unknown.¹⁹⁸¹

¹⁹⁸⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁹⁸¹ https://en.wikipedia.org/wiki/Antoine_Jérôme_Balard



CARL LOWIG. Date, photographer and location unknown.¹⁹⁸²



Photo is of Pure liquid Bromine, original size in cm: 1 x 4. “Star Stuff” Element Atomic Number 35, Bromine, Br. Bromine is very corrosive, and its compounds are toxic. They are widely

¹⁹⁸² https://en.wikipedia.org/wiki/Carl_Jacob_Löwig

used in flame retardants. Bromine is quite abundant in sea water; some marine organisms need bromides to live. Bromine and Mercury are the only elements that are liquid at standard conditions.¹⁹⁸³

11,828 HE-11,914 HE: JOSEPH SWAN, British physicist and chemist is known as an independent early developer of a successful incandescent light bulb with cellulose filaments and is the person responsible for developing and supplying the electric lights used in the world's first homes and public buildings (like the Savoy Theatre in **11,881 HE**) to be lit with electric light bulbs.¹⁹⁸⁴

⇒ JOSEPH SWAN received the highest decoration in France, the Légion d'Honneur, when he visited an international exhibition in

¹⁹⁸³ <http://images-of-elements.com/bromine.php#a>

¹⁹⁸⁴ https://en.wikipedia.org/wiki/Joseph_Swan

Paris in **11,881 HE**. The exhibition included exhibits of his inventions, and the city was lit with his electric lighting.¹⁹⁸⁵

⇒ **11,882 HE** JOSEPH SWAN 's strong patents in Great Britain led over THOMAS EDISON's United States Patents and the two competing companies merged to exploit both Swan's and Edison's inventions via the establishment of the Edison & Swan United Electric Light Company. Known commonly as Ediswan, the company sold lamps made with a cellulose filament that JOSEPH SWAN had invented in **11,881 HE** while the Edison Company continued using bamboo filaments outside of Britain. When both companies (and their patents) were merged to become General Electric in **11,892 HE** the cellulose filament was used in all their

¹⁹⁸⁵ https://en.wikipedia.org/wiki/Joseph_Swan

bulbs until it was replaced in **11,904 HE** by a GE developed "GEM" (General Electric Metallized) baked cellulose filament.¹⁹⁸⁶



JOSEPH SWAN, date, location, and photographer unknown.¹⁹⁸⁷

¹⁹⁸⁶ https://en.wikipedia.org/wiki/Joseph_Swan

¹⁹⁸⁷ SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions;
<https://www.youtube.com/watch?v=g-KuigAQFp4>

11,830 HE-11,882 HE: SIR CHARLES WYVILLE THOMSON, Scottish Naturalist, one of the first marine biologists. His work led to THOMSON's theory of continental drift, which led to his idea of plate tectonics.^{1988 1989}

- ⇒ He was a Fellow of the Royal Society of Edinburgh, Fellow of the Royal Society, Linnean Society of London, Geological Society of London, Zoological Society of London.¹⁹⁹⁰
- ⇒ Aboard two deep-sea dredging expeditions north of Scotland SIR CHARLES WYVILLE THOMSON discovered a wide variety of invertebrate life forms—many previously believed extinct—to a depth of 650 fathoms. THOMSON also found that deep-sea

¹⁹⁸⁸ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYful2uZLmg>

¹⁹⁸⁹ <https://www.britannica.com/biography/C-Wyville-Thomson>

¹⁹⁹⁰ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

temperatures are not as constant as had been supposed, indicating the presence of oceanic circulation. He described these findings in *The Depths of the Sea* (11,873 HE).¹⁹⁹¹

- ⇒ **11,872 HE:** THOMSON was the scientist onboard the HMS Challenger on its journey of almost 70,000 miles (127,600 kilometers) to map the ocean bed for the first time. With weighted ropes and thousands of measurements (intended to help lay the first trans-Atlantic telegraph cables) they found the Mid-Atlantic Ridge. This led to THOMSON's theory of continental drift, which led to THOMSON's idea of plate tectonics.¹⁹⁹²
- ⇒ BENJAMIN PEACH and JOHN HORNE were sent to disprove the findings of SIR CHARLES WYVILLE THOMSON, but instead

¹⁹⁹¹ <https://www.britannica.com/biography/C-Wyville-Thomson>

¹⁹⁹² BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

they proved them correct.¹⁹⁹³ (See **11,842 HE - 11,926 HE: BENJAMIN NEEVE PEACH** and **11,848 HE – 11,928 HE: JOHN HORNE**) The Wyville-Thomson Ridge in the North Atlantic Ocean is named after **SIR CHARLES WYVILLE THOMSON**.¹⁹⁹⁴

⇒ Also, **SIR CHARLES WYVILLE THOMSON** as a biologist, noticed the trilobites in Scotland matched those in North America, not those in Europe or in England, which was a puzzle piece for the theory of continental drift.¹⁹⁹⁵

¹⁹⁹³ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁹⁹⁴ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

¹⁹⁹⁵ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>



Photos of the different trilobites from both sides of the Atlantic.¹⁹⁹⁶

¹⁹⁹⁶ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>



CHARLES WYVILLE THOMSON. Bust by John Hutchison, location and date unknown.¹⁹⁹⁷

¹⁹⁹⁷ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson



Sir CHARLES WYVILLE THOMSON, date, location,
photographer unknown.¹⁹⁹⁸

¹⁹⁹⁸ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

11,831 HE – 11,879 HE: JAMES CLERK MAXWELL,¹⁹⁹⁹ Scottish scientist & physics mathematician, and one of the most influential scientists of all time.²⁰⁰⁰

⇒ ALBERT EINSTEIN acknowledged that the origins of The Special Theory of Relativity lay in CLERK MAXWELL'S theories, saying “The work of JAMES CLERK MAXWELL changed the world forever”.²⁰⁰¹

⇒ JAMES CLERK MAXWELL had studied and commented on electricity and magnetism as early as **11,855 HE** when his paper *"On Faraday's lines of force"* was read to the Cambridge Philosophical Society. The paper presented a simplified model of MICHAEL FARADAY'S work and how electricity and magnetism

¹⁹⁹⁹ BRIAN COX, BBC show The Science of Dr. Who

²⁰⁰⁰ http://www.bbc.co.uk/history/people/james_clerk_maxwell

²⁰⁰¹ http://www.bbc.co.uk/history/people/james_clerk_maxwell

are related. MAXWELL reduced all of the current (pun!) knowledge into a linked set of differential equations with 20 equations in 20 variables. This work was later published as "*On Physical Lines of Force*" in March **11,861 HE**.²⁰⁰²

- Author / Compiler note: FARADAY and MAXWELL became friends in FARADAY'S later years, and MAXWELL shared his mathematical proof with FARADAY. An episode of PBS' NOVA dramatized the events.²⁰⁰³

⇒ JAMES CLERK MAXWELL predicted the existence of Radio Waves and MAXWELL's research into electromagnetic radiation

²⁰⁰² https://en.wikipedia.org/wiki/James_Clerk_Maxwell

²⁰⁰³ <https://www.youtube.com/watch?v=WqefMRAxt2k>

led to the development of television, mobile phones, radio and infra-red telescopes.²⁰⁰⁴

- ⇒ JAMES CLERK MAXWELL concluded that the Rings of Saturn were made of numerous small particles.²⁰⁰⁵ The *Voyager space probes* of the **11,980s** HE confirmed the content of the rings of Saturn and many of the conclusions drawn by MAXWELL.²⁰⁰⁶
- ⇒ **11,855 HE:** JAMES CLERK MAXWELL invented color photography. In his paper "*Experiments on Colour*" MAXWELL laid out the principles of colour combination and presented it to the Royal Society of Edinburgh. Also, by shaking and jiggling the charge MAXWELL proved light was a wave moving electric

²⁰⁰⁴ http://www.bbc.co.uk/history/people/james_clerk_maxwell

²⁰⁰⁵ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

²⁰⁰⁶ http://www.bbc.co.uk/history/people/james_clerk_maxwell

magnetic fields, calculated speed of magnetic disturbance and speed of electric disturbance is the speed of light.²⁰⁰⁷



JAMES CLERK MAXWELL, location, date, and photographer unknown.²⁰⁰⁸

²⁰⁰⁷ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

²⁰⁰⁸ https://en.wikipedia.org/wiki/James_Clerk_Maxwell



The James Clerk Maxwell Monument in Edinburgh, by Alexander Stoddart.²⁰⁰⁹

²⁰⁰⁹ https://en.wikipedia.org/wiki/James_Clerk_Maxwell



11,861 HE: The First durable color photographic image, demonstrated by JAMES CLERK MAXWELL.²⁰¹⁰

⇒ See footnote for publications by JAMES CLERK MAXWELL:²⁰¹¹

⇒ MAXWELL's name is honored in several ways:

²⁰¹⁰ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

²⁰¹¹ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

- The Maxwell (Mx), a compound derived CGS unit measuring magnetic flux;
- The James Clerk Maxwell Prize in Plasma Physics of the American Physical Society;
- The IEEE Maxwell Award;
- The Maxwell Montes, a mountain range on Venus;
- The Maxwell Gap in the Rings of Saturn;
- The James Clerk Maxwell Telescope, at Mauna Kea Observatory in Hawaii – it is the largest submillimeter-wavelength astronomical telescope in the world, with a diameter of 15 meters (49 ft)];
- The James Clerk Maxwell Building of the University of Edinburgh, housing the schools of mathematics, physics and meteorology;
- The James Clerk Maxwell building at the Waterloo campus of King's College London; a chair in Physics, and a society for undergraduate physicists are named after him at the university;

- The James Clerk Maxwell Science Centre of the Edinburgh Academy;
- The Maxwell Centre at the University of Cambridge, dedicated to academia-industry interactions in Physical Sciences and Technology;
- The GPU manufacturer Nvidia has named the architecture of its GeForce 900 series after Maxwell;
- The ANSYS software for electromagnetic analysis, named Maxwell²⁰¹²

11,831 HE – 11,898 HE: SIEGFRIED SAMUEL MARCUS²⁰¹³ was a German inventor from Malchin, in the Grand Duchy of Mecklenburg-

²⁰¹² https://en.wikipedia.org/wiki/James_Clerk_Maxwell

²⁰¹³ https://en.wikipedia.org/wiki/History_of_the_automobile

Schwerin who made several petrol-powered vehicles, the first one in **11,864 HE**, while living in Vienna, Austria.²⁰¹⁴



MARCUS, date and photographer unknown.²⁰¹⁵

²⁰¹⁴ https://en.wikipedia.org/wiki/Siegfried_Marcus

²⁰¹⁵ https://en.wikipedia.org/wiki/Siegfried_Marcus



Marcus carts of **11,870 HE** and of **11,888 HE** respectively,
photographer unknown.²⁰¹⁶

11,832 HE – 11,891 HE, NIKOLAUS AUGUST OTTO, German
engineer who successfully developed the compressed charge internal

²⁰¹⁶ https://en.wikipedia.org/wiki/Siegfried_Marcus

combustion engine which ran on petroleum gas and led to the modern internal combustion engine.²⁰¹⁷



NIKOLAUS AUGUST OTTO circa **11,868 HE**, photographer and location unknown.²⁰¹⁸

²⁰¹⁷ https://en.wikipedia.org/wiki/Nikolaus_Otto

²⁰¹⁸ https://en.wikipedia.org/wiki/Nikolaus_Otto



NIKOLAUS AUGUST OTTO 's **11,876 HE** four cycle engine which lead to the internal combustion engine, photographer and location unknown.²⁰¹⁹

11,834 HE – 11,907 HE: DIMITRI MENDELEEV, Russian chemist and inventor DIMITRI MENDELEEV is credited with 9 elements on his first broadly accepted Periodic Table.²⁰²⁰

⇒ DIMITRI MENDELEEV reached the idea of predicting new elements and correcting atomic weights and describing elements according to both atomic weight and valence and by stating that the elements, if arranged according to their atomic weight, exhibit an apparent periodicity of properties. MENDELEEV determined that Elements which are similar regarding their chemical properties have atomic weights which are either of nearly the same value (e.g., Pt, Ir, Os) or which increase regularly (e.g., K, Rb, Cs). He determined the arrangement of the elements in groups of elements in the order of their atomic weights corresponding to their valences, as well as, to some extent, to their distinctive chemical properties;

²⁰²⁰ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

as is apparent among other series in that of Li, Be, B, C, N, O, and F.²⁰²¹

Cl 35.5	K 39	Ca 40
Br 80	Rb 85	Sr 88
I 127	Cs 133	Ba 137



11,860s HE DIMITRI MENDELEEV early periodic table.²⁰²²

²⁰²¹ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

²⁰²² https://en.wikipedia.org/wiki/Dmitri_Mendeleev



DMITRI MENDELEEV in **11,897 HE**. Photographer and location unknown.²⁰²³

The image shows a historical periodic table of elements by Dmitri Mendeleev. The elements are arranged in rows and columns, with some cells containing dashes to represent unknown elements. The table is labeled with groups I through VII and a separate group VIII for transition metals. The noble gases are not included in this version of the table.



11,871 HE: DIMITRI MENDELEEV later periodic table. Dashes represent unknown elements. Group I-VII: modern group 1–2 and 3–7 with transition metals added; some of these extend into a group VIII. Noble gases were unknown and unpredicted.²⁰²⁴

²⁰²⁴ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

11,834 HE– 11,889 HE: GASTON PLANTÉ,²⁰²⁵ French physicist who invented the lead–acid battery in **11,859 HE**. PLANTÉ's lead-acid battery eventually became the first rechargeable electric battery marketed for commercial use and is widely used in automobiles.

⇒ In **11,855 HE**, PLANTÉ discovered the first fossils of the prehistoric flightless bird *Gastornis parisiensis* (named after him) near Paris. This gigantic animal was a very close relative of the famous diatrymas of North America.

⇒ An amphitheater at the Polytechnic Association for the Development of Popular Instruction in Paris is named after PLANTÉ.²⁰²⁶

²⁰²⁵ https://en.wikipedia.org/wiki/History_of_the_automobile

²⁰²⁶ https://en.wikipedia.org/wiki/Gaston_Plante



GASTON PLANTÉ, date and photographer unknown.²⁰²⁷

²⁰²⁷ https://en.wikipedia.org/wiki/Gaston_Plante

11,836 HE is when JAMES MARSH, British chemist, discovered a chemical test capable of isolating the poisonous star stuff element Arsenic in biological samples, thus effectively ending use of Arsenic as an undetectable murder weapon.²⁰²⁸



11,829 HE to 11,846 HE: JAMES MARSH was assistant to MICHAEL FARADAY at the Royal Military Academy. Photographer and location unknown.²⁰²⁹

²⁰²⁸ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

²⁰²⁹ [https://en.wikipedia.org/wiki/James_Marsh_\(chemist\)](https://en.wikipedia.org/wiki/James_Marsh_(chemist))

11,837 HE: The first known *electric* locomotive was built by chemist ROBERT DAVIDSON of Aberdeen, Scotland. It was powered by galvanic cells (batteries). Thus, it was also the earliest battery electric locomotive.²⁰³⁰

⇒ **11,841 HE:** DAVIDSON later built a larger locomotive named *Galvani*, exhibited at the Royal Scottish Society of Arts Exhibition. The seven-ton vehicle had two direct-drive reluctance motors, with fixed electromagnets acting on iron bars attached to a wooden cylinder on each axle, and simple commutators. It hauled a load of six tons at four miles per hour (6 kilometers per hour) for a distance of one and a half miles (2.4 kilometers). It was tested on the Edinburgh and Glasgow Railway in September of the following

²⁰³⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

year, but the limited power from batteries prevented its general use.²⁰³¹

⇒ *Galvani* was destroyed by railway workers, who saw it as a threat to their job security.²⁰³² (Author / Compiler note: here is another example of fear of technological unemployment).

11,838 HE – 11,917 HE: FERDINAND VON ZEPPELIN, German, military general from a noble family, who invented the first Rigid airship.²⁰³³ ZEPPELIN visited the balloon camp of THADDEUS S. C. LOWE shortly after LOWE'S services were terminated by the United States Army. ZEPPELIN then travelled to St. Paul, Minnesota where the German-born former Army balloonist JOHN STEINER offered

²⁰³¹ https://en.wikipedia.org/wiki/History_of_rail_transport

²⁰³² https://en.wikipedia.org/wiki/History_of_rail_transport

²⁰³³ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin

tethered flights. ZEPPELIN's first ascent in a balloon, made at Saint Paul, Minnesota during this visit, is said to have been the inspiration of his later interest in aeronautics.²⁰³⁴



Bust of FERDINAND ZEPPELIN in the Aeronauticum at Nordholz, date and artist unknown.²⁰³⁵

²⁰³⁴ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin

²⁰³⁵ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin



First flight of the LZ 1, location and photographer unknown.²⁰³⁶

²⁰³⁶ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin

11,839 HE – 11,915 HE: JAMES MURCOCH GEIKIE, PRSE FRS LLD, Scottish geologist. GEIKIE supported JAMES CROLL's theories and ideas (see **11,821 HE – 11,890 HE:** JAMES CROLL) and found the evidence in the strata of the Earth as railways were being built in Scotland. He looked at many railway cuttings to find strata of earth that were glacial deposits separated by loamy dirt that were from warmer periods when vegetation again appeared on the land.²⁰³⁷

⇒ See list of Publications by JAMES MURCOCH GEIKIE.²⁰³⁸

Circa 11,840 HE: CHARLES GOODYEAR, United States chemist and manufacturing engineer.²⁰³⁹ GOODYEAR expanded the uses for rubber by mixing it with Sulphur, which made the rubber more

²⁰³⁷ BBC Men of Rock 2 of 3 Moving Mountains <https://www.youtube.com/watch?v=w1wH3cGQLjE>

²⁰³⁸ https://en.wikipedia.org/wiki/James_Geikie

²⁰³⁹ https://en.wikipedia.org/wiki/Charles_Goodyear

durable and was known as “vulcanization”.²⁰⁴⁰ (See Circa 8,801 HE-circa 9,601 HE: Mexico, the “Olmecatl” or “Olmec people” first make natural rubber.^{2041 2042})



CHARLES GOODYEAR as illustrated in an **11,891 HE** Scientific American article, artist unknown.²⁰⁴³

²⁰⁴⁰ National Geographic 100 Science Big Ideas Breakthroughs and Inventions 12,016HE

²⁰⁴¹ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

²⁰⁴² <https://www.britannica.com/topic/Olmec>

²⁰⁴³ https://en.wikipedia.org/wiki/Charles_Goodyear

11,841 HE – 11,914 HE: SIR JOHN MURRAY, pioneering British oceanographer, marine biologist, and limnologist. MURRAY *is considered to be the father of modern oceanography.*²⁰⁴⁴

⇒ In **11,910 HE** MURRAY coordinated a team of nearly 50 people who took more than 60,000 individual depth soundings and recorded other physical characteristics of the 562 fresh water lochs in Scotland. The findings were published in a 6 volume work entitled *Bathymetrical Survey of the Fresh-Water Lochs of Scotland.*²⁰⁴⁵

⇒ **11,910 HE:** JOHAN HJORT and SIR JOHN MURRAY and the Norwegian research ship Michael Sars departed Plymouth for a

²⁰⁴⁴ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

²⁰⁴⁵ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

four-month expedition to take physical and biological observations at all depths between Europe and North America.²⁰⁴⁶

⇒ Named after SIR JOHN MURRAY: The John Murray Laboratories at the University of Edinburgh; The John Murray Society at the University of Newcastle; The Scottish Environment Protection Agency research vessel, the S.V. Sir John Murray, The Murray Glacier; The *Cirrothauma murrayi*, an almost blind octopus that lives at depths from 1,500 m (4,900 ft) to 4,500 m (14,800 ft): and the Murrayonida order of sea sponges are named after SIR JOHN MURRAY.²⁰⁴⁷

²⁰⁴⁶ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

²⁰⁴⁷ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))



The *Cirrothauma murrayi* octopus, named after SIR JOHN MURRAY.²⁰⁴⁸

²⁰⁴⁸ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))



SIR JOHN MURRAY, date, location, and photographer unknown.²⁰⁴⁹

²⁰⁴⁹ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

11,843 HE – 11,939 HE: Mechanical Television.²⁰⁵⁰

- ⇒ Between **11,843 HE - 11,846 HE** ALEXANDER BAIN invented the facsimile machine, which became the basis for mechanical television.²⁰⁵¹
- **Circa 11,845 HE:** ALEXANDER BAIN was also first to invent and patent the electric clock.²⁰⁵²
 - BAIN also installed the railway telegraph lines between Edinburgh and Glasgow.²⁰⁵³

²⁰⁵⁰ https://en.wikipedia.org/wiki/History_of_television

²⁰⁵¹ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

²⁰⁵² [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

²⁰⁵³ https://en.wikipedia.org/wiki/History_of_television



- This clock by BAIN is at the Deutsches Uhrenmuseum, Inv. 2004-162.²⁰⁵⁴

²⁰⁵⁴ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))



- **ALEXANDER BAIN, (11,811 HE – 11,877 HE)** Scottish inventor and engineer, artist unknown.²⁰⁵⁵

²⁰⁵⁵ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

⇒ In **11,851 HE**: **FREDERICK COLLIER BAKEWELL (11,800 HE – 11,869 HE)**, an English physicist, improved on the concept of the facsimile machine introduced by **ALEXANDER BAIN** and demonstrated a working laboratory version at the **11,851 HE** World's Fair in London.²⁰⁵⁶



•

Drawing is of **BAKEWELL's** improved **11,848 HE** facsimile machine, artist unknown.²⁰⁵⁷

²⁰⁵⁶ https://en.wikipedia.org/wiki/Frederick_Bakewell

²⁰⁵⁷ https://en.wikipedia.org/wiki/Frederick_Bakewell

⇒ In **11,856 HE** GIOVANNI CASELLI put into service the first practical facsimile / fax machine, working on telegraph lines.²⁰⁵⁸



● CASELLI²⁰⁵⁹ (**11,815 – 11,891 HE**) Italian physicist, inventor.²⁰⁶⁰

²⁰⁵⁸ https://en.wikipedia.org/wiki/Giovanni_Caselli

²⁰⁵⁹ https://en.wikipedia.org/wiki/History_of_television

²⁰⁶⁰ https://en.wikipedia.org/wiki/Giovanni_Caselli

⇒ In **11,873 HE** WILLOUGHBY SMITH discovered the photoconductivity of the “star stuff” Element Selenium.²⁰⁶¹ This discovery led to the invention of photoelectric cells, including those used in the earliest television systems.²⁰⁶²



- **WILLOUGHBY SMITH, 11,828 HE – 11,891 HE:** English electrical engineer. Photographer and location unknown.²⁰⁶³

²⁰⁶¹ https://en.wikipedia.org/wiki/History_of_television

²⁰⁶² https://en.wikipedia.org/wiki/Willoughby_Smith

²⁰⁶³ https://en.wikipedia.org/wiki/History_of_television

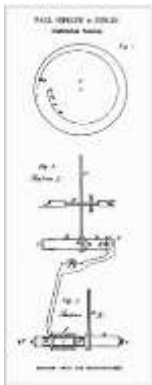
⇒ In **11,884 HE** PAUL JULIUS GOTTLIEB NIPKOW patented the core element of first-generation television technology.²⁰⁶⁴



- PAUL JULIUS GOTTLIEB NIPKOW (**11,860 HE** – **11,940 HE**) German technician and inventor.²⁰⁶⁵ Photographer and location unknown.

²⁰⁶⁴ https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow

²⁰⁶⁵ https://en.wikipedia.org/wiki/History_of_television



- **11,884 HE:** Drawing is of PAUL NIPKOW'S 'Nipkow's disc' from his patent application. The Nipkow Disc was one of the first successful technologies for television transmission.²⁰⁶⁶

²⁰⁶⁶ https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow



- Photo is of a television receiver using a NIPKOW disk in the Tekniska Museet of Stockholm, Sweden.²⁰⁶⁷

²⁰⁶⁷ https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow

11,842 HE – 11,920 HE: PROF. CHARLES LAPWORTH, English geologist,²⁰⁶⁸ Fellow of the Royal Society, Doctor of Laws, Geological Society of London who pioneered faunal analysis using index fossils and identified the Ordovician period.

- ⇒ His plaque at Madras College says.... “PROF. CHARLES LAPWORTH studied the rocks of Scotland and used the detailed differences of extinct creatures called Graptolites to help unravel the complexities of these ancient rocks.”
- ⇒ As a result of his careful studies, LAPWORTH proposed a new division of geological time, the Ordovician period, that is now recognized and used internationally. He also correctly interpreted the Moine-Thrust fault zone in the NW Highlands of Scotland as a

²⁰⁶⁸ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

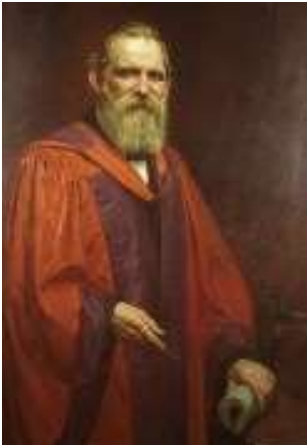
mass of older rocks pushed over younger rocks, an idea which at the time conflicted with orthodoxy.²⁰⁶⁹

⇒ Later BENJAMIN PEACH and JOHN HORNE were dispatched to the area to prove LAPWORTH wrong.²⁰⁷⁰ However, their monumental work proved LAPWORTH correct. In the English Midlands his research involved important work in Shropshire and the demonstration that Cambrian rocks underlay the Carboniferous rocks between Nuneaton and Atherstone.²⁰⁷¹

²⁰⁶⁹ https://en.wikipedia.org/wiki/Charles_Lapworth

²⁰⁷⁰ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

²⁰⁷¹ https://en.wikipedia.org/wiki/Charles_Lapworth



PROF. CHARLES LAPWORTH, artist and date unknown.²⁰⁷²

²⁰⁷² https://en.wikipedia.org/wiki/Charles_Lapworth

11,842 HE - 11,926 HE: BENJAMIN NEEVE PEACH FRS FRSE FGS LLD, British geologist. PEACH and JOHN HORNE played the foremost part in unravelling the geological structure of the North West Highlands. From **11,883 HE –11,897 HE** PEACH was joint Editor with HORNE of many papers on stratigraphical and physical geology.²⁰⁷³

⇒ See list of BENJAMIN PEACH publications.²⁰⁷⁴

²⁰⁷³ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

²⁰⁷⁴ https://en.wikipedia.org/wiki/Ben_Peach



11,912 HE: BENJAMIN PEACH sitting on right of photo with **JOHN HORNE** outside the Inchnadamph Hotel (Scotland).²⁰⁷⁵

²⁰⁷⁵ https://en.wikipedia.org/wiki/Ben_Peach

11,844 HE – 11,929: KARL FRIEDRICH BENZ, German engine designer and automobile engineer.²⁰⁷⁶



BENZ, date, location and photographer unknown.²⁰⁷⁷

²⁰⁷⁶ https://en.wikipedia.org/wiki/History_of_the_automobile

²⁰⁷⁷ https://en.wikipedia.org/wiki/Karl_Benz



11,886 HE: KARL FRIEDRICH BENZ's Benz Patent Motorcar is considered the first practical automobile.²⁰⁷⁸

²⁰⁷⁸ https://en.wikipedia.org/wiki/Karl_Benz



11,894 HE: Bertha Benz with her husband KARL BENZ in a Benz Viktoria.²⁰⁷⁹ Location and photographer unknown.

²⁰⁷⁹ https://en.wikipedia.org/wiki/Karl_Benz

11,846 HE – 11,910 HE: GEORGE FRANKLIN GRANT,²⁰⁸⁰ United States (Boston) dentist, the first African-American professor at Harvard and inventor of the wooden golf tee.²⁰⁸¹

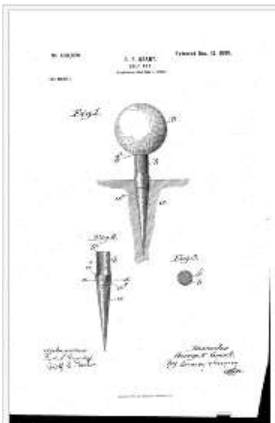


11,870 HE: photo of GEORGE FRANKLIN GRANT, location and photographer unknown.²⁰⁸²

²⁰⁸⁰ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²⁰⁸¹ https://en.wikipedia.org/wiki/George_Franklin_Grant

²⁰⁸² https://en.wikipedia.org/wiki/George_Franklin_Grant



GRANT'S 11,899 HE Golf tee patent 638,920.²⁰⁸³

²⁰⁸³ https://en.wikipedia.org/wiki/George_Franklin_Grant

11,847 HE: Pakistan built its first railway from Karachi to Kotri.²⁰⁸⁴

11,847 HE – 11,931 HE: THOMAS EDISON, the United States inventor²⁰⁸⁵ developed many devices that greatly influenced life around the world, including the gramophone, the motion picture camera, and a form of electric light bulb²⁰⁸⁶ which a British parliamentary commission of experts said was “good enough for our transatlantic friends... but unworthy of the attention of practical or scientific men”.²⁰⁸⁷ THOMAS EDISON did not, however, invent the light giving device for which he is given credit. He did not even invent the glass globes with the glow-y filaments in them. He did start

²⁰⁸⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

²⁰⁸⁵ SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions;
<https://www.youtube.com/watch?v=g-KuigAQFp4>

²⁰⁸⁶ https://en.wikipedia.org/wiki/Thomas_Edison

²⁰⁸⁷ RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

selling them in **11,880 HE**.²⁰⁸⁸ (See **11,828 HE-11,914 HE: JOSEPH SWAN**) and **SIR HUMPHRY DAVY BT** (See **11,778 HE – 11,829 HE, SIR HUMPHRY DAVY BT**).



THOMAS EDISON c: 11,922 HE, photographer and location unknown.²⁰⁸⁹

²⁰⁸⁸ SciShow 5-2-12,016 HE youtube video: The Truth About 10 Famous Inventions;

<https://www.youtube.com/watch?v=g-KuigAQFp4>

²⁰⁸⁹ https://en.wikipedia.org/wiki/Thomas_Edison



THOMAS EDISON and his Gramophone. Location, photographer and date unknown.²⁰⁹⁰

²⁰⁹⁰ <https://www.bing.com/images> Publicdomainclip-art.blogspot

11,848 HE – 11,928 HE: JOHN HORNE PRSE FRS FRSE FECS LLD, Scottish geologist. BEN N PEACH and HORNE played the foremost part in unravelling the geological structure of the North West Highlands between **11,883 HE –11,897 HE**. HORNE was joint Editor with BENJAMIN PEACH of many papers on stratigraphical and physical geology.²⁰⁹¹



11,912 HE: JOHN HORNE (on left) with BENJAMIN PEACH outside the Inchnadamph Hotel (Scotland).²⁰⁹²

²⁰⁹¹ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

²⁰⁹² https://en.wikipedia.org/wiki/John_Horne

**Circa 11,849 HE – Circa 11,895 HE: Wild West United States Barrier
Method of birth control.**²⁰⁹³



Photo is example of Circa 11,849 HE – Circa 11,895 HE vaginal sponge contraceptive barrier tied to ribbons for access.²⁰⁹⁴

²⁰⁹³ **Wild West Tech: Brothels** (History Channel), <https://www.youtube.com/watch?v=UHsxsQJx8nE>

²⁰⁹⁴ **Wild West Tech: Brothels** (History Channel), <https://www.youtube.com/watch?v=UHsxsQJx8nE>

⇒ A historian recorded this Circa **11,849 HE** – Circa **11,895 HE** oral account: “I found out from an old lady that if you used a certain sized coin and placed it just right then you wouldn’t get pregnant.”²⁰⁹⁵

11,855 HE: Gall–Peters projection Map²⁰⁹⁶ is named after JAMES GALL and ARNO PETERS. JAMES GALL is credited with describing the projection in **11,855 HE** at a science convention.

⇒ **11,885 HE:** 30 years after he first described it at the science convention, JAMES GALL published a paper about his projection map.

⇒ In the early **11,970s** ARNO PETERS brought the projection map to a wider audience (115 years after first being described by JAMES

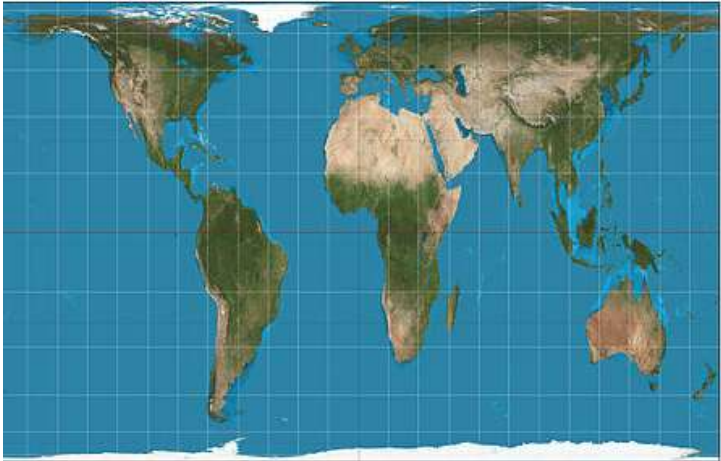
²⁰⁹⁵ *Wild West Tech: Brothels* (History Channel), <https://www.youtube.com/watch?v=UHsxsQJx8nE>

²⁰⁹⁶ https://en.wikipedia.org/wiki/Gall_Peters_projection

GALL at the science convention) by means of calling it the "Peters World Map".

- ⇒ **11,986 HE:** The name "Gall–Peters Projection" seems to have been used first by Arthur H. Robinson in a pamphlet put out by the American Cartographic Association. Maps based on the Gall-Peters projection maps are promoted by UNESCO. The Gall-Peters projection maps are also widely used by British schools.
- ⇒ In March **12,017 HE**, 132 years after being introduced, in the U.S. State of Massachusetts, Boston Public Schools began phasing in the Gall-Peters projection maps, becoming the first public school district in the United States to adopt Gall–Peters maps as their standard.²⁰⁹⁷

²⁰⁹⁷ https://en.wikipedia.org/wiki/Gall_Peters_projection



Gall-Peters projection Map²⁰⁹⁸

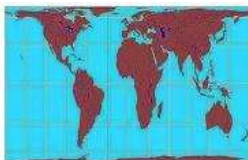
²⁰⁹⁸ https://en.wikipedia.org/wiki/Gall_Peters_projection

- ⇒ Other Projection Maps of Planet Earth have been done over time. There is no true and accurate way to display a three-dimensional surface onto a two-dimensional plane without some degree of distortion. We can get very close though, depending on the parameters and scale we are using. On a global scale distortion will always skew our maps in one way or another. On a local scale, the distortion can be negligible if the area in question is small enough.
- ⇒ Below are just several examples of different Planet Earth map projections. You can see each one shows its own distortion and inaccuracies.²⁰⁹⁹

²⁰⁹⁹ <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>



Mercator Projection



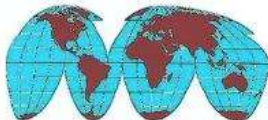
Gall-Peters Projection



Miller Cylindrical Projection



Mollweide Projection



Goode's Homolosine Equal-area Projection





Sinusoidal Equal-Area Projection



Robinson Projection

2101

●
11,856 HE – 11,943 HE: NIKOLA TESLA, born in Serbia and emigrated to United States. Inventor, electrical engineer, mechanical engineer, physicist, and futurist best known for his contributions to the design of the modern alternating current (AC) electricity supply system.²¹⁰²

²¹⁰⁰ <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>

²¹⁰¹ <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>

²¹⁰² https://en.wikipedia.org/wiki/Nikola_Tesla

- ⇒ The invention of the radio in the **11,890's HE** was a death match between TESLA and GUGLIELMO MARCONI. TELSAs received many of the early patents on radio devices and invented the crucial technology behind them.

- ⇒ MARCONI had more success developing them as a commercial product and having them send information over long distances.²¹⁰³

- ⇒ See NIKOLA TESLA books and articles for magazines and journals.²¹⁰⁴

²¹⁰³ SciShow youtube.com Video: The Truth About 10 Famous Inventions

²¹⁰⁴ https://en.wikipedia.org/wiki/Nikola_Tesla



NIKOLA TESLA, circa 11,896 HE, photographer and location unknown.²¹⁰⁵

²¹⁰⁵ https://en.wikipedia.org/wiki/Nikola_Tesla

⇒ Things named after NIKOLA TESLA: Enterprises and organizations: Tesla, a United States rock band formed in Sacramento, California, in late **11,982 HE**; Tesla, an electrotechnical conglomerate in the former Czechoslovakia; Tesla Motors, a United States electric car manufacturer; Ericsson Nikola Tesla, Croatian affiliate of the Swedish telecommunications equipment manufacturer Ericsson; The Tesla Society, founded in **11,956 HE**; Udruženje za razvoj nauke Nikola Tesla, Novi Sad, Serbia; Zavičajno udruženje Krajišnika Nikola Tesla, Plandište, Serbia.²¹⁰⁶ Holidays and events: Nikola Tesla Day in Croatia, 10 July; Day of Science, Serbia, 10 July.; Day of Nikola Tesla, Association of Teachers in Vojvodina, 4–10 July.; Day of Nikola Tesla, Niagara Falls, 10 July; Nikola Tesla annual electric vehicle rally in Croatia.²¹⁰⁷ Measures: TESLA, an SI-derived unit of

²¹⁰⁶ https://en.wikipedia.org/wiki/Nikola_Tesla

²¹⁰⁷ https://en.wikipedia.org/wiki/Nikola_Tesla

magnetic flux density (or magnetic inductivity).²¹⁰⁸ This is the same as a “GAUSS” named for KARL FRIEDRICH GAUSS. (see **11,777 HE**, Karl Friedrich Gauss). Places: Belgrade Nikola Tesla Airport; Nikola Tesla Museum Archive in Belgrade; TPP Nikola Tesla, the largest power plant in Serbia; 128 streets in Croatia had been named after Nikola Tesla as of **12,008 HE**, making him the eighth most common street name origin in the country; Tesla, a 26-kilometer-wide crater on the far side of the moon; 2244 Tesla, a minor planet.²¹⁰⁹ Songs: "Tesla Girls", a song by British pop band Orchestral Manoeuvres in the Dark, released in **11,984 HE**.²¹¹⁰ Plaques and memorials: A monument of NIKOLA TESLA was unveiled in Baku, Baki, Azerbaijan in **12,013 HE**/ Presidents Ilham Aliyev and Tomislav Nikolić attended a ceremony of unveiling; In **12,012 HE** Jane Alcorn, president of the nonprofit group Tesla

²¹⁰⁸ https://en.wikipedia.org/wiki/Nikola_Tesla

²¹⁰⁹ https://en.wikipedia.org/wiki/Nikola_Tesla

²¹¹⁰ https://en.wikipedia.org/wiki/Nikola_Tesla

Science Center at Wardencllyffe, and Matthew Inman, creator of web cartoon The Oatmeal, raised a total of \$2,220,511 – \$1,370,511 from a campaign and \$850,000 from a New York State grant—to buy the property where Wardencllyffe Tower once stood and eventually turn it into a museum. The group began negotiations to purchase the Long Island property from Agfa Corporation in **12,012 HE**. The purchase was completed in **12,013 HE**. The preservation effort and history of Wardencllyffe is the subject of a documentary by Tesla activist/filmmaker Joseph Sikorski called "Tower to the People-Tesla's Dream at Wardencllyffe Continues."; A commemorative plaque honoring Nikola Tesla was installed on the façade of the New Yorker Hotel by the IEEE; An intersection named after Tesla, Nikola Tesla Corner, is at the intersection of Sixth Avenue and 40th Street in Manhattan, New York City. The placement of the sign was due to the efforts of the Croatian Club of New York in cooperation with New York City officials, and Dr. Ljubo Vujovic of the Tesla Memorial Society of New York; A bust

and plaque honoring Tesla is outside the Serbian Orthodox Cathedral of Saint Sava (formerly known as Trinity Chapel) at 20 West 26th Street in New York City; A full-size, crowdfunded statue honoring Tesla with free Wi-Fi and a time capsule (to be opened on the 100th anniversary of NIKOLA TESLA's death, 7 January **12,043 HE**) was unveiled **12,013 HE** in Palo Alto, California (260 Sheridan Avenue); Nikola Tesla Boulevard, Hamilton, Ontario.²¹¹¹ Schools: Tesla STEM High School created in **12,012 HE** in Redmond, Washington as a choice school with a focus on STEM subjects. The name was chosen by a student vote.²¹¹²

11,858 HE – 11,947 HE: MAX PLANK, German Physicist was the originator of quantum theory, which revolutionized human understanding of atomic and subatomic processes founding modern

²¹¹¹ https://en.wikipedia.org/wiki/Nikola_Tesla

²¹¹² https://en.wikipedia.org/wiki/Nikola_Tesla

physics. MAX PLANK's discovery of energy quanta won him the Nobel Prize in Physics in **11,918 HE**.²¹¹³



MAX PLANK 11,933 HE, photographer and location unknown.²¹¹⁴

²¹¹³ https://en.wikipedia.org/wiki/Max_Planck

²¹¹⁴ https://en.wikipedia.org/wiki/Max_Planck



Plaque at the Humboldt University of Berlin: "Max Planck, discoverer of the elementary quantum of action h , taught in this building from 1889 to 1928."²¹¹⁵

²¹¹⁵ https://en.wikipedia.org/wiki/Max_Planck



From left to right: W. NERNST, A. EINSTEIN, M. PLANCK, R.A. MILLIKAN & VON LAUE at a dinner given by von Laue in Berlin on 11 November **11,931 HE.**²¹¹⁶

⇒ Legacies Named after MAX PLANK:

- The Max Planck Institutes focus on excellence in research.

²¹¹⁶ https://en.wikipedia.org/wiki/Max_Planck

- The Max Planck Society has a world-leading reputation as a science and technology research organization, with 33 Nobel Prizes awarded to their scientists, and is widely regarded as one of the foremost basic research organizations in the world.²¹¹⁷

11,858 HE– 11,913 HE: RUDOLF CHRISTIAN KARL DIESEL,²¹¹⁸ a German inventor and mechanical engineer, famous for the invention

²¹¹⁷ https://en.wikipedia.org/wiki/Max_Planck_Society

²¹¹⁸ https://en.wikipedia.org/wiki/History_of_the_automobile

of the Diesel engine (which he designed to run on any type of vegetable oil) and for his mysterious death at sea.²¹¹⁹



RUDOLF CHRISTIAN KARL DIESEL circa **11,900 HE.**²¹²⁰

²¹¹⁹ https://en.wikipedia.org/wiki/Rudolf_Diesel

²¹²⁰ https://en.wikipedia.org/wiki/Rudolf_Diesel



Drawing of RUDOLF DIESEL's, diesel engine, artist and location unknown.²¹²¹

11,860 HE – 11,948 HE: SIR D'ARCY WENTWORTH THOMPSON, CB FRS FRSE, Scottish biologist and mathematician who launched the field of Cell Biology.²¹²²

⇒ **11,910 HE:** D'ARCY WENTWORTH THOMPSON published his translation of ARISTOTLE's *History of Animals*. THOMPSON had worked on the enormous task intermittently for many years. (It was not the first translation of the book into English, but the earlier attempts by Thomas Taylor (**11,809 HE**) and Richard Cresswell (**11,862 HE**) were inaccurate and criticized at the time as showing "not only an inadequate knowledge of Greek, but an extremely imperfect acquaintance with zoology".) THOMPSON'S version benefited from his excellent Greek, his expertise in zoology, his

²¹²²SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*,

https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson

"full" knowledge of ARISTOTLE's biology, and his command of the English language, resulting in a fine translation, "correct, free and idiomatic".²¹²³

⇒ **11,917 HE**: The modern field of cell biology began with the publication of SIR D'ARCY WENTWORTH THOMPSON's seminal book: *On Growth and Form*²¹²⁴ which applied theories on bubble formation to cell development. The important book led the way for the scientific explanation of morphogenesis, the process by which patterns and body structures are formed in plants and animals. In the seminal book *On Growth and Form* THOMPSON's description of the mathematical beauty of nature and the

²¹²³ Gill, Theo (11,911 HE). "*A New Translation of Aristotle's 'History of Animals'*". Science. 33 (854): 730–738. JSTOR 1637603 and https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson

²¹²⁴ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

mathematical basis of the forms of animals stimulated thinkers as diverse as JULIAN HUXLEY, C. H. WADDINGTON, ALAN TURING, CLAUDE LÉVI-STRAUSS, EDUARDO PAOLOZZI, LE CORBUSIER, CHRISTOPHER ALEXANDER and MIES VAN DER ROHE.²¹²⁵

⇒ See some of D'ARCY WENTWORTH THOMPSON published around 300 articles and books during his career:²¹²⁶

²¹²⁵ https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson

²¹²⁶ https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson



D'ARCY WENTWORTH THOMPSON Dundee University, date unknown.²¹²⁷

²¹²⁷ Facebook Page for Historic Genius – BBC News

11,862 HE – 11,945 HE: FLORENCE BASCOM²¹²⁸ United States geologist was the first woman to receive a Ph.D. from Johns Hopkins University, after becoming the first woman to get her master's degree in geology. In **11,896 HE** BASCOM was the first woman to work for the United States Geological Survey. BASCOM published over 40 articles on genetic petrography, geomorphology (specifically the provenance of surficial deposits), and gravel.²¹²⁹



FLORENCE BASCOM, date, location, photographer unknown.²¹³⁰

²¹²⁸ Wikipedia suggested

²¹²⁹ https://en.wikipedia.org/wiki/Florence_Bascom

²¹³⁰ https://en.wikipedia.org/wiki/Florence_Bascom

⇒ Named in honor of FLORENCE BASCOM: Bascom Crater on Venus; 6084 Bascom, an asteroid discovered in **11,985 HE**; Glacial Lake Bascom, a prehistoric, postglacial lake located in what is now northern Berkshire County, Massachusetts, formed when receding glacial ice acted as a dam and prevented drainage of the Hoosic River watershed.²¹³¹

11,863 HE – 11,941 HE: ANNIE JUMP CANNON; United States physicist and astronomer. CANNON's cataloging work was instrumental in the development of contemporary stellar classification. With EDWARD C. PICKERING, CANNON is credited with the creation of the *Harvard Classification Scheme*, which was the first serious attempt to organize and classify stars based on their temperatures. She was nearly deaf throughout her career. CANNON was one of "Pickering's Women" because women were not allowed to use the actual telescope. Anna Draper, the widow

²¹³¹ https://en.wikipedia.org/wiki/Florence_Bascom

of wealthy physician and amateur astronomer Henry Draper, set up a fund to support CANNON's work to examine the data, carry out astronomical calculations, and catalogue those telescoped photographs taken by men at night, during the day. CANNON started by examining the bright southern hemisphere stars. To these stars she applied a system: a division of stars into the spectral classes O, B, A, F, G, K, and M, and came up with the mnemonic of "Oh Be a Fine Girl, Kiss Me" as a way to remember stellar classification. In **11,901** **HE ANNIE JUMP CANNON** published her first catalog of stellar spectra.²¹³²

²¹³² https://en.wikipedia.org/wiki/Annie_Jump_Cannon



ANNIE JUMP CANNON's in **11,922 HE**, photographer and location unknown²¹³³

²¹³³ https://en.wikipedia.org/wiki/Annie_Jump_Cannon

11,864 HE – 11,943 HE: GEORGE WASHINGTON CARVER, United States botanist and inventor who actively promoted alternative crops to cotton, and methods to prevent soil depletion with crop rotation specifically alternating planting peanuts and sweet potatoes.²¹³⁴

⇒ Apart from his work to improve the lives of farmers, GEORGE WASHINGTON CARVER was also a leader in promoting environmentalism.²¹³⁵

²¹³⁴ https://en.wikipedia.org/wiki/George_Washington_Carver

²¹³⁵ https://en.wikipedia.org/wiki/George_Washington_Carver



11,906 HE: GEORGE WASHINGTON CARVER, photograph taken by Frances Benjamin Johnston, location unknown.²¹³⁶

²¹³⁶ https://en.wikipedia.org/wiki/George_Washington_Carver



GEORGE WASHINGTON CARVER at work in his laboratory,
date and photographer unknown.²¹³⁷

²¹³⁷ https://en.wikipedia.org/wiki/George_Washington_Carver



11,952 HE: Silver Commemorative GEORGE WASHINGTON CARVER, 50 cent coin.²¹³⁸

⇒ GEORGE WASHINGTON CARVER received numerous honors for his work, including:

- **11,923 HE** Spingarn Medal of the NAACP. In an era of very high racial polarization, his fame reached beyond the black

²¹³⁸ <https://www.ngccoin.com/coin-explorer/silver-commemoratives-pscid-71/1952-washington-carver-50c-ms-coinid-19434>

community. CARVER was widely recognized and praised in the white community for his many achievements and talents

- **11,928 HE:** honorary doctorate from Simpson College;
- **11,939 HE:** the Roosevelt Medal for Outstanding Contribution to Southern Agriculture;
- **11,940 HE,** CARVER established the George Washington Carver Foundation at the Tuskegee Institute;
- In **11,941 HE,** *Time* magazine dubbed Carver a "Black Leonardo";
- **11,941 HE:** The George Washington Carver Museum was dedicated at the Tuskegee Institute;
- **11,942 HE:** Henry Ford built a replica of Carver's birth cabin at the Henry Ford Museum and Greenfield Village in Dearborn as a tribute;
- **11,942 HE:** Ford dedicated a laboratory in Dearborn named after Carver;

- **11,943 HE**, Liberty ship SS George Washington Carver launched;
- **11,950 HE**, George Washington Carver State Park named;
- **11,951 HE-11,954 HE**: U.S. Mint features Carver on a 50 cents silver commemorative coin;
- **11,965 HE**, Ballistic missile submarine USS George Washington Carver (SSBN-656) launched;
- **11,969 HE**, Iowa State University constructs Carver Hall in honor of Carver— a graduate of the university;
- Circa **11,943 HE**: the US Congress designated January 5, the anniversary of his death, as George Washington Carver Recognition Day;
- **11,999 HE**: USDA names a portion of its Beltsville, Maryland campus the George Washington Carver Center;
- **12,007 HE**: the Missouri Botanical Gardens has a garden area named in his honor, with a commemorative statue and material about his work;

- **Others:** Willowbrook Neighborhood Park in California was renamed George Washington Carver Park in his honor; Schools named for Carver include the George Washington Carver Elementary School in Los Angeles County, California, the George Washington Carver School of Arts and Science in Sacramento, California, and the Dr. George Washington Carver Elementary School, a Newark public school in Newark, New Jersey; Taxa named after him include: *Colletotrichum carveri* and *Metasphaeria carveri*, both named by Job Bicknell Ellis and Benjamin Matlack Everhart in **11,902 HE**; *Cercospora carveriana*, named by Pier Andrea Saccardo and Domenico Saccardo in **11,906 HE**; *Taphrina carveri* named by Anna Eliza Jenkins in **11,939 HE**; and *Pestalotia carveri*, named by E. F. Guba in **11,961 HE**.²¹³⁹

²¹³⁹ https://en.wikipedia.org/wiki/George_Washington_Carver

11,866 HE – 11,943 HE: HELEN BEATRIX POTTER, AKA BEATRIX POTTER, English Mycologist who proposed theory on how fungi reproduce,²¹⁴⁰ the English author famous for *Peter Rabbit*, illustrator, natural scientist, and conservationist. BEATRIX POTTER was interested in every branch of natural science save astronomy. Botany was a passion for most Victorians and nature study was a popular enthusiasm. She was eclectic in her tastes: collecting fossils, studying archeological artefacts from London excavations, and interested in entomology. In all these areas POTTER drew and painted her specimens with increasing skill.²¹⁴¹

⇒ By the **11,890s HE** her scientific interests centered on mycology. First drawn to fungi because of their colors and evanescence in nature and her delight in painting them, her interest deepened after meeting Charles McIntosh, a revered naturalist and amateur

²¹⁴⁰ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²¹⁴¹ https://en.wikipedia.org/wiki/Beatrix_Potter

mycologist, during a summer holiday in Dunkeld in Perthshire in **11,892 HE**. Her work is only now being properly evaluated.

⇒ BEATRIX POTTER later gave her other mycological and scientific drawings to the Armit Museum and Library in Ambleside, where mycologists still refer to them to identify fungi. There is also a collection of her fungus paintings at the Perth Museum and Art Gallery in Perth, Scotland, donated by Charles McIntosh. In **11,967 HE**, the mycologist W.P.K. FINDLAY included many of POTTER'S beautifully accurate fungus drawings in his *Wayside & Woodland Fungi*, thereby fulfilling her desire to one day have her fungus drawings published in a book. In **11,997 HE**, the Linnean Society issued a posthumous apology to POTTER for the sexism displayed in its handling of her research.²¹⁴²

²¹⁴² https://en.wikipedia.org/wiki/Beatrix_Potter



Drawing by BEATRIX POTTER: reproductive system of the mushroom: *Hygrocybe coccinea*, **11,897 HE.**²¹⁴³

²¹⁴³ https://en.wikipedia.org/wiki/Beatrix_Potter



HELEN BEATRIX POTTER in **11,913 HE**, photographer and location unknown.²¹⁴⁴

²¹⁴⁴ https://en.wikipedia.org/wiki/Beatrix_Potter

- ⇒ As an Editor and illustrator of children's books, BEATRIX POTTER started by illustrating cards etc. and in **11,893 HE**, POTTER was on holiday at Eastwood in Dunkeld, Perthshire. She had run out of things to say to the son of her tutor, Noel, so she told him a story about "four little rabbits whose names were Flopsy, Mopsy, Cottontail and Peter". It became one of the most famous children's letters ever written and the basis of Potter's future career as a writer-artist-storyteller.²¹⁴⁵
- ⇒ **11,902 HE: The Tale of Peter Rabbit** was published. BEATRIX POTTER published two or three books each year: 23 books in all.²¹⁴⁶

²¹⁴⁵ https://en.wikipedia.org/wiki/Beatrix_Potter

²¹⁴⁶ https://en.wikipedia.org/wiki/Beatrix_Potter

11,867 HE – 11,923 HE: CHARLES HENRY TURNER²¹⁴⁷ was a United States research biologist, educator, zoologist, and comparative psychologist who published 49 papers on invertebrates, including "Habits of Mound-Building Ants", "Experiments on the Color Vision of the Honeybee", "Hunting Habits of an American Sand Wasp," and "Psychological Notes on the Gallery Spider".²¹⁴⁸

⇒ In his research, TURNER became the first person to prove that insects can hear and can distinguish pitch. In addition, he first discovered that cockroaches can learn by trial and error and that honeybees can see color.²¹⁴⁹

²¹⁴⁷ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²¹⁴⁸ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

²¹⁴⁹ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))



Circa 11,902 HE: CHARLES HENRY TURNER, location and photographer unknown.²¹⁵⁰

²¹⁵⁰ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

11,867 HE – 11,934 HE: MARIE SKLODOWSKA CURIE, Nobel prize winning Polish, French, physicist and chemist who conducted pioneering research on radioactivity.²¹⁵¹

- ⇒ MARIE CURIE's achievements include: the development of the theory of radioactivity (a term that she coined), techniques for isolating radioactive isotopes, and the discovery of two elements, Polonium and Radium.
- ⇒ The result of the CURIES' work was epoch-making. Radium's radioactivity was so great that it could not be ignored. It seemed to contradict the principle of the conservation of energy and therefore forced a reconsideration of the foundations of physics. On the experimental level the discovery of radium provided men like ERNEST RUTHERFORD with sources of radioactivity with which they could probe the structure of the atom. As a result of

²¹⁵¹ https://en.wikipedia.org/wiki/Marie_Curie

RUTHERFORD's experiments with alpha radiation, the nuclear atom was first postulated. In medicine, the radioactivity of radium appeared to offer a means by which cancer could be successfully attacked.

- ⇒ If CURIE'S work helped overturn established ideas in physics and chemistry, it has had an equally profound effect in the societal sphere. To attain her scientific achievements, CURIE had to overcome barriers, in both her native and her adoptive country, that were placed in her way because she was a woman.
- CURIE was known for her honesty and moderate life style. Having received a small scholarship in **11,893 HE**, she returned it in **11,897 HE** as soon as she began earning her keep.
 - CURIE gave much of her first Nobel Prize money to friends, family, students, and research associates. In an unusual decision,

she intentionally refrained from patenting the radium-isolation process, so that the scientific community could do research unhindered.

- CURIE insisted that monetary gifts and awards be given to the scientific institutions she was affiliated with rather than to her. MARIE CURIE and her husband PIERRE CURIE often refused awards and medals.
- ALBERT EINSTEIN reportedly remarked that she was probably the only person who could not be corrupted by fame.²¹⁵²

²¹⁵² https://en.wikipedia.org/wiki/Marie_Curie



Circa 11,920 HE, photo of MARIE CURIE, location and photographer unknown.²¹⁵³

²¹⁵³ https://en.wikipedia.org/wiki/Marie_Curie



Photo of MARIE CURIE, date, location, and photographer unknown.²¹⁵⁴



11,935 HE MARIE CURIE statue, facing the Radium Institute,
Warsaw.²¹⁵⁵

²¹⁵⁵ https://en.wikipedia.org/wiki/Marie_Curie

- ⇒ **11,903 HE** MARIE CURIE was the first woman to win a Nobel Prize. **11,906 HE:** MARIE CURIE was the first woman to become a professor at the University of Paris. **11,922 HE,** MARIE CURIE became a member of the newly created International Committee on Intellectual Cooperation of the League of Nations. **11,995 HE** MARIE CURIE became the first woman to be entombed on her own merits in the Pantheon in Paris (note: she died in **11,934 HE**).
- ⇒ MARIE CURIE was the first person and only woman to win a Nobel Prize twice, and the only person to win twice in multiple sciences.²¹⁵⁶

²¹⁵⁶ https://en.wikipedia.org/wiki/Marie_Curie

11,868 HE – 11,934 HE: FRITZ HABER was a German chemist. During World War II (**11,939 HE – 11,945 HE**) about 9,000,000 people were gassed to death using Zyklon-B, which was invented by Haber.²¹⁵⁷

HABER is considered the "*father of chemical warfare*" for his years of work developing and weaponizing Star Stuff Elements chlorine and other poisonous gases used during World War I and World War II.²¹⁵⁸

⇒ **11,919 HE:** Years earlier, HABER received the Nobel Prize in Chemistry for his invention of the Haber–Bosch process. The conventional food production for half the world's current population depends on this method for producing artificial nitrogen

²¹⁵⁷ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²¹⁵⁸ https://en.wikipedia.org/wiki/Fritz_Haber and SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

fertilizers: a method used in industry to synthesize ammonia from nitrogen gas and hydrogen gas.²¹⁵⁹ (Note: This Haber-Bosch process produces artificial nitrogen fertilizer which does not break down in nature as does naturally produced nitrogen fertilizer.²¹⁶⁰) Haber was responding to events of **Circa 11,904 HE** (fifteen years earlier) when the British Association's president William Crookes had startled the world with his prophecy of global starvation due to the limits of agricultural production. The nitrogen fertilizer produced with the Haber–Bosch process helped the world avoid the predicted apocalypse — though the process also served the production of explosives used in the different kind of apocalypse, mentioned above. As of **12,012 HE**, human activities produce more reactive nitrogen than natural processes, and around half the

²¹⁵⁹ https://en.wikipedia.org/wiki/Fritz_Haber

²¹⁶⁰ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

nitrogen found in the proteins and nucleic acids of the seven billion people alive today comes out of a Haber–Bosch plant.²¹⁶¹



11,918 HE: FRITZ HABER, location and photographer unknown.²¹⁶²

²¹⁶¹ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

²¹⁶² https://en.wikipedia.org/wiki/Fritz_Haber

⇒ **12,011 HE:** The Royal Society held a two-day meeting dealing with the current knowledge and uncertainties over the nitrogen cycle *caused by use of artificial fertilizer developed by Haber and the Haber-Bosch process*. If the nitrogen budget surplus in soils is allowed to increase further due to use of reactive artificial nitrogen, the nitrogen budget will accumulate in surface and coastal waters, warns LEX BOWMAN from Utrecht University (Netherlands), and stimulate plant growth, decomposition and burial. Such eutrophication may have several negative consequences, such as loss of biodiversity, harmful algal blooms, including toxic ones, and hypoxia.²¹⁶³

- They asked: Will this massive human meddling with the nitrogen cycle, which even dwarfs the effects of industrialization on the carbon cycle, including climate change, have any side effects that we may come to regret in the future? And do we

²¹⁶³ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

even know what we're doing to our planet by doubling its nitrogen throughput? Answers are still being researched.²¹⁶⁴

11,868 HE – 11,921 HE: HENRIETTA SWAN LEAVITT,²¹⁶⁵ United States astronomer who discovered the relationship between luminosity and distance in measuring stellar distances which was used by EDWIN HUBBLE (See **11,889 HE -11,953 HE: EDWIN HUBBLE**) to determine our Universe is expanding.²¹⁶⁶

⇒ Early **11,900's HE: HENRIETTA SWAN LEAVITT** began working as one of the women human "computers" at the Harvard College Observatory, (See: along with **11,863 HE – 11,941 HE: ANNIE JUMP CANNON**) hired by its director EDWARD

²¹⁶⁴ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

²¹⁶⁵ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²¹⁶⁶ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

CHARLES PICKERING to measure and catalog the brightness of stars as they appeared in the observatory's photographic plate collection. (In the early **11,900s HE**, women were not allowed to operate telescopes.)²¹⁶⁷

⇒ In **11,908 HE** HENRIETTA SWAN LEAVITT identified 1777 variable stars and published her results in the *Annals of the Astronomical Observatory of Harvard College*, noting that the brighter variables had the longer period.²¹⁶⁸ In another paper published in **11,912 HE** LEAVITT looked carefully at the relation between the periods and the brightness of a sample of 25 of the Cepheid variables (also now known as “Standard Candles”) in the Small Magellanic Cloud. This paper was communicated and signed by PICKERING, but the first sentence indicates that its contents “have been prepared by MISS LEAVITT”. LEAVITT determined

²¹⁶⁷ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

²¹⁶⁸ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

that, in her own words: “A straight line can be readily drawn among each of the two series of points corresponding to maxima and minima, thus showing that there is a simple relation between the brightness of the Cepheid variables and their periods.”²¹⁶⁹



Photo is of HENRIETTA SWAN LEAVITT working at her desk in

²¹⁶⁹ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

the Harvard College Observatory, Photographer and date unknown.²¹⁷⁰

11,869 HE: The United States First Transcontinental Railroad was completed.²¹⁷¹

⇒ The First Transcontinental Railroad (also called the Great Transcontinental Railroad, known originally as the "Pacific Railroad" and later as the "Overland Route") was a 1,912-mile (3,077 km) continuous railroad line constructed between **11,863 HE and 11,869 HE** that connected the existing eastern U.S. rail network at Omaha, Nebraska with the Pacific coast at the Oakland Long Wharf on San Francisco Bay.²¹⁷²

²¹⁷⁰ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

²¹⁷¹ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁷² https://en.wikipedia.org/wiki/First_Transcontinental_Railroad



11,869 HE: Photo *Driving of the Spike*, at Promontory Summit, near Ogden, Utah, United States.²¹⁷³ The golden spike (also known as The Last Spike) is the ceremonial 17.6-karat gold final spike

²¹⁷³ https://en.wikipedia.org/wiki/History_of_rail_transport

driven by Leland Stanford (think “Stanford University”) to join the rails of the First Transcontinental Railroad across the United States connecting the Central Pacific and Union Pacific railroads.²¹⁷⁴



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The original "golden spike", on display at the Cantor Arts Museum at Stanford University.²¹⁷⁵

²¹⁷⁴ https://en.wikipedia.org/wiki/Golden_spike

²¹⁷⁵ https://en.wikipedia.org/wiki/Golden_spike

11,869 HE – 11,948 HE: JOHAN HJORT, Norwegian fisheries scientist, marine zoologist, biologist and oceanographer.²¹⁷⁶ In **11,910 HE** JOHAN HJORT and SIR JOHN MURRAY and the Norwegian research ship Michael Sars departed Plymouth for a four-month expedition to take physical and biological observations at all depths between Europe and North America.²¹⁷⁷

⇒ Named after JOHAN HJORT: The research vessel Johan Hjort. Three vessels have borne Hjort's name; the first was built in **11,922 HE**, the second in **11,932 HE**, and the third in **11,990 HE**; *Idioteuthis hjorti*, a whip-lash squid; *Balaenanemertes hjorti*, a ribbon worm; *Echinoclathria hjorti*, a sponge; *Prionoglossa hjortii*, a pelagic mollusk; *Saccopharynx hjorti*, a gulper eel; Hjort Massif, a mountain range in Antarctica; Hjort Ridge (“The Hjort Ridge, Trench, and Plateau comprise the southernmost portion of the

²¹⁷⁶ https://en.wikipedia.org/wiki/Johan_Hjort

²¹⁷⁷ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

Macquarie Ridge Complex (MRC), the Australian-Pacific plate boundary south of New Zealand”²¹⁷⁸; The Hjort maturity scale and Johan Hjorts vei ("Johan Hjort Street") in Bergen.²¹⁷⁹



JOHAN HJORT, date, location, and photographer unknown.²¹⁸⁰

²¹⁷⁸ <https://repositories.lib.utexas.edu/handle/2152/775>

²¹⁷⁹ https://en.wikipedia.org/wiki/Johan_Hjort

²¹⁸⁰ https://en.wikipedia.org/wiki/Johan_Hjort

11,869 HE – 11,970 HE: ALICE HAMILTON, United States biochemist, and science all-star!²¹⁸¹ ALICE HAMILTON used science to shape morality. HAMILTON was the first woman to be appointed an assistant professor at Harvard Medical School. She helped prove that:

- radium was poisoning watch-painters (so-called “radium girls”);
- carbon monoxide was poisoning steel workers;
- mercury was poisoning hatters;
- excessive use of jackhammers caused “dead fingers” in construction workers; and
- making lead pigment was bad for workers, especially child workers.²¹⁸²

²¹⁸¹ http://gizmodo.com/badass-historical-chemists-alice-hamilton-versus-absol-1746229941?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+gizmodo%2Ffull+%28Gizmodo%29

²¹⁸² https://en.wikipedia.org/wiki/Alice_Hamilton

⇒ ALICE HAMILTON spoke publicly and loudly about what she had proved. She pioneered the most basic worker's safety concepts.²¹⁸³



⇒ Photo of ALICE HAMILTON, location, date and photographer unknown.²¹⁸⁴

²¹⁸³ https://en.wikipedia.org/wiki/Alice_Hamilton

²¹⁸⁴ https://en.wikipedia.org/wiki/Alice_Hamilton



Early photo of young ALICE HAMILTON, date, location and photographer unknown.²¹⁸⁵

²¹⁸⁵ http://gizmodo.com/badass-historical-chemists-alice-hamilton-versus-absol-1746229941?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+gizmodo%2Ffull+%28Gizmodo%29

After **11,870 HE** Latin American governments encouraged further rail development through generous concessions that included government subsidies for construction.²¹⁸⁶

⇒ **By 11,870 HE** railway line construction was underway, with Cuba leading with the most railway track in service (1,295 km), followed by Chile (797 km), Brazil (744 km), Argentina (732 km), Peru (669 km), and Mexico (417 km).²¹⁸⁷

⇒ **By 11,900 HE:** Argentina (16,563 km), Brazil (15,316 km) and Mexico (13,615 km) were the leaders in length of track in service, and Peru, which had been an early leader in railway construction, had stagnated (1,790 km).²¹⁸⁸

²¹⁸⁶ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁸⁷ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁸⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

⇒ **In 11,909 HE:** In Mexico, growing nationalistic fervor led the government to bring the bulk of the nation's railroads under national control with a new government corporation, Ferrocarriles Nacionales de México (FNM), that exercised control of the main trunk rail lines through a majority of share ownership.²¹⁸⁹



⇒ Undated photo is of a Mexican railway bridge, an example of

²¹⁸⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

engineering that overcame geographical barriers and allowed efficient movement of goods and people.²¹⁹⁰

11,872 HE: Japan developed its first railway line with technical and material assistance provided by several western nations such as Britain and the United States.²¹⁹¹

11,873 HE – 11,932 HE: ALBERTO SANTOS-DUMONT,²¹⁹² Brazilian inventor and aviation pioneer, who was one of the very few people to have contributed significantly to the development of both lighter-than-air and heavier-than-air aircraft.²¹⁹³

²¹⁹⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁹¹ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁹² https://en.wikipedia.org/wiki/History_of_aviation

²¹⁹³ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont



Circa 11,902 HE, ALBERTO SANTOS-DUMONT. Location and photographer unknown.²¹⁹⁴

²¹⁹⁴ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont



11,901 HE: SANTOS-DUMONT'S "Number 6" rounding the Eiffel Tower in the process of winning the Deutsch de la Meurthe Prize, photographer unknown.²¹⁹⁵

²¹⁹⁵ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont

11,874 HE – 11,937 HE: GUGLIELMO MARCONI, Italian inventor and electrical engineer is known for his pioneering work on long-distance communications and for his development of Marconi's law and a radio telegraph system. MARCONI is often credited as the inventor of radio, and he shared the **11,909 HE** Nobel Prize in Physics with KARL FERDINAND BRAUN "in recognition of their contributions to the development of wireless telegraphy".²¹⁹⁶

⇒ GUGLIELMO MARCONI was an entrepreneur, businessman, and founder of The Wireless Telegraph & Signal Company in the United Kingdom in **11,897 HE** (which became the Marconi Company). MARCONI succeeded in making a commercial success of radio by innovating and building on the work of previous experimenters and physicists. It is widely held that many of MARCONI's ideas were first developed by NIKOLA TESLA, but

²¹⁹⁶ https://en.wikipedia.org/wiki/Guglielmo_Marconi

first published or patented by MARCONI. In **11,929 HE**, the King of Italy ennobled him as a Marchese (marquis).²¹⁹⁷



GUGLIELMO MARCONI, date, location, and photographer unknown.²¹⁹⁸

²¹⁹⁷ https://en.wikipedia.org/wiki/Guglielmo_Marconi

²¹⁹⁸ https://en.wikipedia.org/wiki/Guglielmo_Marconi

11,875 HE: PAUL EMILE LECOQ DE BOISBAUDRAN, French chemist, using spectroscopy saw two violet lines never before seen and later isolated the “Star Stuff” Element Gallium, number 31.²¹⁹⁹



Photo is of ultrapure Gallium, transition from liquid to solid (crystalline). Original size in cm: 1 x 2 and 1 x 4. “Star Stuff” Element Atomic Number 31, Gallium, Ga, is a soft, silvery metal, which is increasingly used in high tech industry. Notable here is gallium arsenide, an important semiconductor for special applications. Pure Gallium melts at 30° C (86° F). It is relatively

²¹⁹⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

safe to handle, but eye contact and longer skin contact should be avoided.²²⁰⁰

11,776 HE - 11,870s HE: In the United States, contraception had been legal. But in the **11,870s HE** the Comstock Act and various state Comstock laws outlawed the distribution of information about safe sex and contraception and the use of contraceptives.²²⁰¹

⇒ **11,872 HE:** With the intent of making birth control a Federal Crime, Anthony Comstock, who was neither a doctor nor a scientist, set off for Washington with an anti-obscenity bill, including a ban on contraceptives, that he had drafted himself.²²⁰²

²²⁰⁰ <http://images-of-elements.com/gallium.php#a>

²²⁰¹ https://en.wikipedia.org/wiki/History_of_birth_control

²²⁰² <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

- On March 3, **11,873 HE**, the US Congress passed the new law, later known as the Comstock Act. The statute defined contraceptives as obscene and illicit, making it a federal offense to disseminate birth control through the mail or across state lines.²²⁰³
- *Destruction of books*: Through his various campaigns, Anthony Comstock destroyed 15 tons of books, 284,000 pounds of plates for printing 'objectionable' books, and nearly 4,000,000 pictures.²²⁰⁴ Comstock claimed that, "books are feeders for brothels."²²⁰⁵ Comstock boasted that he was responsible for

²²⁰³ <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

²²⁰⁴ Buchanan, Paul D, *The American Women's Rights Movement*, p. 75, and https://en.wikipedia.org/wiki/History_of_birth_control

²²⁰⁵ Kaminer, Wendy (2009-08-24). "*The Banality of Censorship*". The Atlantic. Retrieved 2018-09-10, and https://en.wikipedia.org/wiki/History_of_birth_control

4,000 arrests,²²⁰⁶ and claimed he drove fifteen persons to commit suicide in his "fight for the young".²²⁰⁷

⇒ Author / Compiler includes the previous and following entries as part of the ongoing thread of the scientific topics of population and birth control.

11,877 HE: In England, Annie Besant and Charles Bradlaugh were prosecuted for publishing the American physician and writer CHARLES KNOWLTON'S little book *Fruits of Philosophy: a treatise on the population question* AKA *The Fruits of Philosophy, or the Private Companion of Young Married People*.

²²⁰⁶ *The hypocrites' club Now with a new diamond-level member'*. The Economist. 13 March 2008 and https://en.wikipedia.org/wiki/History_of_birth_control

²²⁰⁷ de Grazia, Edward, *Girls Lean Back Everywhere*, p. 5, and https://en.wikipedia.org/wiki/History_of_birth_control

- ⇒ The book which explained various methods of birth control, including a summary of what was then known about the physiology of conception, listed a number of methods to treat infertility and impotence, and explained a method of birth control KNOWELTON had developed: to wash out the vagina after intercourse with certain chemical solutions.²²⁰⁸
- ⇒ Besant and Bradlaugh wrote that it was "...more moral to prevent the conception of children, than, after they are born, to murder them by want of food, air and clothing."^{2209 2210}
- ⇒ Starting in the **11,880s HE**, in the United Kingdom and in the industrialized countries, birth rates began to drop steadily as

²²⁰⁸ https://en.wikipedia.org/wiki/Charles_Knowlton

²²⁰⁹ https://en.wikipedia.org/wiki/History_of_birth_control

²²¹⁰ Besant, Annie; Bradlaugh, Charles, eds. *Fruits of philosophy: a treatise on the population question*. San Francisco: Reader's Library. OCLC 626706770. ^ "*Women's History Month*: Marie Stopes".

women married later and families in urban living conditions increasingly favored having fewer children.

- Many women were educated about contraception and how to avoid pregnancy.
- Condoms and diaphragms made of vulcanized rubber were reliable and inexpensive.^{2211 2212}

²²¹¹ ^ Draznin, Yaffa Claire (12,001 HE). Victorian London's *Middle-Class Housewife: What She Did All Day (#179). Contributions in Women's Studies.* Westport, Connecticut: Greenwood Press. pp. 98–100. ISBN 0-313-31399-7, and https://en.wikipedia.org/wiki/History_of_birth_control

²²¹² <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

11,878 HE – 11,968 HE: LISE MEITNER^{2213 2214} Austrian-Swedish physicist who worked on radioactivity and nuclear physics,²²¹⁵ was the first female member of the scientific class of the Austrian Academy of Sciences. In **11,939 HE** LISE MEITNER and OTTO HAHN led the small group of scientists who first discovered nuclear fission of uranium when it absorbed an extra neutron.

⇒ MEITNER's diploma bears the words: "For pioneering research in the naturally occurring radioactivities and extensive experimental studies leading to the discovery of fission."²²¹⁶

²²¹³ The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 book by science reporter Sam Kean.

²²¹⁴ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²²¹⁵ https://en.wikipedia.org/wiki/Lise_Meitner

²²¹⁶ https://en.wikipedia.org/wiki/Lise_Meitner



LISE MEITNER in **11,946 HE**, location and photographer unknown²²¹⁷

²²¹⁷ https://en.wikipedia.org/wiki/Lise_Meitner



OTTO HAHN, DR. HARTMANN, LISE MEITNER, WERNER HEISENBERG, THEODOR HEUSS in **11,958 HE**. Credit: Ullstein Bild, Getty Images.²²¹⁸

²²¹⁸ <https://blogs.scientificamerican.com/voices/honoring-a-pioneering-woman-in-physics/>



Nuclear fission experimental setup, reconstructed at the Deutsches Museum, Munich, photographer unknown.²²¹⁹

²²¹⁹ https://en.wikipedia.org/wiki/Lise_Meitner



Statue of LISE MEITNER (sculptor: Anna Franziska Schwarzbach, **12,014 HE**), at Humboldt University in Berlin.²²²⁰

- ⇒ Since her **11,968 HE** death, she has received many naming honors: In **11,997 HE**, element 109 was named Meitnerium in her honor. MEITNER is the first and, so far, only non-mythological woman thus honored. (Curium was named after both Marie and Pierre

²²²⁰ https://en.wikipedia.org/wiki/Lise_Meitner

Curie.) Additional naming honors are the Hahn–Meitner Institute in Berlin, craters on the Moon and on Venus, and the main-belt asteroid 6999 Meitner. In **12,000 HE**, the European Physical Society established the biannual "Lise Meitner Prize" for excellent research in nuclear science. In **12,006 HE** the "Gothenburg Lise Meitner Award" was established by the University of Gothenburg in Sweden; it is awarded annually to a scientist who has made a breakthrough in physics. In **12,008 HE**, the chemical, biological, radiological, and nuclear defense school of the Austrian Armed Forces (NBC) established the Lise Meitner Award. In **12,010 HE**, a building at the Free University of Berlin was named the Hahn-Meitner Building; this was a renaming of a building previously known as the Otto Hahn Building. In **12,014 HE** the statue of LISE MEITNER was unveiled in the garden of the Humboldt University of Berlin next to similar statues of HERMANN VON HELMHOLTZ and MAX PLANCK. A short residential street in Bramley, Hamshire, UK, her resting place, is named Meitner Close.

Schools and streets were named after her in many cities in Austria and Germany. Since **12,015 HE** AlbaNova university centre in Stockholm has an annual LISE MEITNER Distinguished Lecture. In **12,017 HE**, the Advanced Research Projects Agency-Energy in the United States named a major nuclear energy research program in her honor.²²²¹

11,879 HE – 11,955 HE: ALBERT EINSTEIN, Subject of the Kingdom of Württemberg during the German Empire: (**11,879 HE–11,896 HE**); Stateless: (**11,896 HE–11,901 HE**); Citizen of Switzerland (**11,901 HE–11,955 HE**); Austrian subject of the Austro-Hungarian Empire (**11,911 HE–11,912 HE**); Subject of the Kingdom of Prussia during the German Empire (**11,914 HE–11,918 HE**); German citizen of the Free State of Prussia; Weimar Republic, **11,918 HE–11,933**

²²²¹ https://en.wikipedia.org/wiki/Lise_Meitner

HE; Citizen of the United States (**11,940 HE–11,955 HE**): Physicist and Philosopher.²²²²

⇒ After graduating in **11,900 HE**, ALBERT EINSTEIN spent almost two frustrating years searching for a teaching post. EINSTEIN acquired Swiss citizenship in February **11,901 HE** but was not conscripted into the military for medical reasons. With the help of Marcel Grossmann's father, he secured a job in Bern at the Federal Office for Intellectual Property, the patent office, as an assistant examiner – level III. EINSTEIN evaluated patent applications for a variety of devices including a gravel sorter and an electromechanical typewriter. In **11,903 HE** his position at the Swiss Patent Office became permanent, although he was passed over for promotion until he "fully mastered machine technology". *Eventually, much of EINSTEIN's work at the patent office related to questions about transmission of electric signals and electrical-*

²²²² https://en.wikipedia.org/wiki/Albert_Einstein

*mechanical synchronization of time, two technical problems that show up conspicuously in the thought experiments that eventually led him to his radical conclusions about the nature of light and the fundamental connection between space and time.*²²²³

- ⇒ EINSTEIN developed the *Theory of Special Relativity*, and the *Theory of General Relativity*, pillars of modern physics (alongside quantum mechanics). His work is also known for its influence on the philosophy of science. EINSTEIN is best known to the general public for his mass–energy equivalence formula $E = mc^2$, which has been dubbed "the world's most famous equation".
- ⇒ ALBERT EINSTEIN received the **11,921 HE** Nobel Prize in Physics “for his services to theoretical physics, and especially for

²²²³ https://en.wikipedia.org/wiki/Albert_Einstein

his discovery of the law of the photoelectric effect,” a pivotal step in the development of quantum theory.²²²⁴

- ⇒ From **11,926 HE** until **11,934 HE** EINSTEIN and his former student Leo Szilárd collaborated on ways to improve home non-electric refrigeration technology requiring only a heat source to operate. EINSTEIN used the experience he had gained during his years at the Swiss Patent Office to apply for valid patents for their inventions in several countries. The two were eventually granted 45 patents in their names for three different models.²²²⁵ Scientists from Oxford are struggling to revive his invention today.²²²⁶
- ⇒ EINSTEIN was a passionate, committed antiracist and joined the National Association for the Advancement of Colored People

²²²⁴ https://en.wikipedia.org/wiki/Albert_Einstein

²²²⁵ https://en.wikipedia.org/wiki/Einstein_refrigerator

²²²⁶ <https://www.greenoptimistic.com/einstein-refrigerator/>

(NAACP) in Princeton, where he campaigned for the civil rights of African-Americans. He considered racism America's "worst disease," seeing it as "handed down from one generation to the next".²²²⁷

⇒ ALBERT EINSTEIN resolved the two differing opinions of ARISTOTLE and of ISAAC NEWTON to define time as we now know it.²²²⁸

- ARISTOTLE had concluded that time is measured by the changing of things. ARISTOTLE had concluded that if nothing changes, there is no time.²²²⁹

²²²⁷ https://en.wikipedia.org/wiki/Albert_Einstein

²²²⁸ Carlo Rovelli's The Order of Time

²²²⁹ Carlo Rovelli's *The Order of Time*

- NEWTON had concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.²²³⁰
- EINSTEIN concluded that ARISTOTLE and NEWTON were both correct. He mathematically combined space and time into “spacetime”. In EINSTEIN'S theories, the ideas of absolute time and space were superseded by the notion of spacetime in Special Relativity.²²³¹ Time varies depending on the observer’s frame of reference. Someone moving faster than someone else will experience time passing at a different rate. Someone closer to a massive body (like our sun) will experience time differently than someone more distant from that massive body.²²³²

²²³⁰ Carlo Rovelli’s *The Order of Time*

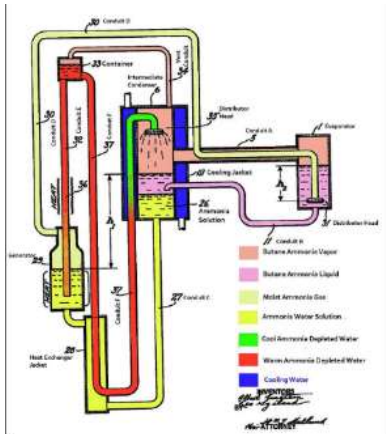
²²³¹ https://en.wikipedia.org/wiki/Absolute_space_and_time

²²³² Carlo Rovelli’s *The Order of Time*



ALBERT EINSTEIN / artist: Max Westfield / Oil on canvas,
11,944 HE; National Portrait Gallery, Smithsonian Institution; gift
of the artist.²²³³

²²³³ <http://npg.si.edu/blog/portrait-albert-einstein-max-westfield>



ALBERT EINSTEIN and his former student Leo Szilárd's Annotated non-electric refrigerator patent drawing.²²³⁴

²²³⁴ https://en.wikipedia.org/wiki/Einstein_refrigerator

⇒ Awards and Honors Received by ALBERT EINSTEIN:

- **11,925 HE** the Royal Society awarded ALBERT EINSTEIN the Copley Medal. In **11,929 HE**, MAX PLANCK presented ALBERT EINSTEIN with the Max Planck medal of the German Physical Society in Berlin, for extraordinary achievements in theoretical physics. In **11,931 HE** EINSTEIN received the Prix Jules Janssen award. In **11,934 HE** ALBERT EINSTEIN gave the Josiah Willard Gibbs lecture. In **11,936 HE**, ALBERT EINSTEIN was awarded the Franklin Institute's Franklin Medal for his extensive work on relativity and the photo-electric effect. The International Union of Pure and Applied Physics named **12,005 HE** the "World Year of Physics" in commemoration of the 100th anniversary of the publication of EINSTEIN's paper on Special Relativity.²²³⁵

²²³⁵ https://en.wikipedia.org/wiki/Einsteins_awards_and_honors

⇒ Named after ALBERT EINSTEIN:

- The Albert Einstein College of Medicine is a research-intensive medical school located in the Morris Park neighborhood of the Bronx in New York City. The Albert Einstein Science Park is located on the hill Telegrafenberg in Potsdam, Germany. The best-known building in the park is the Einstein Tower which has a bronze bust of Einstein at the entrance. The Tower is an astrophysical observatory that was built to perform checks of Einstein's theory of General Relativity. The Albert Einstein Memorial in central Washington, D.C. is a monumental bronze statue depicting Einstein seated with manuscript papers in hand. The statue, commissioned in **11,979 HE**, is located in a grove of trees at the southwest corner of the grounds of the National Academy of Sciences on Constitution Avenue. The chemical element 99, Einsteinium, was named for him in August **11,955 HE**, four months after Einstein's death. "2001 Einstein" is an

inner main belt asteroid discovered on 5 March **11,973 HE**. In **11,999 HE**, Time magazine named ALBERT EINSTEIN the Person of the Century, ahead of Mahatma Gandhi and Franklin Roosevelt, among others. In the words of a biographer, "to the scientifically literate and the public at large, Einstein is synonymous with genius". Also in **11,999 HE**, an opinion poll of 100 leading physicists ranked ALBERT EINSTEIN the "greatest physicist ever". A Gallup poll recorded ALBERT EINSTEIN as the fourth most admired person of the 20th century in the U.S. In **11,990 HE**, ALBERT EINSTEIN's name was added to the Walhalla temple, located in Donaustauf, Bavaria for "laudable and distinguished Germans". The United States Postal Service honored Einstein with a Prominent Americans series (**11,965 HE–11,978 HE**) 8¢ postage stamp. In

12,008 HE, ALBERT EINSTEIN was inducted into the New Jersey Hall of Fame.²²³⁶

⇒ Scientific and mathematical concepts named after ALBERT EINSTEIN: Bose–Einstein condensate; Bose–Einstein statistics; Einstein's mass-energy relation; Einstein's constant; Einstein's radius of the universe; Einstein (unit); Einstein notation; Einstein coefficients; Einstein cosmological constant, see cosmological constant; Einstein relation (kinetic theory); Planck–Einstein relation; Einstein–Brillouin–Keller method; Einstein–Cartan theory; Einstein–Hopf drag; Einstein–de Haas effect; Einstein–de Sitter universe; Einstein–Maxwell–Dirac equations; Einstein–Hermitian vector bundle; Einstein–Hilbert action; Einstein–Podolsky–Rosen paradox; Einstein–Rosen bridge; Einstein shift; Einstein–Schrödinger equation, see Wheeler–DeWitt equation; Einstein Cross; Einstein field equations; Einstein force; Einstein

²²³⁶ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

frequency, see Einstein solid; Einstein manifold; Einstein model, see Einstein solid; Einstein radius; Einstein group; Einstein ring; Einstein–Infeld–Hoffmann equations; Einstein solid; Einstein synchronization; Einstein tensor; Higher-dimensional Einstein gravity; Wiener–Khinchin–Einstein theorem; Einstein pseudotensor, see Stress–energy–momentum pseudotensor; Stark–Einstein law; Stokes–Einstein equation (translational diffusion); Stokes–Einstein–Debye equation (rotational diffusion).²²³⁷

⇒ Technology named after ALBERT EINSTEIN: Einstein refrigerator; Tatung Einstein, an eight-bit home/personal computer; Einstein Observatory, the first fully imaging X-ray telescope; Einstein Telescope, a future third generation gravitational wave

²²³⁷ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

detector; Albert Einstein ATV, a European unmanned cargo resupply spacecraft.²²³⁸

⇒ Schools named after ALBERT EINSTEIN: Albert Einstein College of Medicine at Yeshiva University, The Bronx, New York City; The Albert Einstein Mathematics Institute, Hebrew University, Jerusalem; Albert Einstein Academy Charter School, San Diego, California; Albert Einstein High School, Kensington, Maryland; Albert Einstein Intermediate (later Junior High) School, aka I.S. 131, The Bronx, New York City; Albert-Einstein-Schule, a German gymnasium in Bochum, Germany; Albert Einstein International School of San Pedro Sula, a college preparatory school in San Pedro Sula, Honduras; A high school named after Albert Einstein in Ben Shemen Youth Village, Israel; Einstein School in Amsterdam, Netherlands; Einstein Primary School, Haifa, Israel; Albert Einstein

²²³⁸ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

School, a German gymnasium in Groß-Bieberau; Grammar School of Albert Einstein, Bratislava, Slovakia.²²³⁹

- ⇒ Streets named after ALBERT EINSTEIN: Einsteinova ulica, a major road in Bratislava, Slovakia; Einsteinova, a street in Prague, Czech Republic; Einsteinova, a street in Olomouc, Czech Republic; Einsteinova, a street in Karviná, Czech Republic; Einsteinstraße, Munich, Germany; Albert Einstein Straße, Göttingen, Germany; Albert-Einstein-Allee, Ulm, Germany; Albert Einstein Street in Coimbra, Portugal; Einstein Street, Tel Aviv, Israel; Einstein Street, Haifa, Israel; Einstein St. in Norman, Oklahoma.²²⁴⁰
- ⇒ Buildings or places named after ALBERT EINSTEIN: Albert Einstein Hospital in São Paulo, Brazil; Albert Einstein Medical Center, Philadelphia, Pennsylvania; Einstein metro station, on the

²²³⁹ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

²²⁴⁰ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

Santiago Metro, in Santiago, Chile; Einstein Tower, astrophysical observatory in the Albert Einstein Science Park in Potsdam, Germany; Albert Einstein House, a National Historic Landmark in Princeton, New Jersey.²²⁴¹

- ⇒ Other items named after ALBERT EINSTEIN: Bohr–Einstein debates, a series of epistemological challenges and responses by ALBERT EINSTEIN and NIELS BOHR; Russell–Einstein Manifesto, issued in **11,955 HE** by BERTRAND RUSSELL in the midst of the Cold War; Einstein–Szilárd letter, a letter sent to President Franklin Delano Roosevelt in August **11,939 HE**; Einstein Symposium, on the centennial of **11,905 HE** publication of the Special Theory of Relativity; *Rebutia einsteinii*, a cactus named after Einstein by its finder, Alberto Vojtěch Frič; Albert Einstein Institution, a non-profit organization studying methods of non-violent resistance; Albert Einstein German Academic Refugee

²²⁴¹ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

Initiative Fund, a scholarship fund for refugees; Einstein (crater), a large lunar crater of the Moon; Einsteinium, an element; Zebra Puzzle, also known as Einstein's Puzzle or Riddle.²²⁴²

²²⁴² https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

11,879 HE – 11,966 HE: MARGARET HIGGINS SANGER SLEE AKA MARGARET SANGER: United States nurse, writer, social reformer.²²⁴³



11,922 HE: MARGARET HIGGINS SANGER SLEE, location and photographer unknown.²²⁴⁴

²²⁴³ https://en.wikipedia.org/wiki/History_of_birth_control

²²⁴⁴ https://en.wikipedia.org/wiki/Margaret_Sanger

⇒ **11,916 HE:** SANGER opened a family planning and birth control clinic at 46 Amboy Street in the Brownsville neighborhood of Brooklyn, the first of its kind in the United States.²²⁴⁵

⇒ Books and pamphlets by MARGARET HIGGINS SANGER SLEE:

- In **11,911 HE** or **11,912 HE:** *What Every Mother Should Know* - Originally based on a series of articles SANGER SLEE published in **11,911 HE** in the New York Call, which were, in turn, based on a set of lectures SANGER SLEE gave to groups of Socialist Party women in **11,910 HE –11,911 HE**.²²⁴⁶ Multiple editions were published through the **11,920s HE** by

²²⁴⁵ https://en.wikipedia.org/wiki/Margaret_Sanger

²²⁴⁶ Coates, p. 48. Hoolihan, Christopher (2004), *An Annotated Catalogue of the Edward C. Atwater Collection of American Popular Medicine and Health Reform*, Vol. 2 (M–Z), University Rochester Press, p. 299, and https://en.wikipedia.org/wiki/Margaret_Sanger

Max N. Maisel, Sincere Publishing, with the title *What Every Mother Should Know, or how six little children were taught the truth*. (Online **11,921 HE** edition, Michigan State University);

- **11,914 HE:** *Family Limitation* – Originally published as a 16-page pamphlet; also published in several later editions. (Online **11,917 HE** 6th edition, Michigan State University);
- **11,916 HE:** *What Every Girl Should Know* – Originally published by Max N. Maisel; 91 pages; also published in several later editions. (Online **11,922 HE** edition, Michigan State University);
- **11,916 HE:** *Fight for Birth Control*, New York (The Library of Congress);

- **11,917 HE:** *The Case for Birth Control: A Supplementary Brief and Statement of Facts* – published to provide information to the court in a legal proceeding. (Online at Internet Archive);
- **11,919 HE:** *Birth Control A Parent's Problem or Women's?"* The Birth Control Review;
- **11,920 HE:** *Woman and the New Race*, Truth Publishing, foreword by Havelock Ellis. Online (Harvard University); Online (Project Gutenberg); Online (Internet Archive); Audio on Archive.org;
- **11,921 HE:** *Debate on Birth Control*, text of a debate between Sanger, Theodore Roosevelt, Winter Russell, George Bernard Shaw, Robert L. Wolf, and Emma Sargent Russell. Published as

issue 208 of Little Blue Book series by Haldeman-Julius Co. Online (**11,921 HE**, Michigan State University);

- **11,922 HE:** *The Pivot of Civilization*, Brentanos. Online (**11,922 HE**, Project Gutenberg); Online (**11,922 HE**, Google Books);
- **11,928 HE:** *Motherhood in Bondage*, Brentanos. Online (Google Books);
- **11,931 HE:** *My Fight for Birth Control*, New York: Farrar & Rinehart;
- **11,938 HE:** *An Autobiography*. New York, NY: Cooper Square Press. ISBN 0-8154-1015-8;

- Periodicals by MARGARET HIGGINS SANGER SLEE: *The Woman Rebel* – Seven issues published monthly from March **11,914 HE** to August **11,914 HE**. SANGER SLEE was publisher and editor; *Birth Control Review* – Published monthly from February **11,917 HE** – **11,940 HE**. SANGER SLEE was Editor until **11,929 HE**; Not to be confused with *Birth Control News*, published by the London-based Society for Constructive Birth Control and Racial Progress.²²⁴⁷

²²⁴⁷ https://en.wikipedia.org/wiki/Margaret_Sanger

long lines of alveolar clefts and incisors (which by
resting is lateral incisors).

The reader will often find it difficult. There
are many girls who have had no education and who are
not at all of the intelligence of the men who they are
married to. The women have a dignified and respectful
front which is never seen in our women. Much de-
pends upon the attitude of the man toward the relation.

THE FRIGATE AND THE SPONGE

Another form of prevention is the FRIGATE CAP
(see). This is one of the most common preventive
articles used in France as well as among the women
of the middle and upper class in America. At one
time the use of them, as well as of other devices, as
they were imported into this country from France.
Today they are no longer in the market, and may
be had from the following.

They come in three varieties, and are of small
size. It is not to get the neck too tight, as the neck
is only for very small bones, and they get
out of place.



FRIGATE

In my experience a well fitted frigate cap of the
above material, of preventing conception, I have
known hundreds of women who have used it for years
with the most satisfactory results. The device is



This page from SANGER'S *Family Limitation*, 11,917 HE edition,
describes a cervical cap.²²⁴⁸

11,879 HE: "Star Stuff" Element Scandium discovered by LARS
FREDRIK NILSON a Swedish chemist.²²⁴⁹



LARS FREDRIK NILSON, **11,840 HE** – **11,899 HE**, photographer and date unknown.²²⁵⁰

²²⁵⁰ https://en.wikipedia.org/wiki/Lars_Fredrik_Nilson



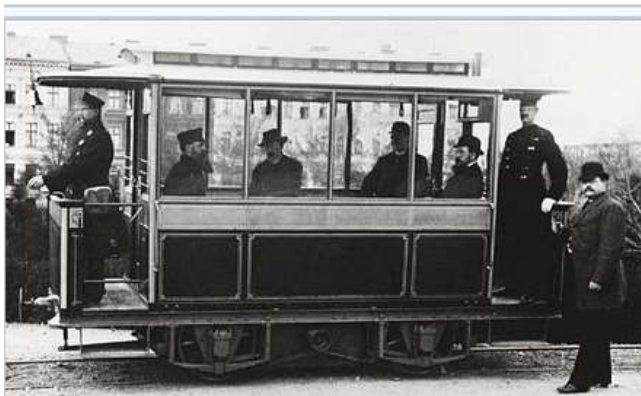
- The photo is of ultrapure crystalline scandium, 5 grams. Original size in cm: 2. “Star Stuff” Element Atomic Number 21, Scandium, Sc, Scandium is the first transition metal and the first rare earth element; the latter also includes Yttrium and the Lanthanoids. The chemistry of the ignoble light metal Element Scandium isn't so complex, and it also is rather expensive. It is used in high-quality, light alloys, e.g. for frames of racing bicycles.²²⁵¹

²²⁵¹ <http://images-of-elements.com/scandium.php#a>

11,881 HE: Near Berlin, Lichterfelde, Germany: the world's first electric tram line, Gross-Lichterfelde Tramway, opened in Lichterfelde. It was built by Siemens.

- ⇒ The tram ran on 180 Volt DC, which was supplied by running rails. In **11,891 HE** the track was equipped with an overhead wire and the line was extended to Berlin-Lichterfelde West station.
- ⇒ The railway is still operational, thus making it the oldest operational electric railway in the world.²²⁵²

²²⁵² https://en.wikipedia.org/wiki/History_of_rail_transport



11,882 HE: Photo of a Lichterfelde tram, photographer unknown.²²⁵³

²²⁵³ https://en.wikipedia.org/wiki/History_of_rail_transport



12,012 HE: photo of the current Lichterfelde tram.²²⁵⁴

²²⁵⁴ [https://www.bing.com/images/search =lichterfelde+tram](https://www.bing.com/images/search?q=lichterfelde+tram)

11,881 HE – 11,965 HE: SIR EDWARD BATTERSBY BAILEY,
English geologist, FRS, FRSE MC CB, LLD, and “cold water nutter”
who discovered and defined how the land on Earth moves.²²⁵⁵



Sir EDWARD BATTERSBY BAILEY, photo by and at The Royal
Society.²²⁵⁶

²²⁵⁵ BBC Men of Rock 2 of 3 12,010 HE BBC TV show “Moving Mountains”

²²⁵⁶ Pictures.royalsociety.org bing search

11,882 HE – 11,935 HE: EMMY NOETHER, German and United States mathematician known for her landmark contributions to abstract algebra and theoretical physics.²²⁵⁷

⇒ EMMY NOETHER was described by Pavel Alexandrov, ALBERT EINSTEIN, Jean Dieudonné, Hermann Weyl, and Norbert Wiener as the *most important woman in the history of mathematics*. As one of the leading mathematicians of her time, she developed the theories of rings, fields, and algebras. In physics, NOETHER's theorem explains the connection between symmetry and conservation laws. Her most important contribution to mathematics was development of abstract algebra.²²⁵⁸

²²⁵⁷ Podcast: Stuff You Missed in History Class

²²⁵⁸ https://en.wikipedia.org/wiki/Emmy_Noether

⇒ In physics, some of EMMY NOETHER's main articles were: Noether's theorem, Conservation law (physics), and Constant of Motion.²²⁵⁹ Tim James says EMMY NOETHER ranked up there with EINSTEIN and FEYNMAN.²²⁶⁰



⇒ NOETHER in **11,930 HE**, location and photographer unknown.²²⁶¹

²²⁵⁹ https://en.wikipedia.org/wiki/Emmy_Noether

²²⁶⁰ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²²⁶¹ https://en.wikipedia.org/wiki/Emmy_Noether



Young EMMY NOETHER, date, location and photographer unknown.²²⁶²

²²⁶² https://en.wikipedia.org/wiki/Emmy_Noether

⇒ List of things named after EMMY NOETHER: The crater Nöther on the far side of the Moon is named after her; the minor planet 7001 Noether is named for her; Google put a memorial doodle on Google's homepage in many countries on 23 March **12,015 HE** to celebrate her 133rd birthday; Noetherian, Noetherian group, Noetherian ring, Noetherian module, Noetherian space, Noetherian induction, Noetherian scheme, Noether normalization dilemma, Noether problem, Noether's theorem, Noether's second theorem, Lasker–Noether theorem, Skolem–Noether theorem, Brill–Noether theorem, Brauer–Noether theorem, and Albert–Brauer–Hasse–Noether theorem.²²⁶³

²²⁶³ https://en.wikipedia.org/wiki/Emmy_Noether

11,883 HE: Near Vienna in Austria, the Mödling and Hinterbrühl Tram opened. It was the first tram line in the world in regular service powered from an overhead electric line.²²⁶⁴

11,886 HE: CLEMENS WINKLER, German chemist, discovered / isolated “Star Stuff” Element Germanium (15 years after DIMITRI MENDELEEV had predicted, in **11,871 HE**, the existence of the element and its properties).²²⁶⁵



Crystals of the “Star Stuff” atomic element 32: Germanium, the largest is 5 mm long. Germanium is a shiny silvery metalloid and a semiconductor. The latter makes it an important material in

²²⁶⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

²²⁶⁵ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

electronics and solar technology. Germanium is corrosion-resistant, very brittle and slightly toxic. It has no biological functions. Sometimes germanium compounds are sold as obscure miracle cures. These have no medicinal benefit and are rather noxious.²²⁶⁶



Photo of **CLEMENS ALEXANDER WINKLER: 11,838 HE – 11,904 HE**; date, location and photographer unknown.²²⁶⁷

²²⁶⁶ <http://images-of-elements.com/germanium.php#a>

²²⁶⁷ https://en.wikipedia.org/wiki/Clemens_Winkler

11,886 HE: HENRI MOISSAN, France, chemist, discovered / isolated “Star Stuff” element Fluorine.²²⁶⁸ MOISSAN was awarded the **11,906 HE** Nobel Prize in Chemistry and he was one of the original members of the International Atomic Weights Committee.²²⁶⁹



• The photo is natural fluorite, stained by impurities, 15 grams, “Star Stuff” Element Atomic Number 9, Fluorine, F. Fluorine is the most chemically aggressive element. In pure form it is a pale, yellow-green F_2 gas. It is extremely toxic and reacts with

²²⁶⁸ www.chemistryexplained.com/elements/C-K/Fluorine.html

²²⁶⁹ https://en.wikipedia.org/wiki/Henri_Moissan

nearly everything, in most cases very violently. At contact with water, it forms the very caustic hydrofluoric acid, HF.²²⁷⁰ HENRI

- MOISSAN collected Fluorine gas by passing an electric current through one of its compounds, hydrogen fluoride. Consumers are most familiar with fluorine's use in two products. Fluorine gas is used to make fluorides, compounds that were made part of toothpastes since the **11,950s HE**. Fluorides are effective in preventing tooth decay and are added to urban water supplies as well.²²⁷¹
- The salts of the element Fluorine (fluorides), especially fluorite (calcium fluoride, CaF_2), frequently occur in nature as minerals. Fluoride is needed for bones and teeth and supplementation with

²²⁷⁰ <http://images-of-elements.com/fluorine.php#a>

²²⁷¹ www.chemistryexplained.com/elements/C-K/Fluorine.html

fluoride for the first time in history allowed humans to die with their own teeth in their mouths, but quickly becomes poisonous if the dose is too high.²²⁷²



11,852 HE – 11,907 HE: HENRI MOISSAN, France, chemist, photographer and location unknown.²²⁷³

²²⁷² <http://images-of-elements.com/fluorine.php#a>

²²⁷³ www.chemistryexplained.com/elements/C-K/Fluorine.html

11,886 HE: Pears Transparent Soap was the world's first mass-market translucent soap. It was first produced and sold by Andrew Pears at a factory just off Oxford Street in London, England.²²⁷⁴



11,886 HE advertisement for Pears soap²²⁷⁵

²²⁷⁴ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

²²⁷⁵ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

⇒ (Author / Compiler was disgusted to see these next ads and includes them to avoid writing them out of history and to recognize how far we as a fair-minded society have advanced):



• **11,884 HE:** The original Pears soap advertisement based on the fable “Washing the Blackamoor White,” published in the *Graphic for Christmas*.²²⁷⁶

²²⁷⁶ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))



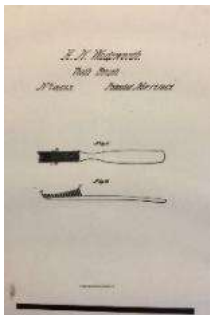
- **11,890s HE:** Advertisement for Pears soap promoting cleanliness as a justification for racist imperialism.²²⁷⁷

11,887 HE: The nation of Iran installed an approximately 20-km long railway between Tehran and Ray.²²⁷⁸

²²⁷⁷ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

²²⁷⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

11,887 HE: H.N. WADSWORTH patented the first toothbrush in America. It was made of animal bone and swine hair.²²⁷⁹



H.N. WADSWORTH's toothbrush patent.²²⁸⁰

²²⁷⁹ <https://www.padental.org/Online/Public/Children/Invention%20of%20Toothbrush.aspx>

²²⁸⁰ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>



11,800's HE: bone toothbrushes dug out of a garbage dump in Scotland, photographer and location unknown.²²⁸¹

⇒ Author / Compiler note: the photo has been lost, but during a family visit to 4-Mile-House in Denver, Co, the docent showed a replica of the toothbrush that the travelers had shared when their wagons stayed overnight at the property. Evidently personal toothbrushes were rare in the **11,800's HE**.

²²⁸¹ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

11,888 HE: ANDREAS FLOCKEN (**11,845 HE – 11,913 HE**) was a German entrepreneur and inventor who created possibly the first real *passenger electric car* in the world called the Flocken Elektrowagen.²²⁸²



ANDREAS FLOCKEN, 11,910 HE, photographer and location unknown.²²⁸³

²²⁸² https://en.wikipedia.org/wiki/Andreas_Flocken

²²⁸³ https://en.wikipedia.org/wiki/Andreas_Flocken



Reconstruction of Flocken Elektrowagen, (reconstruction, **12,011 HE**) photographer and location unknown.²²⁸⁴

²²⁸⁴ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11,888 HE: Richmond, Virginia: US electric trolleys were pioneered on the Richmond Union Passenger Railway using equipment designed by FRANK J. SPRAGUE, “*The Father of Electric Traction*”.²²⁸⁵



FRANK J. SPRAGUE, (11,857 HE – 11,934 HE) unknown photographer, date, location.²²⁸⁶

²²⁸⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

²²⁸⁶ https://en.wikipedia.org/wiki/Frank_J._Sprague



11,923 HE: Drawing of the Richmond Theatrical District, with Perley Thomas streetcars.²²⁸⁷

Circa 11,888 HE: Author / Compiler includes the two famous paintings of the night skies, *because* as recently as when these paintings were created, although stars in the night sky could be enjoyed, used by

²²⁸⁷ https://en.wikipedia.org/wiki/Richmond_Union_Passenger_Railway

travelers, and referred to in poetry, song, stories and art, *scientists and humanity still did not know what stars were!*²²⁸⁸



11,888 HE: Vincent van Gogh's painting “Starry Night over the Rhone”. Location: Musée d'Orsay.²²⁸⁹

²²⁸⁸ Neil de grass Tyson Youtube.com video

²²⁸⁹ https://en.wikipedia.org/wiki/The_Starry_Night



11,889 HE: Vincent van Gogh's painting 'Starry Night' Location: New York Museum of Modern Art.²²⁹⁰

²²⁹⁰ https://en.wikipedia.org/wiki/The_Starry_Night

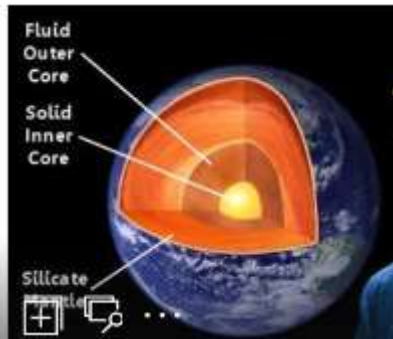
11,888 HE – 11,993 HE: INGE LEHMANN,²²⁹¹ Danish seismologist and geophysicist and the longest-lived woman scientist - having lived for over 104 years.²²⁹²

⇒ **11,936 HE:** INGE LEHMANN discovered that the Earth has a solid inner core surrounded by a molten outer core. (Before that, seismologists believed Earth's core to be a single molten sphere, being unable, however, to explain careful measurements of seismic waves from earthquakes, which were inconsistent with this idea.) LEHMANN analyzed the seismic wave measurements and concluded that Earth must have a solid inner core and a molten outer core to produce seismic waves that matched the

²²⁹¹ Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

²²⁹² https://en.wikipedia.org/wiki/Inge_Lehmann

measurements. Other seismologists tested and then accepted LEHMANN'S explanation.²²⁹³



11,936 HE: drawing of INGE LEHMANN'S discovery that the Earth has a solid inner core inside a molten outer core.²²⁹⁴

²²⁹³ https://en.wikipedia.org/wiki/Inge_Lehmann

²²⁹⁴ [Famousscientists.org](https://www.famousscientists.org)



11,932 HE: Photo of INGE LEHMANN, location unknown, photographer signed the photo.²²⁹⁵



12,017 HE: A new memorial dedicated to LEHMANN was installed on Frue Plads in Copenhagen. The monument is designed by Elisabeth Toubro.²²⁹⁶

⇒ INGE LEHMANN received many honors for her outstanding scientific achievements, among them: The asteroid 5632 *Ingelehmann* and **11,997 HE** the American Geophysical Union established the annual Inge Lehmann Medal to honor "outstanding contributions to the understanding of the structure, composition,

and dynamics of the Earth's mantle and core." In **12,015 HE** (which was the 100th anniversary of women's suffrage in Denmark) LEHMANN got, in recognition of her great struggle against the male-dominated research community that existed in Denmark in the **mid-11,900's HE**, a new beetle species named after her: *Globicornis (Hadrotoma) ingelehmannae*; In **12,015 HE**, on the 127th anniversary of her birth, Google dedicated its worldwide Google Doodle to her.²²⁹⁷

11,889 HE -11,953 HE: EDWIN HUBBLE, United States Astronomer, played a crucial role in establishing the field of extragalactic astronomy and because he was good at self-promotion is generally regarded as one of the most important observational cosmologists of the **11,900's HE**. EDWIN HUBBLE used the work of, among others, HENRIETTA SWAN LEAVITT (see **11,868 HE – 11,921 HE**)

²²⁹⁷ https://en.wikipedia.org/wiki/Inge_Lehmann

United States astronomer, who discovered the relationship between luminosity and distance in measuring stellar distances.²²⁹⁸

- ⇒ HUBBLE is known for showing that the recession velocity of a galaxy increases with its distance from the earth, implying the universe is expanding, known as "Hubble's law" although this relation had been discovered previously by GEORGES LEMAÎTRE, who published his work in a less visible journal.
- ⇒ He is also known for providing substantial evidence that many objects then classified as "nebulae" were actually galaxies beyond the Milky Way. United States astronomer VESTO SLIPHER had provided the first evidence for this argument almost a decade before.²²⁹⁹

²²⁹⁸ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²²⁹⁹ https://en.wikipedia.org/wiki/Edwin_Hubble

- **11,919 HE...** “when HUBBLE first put his head to the eyepiece, the number of galaxies that were known to us was exactly one: the Milky Way. Everything else was thought to be either part of the Milky Way itself or one of the many distant peripheral puffs of gas. HUBBLE quickly demonstrated how wrong that belief was.”²³⁰⁰

²³⁰⁰ Bill Bryson: A Short History of Nearly Everything



EDWIN HUBBLE, date, location, and photographer unknown.²³⁰¹

²³⁰¹ https://en.wikipedia.org/wiki/Edwin_Hubble



A simulation of our universe on very large scales, featuring billions of galaxies each with billions of stars many with solar systems like our own. Millennium Simulation Project.^{2302 2303}

²³⁰² <http://wwwmpa.mpa-garching.mpg.de/galform/virgo/millennium/>

²³⁰³ SEAN CARROLL *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*

11,889 HE – 11,964 HE: Ms. ROGER ARLINER YOUNG,²³⁰⁴ United States female scientist of zoology, biology, and marine biology. YOUNG was the first African-American woman to receive a doctorate degree in zoology.²³⁰⁵

⇒ **12,005 HE:** Ms. ROGER ARLINER YOUNG was recognized in a Congressional Resolution along with four other African-American women "who have broken through many barriers to achieve greatness in science." The others honored were RUTH ELLA MOORE ("who in **11,933 HE** became the first African-American woman to earn a Ph.D. in natural science from the Ohio State University"), EUPHEMIA LOFTON HAYNES ("who in **11,943 HE** became the first African-American woman to receive a Ph.D. in mathematics from the Catholic University of America"), SHIRLEY ANN JACKSON ("who in **11,973 HE** became the first

²³⁰⁴ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²³⁰⁵ https://en.wikipedia.org/wiki/Roger_Arliner_Young

African-American woman to receive a Ph.D. in physics from the Massachusetts Institute of Technology"), and MAE JEMISON ("a physician and the first African-American woman in space").

- ⇒ A group of environmental and conservation groups established the ROGER ARLINER YOUNG (RAY) *Marine Conservation Diversity Fellowship* in Young's honor, to support young African-Americans who want to become involved in marine environmental conservation work.²³⁰⁶

²³⁰⁶ https://en.wikipedia.org/wiki/Roger_Arliner_Young



ROGER ARLINER YOUNG, photographer, date and location unknown.²³⁰⁷

²³⁰⁷ https://en.wikipedia.org/wiki/Roger_Arliner_Young

11,890 HE – 11,965 HE: PROF. ARTHUR HOLMES FRS, FRSE, LLD, British geologist pioneered the use of radiometric dating of minerals and Earth's age based on measurements of the relative abundance of uranium isotopes by ALFRED O. C. NIER. The general method is now known as the Holmes-Houterman model after FRITZ HOUTERMANS who published in the same year.²³⁰⁸

- ⇒ ARTHUR HOLMES was the first earth scientist to grasp the mechanical and thermal implications of mantle convection, which led eventually to the acceptance of plate tectonics.^{2309 2310}
- ⇒ ARTHUR HOLMES championed the theory of continental drift promoted by ALFRED WEGENER at a time when it was deeply unfashionable with HOLMES's more conservative peers. One

²³⁰⁸ BBC Men of Rock 2 of 3 12,010 HE BBC TV show "Moving Mountains"

²³⁰⁹ https://en.wikipedia.org/wiki/Arthur_Holmes

²³¹⁰ BBC Men of Rock 2 of 3 12,010 HE BBC TV show "Moving Mountains"

problem with the theory lay in the mechanism of movement, and he proposed that Earth's mantle contained convection cells that dissipated radioactive heat and moved the crust at the surface.

⇒ ARTHUR HOLMES *Principles of Physical Geology* ended with a chapter on continental drift. Part of the model was the origin of the seafloor spreading concept.²³¹¹

²³¹¹ https://en.wikipedia.org/wiki/Arthur_Holmes



ARTHUR HOLMES around age 22; photographer and location unknown²³¹²

²³¹² https://en.wikipedia.org/wiki/Arthur_Holmes

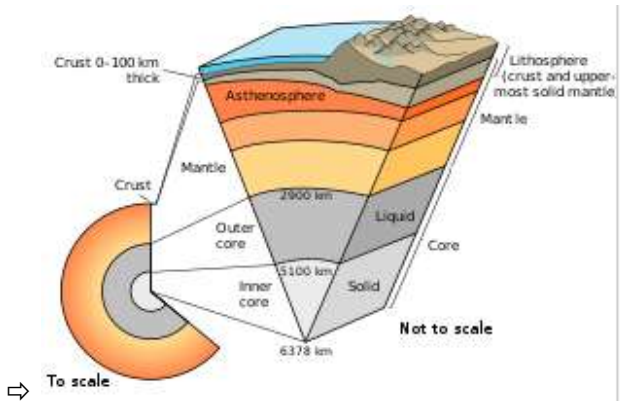
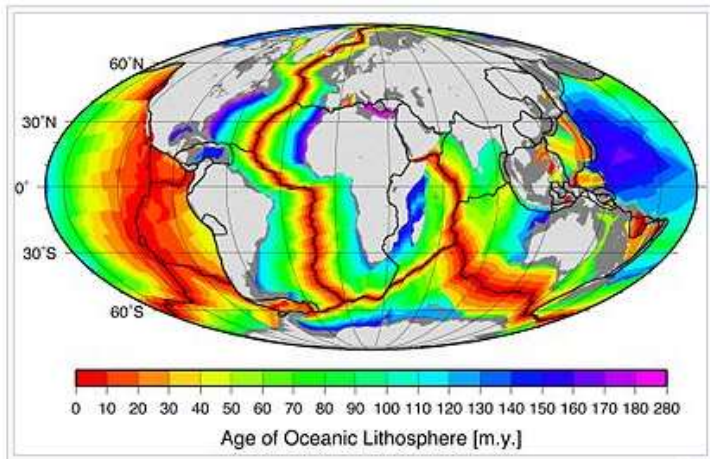


Diagram of the internal layering of the Earth showing the lithosphere above the asthenosphere (not to scale).²³¹⁴

²³¹⁴ https://en.wikipedia.org/wiki/Plate_tectonics



• Sea Floor spreading by continental drift.²³¹⁵

²³¹⁵ https://en.wikipedia.org/wiki/Seafloor_spreading


⇒ Honors named after ARTHUR HOLMES include: a crater on Mars; The Durham University Department of Earth Sciences' Isotope Geology Laboratory and the students' Geology Society.²³¹⁶

Circa 11,890 HE: Electric Automobiles come into use in the United States. The first Baker electric vehicle was a two-seater with a selling price of US \$850. One was sold to THOMAS EDISON as his first car. EDISON also designed the nickel-iron batteries used in some Baker electrics. These batteries have extremely long lives with some still in use early **12,000's HE.**²³¹⁷

²³¹⁶ https://en.wikipedia.org/wiki/Arthur_Holmes

²³¹⁷ https://en.wikipedia.org/wiki/Baker_Motor_Vehicle



1909 Baker Suburban Runabout 



2318



Photo captures of ads for electric vehicles.²³¹⁹

²³¹⁹ https://en.wikipedia.org/wiki/Baker_Motor_Vehicle

11,893 HE – 11,916 HE: ERNST MACH, Austrian physicist and philosopher who discovered the non-acoustic function of the inner ear which helps control human balance. One of his best-known ideas is the so-called "Mach principle," concerning the physical origin of inertia.

- ⇒ Most of MACH's initial studies in the field of experimental physics concentrated on the interference, diffraction, polarization and refraction of light in different media under external influences. From there followed important explorations in the field of supersonic fluid mechanics.
- The ratio of the speed of a fluid to the local speed of sound is now called the Mach number. It is a critical parameter in the

description of high-speed fluid movement in aerodynamics and hydrodynamics.²³²⁰

⇒ ERNST MACH also became well known for his philosophy developed in close interplay with his science. MACH defended a type of phenomenalism recognizing only sensations as real. This position seemed incompatible with the view of atoms and molecules as external, mind-independent things. He famously declared, after an **11,897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!"^{2321 2322 2323}

²³²⁰ https://en.wikipedia.org/wiki/Ernst_Mach

²³²¹ Yourgrau, P. (2005). A World Without Time: The Forgotten Legacy of Gödel and Einstein. Allen Lane

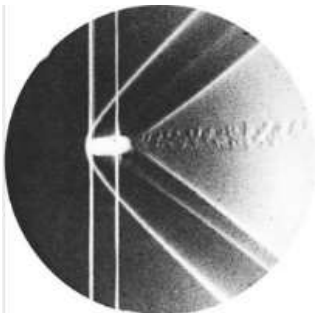
²³²² https://en.wikipedia.org/wiki/Ernst_Mach

²³²³ Max Tegmark, Our Mathematical Universe



ERNST MACH, date, photographer and location unknown.²³²⁴

²³²⁴ https://en.wikipedia.org/wiki/Ernst_Mach



ERNST MACH'S work also focused on the Doppler effect in optics and acoustics.²³²⁵ This historic **11,887 HE** shadowgraph is of a bow shockwave around a supersonic bullet.²³²⁶

²³²⁵ https://en.wikipedia.org/wiki/Ernst_Mach

²³²⁶ John D. Anderson, Jr. "Research in Supersonic Flight and the Breaking of the Sound Barrier -- Chapter 3". history.nasa.gov. p. 65.

11,894 HE - 11,996 HE: GEORGES LEMAÎTRE, Belgian priest – scholar; astronomer and professor of physics²³²⁷ who proposed the theory of the expansion of the universe, which is widely misattributed to EDWIN HUBBLE.

⇒ GEORGES LEMAÎTRE was the first to derive what is now known as *Hubble's Law* and made the first estimation of what is now called the *Hubble Constant*, which LEMAÎTRE published in **11,927 HE**, two years before HUBBLE's article. LEMAÎTRE also proposed what became known as the *Big Bang* theory of the origin of the universe,²³²⁸ (See another who gets credit for the term Big Bang: **11,915 HE – 12,001 HE** FRED HOYLE). LEMAÎTRE

²³²⁷ Bill Bryson Short History of Nearly Everything ebook

²³²⁸ Bill Bryson Short History of Nearly Everything ebook

called the Big Bang his "hypothesis of the primeval atom" or the "Cosmic Egg".²³²⁹

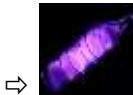


LEMAÎTRE circa **11,933 HE**, photographer and location unknown.²³³⁰

²³²⁹ https://en.wikipedia.org/wiki/Georges_Lemaitre

²³³⁰ https://en.wikipedia.org/wiki/Georges_Lemaitre

11,894 HE: “Star Stuff” element Argon is discovered by JOHN WILLIAM STRUTT (**11,842 HE – 11,919 HE**) and WILLIAM RAMSEY (**11,852 HE – 11,916 HE**).²³³¹



⇒ The photo is of a vial of glowing ultrapure argon. Our air consists to 1% of “Star Stuff” Element Atomic Number 18, Argon, Ar.

- Because of its abundance, Argon is the cheapest and most frequently used noble gas, which comes into operation when an inert atmosphere is needed.²³³² It is more than twice as abundant

²³³¹<https://www.bing.com/search?q=what%20year%20was%20argon%20element%20discovered%3F&qs=n&form=QBRE&sp=-1&pq=undefined&sc=0-39&sk=&cvid=5CC3DFB9A91445B192A739969CD88D16>

²³³² <http://images-of-elements.com/argon.php#a>

as water vapor (which averages about 4000 ppmv, but varies greatly), 23 times as abundant as carbon dioxide (400 ppmv), and more than 500 times as abundant as neon (18 ppmv). Argon is the most abundant noble gas in Earth's crust, comprising 0.00015% of the crust.²³³³



⇒ JOHN WILLIAM STRUTT and WILLIAM RAMSAY, photographers, locations and dates unknown.²³³⁴

²³³³ <https://en.wikipedia.org/wiki/Argon>

²³³⁴ <https://www.bing.com/search?q=who+discovered+argon+element&PC=U316&FORM=CHROMN>

11,895 HE: The formal isolation / discovery of the “Star Stuff” element Helium was made in **11,895 HE** by two Swedish chemists, PER TEODOR CLEVE and NILS ABRAHAM LANGLET, who found helium emanating from the uranium ore cleveite.²³³⁵

⇒ The “Star Stuff” element Helium was first detected as an unknown yellow spectral line signature in sunlight during a solar eclipse in **11,868 HE** by GEORGES RAYET, CAPTAIN C. T. HAIG, NORMAN R. POGSON, AND LIEUTENANT JOHN HERSCHEL, and was subsequently confirmed by French astronomer JULES JANSSEN.

- JULES JANSSEN is often jointly credited with detecting the element along with NORMAN LOCKYER. JULES JANSSEN recorded the “Star Stuff” Helium spectral line during the solar eclipse of **11,868 HE** while NORMAN LOCKYER observed it

²³³⁵ <https://en.wikipedia.org/wiki/Helium>

from Britain. NORMAN LOCKYER was the first to propose that the line was due to a new element present in the sun, a proposal which caused controversy within the scientific community. NORMAN LOCKYER named it Helium.²³³⁶



- Photo of a vial of glowing ultrapure helium. About 20% of the visible matter in the universe is the “Star Stuff” Element Atomic Number 2, Helium, He. However, because it is so light and doesn't react chemically with anything, most terrestrial Helium escaped from Earth into space when the solar system was young.

²³³⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

So now it is quite rare here. Nonetheless it has multiple applications, from making balloons fly to cooling things to extremely low temperatures with liquid helium. Helium 4 nuclei are emitted at radioactive α -decays.²³³⁷

11,895 HE: The first use of electrification on a main rail line was on a four-mile stretch of the Baltimore Belt Line of the Baltimore and Ohio Railroad (B&O) connecting the main portion of the B&O to the new line to New York through a series of tunnels around the edges of Baltimore's downtown.²³³⁸

²³³⁷ <http://images-of-elements.com/helium.php#a>

²³³⁸ https://en.wikipedia.org/wiki/History_of_rail_transport



Photo is of 3 men with a Baltimore & Ohio electric engine, photographer and date unknown.²³³⁹

²³³⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

11,895 HE: Electric car built by THOMAS PARKER.



PARKER's electric car. Photographer and location unknown²³⁴⁰

²³⁴⁰ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11,897 HE: This tool was used in the construction of the Panama Canal.



C.L. Berger Transit, Boston, Mass. Patented in **11,897 HE.**²³⁴¹

²³⁴¹ This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.



More various circa **11,800 HE** – **11,900 HE** engineer's tools.²³⁴²

²³⁴² This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.

11,897 HE– 11,956 HE: IRÈNE JOLIOT-CURIE, French scientist, the daughter of MARIE CURIE and PIERRE CURIE and the wife of FRÉDÉRIC JOLIOT-CURIE.²³⁴³

⇒ Jointly with her husband, IRÈNE JOLIOT-CURIE was awarded the Nobel Prize in Chemistry in **11,935 HE** for their discovery of artificial radioactivity. This made the CURIES the family with the most Nobel laureates to date.

- Both children of the Joliot-Curies, HÉLÈNE and PIERRE, are also esteemed scientists.²³⁴⁴

²³⁴³ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²³⁴⁴ https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie



IRÈNE JOLIOT-CURIE, date, location, and photographer
unknown²³⁴⁵

²³⁴⁵ https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie

11,898 HE: The “Star Stuff” element NEON was discovered as one of the three residual rare inert elements remaining in dry air, after nitrogen, oxygen, argon, and carbon dioxide were removed.²³⁴⁶ Discovered by WILLIAM RAMSAY and MORRIS TRAVERS.²³⁴⁷



The photo is a vial of glowing ultrapure neon (think “neon light”). The “Star Stuff” Element Atomic Number 10, Neon, Ne, is very rare on earth, but quite abundant in space. It is about one third lighter than air and is the most noble, inert element. No neon

²³⁴⁶ <https://en.wikipedia.org/wiki/Neon>

²³⁴⁷ <https://en.wikipedia.org/wiki/Neon>

compound has been produced so far. It is mainly used for light sources, as it glows in a characteristic reddish-orange light.²³⁴⁸



WILLIAM RAMSAY, date, location, photographer unknown.²³⁴⁹

²³⁴⁸ <http://images-of-elements.com/neon.php#a>

²³⁴⁹ <https://en.wikipedia.org/wiki/Neon>

Circa 11,900 HE: The population of the world was approximately 1,600,000,000 people.²³⁵⁰

11,900 HE – 11,979 HE: CECILIA PAYNE-GAPOSCHKIN: British United States Astronomer and Physicist was the first person to earn a PhD in astronomy from all-female Radcliffe College. PAYNE-GAPOSCHKIN proposed in her PhD thesis an explanation for the composition of stars in terms of the relative abundances of hydrogen and helium. She defined that the composition of the Sun was predominantly hydrogen and thus very different from that of the Earth. She was able to determine the paths of stellar evolution.²³⁵¹

²³⁵⁰ <http://www.worldometers.info/world-population/world-population-by-year/>

²³⁵¹ https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin



CECILIA PAYNE-GAPOSCHKIN, date, location, and photographer unknown.²³⁵²

²³⁵² https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin

11,901 HE – 11,954 HE: ENRICO FERMI, born in Italy and later naturalized as a citizen of the United States. Physicist and the creator of the world's first nuclear reactor, the Chicago Pile-1.²³⁵³

⇒ Nobel Prize in Physics, **11,938 HE**. In **11,926 HE**, FERMI discovered the statistical laws, nowadays known as the *Fermi statistics* governing the particles subject to PAULI's exclusion principle (now referred to as fermions, in contrast with bosons which obey the Bose-Einstein statistics). In **11,927 HE**, Fermi was elected Professor of Theoretical Physics at the University of Rome (a post which he retained until **11,938 HE**, when he – immediately after the receipt of the Nobel Prize – emigrated to the United States, primarily to escape Mussolini's fascist dictatorship).²³⁵⁴

²³⁵³ https://en.wikipedia.org/wiki/Enrico_Fermi

²³⁵⁴ <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>



Photo of ENRICO FERMI, location, date, photographer
unknown.²³⁵⁵

²³⁵⁵ <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>

11,901 HE – 11-994 HE: LINUS PAULING, United States chemist and biochemist,²³⁵⁶ peace activist, editor, educator, and husband of United States human rights activist Ava Helen Pauling.²³⁵⁷ LINUS PAULING published more than 1,200 papers and books, of which about 850 dealt with scientific topics. *New Scientist* called him one of the 20 greatest scientists of all time, and as of **12,000 HE** he was rated the 16th most important scientist in history.²³⁵⁸

⇒ LINUS PAULING was one of the founders of the fields of quantum chemistry and molecular biology.

⇒ PAULING's contributions to the theory of the chemical bond include the concept of orbital hybridization and the first accurate

²³⁵⁶ SAM KEAN, *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements.*

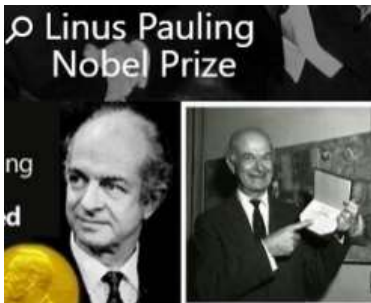
²³⁵⁷ https://en.wikipedia.org/wiki/Linus_Pauling

²³⁵⁸ https://en.wikipedia.org/wiki/Linus_Pauling

scale of electronegativities of the elements. He also worked on the structures of biological molecules, and his discoveries inspired the work of ROSALIND FRANKLIN, JAMES WATSON, and FRANCIS CRICK on the structure of DNA, which in turn made it possible for geneticists to crack the DNA code of all organisms.

- ⇒ In his later years PAULI promoted nuclear disarmament, as well as orthomolecular medicine, megavitamin therapy, and dietary supplements.
- ⇒ For his scientific work, PAULING was awarded the Nobel Prize in Chemistry in **11,954 HE**. For his peace activism, he was awarded the Nobel Peace Prize in **11,962 HE**. He is one of only four individuals to have won more than one Nobel Prize (the others being MARIE CURIE, JOHN BARDEEN, AND FREDERICK SANGER). Of these, he is the only person to have been awarded

two unshared Nobel Prizes, and one of two people to be awarded Nobel Prizes in different fields, the other being MARIE CURIE.²³⁵⁹



LINUS PAULING receiving the Nobel Prize, **11,954 HE**, Stockholm; photographer unknown.²³⁶⁰

²³⁵⁹ https://en.wikipedia.org/wiki/Linus_Pauling

²³⁶⁰ <https://www.bing.com/images/search?q=linus+pauling&qpv=linus+pauling&FORM=IGRE>

11,902 HE: Italian railways were the first in the world to introduce electric traction for the entire length of a main line rather than just a short stretch. The 106 km *Valtellina line* was opened in **11,902 HE**. The electrical system was three-phase at 3 kV 15 Hz designed by KALMAN KANDO and a team from the Ganz works.



11,901 HE: Prototype of the Ganz AC electric locomotive in Valtellina, Italy.²³⁶¹

²³⁶¹ https://en.wikipedia.org/wiki/History_of_rail_transport

11,902 HE – 11,992 HE: BARBARA MCCLINTOCK²³⁶² United States Nobel Prize winning scientist and cytogeneticist.²³⁶³ Cytogenetics is a branch of genetics that is concerned with how the chromosomes relate to cell behavior, particularly to their behavior during mitosis and meiosis.²³⁶⁴ During the **11,940s HE and 11,950s HE** BARBARA MCCLINTOCK discovered *transposition* and used it to demonstrate that genes are responsible for turning physical characteristics on and off. She developed theories to explain the suppression and expression of genetic information from one generation of maize plants to the next. Due to skepticism of her research and its implications, she stopped publishing her data in **11,953 HE**.²³⁶⁵

²³⁶² <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²³⁶³ https://en.wikipedia.org/wiki/Barbara_McClintock

²³⁶⁴ <https://en.wikipedia.org/wiki/Cytogenetics>

²³⁶⁵ https://en.wikipedia.org/wiki/Barbara_McClintock

- ⇒ MCCLINTOCK proposed the idea of genetic recombination in reproduction.²³⁶⁶
- ⇒ In **11,973 HE**, in reference to her decision 20 years earlier to stop publishing detailed accounts of her work, she wrote: *“Over the years I have found that it is difficult if not impossible to bring to consciousness of another person the nature of his tacit assumptions when, by some special experiences, I have been made aware of them. This became painfully evident to me in my attempts during [the 11,950s HE] to convince geneticists that the action of genes had to be and was controlled. It is now equally painful to recognize the fixity of assumptions that many persons hold on the nature of controlling elements in maize and the manners of their operation. One must await the right time for conceptual change.”*²³⁶⁷

²³⁶⁶ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²³⁶⁷ https://en.wikipedia.org/wiki/Barbara_McClintock

⇒ **11,983 HE:** BARBARA MCCLINTOCK received the Nobel Prize for Physiology or Medicine.

- MCCLINTOCK was the first woman to win that prize unshared, and the first United States woman to win any unshared Nobel Prize.
- The Nobel Prize was given to her by the Nobel Foundation for discovering "*mobile genetic elements*"; this was more than 30 years after she initially described the phenomenon of controlling elements.²³⁶⁸

²³⁶⁸ https://en.wikipedia.org/wiki/Barbara_McClintock



BARBARA MCCLINTOCK shown in her laboratory, date and photographer unknown.²³⁶⁹

²³⁶⁹ https://en.wikipedia.org/wiki/Barbara_McClintock



MCCLINTOCK's microscope and ears of corn on exhibition at the National Museum of Natural History, date and photographer unknown.²³⁷⁰

²³⁷⁰ https://en.wikipedia.org/wiki/Barbara_McClintock



11,983 HE Photo of BARBARA MCCLINTOCK giving her Nobel Lecture.²³⁷¹

⇒ Honors and Awards: In **11,947 HE**, BARBARA MCCLINTOCK received the Achievement Award from the American Association

²³⁷¹ https://en.wikipedia.org/wiki/Barbara_McClintock

of University Women. She was elected a Fellow of the American Academy of Arts and Sciences in **11,959 HE**. In **11,967 HE**, MCCLINTOCK was awarded the Kimber Genetics Award; three years later, she was given the National Medal of Science by Richard Nixon in **11,970 HE**. She was the first woman to be awarded the National Medal of Science. Cold Spring Harbor named a building in her honor in **11,973 HE**. She received the Louis and Bert Freedman Foundation Award and the Lewis S. Rosensteil Award in **11,978 HE**. In **11,981 HE** she became the first recipient of the MacArthur Foundation Grant and was awarded the Albert Lasker Award for Basic Medical Research, the Wolf Prize in Medicine, and the Thomas Hunt Morgan Medal by the Genetics Society of America. In **11,982 HE** she was awarded the Louisa Gross Horwitz Prize from Columbia University for her research in the "evolution of genetic information and the control of its expression."

- ⇒ BARBARA MCCLINTOCK was compared to GREGOR MENDEL (see **11,822 HE – 11,884 HE**) in terms of her scientific career by the Swedish Academy of Sciences when she was awarded the Prize. She was elected a Foreign Member of the Royal Society (ForMemRS) in **11,989 HE**. MCCLINTOCK received the Benjamin Franklin Medal for Distinguished Achievement in the Sciences of the American Philosophical Society in **11,993 HE**. She was awarded 14 Honorary Doctor of Science degrees and an Honorary Doctor of Humane Letters. In **11,986 HE** she was inducted into the National Women's Hall of Fame.
- ⇒ During her final years, MCCLINTOCK led a more public life, especially after Evelyn Fox Keller's **11,983 HE** biography of her, *A Feeling for the Organism*, brought MCCLINTOCK's story to the public. She remained a regular presence in the Cold Spring Harbor community and gave talks on mobile genetic elements and the history of genetics research for the benefit of junior scientists.

⇒ The McClintock Prize is named in her honor. Laureates of the award include DAVID BAULCOMBE, DETLEF WEIGEL ROBERT A. MARTIENSSEN, JEFFREY D. PALMER, AND SUSAN R. WESSLER.²³⁷²

11,903 HE: WILBER WRIGHT & ORVILLE WRIGHT, United States,²³⁷³ at Kill Devil Hills on the Outer Banks of North Carolina,²³⁷⁴ 4 miles south of Kitty Hawk, North Carolina, the WRIGHTS made the first controlled, sustained flight of a powered, heavier-than-air passenger carrying aircraft.²³⁷⁵

- Author / Compiler note: We celebrate them and recognize they stood on the shoulders of giants. Research says: While WILBER

²³⁷² https://en.wikipedia.org/wiki/Barbara_McClintock

²³⁷³ https://en.wikipedia.org/wiki/Wright_brothers

²³⁷⁴ <https://www.nps.gov/wrbr/learn/historyculture/thefirstflight.htm>

²³⁷⁵ https://en.wikipedia.org/wiki/Wright_brothers

WRIGHT & ORVILLE WRIGHT's contributions were pivotal, the concept of powered human flight did not originate with them.

- DAVINCI had drawings of flying machines in his workbooks.
- Orniflappers were early attempts at flying machines.
- GEORGE CAYLEY, Englishman, **11,773 HE – 11,857 HE** focused his science on fixed wing shape.
- Later, OTTO LILIENTHAL, **11,848 HE – 11,896 HE**, put CAYLEY'S ideas into practice building gliders and gathering data that the WRIGHTS utilized to make their flying machines.

- There was also ALBERTO SANTOS-DUMONT, **11,873 HE – 11,932 HE**, Brazilian inventor and aviation pioneer.²³⁷⁶
- The WRIGHTS relied on aviation research and also automobile research. Lighter and faster internal combustion engines were being put into early cars.
- The WRIGHTS put all the information/research together and built a machine people could actually fly.²³⁷⁷

²³⁷⁶ https://en.wikipedia.org/wiki/History_of_aviation

²³⁷⁷ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

⇒ **11,867 HE – 11,912 HE: WILBER WRIGHT**, Editor, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.²³⁷⁸



- **WILBER WRIGHT**, date, location and photographer unknown.²³⁷⁹

²³⁷⁸ https://en.wikipedia.org/wiki/Wright_brothers

²³⁷⁹ https://en.wikipedia.org/wiki/Wright_brothers

⇒ **11,871HE – 11,948HE: ORVILLE WRIGHT**, Printer/publisher, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.²³⁸⁰



● **ORVILLE WRIGHT**, date, location and photographer unknown²³⁸¹

²³⁸⁰ https://en.wikipedia.org/wiki/Wright_brothers

²³⁸¹ https://en.wikipedia.org/wiki/Wright_brothers



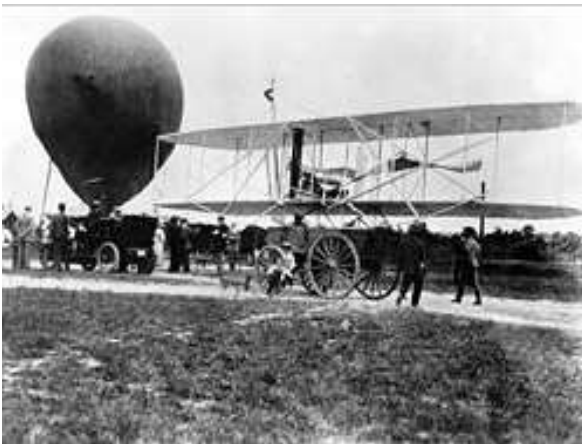
11,929 HE: Above is a photograph of founding members of NACA (National Advisory Committee for Aeronautics) at Committee meeting. ORVILLE WRIGHT served on NACA for 28 years.²³⁸²

²³⁸² https://en.wikipedia.org/wiki/Wright_brothers



National Advisory Committee for Aeronautics (NACA) seal, with an image of the WRIGHT flier. NASA was created from the National Advisory Committee on Aeronautics in **11,958 HE.**²³⁸³

²³⁸³ <https://wright.nasa.gov/orville.htm>



The Wright Military Flyer aboard a wagon in **11,908 HE**,
photographer unknown.²³⁸⁴

²³⁸⁴ https://en.wikipedia.org/wiki/Wright_brothers

- ⇒ It is notable that distinguished, accomplished, and recognized United States scientists of the time **WILLIAM HENRY PICKERING (11,858 HE – 11,938 HE)** and **SIMON NEWCOMB (11,835 HE – 11,909 HE)** both said flight by humans could not be a serious or practical proposition.²³⁸⁵
- ⇒ Also, Bishop Milton Wright, (**11,828 HE -11,917 HE**) United States Episcopalian Bishop and Father of **WILBUR WRIGHT** and **ORVILLE WRIGHT** said, “Men will never fly, because flying is reserved for angels.”²³⁸⁶

²³⁸⁵ RICHARD DAWKINS *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder*

²³⁸⁶ *Asimov's Book of Science and Nature Quotations* (Blue Cliff Edition), edited by ISAAC ASIMOV and Jason A. Shulman, section 1.14

11,903 HE – 11,972 HE: LOUIS LEAKEY, British and Kenyan paleoanthropologist and archeologist.²³⁸⁷ LOUIS LEAKEY's work was important in demonstrating that humans evolved in Africa, particularly through discoveries made at Olduvai Gorge with his wife, fellow paleontologist MARY LEAKEY.

⇒ Another of LOUIS LEAKEY's legacies stems from his role in fostering field research of primates in their natural habitats, which saw as key to understanding human evolution. He personally chose three female researchers, JANE GOODALL, DIAN FOSSEY, and BIRUTĖ GALDIKAS, calling them The Trimates. LEAKEY also played a major role in creating organizations for future research in Africa and for protecting wildlife of the area.²³⁸⁸

²³⁸⁷ https://en.wikipedia.org/wiki/Wright_brothers

²³⁸⁸ https://en.wikipedia.org/wiki/Louis_Leakey



LOUIS LEAKEY examining skulls from Olduvai Gorge, Tanzania, date, location, and photographer unknown²³⁸⁹

²³⁸⁹ https://en.wikipedia.org/wiki/Human_evolution#First_fossils

11,904 HE – 11,983 HE: JOSEPH EDWARD MAYER,²³⁹⁰ United States chemist who formulated the Mayer expansion in statistical field theory.²³⁹¹ It was through finding him that we learned of his **11,963 HE** Nobel Laureate Wife (See **11,906 HE – 11,972 HE:** MARIA GOEPPERT MAYER).

11,904 HE:



German electric car, with the chauffeur on top²³⁹²

²³⁹⁰ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²³⁹¹ https://en.wikipedia.org/wiki/Joseph_Edward_Mayer

²³⁹² https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11,905 HE:



Columbia Electric's (**11,896 HE** – **11,899 HE**) "Victoria" electric cab on Pennsylvania Ave., Washington D.C., seen from Lafayette Park in **11,905 HE**; photographer unknown.²³⁹³

²³⁹³ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11,905 HE – 11,962 HE: Dr. WILLIAM W. CARDOZO, United States Pediatrician published in **11,937 HE:** "*Immunologic Studies in Sickle Cell Anemia*" in the Archives of Internal Medicine; many of the findings are still valid today.²³⁹⁴



Dr. CARDOZO, artist, date and location unknown.²³⁹⁵

²³⁹⁴ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²³⁹⁵ <https://aaregistry.org/story/sickle-cell-pioneer-william-w-cardozo/>

11,905 HE – 11,989 HE: EMILIO SEGRÈ²³⁹⁶, Italian born United States physicist and a **11,959 HE** shared Nobel Prize winner. SEGRÈ and others discovered the antiproton.

⇒ **11,937 HE: SEGRÈ** discovered Technetium, which was *not* a Star Stuff Element. It was the first artificially synthesized element that does not occur in nature.

⇒ From **11,943 HE to 11,946 HE SEGRÈ** worked at the Los Alamos National Laboratory for the Manhattan Project. He helped discover the element Astatine and the isotope plutonium-239, which was used to make the nuclear bomb dropped on Nagasaki.

⇒ **EMILIO SEGRÈ** was also active as a photographer and took many photos documenting events and people in the history of modern

²³⁹⁶ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

science, which were donated to the American Institute of Physics after his death. The American Institute of Physics named its photographic archive of physics history in his honor.²³⁹⁷



EMILIO SEGRÈ, date, location and photographer unknown.²³⁹⁸

²³⁹⁷ https://en.wikipedia.org/wiki/Emilio_Segrè

²³⁹⁸ https://en.wikipedia.org/wiki/Emilio_Segrè

11,906 HE – 11,972 HE: MARIA GOEPPERT MAYER²³⁹⁹ was a German-born United States theoretical physicist and Nobel laureate in Physics for proposing the nuclear shell model of the atomic nucleus. MARIA GOEPPERT MAYER was the second woman to win a Nobel Prize in Physics, the first being MARIE CURIE.²⁴⁰⁰ A graduate of the University of Göttingen, GOEPPERT MAYER wrote her doctoral thesis on the theory of possible two-photon absorption by atoms. At the time, the chances of experimentally verifying her thesis seemed remote, but the development of the laser permitted this verification.

⇒ MARIA GOEPPERT married JOSEPH EDWARD MAYER (See **11,904 HE – 11,983 HE**) and moved to the United States, where he

²³⁹⁹ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²⁴⁰⁰ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

was an associate professor at Johns Hopkins University. Strict rules against nepotism prevented Johns Hopkins University from taking her on as a faculty member, but she was given a job as an assistant.²⁴⁰¹

⇒ **11,935 HE:** MARIA GOEPPERT MAYER published a landmark paper on double beta decay.²⁴⁰²

⇒ **11,937 HE:** MARIA GOEPPERT MAYER moved to Columbia University, where she was only offered an unpaid position.²⁴⁰³

⇒ **Circa 11,939 HE – 11,945 HE:** During World War II, MARIA GOEPPERT MAYER worked for the Manhattan Project at

²⁴⁰¹ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁴⁰² https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁴⁰³ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

Columbia on isotope separation, and with EDWARD TELLER at the Los Alamos Laboratory on the development of Teller's "Super" bomb.²⁴⁰⁴

⇒ **Circa 11,950 HE:** After the war, MARIA GOEPPERT MAYER became an unpaid associate professor of Physics at the University of Chicago and a senior physicist at the nearby Argonne National Laboratory. GOEPPERT MAYER developed the mathematical model for the structure of nuclear shells, for which she was awarded the Nobel Prize in Physics in **11,963 HE**, which she shared with J. HANS D. JENSEN and EUGENE WIGNER.²⁴⁰⁵ GOEPPERT MAYER's model explained why certain numbers of nucleons in an atomic nucleus result in particularly stable

²⁴⁰⁴ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁴⁰⁵ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

configurations. These numbers are what EUGENE WIGNER called magic numbers: 2, 8, 20, 28, 50, 82, and 126.²⁴⁰⁶

⇒ ENRICO FERMI (SEE **11,901 HE – 11,954 HE**: ENRICO FERMI) provided a critical insight by asking GOEPPERT MAYER: "Is there any indication of spin orbit coupling?" She realized that this was indeed the case and described the idea as follows:

- *“Think of a room full of waltzers. Suppose they go round the room in circles, each circle enclosed within another. Then imagine that in each circle, you can fit twice as many dancers by having one pair go clockwise and another pair go counterclockwise. Then add one more variation; all the dancers are spinning twirling round and round like tops as they circle the room, each pair both twirling and circling. But only some of*

²⁴⁰⁶ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

those that go counterclockwise are twirling counterclockwise. The others are twirling clockwise while circling counterclockwise. The same is true of those that are dancing around clockwise: some twirl clockwise, others twirl counterclockwise”.

⇒ In **11,960 HE**, MARIA GOEPPERT MAYER was appointed full professor of physics at the University of California, San Diego.²⁴⁰⁷



⇒ MARIA GOEPPERT MAYER, date, location and photographer unknown.²⁴⁰⁸

²⁴⁰⁷ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁴⁰⁸ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer



11,963 HE: The year she was awarded her Nobel Prize in Physics. This photo is of MARIA GOEPPERT MAYER walking into the Nobel ceremony with King Gustaf VI Adolf of Sweden.²⁴⁰⁹

⇒ Other Honors: Crater Goeppert Mayer on Venus with a diameter of about 35 km is named after Goeppert-Mayer. The unit for the two-

²⁴⁰⁹ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

photon absorption cross section is named the Goeppert Mayer (GM) unit. In **12,011 HE**, she was included in the third issuance of the American Scientists collection of US postage stamps, along with MELVIN CALVIN, ASA GRAY, AND SEVERO OCHOA. Her papers are in the Geisel Library at the University of California, San Diego, and the university's physics department is housed in Mayer Hall, which is named after her and her husband, JOSEPH EDWARD MAYER.²⁴¹⁰

11,906 HE – 11,992 HE: GRACE BREWSTER MURRAY HOPPER was an American computer scientist who popularized the idea of machine-independent programming languages, which led to the development of COBOL (an acronym for COmmon Business-Oriented Language),

²⁴¹⁰ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

an early high-level computer programming business language. She was also a Navy Rear Admiral.²⁴¹¹



11,984 HE: Rear Admiral GRACE M. HOPPER.²⁴¹²

²⁴¹¹ https://en.wikipedia.org/wiki/Grace_Hopper

²⁴¹² https://en.wikipedia.org/wiki/Grace_Hopper



11,978 HE: GRACE HOPPER in a computer room in Washington DC. Photographed by Lynn Gilbert.²⁴¹³

²⁴¹³ https://en.wikipedia.org/wiki/Grace_Hopper



Circa 11,960 HE: GRACE HOPPER (and three other unnamed people) at the UNIVAC I console. Photographer unknown.²⁴¹⁴

²⁴¹⁴ https://en.wikipedia.org/wiki/Grace_Hopper

11,907 HE– 11,964 HE: RACHEL CARSON, United States marine biologist, author of *Silent Spring*, and conservationist.²⁴¹⁵



11,940 HE: RACHEL CARSON (Fish & Wildlife Service employee photo).²⁴¹⁶

²⁴¹⁵ https://en.wikipedia.org/wiki/Rachel_Carson

²⁴¹⁶ https://en.wikipedia.org/wiki/Rachel_Carson



Statue of RACHEL CARSON at the Museo Rocsen, Nono, Argentina.²⁴¹⁷

²⁴¹⁷ https://en.wikipedia.org/wiki/Rachel_Carson

11,909 HE: It was not until this year that Pure “Star Stuff” Element Boron was first *isolated and produced* by the United States chemist EZIEKIEL WEINTRAUB.²⁴¹⁸ However:

- ⇒ **Circa 11,350 HE** in “The Prologue” of Chaucer’s *Canterbury Tales* “Borax” is mentioned.²⁴¹⁹ The people of the time had an idea of how to use it... but did not know it was an element.

- ⇒ **In the early 11,800’s HE**, multiple scientists *recognized* the “Star Stuff” element Boron: SIR HUMPHRY DAVY BT, JOSEPH LOUIS GAY-LUSSAC, LOUIS JACQUES THENARD, and JONS JAKOB BERZELIUS.²⁴²⁰

²⁴¹⁸ <https://en.wikipedia.org/wiki/Boron>

²⁴¹⁹ Dr. Paul Parsons and Gail Dixon book: *The Periodic Table: A Visual Guide to the Elements*

²⁴²⁰ <https://en.wikipedia.org/wiki/Boron>



The photo is of pure crystalline “Star Stuff” Element Boron. Original size in cm: 2 x 3. Atomic Number 5, Boron, B. Boron is not a very common element and is found in nature only in compounds with oxygen. Crystalline boron, which is shown here, is nearly as hard as diamond (9.5 on Mohs scale, diamond has 10). Boron has different biological functions. Boron compounds have many, often very special applications, a common one is B_2O_3 for borosilicate glass. Most famous probably are the perborates as bleach and as washing agent. Because of their bad biodegradability, the use of perborates has stopped.²⁴²¹

²⁴²¹ <http://images-of-elements.com/boron.php#a>

11,909 HE – 12,012 HE: RITA LEVI-MONTALCINI, OMRI, OMCA, Italian. In **11,986 HE** she was awarded the Nobel Prize in Physiology or Medicine jointly with colleague STANLEY COHEN for the discovery of nerve growth factor (NGF). Although an atheist, this made LEVI-MONTALCINI the fourth Nobel Prize winner to come from Italy's small (less than 50,000 people) but very old Jewish community, after EMILIO SEGRÈ, SALVADOR LURIA (a university colleague and friend), and FRANCO MODIGLIANI.²⁴²²

⇒ RITA LEVI-MONTALCINI, Some Honors and Awards: In **11,966 HE**, she was elected a Fellow of the American Academy of Arts and Sciences. In **11,968 HE**, she became the tenth woman elected to the United States National Academy of Sciences. In **11,987 HE**, she received the National Medal of Science, the highest American scientific honor. In **11,991 HE**, she expressed her desire to formulate a Carta of Human Duties as necessary counterpart of the

²⁴²² https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

too much neglected Declaration of Human Rights. Her vision of came true with the issuing of the Trieste Declaration of Human Duties and the foundation in **11,993 HE** of the International Council of Human Duties (ICHD) at the University of Trieste. She was elected a Foreign Member of the Royal Society (ForMemRS) in **11,995 HE**. In **12,009 HE**, she received the Leonardo da Vinci Award from European Academy of Sciences. In **12,011 HE**, at the Sapienza University of Rome she received the PhD Honoris Caus from the McGill University, Canada. She was a founding member of Città della Scienza and Academician of Studium, Accademia di Casale e del Monferrato, Italy.

⇒ On 22 April **12,009 HE**, LEVI-MONTALCINI became the first Nobel laureate ever to reach the age of 100 and the event was feted

with a party at Rome's City Hall. At the time of her death, she was the oldest living Nobel laureate.²⁴²³



12,009 HE Photo of RITA LEVI-MONTALCINI. Location and photographer unknown.²⁴²⁴

²⁴²³ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²⁴²⁴ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

11,909 HE: RICHARD RICHTER, German, developed the first intrauterine birth control device made from silkworm gut which was further developed and marketed in Germany by Ernst Gräfenberg in the late **11,920s HE**.^{2425 2426}

11,910 HE – 12,008 HE: DOROTHY JOHNSON VAUGHAN²⁴²⁷ United States mathematician and human computer who worked for the National Advisory Committee for Aeronautics (NACA), and NASA,²⁴²⁸ and became acting supervisor of the West Area Computers, the first African-American woman to supervise a group

²⁴²⁵ https://en.wikipedia.org/wiki/History_of_birth_control

²⁴²⁶ Fritz, Marc A.; Speroff, Leon (12,011 HE). *"Intrauterine contraception"*. Clinical gynecologic endocrinology and infertility (8th ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins. pp. 1095–1098. ISBN 978-0-7817-7968-5.

²⁴²⁷ *Hidden Figures: The American Dream and the Untold Story of the Black Women*

Mathematicians Who Helped Win the Space Race. by Margot Lee Shetterly

²⁴²⁸ https://en.wikipedia.org/wiki/Dorothy_Vaughan

of staff composed entirely of African-American women mathematicians at NACA.²⁴²⁹



DOROTHY JOHNSON VAUGHAN date, location and photographer unknown.²⁴³⁰

²⁴²⁹ https://en.wikipedia.org/wiki/Dorothy_Vaughan

²⁴³⁰ https://en.wikipedia.org/wiki/Dorothy_Vaughan

11,910 HE – 11,997 HE: JACQUES-YVES COUSTEAU, French naval officer, explorer, conservationist, filmmaker, innovator, scientist, photographer, editor, and researcher who studied the seas and life in the seas. During the **11,940s HE**, COUSTEAU is credited with improving the aqualung design which gave birth to the open-circuit scuba technology used today. In **11,950 HE**, COUSTEAU founded the French Oceanographic Campaigns (FOC), and leased a ship called *Calypso* from Thomas Loel Guinness for a symbolic one franc a year. COUSTEAU refitted the *Calypso* as a mobile laboratory for field research and as his principal vessel for diving and filming. He also carried out underwater archaeological excavations in the Mediterranean, in particular at Grand-Congloué (**11,952 HE**).²⁴³¹

²⁴³¹ https://en.wikipedia.org/wiki/Jacques_Cousteau



COUSTEAU'S submarine near Oceanographic Museum in Monaco. Photographer and date unknown.²⁴³²

²⁴³² https://en.wikipedia.org/wiki/Jacques_Cousteau



JACQUES-YVES COUSTEAU in **11,972 HE**. Photographer and location unknown.²⁴³³

²⁴³³ https://en.wikipedia.org/wiki/Jacques_Cousteau

11,910 HE– 11,994 HE: DOROTHY MARY CROWFOOT HODGKIN
OM FRS HonFRSC, British **11,964 HE** Nobel Prize winning chemist
who invented / developed *Protein Crystallography*: the technique
which shines light at proteins to expose their 3-dimensional
structure.²⁴³⁴ (See **11,638 HE – 11,686 HE: NICHOLAS STENO**,
Danish Geologist²⁴³⁵ who developed crystallography.²⁴³⁶)

⇒ As of **12,016 HE** she remained the only British woman scientist to
have been awarded a Nobel Prize in any of the three sciences it
recognizes.²⁴³⁷

⇒ Some of the Honors, awards and legacies of **DOROTHY MARY
CROWFOOT HODGKIN**: Elected a Fellow of the Royal Society

²⁴³⁴ <https://www.youtube.com/watch?v=dCe9y053pqE> TimJamesScience

²⁴³⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

²⁴³⁶ https://en.wikipedia.org/wiki/Nicolas_Steno

²⁴³⁷ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

(FRS) in **11,947 HE** and EMBO Membership in **11,970 HE**; The National Portrait Gallery, London lists 17 portraits of CROWFOOT HODGKIN. **In 11,965 HE:** CROWFOOT HODGKIN was the second woman in 60 years, after Florence Nightingale, to be appointed to the Order of Merit by a king or queen. As of **12,016 HE** she was the first woman to receive the Copley Medal. She was elected a Foreign Honorary Member of the American Academy of Arts and Sciences and a foreign member of the USSR Academy of Sciences. The communist government of Bulgaria awarded her its Dimitrov Prize; In **11,983 HE** she received the Austrian Decoration for Science and Art. Asteroid 5422 was named "Hodgkin" in her honor.

⇒ Over the years British postage stamps have twice commemorated CROWFOOT HODGKIN.²⁴³⁸

²⁴³⁸ https://en.wikipedia.org/wiki/Dorothy_Hodgkin



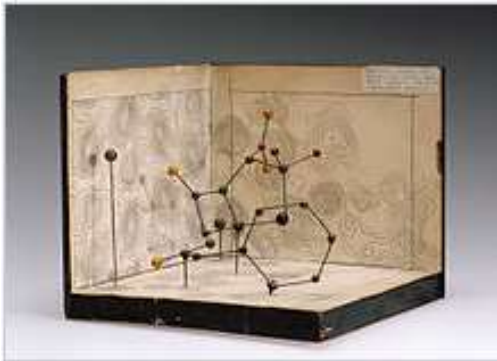
Photo of DOROTHY MARY CROWFOOT HODGKIN, date, location and photographer unknown.²⁴³⁹

²⁴³⁹ https://en.wikipedia.org/wiki/Dorothy_Hodgkin



Circa 11,945 HE: Model of the structure of penicillin by DOROTHY MARY CROWFOOT HODGKIN, photographer and location unknown.²⁴⁴⁰

²⁴⁴⁰ https://en.wikipedia.org/wiki/Dorothy_Hodgkin



Circa 11,945 HE: Molecular model of penicillin by DOROTHY MARY CROWFOOT HODGKIN, photographer and location unknown.²⁴⁴¹

²⁴⁴¹ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

11,912 HE – 11,997 HE: CHIEN-SHIUNG WU²⁴⁴² was a Chinese-American experimental physicist who made significant contributions in the field of nuclear physics. Her nicknames include "the First Lady of Physics", "the Chinese Madame Curie", and the "Queen of Nuclear Research". She worked on the Manhattan Project, where she helped develop the process for separating uranium metal into uranium-235 and uranium-238 isotopes by gaseous diffusion. CHIEN-SHIUNG WU is best known for conducting the Wu experiment, which contradicted the hypothetical law of conservation of parity. This discovery resulted in her colleagues TSUNG-DAO LEE and CHEN-NING YANG winning the **11,957 HE** Nobel Prize in physics and earned WU the inaugural Wolf Prize in Physics in **11,978 HE**.²⁴⁴³

²⁴⁴² SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²⁴⁴³ https://en.wikipedia.org/wiki/Chien-Shiung_Wu



11,958 HE Photo is of CHIEN-SHIUNG WU at Columbia University. Photographer unknown.²⁴⁴⁴

²⁴⁴⁴ https://en.wikipedia.org/wiki/Chien-Shiung_Wu



The experiments of Columbia University physicists (left to right) CHIEN-SHIUNG WU, Y.K. LEE, AND L.W. MO confirmed the theory of conservation of vector current. In the experiments, which took several months to complete, proton beams from Columbia's Van de Graaff accelerator were transmitted through pipes to strike a 2 mm Boron target at the entrance to a spectrometer chamber.²⁴⁴⁵

²⁴⁴⁵ https://en.wikipedia.org/wiki/Chien-Shiung_Wu



Statue of CHIEN-SHIUNG WU at one of the campuses of a Ming De School, unknown date, photographer, and unknown which location of Ming De School (of which there are several).²⁴⁴⁶

²⁴⁴⁶ https://en.wikipedia.org/wiki/Chien-Shiung_Wu

11,912 HE – 11,991 HE: SALVADOR LURIA²⁴⁴⁷ Italian microbiologist, later a naturalized United States citizen and a **11,969 HE** shared Nobel Laureate with MAX DELBRÜCK and ALFRED HERSHEY, for their discoveries on the replication mechanism and the genetic structure of viruses. LURIA also showed that bacterial resistance to viruses (phages) is genetically inherited.²⁴⁴⁸

⇒ **11,963 HE:** While on sabbatical to study at the Institut Pasteur in Paris, SALVADOR LURIA found that bacteriocins impair the function of cell membranes. After he returned to MIT, his lab discovered that bacteriocins achieve this impairment by forming holes in the cell membrane, allowing ions to flow through and destroy the electrochemical gradient of cells.²⁴⁴⁹

²⁴⁴⁷ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²⁴⁴⁸ https://en.wikipedia.org/wiki/Salvador_Luria

²⁴⁴⁹ https://en.wikipedia.org/wiki/Salvador_Luria

- SALVADOR LURIA awards and recognitions: He was named a member of the National Academy of Sciences in **11,960 HE**. From **11,968 HE** to **11,969 HE**, he served as president of the American Society for Microbiology. In **11,969 HE**, he was awarded the Louisa Gross Horwitz Prize from Columbia University together with MAX DELBRÜCK. In the U.S. he won the **11,974 HE** National Book Award in Science for his popular science book *Life: The Unfinished Experiment* and received the National Medal of Science in **11,991 HE**.²⁴⁵⁰

²⁴⁵⁰ https://en.wikipedia.org/wiki/Salvador_Luria



The photo is of SALVADOR LURIA, date, location and photographer unknown.²⁴⁵¹

²⁴⁵¹ https://en.wikipedia.org/wiki/Salvador_Luria

11,912 HE – 11,977 HE: WERNHER MAGNUS MAXIMILIAN FREIHERR VON BRAUN²⁴⁵² German, and, later, United States aerospace engineer and space architect.

⇒ **11,942 HE:** VON BRAUN helped develop the Nazi V2 rocket (German, military, sub-orbital). **11,944 HE:** VON BRAUN claimed that he was aware of the treatment of prisoners in German concentration camps but felt helpless to change the situation, after former Buchenwald inmate Adam Cabala claimed that von Braun went to the concentration camp to pick slave laborers: “also the German scientists led by Prof. Wernher von Braun were aware of everything daily. As they went along the corridors, they saw the exhaustion of the inmates, their arduous work and their pain. Not one single time did Prof. Wernher von Braun protest against this cruelty during his frequent stays at Dora. Even the aspect of corpses did not touch him: On a small area near the ambulance shed,

²⁴⁵² Paul Premack suggested his name

inmates tortured to death by slave labor and the terror of the overseers were piling up daily. But Prof. Wernher von Braun passed them so close that he was almost touching the corpses.”²⁴⁵³

⇒ **11,945 HE**, The U.S. Secretary of State approved the transfer of VON BRAUN and his specialists to the United States; however, this was not announced to the public until later that year. VON BRAUN was among those scientists for whom the Joint Intelligence Objectives Agency (JIOA) arguably falsified employment histories and expunged Nazi memberships.²⁴⁵⁴ Either the US got him or the Soviets, so this was the way the US got him.²⁴⁵⁵ **11,952 HE - 11,956 HE**, VON BRAUN led the US Army's rocket development team resulting in the Redstone rocket. with the first high-precision inertial guidance system. **11,958 HE**: As

²⁴⁵³ https://en.wikipedia.org/wiki/Wernher_von_Braun

²⁴⁵⁴ https://en.wikipedia.org/wiki/Wernher_von_Braun

²⁴⁵⁵ Paul Premack clarified

director of the Development Operations Division of the Army Ballistic Missile Agency, VON BRAUN, with his team, then developed the Jupiter-C, a modified Redstone rocket. The Jupiter-C successfully launched the West's first satellite, *Explorer 1*. This event signaled the birth of America's space program.²⁴⁵⁶



11,960 HE WERNHER VON BRAUN (photographer unknown) was the leading figure in the development of rocket technology in

²⁴⁵⁶ https://en.wikipedia.org/wiki/Wernher_von_Braun

Germany and the father of rocket technology and space science in the United States.²⁴⁵⁷

11,912 HE:



Detroit Electric vehicle advertisement, artist unknown.²⁴⁵⁸

²⁴⁵⁷ https://en.wikipedia.org/wiki/Wernher_von_Braun

²⁴⁵⁸ https://en.wikipedia.org/wiki/History_of_the_automobile

11,913 HE:



2459

The Ford Model T, created by the Ford Motor Company five years prior, became the first automobile to be mass-produced on a moving assembly line. By **11,927 HE**, Ford had produced over 15,000,000 Model T automobiles.²⁴⁶⁰

²⁴⁵⁹ https://en.wikipedia.org/wiki/Ford_Model_T

²⁴⁶⁰ https://en.wikipedia.org/wiki/History_of_the_automobile

11,913 HE:



THOMAS EDISON and an electric car, photographer and location unknown.²⁴⁶¹

²⁴⁶¹ https://en.wikipedia.org/wiki/History_of_the_automobile

11,913 HE – 11,996 HE, MARY LEAKEY; British and Kenyan paleoanthropologist. For much of her career MARY LEAKEY worked with her husband LOUIS LEAKEY at Olduvai Gorge, where they uncovered fossils of the earliest hominins, as well as the stone tools produced by them. MARY LEAKEY discovered the first fossilized *Proconsul* skull, an extinct ape now believed to be ancestral to humans. She also discovered the robust *Zinjanthropus* skull at Olduvai Gorge in Tanzania, eastern Africa. She developed a system for classifying the stone tools found at Olduvai Gorge. She discovered the Laetoli footprints, and at the Laetoli site she discovered hominin fossils that were more than 3.75 million years old. During her career, she discovered fifteen new species of other animals, and one new genus.²⁴⁶²

²⁴⁶² https://en.wikipedia.org/wiki/Mary_Leakey

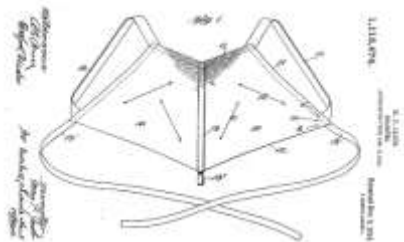
Mary Leakey



11,977 HE MARY LEAKEY, photographer unknown and location unknown.²⁴⁶³

²⁴⁶³ https://en.wikipedia.org/wiki/Mary_Leakey

11,914 HE: MARY P. JACOB patents the first modern bra.²⁴⁶⁴



United States Patent for the first modern bra.²⁴⁶⁵

²⁴⁶⁴ <https://www.youtube.com/watch?v=aqKm-tYHlwM>

²⁴⁶⁵ <http://pdfpiw.uspto.gov/.piw?docid=01115674&SectionNum=1&IDKey=896491A07006&HomeUrl=http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1%2526Sect2=HITOFF%2526d=PALL%2526p=1%2526u=%25252Fmetahtml%25252FPTO%25252Fsrchnum.htm%2526r=1%2526f=G%2526l=50%2526s1=1,115,674.PN.%2526OS=PN/1,115,674%2526RS=PN/1,115,674>



11,914 HE:

Swiss & German co-production of world's first functional diesel-electric railcar. Location and photographer unknown.²⁴⁶⁶

²⁴⁶⁶ https://en.wikipedia.org/wiki/History_of_rail_transport

11,914 HE - 12,000 HE: HEDY LAMARR²⁴⁶⁷ born Hedwig Eva Maria Kiesler, Austrian-born United States inventor and film star.²⁴⁶⁸ At the beginning of World War II, HEDY LAMARR and composer George Antheil developed a radio guidance system for Allied torpedoes which used spread spectrum and frequency hopping technology to defeat the threat of jamming by the Axis powers. It was publicly said that the US Navy did not adopt the technology until the **11,960s HE**, however there were unauthorized reports that the work helped the US win WWII. The principles of their work are arguably incorporated into Bluetooth technology, and are similar to methods used in legacy versions of CDMA and Wi-Fi.^{2469 2470}

²⁴⁶⁷ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²⁴⁶⁸ https://en.wikipedia.org/wiki/Hedy_Lamarr

²⁴⁶⁹ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²⁴⁷⁰ https://en.wikipedia.org/wiki/Hedy_Lamarr



HEDY LAMARR, date, location, artist unknown.²⁴⁷¹

²⁴⁷¹ https://en.wikipedia.org/wiki/Hedy_Lamarr

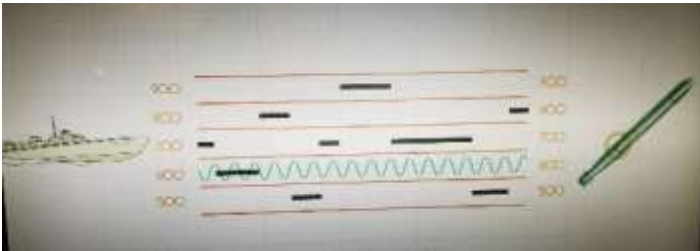


Illustration of Frequency Hopping technology invented by LAMARR.²⁴⁷²

²⁴⁷² Netflix: Bombshell: The Hedy Lamarr Story

Circa 11,915 HE: According to CARL SAGAN, due to scientific advancements, human life expectancy rose to about 50 years. To put that into context: A) Around **39,000 BHE** human life expectancy in hunter-gather, pre-agricultural times was about 20-30 years; B) It took about 50,000 years to increase life expectancy by ten years to age 40 by about **11,870 HE**.

⇒ Due to increases in science-based health care, and the use of artificial, non-degrading, nitrogen to grow crops, it had taken only 45 years to gain another ten years of life expectancy. In the hundred years that followed, average life expectancy for females in the US reached 84 years of age, adding another 34 years of average longevity. (See above LOUIS PASTEUR and ROBERT TYNDALL and Fritz Haber.)²⁴⁷³

²⁴⁷³ CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

11,915 HE - 11,958 HE: NACA, United States National Advisory Committee for Aeronautics, a U.S. federal agency, founded to undertake, promote, and institutionalize aeronautical research. It was the foundation agency for NASA.²⁴⁷⁴

Born 11,918 HE: KATHERINE COLEMAN GOBLE JOHNSON, United States mathematician who for much of her life was employed by NACA and NASA and calculated the math for ALAN SHEPARD's historic rocket launch and splashdown.²⁴⁷⁵ JOHNSON was cited as a pioneering example of African-American women in STEM.²⁴⁷⁶

⇒ At the **12,016 HE** NASA building dedication event in honor of KATHERINE JOHNSON, deputy director Lewin said this about

²⁴⁷⁴ https://en.wikipedia.org/wiki/National_Advisory_Committee_for_Aeronautics

²⁴⁷⁵ ***Hidden Figures: The American Dream and the Untold Story of the Black Women Who Helped Win the Space Race*** written by Margot Lee Shetterly. Author / Compiler Note: This is a wonderful book that will enrich any reader.

²⁴⁷⁶ https://en.wikipedia.org/wiki/Katherine_Johnson

JOHNSON: "Millions of people around the world watched SHEPARD'S flight, but what they didn't know at the time was that the calculations that got him into space and safely home were done by today's guest of honor, KATHERINE JOHNSON".

- ⇒ During the event, JOHNSON also received a Silver Snoopy award; often called the astronaut's award. NASA stated it is given to those "who have made outstanding contributions to flight safety and mission success". In **12,016 HE**, JOHNSON was included in the list of "100 Women", BBC's list of 100 influential women worldwide. NASA stated, "Her calculations proved as critical to the success of the Apollo Moon landing program and the start of the Space Shuttle program, as they did to those first steps on the country's journey into space."²⁴⁷⁷

²⁴⁷⁷ https://en.wikipedia.org/wiki/Katherine_Johnson



KATHERINE COLEMAN GOBLE JOHNSON at NASA in
11,966 HE, photographer unknown.²⁴⁷⁸

²⁴⁷⁸ https://en.wikipedia.org/wiki/Katherine_Johnson



12,015 HE: KATHERINE COLEMAN GOBLE JOHNSON being awarded the Presidential Medal of Freedom by President Obama.²⁴⁷⁹ (Author / Compiler did not remove other face from the photo).

²⁴⁷⁹ https://en.wikipedia.org/wiki/Katherine_Johnson

11,918 HE – 12,003 HE: FRANCO MODIGLIANI²⁴⁸⁰ was an Italian born United States economist and the recipient of the **11,985 HE** Nobel Prize in Economics "for his pioneering analyses of saving and of financial markets."²⁴⁸¹ MODIGLIANI, from the **11,950s HE**, is the originator of the life-cycle hypothesis, which attempts to explain the level of saving in the economy. In the hypothesis it is proposed that consumers aim for a stable level of consumption throughout their lifetime (for example by saving during their working years and then spending during their retirement).²⁴⁸²

⇒ Author / Compiler note: As of **12,019 HE**, people are often outliving their money. Evidently such a notion was inconceivable in as little time as the less than 40 years which have passed since

²⁴⁸⁰ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²⁴⁸¹ https://en.wikipedia.org/wiki/Franco_Modigliani

²⁴⁸² https://en.wikipedia.org/wiki/Franco_Modigliani

MODIGLIANI was awarded the Nobel Prize in Economics for his pioneering analyses of saving and of financial markets.



12,000 HE photo is of FRANCO MODIGLIANI, location and photographer unknown.²⁴⁸³

²⁴⁸³ https://en.wikipedia.org/wiki/Franco_Modigliani

11,918 HE: KALMAN KANDO (Hungarian engineer, **11,869 HE - 11,931 HE**) invented and developed the rotary phase converter, enabling electric locomotives to use three-phase motors while supplied electricity via a single overhead wire, carrying the simple industrial frequency (50 Hz) single phase AC of the high voltage national networks.²⁴⁸⁴



KALMAN KANDO, date, location, photographer unknown.²⁴⁸⁵

²⁴⁸⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

²⁴⁸⁵ https://en.wikipedia.org/wiki/Kálmán_Kandó

11,918 HE - 11,999 HE: GERTRUDE BELLE ELION; United States, biochemist and pharmacologist who shared the **11,988 HE** Nobel Prize in Physiology or Medicine with GEORGE H. HITCHINGS AND SIR JAMES BLACK.²⁴⁸⁶

⇒ When she was 15, her grandfather died of cancer, instilling in her a desire to do all she could to try and cure the disease. She graduated from Hunter College in **11,937 HE** with a degree in chemistry and New York University (M.Sc.) in **11,941 HE**, while working as a high school teacher during day time. Her fifteen fellowship applications were turned down due to gender bias at the time, so she enrolled in a secretarial school, which lasted six weeks before she found a job. Unable to obtain a graduate research position, she

²⁴⁸⁶ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion

worked as a food quality supervisor at A&P supermarkets and other odd jobs while she did her science research.²⁴⁸⁷

⇒ Working alone as well as with HITCHINGS and BLACK, ELION developed a multitude of new drugs, using innovative research methods that would later lead to the development of the AIDS drug AZT.²⁴⁸⁸ Rather than relying on trial-and-error, she and HITCHINGS used the differences in biochemistry between normal human cells and pathogens (disease-causing agents such as cancer cells, protozoa, bacteria, and viruses) to design drugs that could kill or inhibit the reproduction of particular pathogens without harming the host cells. The drugs they developed are used to treat a variety of maladies, such as leukemia, malaria, organ transplant rejection, as well as herpes (which was the first selective and effective drug

²⁴⁸⁷ https://en.wikipedia.org/wiki/Gertrude_B._Elion

²⁴⁸⁸ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion

of its kind).²⁴⁸⁹ She invented treatments for gout, meningitis, septicemia, and bacterial infections of the urinary and respiratory tracts, and cancer treatment.²⁴⁹⁰



GERTRUDE BELLE ELION, photographer, date and location unknown.²⁴⁹¹

²⁴⁸⁹ https://en.wikipedia.org/wiki/Gertrude_B._Elion

²⁴⁹⁰ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion

²⁴⁹¹ https://en.wikipedia.org/wiki/Gertrude_B._Elion

11,918 HE - 11,988 HE: RICHARD FEYNMAN, United States, Theoretical Physicist. FEYNMAN is known for his clear presentation of ideas, methodical research, playfulness, work in the path integral formulation of quantum mechanics, the theory of quantum electrodynamics, and the physics of the superfluidity of supercooled liquid helium, as well as in particle physics for which he proposed the parton model.²⁴⁹²

⇒ In **11,965 HE:** For his contributions to the development of quantum electrodynamics, RICHARD FEYNMAN, jointly with JULIAN SCHWINGER and SIN-ITIRO TOMONAGA, received the Nobel Prize in Physics.²⁴⁹³

²⁴⁹² https://en.wikipedia.org/wiki/Richard_Feynman

²⁴⁹³ https://en.wikipedia.org/wiki/Richard_Feynman

- ⇒ FEYNMAN developed a widely used pictorial representation scheme for the mathematical expressions governing the behavior of subatomic particles, which later became known as Feynman diagrams.²⁴⁹⁴
- ⇒ During his lifetime, RICHARD FEYNMAN became one of the best-known scientists in the world. In an **11,999 HE** poll of 130 leading physicists worldwide by the British journal *Physics World*, FEYNMAN was ranked as one of the ten greatest physicists of all time.²⁴⁹⁵ FEYNMAN was a keen popularizer of physics through both books and lectures.²⁴⁹⁶

²⁴⁹⁴ https://en.wikipedia.org/wiki/Richard_Feynman

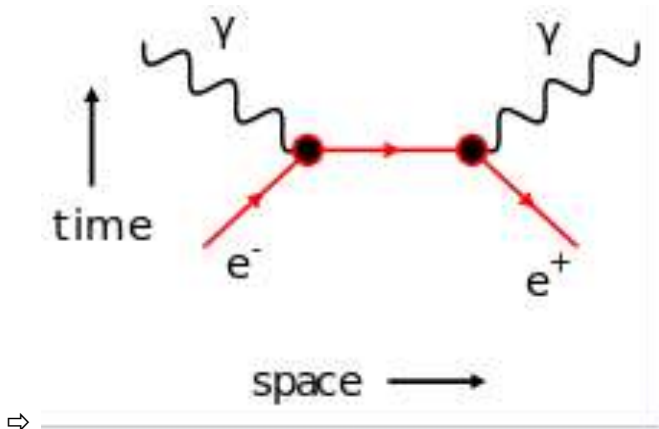
²⁴⁹⁵ https://en.wikipedia.org/wiki/Richard_Feynman

²⁴⁹⁶ https://en.wikipedia.org/wiki/Richard_Feynman



RICHARD FEYNMAN at the Robert Treat Paine Estate in Waltham, Massachusetts in **11,984 HE.**²⁴⁹⁷

²⁴⁹⁷ https://en.wikipedia.org/wiki/Richard_Feynman



⇒ One example of a Feynman diagram. This example is of electron/positron annihilation²⁴⁹⁸

²⁴⁹⁸ https://en.wikipedia.org/wiki/Richard_Feynman



The Feynman section at the Caltech bookstore, date and photographer unknown.²⁴⁹⁹

²⁴⁹⁹ https://en.wikipedia.org/wiki/Richard_Feynman

11,919 HE – 12,013 HE: Dr. JANE COOKE WRIGHT (also known as "Jane Jones" due to her marriage to anti-poverty attorney David Jones) was a pioneering cancer researcher and surgeon noted for her contributions to chemotherapy.²⁵⁰⁰

⇒ WRIGHT is credited with developing the technique of using human tissue culture rather than laboratory mice to test the effects of potential drugs on cancer cells. She also pioneered the use of the drug methotrexate to treat breast cancer and skin cancer (mycosis fungoids).²⁵⁰¹

²⁵⁰⁰ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²⁵⁰¹ https://en.wikipedia.org/wiki/Jane_C._Wright



Dr. JANE COOKE WRIGHT, date, location and photographer
unknown²⁵⁰²

²⁵⁰² https://en.wikipedia.org/wiki/Jane_C._Wright

11,920 HE – 11,958 HE: ROSALIND FRANKLIN²⁵⁰³ English chemist and X-ray crystallographer who made contributions to understanding the molecular structures of DNA (deoxyribonucleic acid), RNA (ribonucleic acid), viruses, coal, and graphite. Although her works on coal and viruses were unappreciated in her lifetime, ROSALIND FRANKLIN's contributions to the discovery of the structure of DNA were largely recognized posthumously.²⁵⁰⁴ ROSALIND FRANKLIN first imaged DNA with X-rays. It is said she told Watson & Crick, who stole the idea and did not give her credit for discovering DNA's double-helix structure. ROSALIND FRANKLIN died before she could be awarded the Nobel prize or any other prize.²⁵⁰⁵

²⁵⁰³ <https://www.youtube.com/watch?v=dCeqyO53ppE> TimJamesScience and Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

²⁵⁰⁴ https://en.wikipedia.org/wiki/Rosalind_Franklin

²⁵⁰⁵ <https://www.youtube.com/watch?v=dCeqyO53ppE> TimJamesScience



ROSALIND FRANKLIN, photographer, location, and date unknown.²⁵⁰⁶

²⁵⁰⁶ https://en.wikipedia.org/wiki/Rosalind_Franklin

11,920 HE – 12,006 HE: MARIE THARP, United States oceanographer and geologist.²⁵⁰⁷

- ⇒ Before the **11,950s HE**, little was known about the layout of the ocean floor. (SEE **11,869 HE – 11,948 HE:** JOHAN HJORT). Although THARP had a geology degree, she is also considered an oceanographer. Prior to THARP, the ocean floor had previously been envisioned as a flat plain of mud. THARP and BRUCE HEEZEN became part of a research project to map the topography – or layout – of the ocean floor.
- ⇒ However, women at this time were not allowed on boats. So, while THARP never physically got to voyage on the sea while working on the ocean floor mapping, she was a primary contributor to the success of the project. (See **11,863 HE – 11,941 HE:** ANNIE JUMP CANNON.) BRUCE HEEZEN went on research vessels and

²⁵⁰⁷ <https://exploration.marinersmuseum.org/subject/marie-tharp/>

collected the initial data. Much of the raw data came from SONAR measurements of the ocean depths. This data was sent to THARP on land. THARP took the SONAR readings and working with only pens and rulers, drew the details of the ocean floor using longitude degree by latitude degree. THARP's drawings revealed that the ocean floor was not flat, but covered with features like canyons, ridges, and mountains just like dry land.

- ⇒ **11,953 HE:** MARIE THARP's observations led her to promote the theory of continental drift, or seafloor spreading – the idea that the continents move by spreading across the ocean bed. Continental drift had not been accepted as a theory. (See German meteorologist **11,880 HE – 11,930 HE: ALFRED WEGENER**) (Also See **11,890 HE – 11,965 HE** PROF. ARTHUR HOLMES, British geologist.) THARP noticed that several of the small earthquakes occurring under the sea came from her proposed rift valley. However, the other scientists on the project continually rejected her findings.

- ⇒ **11,957 HE:** Based THARP's calculations, the first map of the North Atlantic Ocean was published.
- ⇒ **11,961 HE:** Based THARP's calculations, a map showing the South Atlantic Ocean floor was published.
- ⇒ **11,964 HE:** Based THARP's calculations, a map of the Indian ocean floor was published.
- ⇒ **11,977 HE:** THARP completed a full world's ocean map titled: *The World Ocean Floor*. While completing her drawings, MARIE THARP's maps revealed 40,000 miles of an underwater ridge.²⁵⁰⁸

²⁵⁰⁸ <https://exploration.marinersmuseum.org/subject/marie-tharp/>



MARIE THARP. Photographer, location, and date unknown.²⁵⁰⁹

²⁵⁰⁹ <https://exploration.marinersmuseum.org/subject/marie-tharp/>



MARIE THARP with *The World Ocean Floor* map in globe format. Photographer, location, and date unknown.²⁵¹⁰

11,922 HE – 11,995 HE: CESARE EMILIANI, Italian-United States geologist, micropaleontologist, founder of paleoceanography and *Inventor of the Holocene Era calendar*. EMILIANI developed the timescale of marine isotope stages, which despite modifications remains in very wide use today.²⁵¹¹

- ⇒ EMILIANI established that the ice ages of the last half million years or so are a cyclic phenomenon, which gave strong support to the hypothesis of MILANKOVITCH and revolutionized ideas about the history of the oceans and of the glaciations.²⁵¹²
- ⇒ EMILIANI was the proponent of Project "LOCO" (for Long Cores) to the U.S. National Science Foundation. The project was a success, providing evidence of the history of the oceans and serving to test

²⁵¹¹ https://en.wikipedia.org/wiki/Cesare_Emiliani

²⁵¹² https://en.wikipedia.org/wiki/Cesare_Emiliani

the hypotheses of seafloor spreading and plate tectonics.²⁵¹³ (Also see **11,452 HE– 11,519 HE**: LEONARDO DA VINCI and **11,830 HE-11,882 HE**: SIR CHARLES WYVILLE THOMSON, and **11,890 HE – 11,965 HE**: PROF. ARTHUR HOLMES, and **11,920 HE – 12,006 HE**: MARIE THARP.)

⇒ CESARE EMILIANI was honored by having the genus *Emiliana* erected as home for the taxon *huxleyi*, which had previously been assigned to *Coccolithus*. EMILIANI was further honored by receiving the Vega Medal of the Swedish Society for Anthropology and Geography (SSAG) (Swedish: Svenska Sällskapet for Antropologi och Geografi) in **11,983 HE**, and the Alexander Agassiz Medal of the U.S. National Academy of Sciences in

²⁵¹³ https://en.wikipedia.org/wiki/Cesare_Emiliani

11,989 HE for his isotopic studies on Pleistocene and Holocene planktic foraminifera.²⁵¹⁴

⇒ **Circa 11,993 HE:** In his later years, EMILIANI dedicated a great deal of time to promoting a calendar reform based on the Holocene Era (**HE**) calendar concept to eliminate the BC–AD chronology gap caused by the lack of a year 0.²⁵¹⁵

- The Holocene Era (HE) – The word Holocene means *entirely recent* – and the calendar reform idea encompasses the growth and impacts of the human species worldwide, including its written history and the development of major civilizations.
- EMILIANI's proposal for a calendar reform sought to solve a number of alleged problems with the current *Anno Domini* / AD

²⁵¹⁴ https://en.wikipedia.org/wiki/Cesare_Emiliani

²⁵¹⁵ https://en.wikipedia.org/wiki/Cesare_Emiliani

era, which number the years of the commonly accepted world calendar. The current Anno Domini / AD era is based on the birth of Jesus which is a less relevant event to all humans living around the world, than the approximate beginning of the geological Holocene Era.²⁵¹⁶

- The *Anno Domini* / AD era has no year zero, with 1 BC followed immediately by AD 1, complicating the calculation of timespans further.²⁵¹⁷
- The years BC are counted down when moving from past to future, making calculation of timespans difficult.²⁵¹⁸

²⁵¹⁶ https://en.wikipedia.org/wiki/Cesare_Emiliani

²⁵¹⁷ https://en.wikipedia.org/wiki/Cesare_Emiliani

²⁵¹⁸ https://en.wikipedia.org/wiki/Cesare_Emiliani

- Also, it is difficult to follow the numbering of the centuries in the Anno Domini / AD calendar. For example: When referring to the fourth century AD/CE or the fourth century BC/BCE the timing is less definable than by using **10,400 HE or 9,601 BHE**.²⁵¹⁹ (See the included HE Year Converter Calculator.²⁵²⁰)
- HE places its beginning at **1 HE**, a rough approximation of the start of the current geologic epoch: the Holocene/Human Era.²⁵²¹

²⁵¹⁹ https://en.wikipedia.org/wiki/Cesare_Emiliani

²⁵²⁰ By Paul Premack, JD, CELA

²⁵²¹ https://en.wikipedia.org/wiki/Cesare_Emiliani



CESARE EMILIANI in the early **11,950s HE** while conducting pioneering research at the University of Chicago. (Photo: Archives of the Rosenstiel School of Marine and Atmospheric Science, University of Miami.)²⁵²²

²⁵²² https://en.wikipedia.org/wiki/Cesare_Emiliani

11,922 HE - 11,999 HE: MARIE VAN BRITTAN BROWN, United States Inventor of the home security system in **11,966 HE**.²⁵²³

⇒ Thirteen inventors who came along after **BROWN** have cited her patent, with the latest being in **12,013 HE**. Even now, over fifty years after her patent was granted, her invention is being used by smaller businesses and living facilities. Although the system was originally intended for domestic uses, many businesses began to adopt her system due to its effectiveness. For her invention **MARIE VAN BRITTAN BROWN** received an award from the National Science Committee.²⁵²⁴

²⁵²³ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²⁵²⁴ https://en.wikipedia.org/wiki/Marie_Van_Brittan_Brown

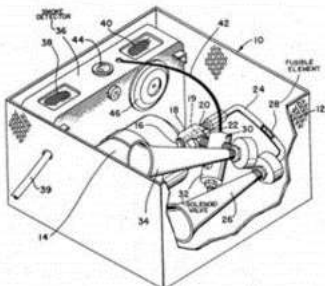


Photo is of MARIE VAN BRITTAN BROWN and part of the drawing for her Home Security System. Date, location and photographer and artist unknown.²⁵²⁵

²⁵²⁵ <https://www.bing.com/images/search> Greatest-Gadgets-Created-By-Black-Inventors-Home-Security-System



11,966 HE: one drawing from BROWN's U.S. Patent 3,482,037 for the first home security system.²⁵²⁶

²⁵²⁶ <https://patents.google.com/patent/US3482037>

11,922 HE – 11,995 HE: CLAIR CAMERON (PAT) PATTERSON, United States Geochemist²⁵²⁷ whose research on the age of the earth had made him the world's leading expert on measuring trace amounts of lead. This led to a total re-evaluation of the growth in industrial lead concentrations in the atmosphere and in the human body, and his subsequent campaigning was seminal in the banning of tetraethyl lead in gasoline and lead solder in food cans.²⁵²⁸

⇒ Both he and his wife **LORNA (LAURIE) PATTERSON** as scientists were sent to work on the Manhattan Project.²⁵²⁹ At Oak Ridge, they worked together at the uranium-235 electromagnetic

²⁵²⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵²⁸ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

²⁵²⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

separation plant. This is where CLAIRE PATTERSON gained experience with the mass spectrometer.²⁵³⁰

- Because the following interview answer is all the information we could find on LAURIE PATTERSON, she is included here with her husband's entry. LAURIE PATTERSON stated in an interview that "We ... were asked to meet with the Colonel in charge of the Manhattan Project at 5th Army Headquarters. He suggested that he send us to Oak Ridge, where there were many young people."²⁵³¹

⇒ **11,956 HE:** CLAIR CAMERON PATTERSON developed the uranium–lead dating method into the lead–lead dating method. By using lead isotopic data from the Canyon Diablo meteorite,

²⁵³⁰ <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

²⁵³¹ <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

PATTERSON calculated an age for the Earth of 4.55 billion years; a figure far more accurate than those that existed at the time and one that has remained largely unchanged.²⁵³²

⇒ CLAIR CAMERON PATTERSON had first encountered lead contamination in the late **11,940s HE** as a graduate student at the University of Chicago.²⁵³³

⇒ You may ask: why is lead so poisonous to us? Druyan and DEGRASSE TYSON answer: Because when it gets into our bodies, lead mimics other metals, like zinc and iron, the ones our cells actually need to grow and flourish. Enzymes in the cell are fooled by the lead's masquerade, and they begin to dance. But it's a dance of death, because the lead is an imposter that can't fulfill the cell's vital needs. Lead also blocks neurotransmitters, the

²⁵³² https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

²⁵³³ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

communication network between the cells. It interferes with the molecular receptors that are vital to memory and learning. This is especially damaging to children - but lead poisoning spares no one.²⁵³⁴

⇒ Starting about **11,900 HE**, the makers of leaded paint hired the fledgling advertising industry to persuade the consumer that lead was child-friendly. But lead production didn't really shift into high gear until the early **11,920's HE** when chemist Thomas Midgley and inventor Charles Kettering of General Motors found that tetraethyl lead could be marketed as an anti-knock additive to gasoline. It had once been considered for use as a poison gas by the U.S. war department. Unlike the lead in paint, tetraethyl lead was fat soluble. Half a cup of it on your skin could kill you.²⁵³⁵

²⁵³⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵³⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- The manufacturers calculated that they could sell the poison, but some of the workers who processed lead in factories in Delaware and New Jersey were going insane, hallucinating, jumping out of windows. (The workers died screaming. See above: Circa **9,855 HE** – circa **10,529 HE**: Antiquity Roman Empire.)²⁵³⁶
- The marketers of this poison needed a scientist to calm the public's fears and improve lead's image. Robert Kehoe, a young doctor from Cincinnati, was hired by GM to raise scientific doubts in the public's mind about the dangers of lead. Lead was naturally occurring in the environment, he said: Yes, there might be occupational hazards for the people who worked with lead, but that could be best handled by industry self-regulation. And

²⁵³⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

Kehoe said there was no evidence to suggest that lead posed any threat to the consumer.²⁵³⁷

- This was one of the first times the authority of science was used to cloak a threat to public health and the environment. For decades no one challenged Kehoe until CLAIR PATTERSON went searching for the age of the earth.²⁵³⁸

⇒ PATTERSON and everyone else at the time assumed the prevalence of lead in the environment occurred naturally.²⁵³⁹ He set out to discover everything he could about how lead circulates through the environment. On a grant from the American Petroleum Institute, PATTERSON carefully measured the concentrations of

²⁵³⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵³⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵³⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

lead in deep and shallow seawater. PATTERSON found that his initial data made no sense.²⁵⁴⁰

- There were only minuscule concentrations of lead in deep ocean water. But in shallow waters and at the surface, the concentrations of lead were hundreds of times greater. It takes a few hundred years for the shallow ocean waters to mix with the deep. PATTERSON concluded that the large amount of lead in the surface waters had arrived recently; otherwise it would have been more evenly distributed.²⁵⁴¹

²⁵⁴⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵⁴¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- Knowing the quantity of lead in the shallow seas and the time needed to mix it into the deeper layers, PATTERSON was able to estimate the rate of lead contamination at the surface.²⁵⁴²
- PATTERSON asked what could supply lead to the world's oceans at such a rate? His research concluded that it was from leaded gasoline. PATTERSON wrote and sought to publish a scientific paper that would make the case against leaded gasoline. When he submitted the paper to the scientific journal Nature, PATTERSON put his own name second to the students who aided him, to help advance their reputations. He shunned the limelight and the privileges that come with it.²⁵⁴³

²⁵⁴² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵⁴³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- The U.S. government - the Army, the Navy, the atomic energy commission, the public health service, and the National Science Foundation supported PATTERSON's research on lead pollution.²⁵⁴⁴
- PATTERSON's investigations took him from Greenland to Antarctica, and to rivers, mountains, and valleys in between. In even the most hostile conditions, he and his team worked to replicate the immaculate environment of the clean room. Their plastic suits were replaced daily. Working ten to twelve-hour days in subzero weather, they dug a 200-foot-long shaft into the ice of Antarctica.²⁵⁴⁵ It was a form of time travel, to recover

²⁵⁴⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵⁴⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

snow that had fallen three centuries ago, before the start of the Industrial Revolution.²⁵⁴⁶

- PATTERSON found that the amount of lead was much lower in the snow of a few hundred years before. No matter where he searched on earth, no matter how far he traveled back in time, the results always showed the naturally occurring levels of lead in the air and water in the past were far lower.²⁵⁴⁷
- PATTERSON published his findings in a major environmental health journal and sent copies to various government leaders, including Senator Edmund Muskie of Maine, the chairman of the senate subcommittee on air and water pollution. In **11,966 HE**, Muskie held hearings on the lead question. The first witness was Dr. Robert Kehoe, longtime scientific advocate for leaded

²⁵⁴⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵⁴⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

gasoline. It was Kehoe's conclusion that over the last 30 years there had been no increase in the amount of lead in the atmosphere. PATTERSON, who was in Antarctica during the hearings, unexpectedly appeared on the fifth day of testimony. PATTERSON showed the actual measurements on the increase in the concentration of lead in humans as a result of exposure to the environment. He showed proof that at these levels Lead is a severe chronic insult to the human body; that it was irresponsible to mine millions of tons of toxic material and disperse it into the environment.

- He fought the industry for another 20 years before lead was finally banned in U.S. consumer products. In just a few years thereafter, average lead levels in the blood of children plummeted by about 75%.²⁵⁴⁸

²⁵⁴⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- ⇒ *Today, the medical consensus is unanimous that there is no such thing as a nontoxic level of lead in humans, however small. Today, scientists sound the alarm on other environmental dangers. Vested interests still hire their own scientists to confuse the issue. In the end, nature will not be fooled.*²⁵⁴⁹
- ⇒ PATTERSON, the man who figured out the age of the earth, was also responsible for one of the greatest public health victories of the 20th century.²⁵⁵⁰

²⁵⁴⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²⁵⁵⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7



CLAIR CAMERON PATTERSON, date, location, photographer unknown.²⁵⁵¹

²⁵⁵¹ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson



LORNA (LAURIE) MCCLEARY PATTERSON; United States, chemist. Photo **11,943 HE**, Graduation from Grinnell College.²⁵⁵²

11,922 HE: NIELS HENRIK DAVID BOHR (11,885 HE – 11,962 HE)

Danish physicist, philosopher and a promoter of scientific research received the Nobel Prize in Physics. BOHR made foundational contributions to understanding atomic structure and quantum theory. He predicted the existence of a new zirconium-like element, which was named Hafnium, after the Latin name for Copenhagen, where it was discovered. Later, the element Bohrium was named after him.

- ⇒ During the **11,930s HE**, BOHR helped refugees from Nazism. After Denmark was occupied by the Germans, he had a famous meeting with HEISENBERG, who had become the head of the German nuclear weapon project. In September **11,943 HE**, word reached BOHR that he was about to be arrested by the Germans, and he fled to Sweden. From there, he was flown to Britain, where he joined the British Tube Alloys nuclear weapons project, and was part of the British mission to the Manhattan Project. After the war, BOHR called for international cooperation on nuclear energy. He

was involved with the establishment of CERN and the Research Establishment Risø of the Danish Atomic Energy Commission and became the first chairman of the Nordic Institute for Theoretical Physics in **11,957 HE**.²⁵⁵³

- ⇒ Things named after NIELS BOHR: Physics and Chemistry: Bohr–Kramers–Slater theory, see BKS theory; Bohr–Sommerfeld quantization, see Sommerfeld–Bohr theory; Bohr–van Leeuwen theorem; BKS theory; Bohr–Einstein debates; Bohr complementarity principle, see Complementarity principle; Bohr correspondence principle, see Correspondence principle; Bohr frequency, see Bohr model; Bohr magneton'; Bohr model; Bohr model of the chemical bond; Bohrium, the chemical element with atomic number 107; Bohr orbital; Bohr radius; Sommerfeld–Bohr theory. Astronomy: An asteroid, 3948 Bohr, was named after him, Bohr (crater), and a lunar crater. Other: Niels Bohr Institute in

²⁵⁵³ https://en.wikipedia.org/wiki/Niels_Bohr

Copenhagen; Neil's Bahr, a comic and science-fiction based bar in Houston, Texas; At the CERN site in Meyrin, close to Geneva, there is a street called Route Bohr in honour of Niels Bohr; Niels Bohr Library & Archives of American Institute of Physics.²⁵⁵⁴



BOHR founded the Institute of Theoretical Physics at the University of Copenhagen, now known as the Niels Bohr Institute,

²⁵⁵⁴ https://en.wikipedia.org/wiki/List_of_things_named_after_Niels_Bohr

which opened in **11,920 HE**. (Date of photo and photographer unknown.)



NIELS HENRIK DAVID BOHR, date, location and photographer unknown.²⁵⁵⁵

²⁵⁵⁵ https://en.wikipedia.org/wiki/Niels_Bohr

11,923 HE: Star stuff element 72, Hafnium was discovered by DIRK COSTER, Dutch physicist and GEORG VON HEVESY Hungarian Chemist²⁵⁵⁶ by means of X-ray spectroscopic analysis of building block Element 40 Zirconium ore. The discovery took place in Copenhagen, Denmark. “Hafnia” is the Latin name for Copenhagen.²⁵⁵⁷



- Photo is of Electrolytic Hafnium, 22 grams. Original size in cm: 1 x 2 x 3. “Star Stuff” elements Hafnium and Zirconium are two of the elements that are most similar to each other. Therefore,

²⁵⁵⁶ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²⁵⁵⁷ https://en.wikipedia.org/wiki/Dirk_Coster

they are hard to separate. The silvery, heavy Hafnium so far is used only for a few special technical applications. Hafnium carbide (HfC) and tantalum hafnium carbide (Ta₄HfC₅) are very hard and mechanically enduring, the latter the highest melting point of all materials at over 4000° C.²⁵⁵⁸

⇒ **11,885 HE – 11,966 HE:** GEORG VON HEVESY, who in **11,943 HE** received the Nobel Prize for Chemistry. He was a Fellow of the Royal Society²⁵⁵⁹ and discovered that water takes 9 days to pass through the human body by consuming heavy water and measuring the output.²⁵⁶⁰ HEVESY was also the first person to use a radioactive tracer, now widely used in medicine (radiology). He was trying to separate lead from radium (later found to be

²⁵⁵⁸ <http://images-of-elements.com/hafnium.php#a>

²⁵⁵⁹ https://en.wikipedia.org/wiki/George_de_Hevesy

²⁵⁶⁰ SAM KEAN The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements

impossible, since there was not radium in the sample, just radioactive lead).

- Sam Kean relates a story of the first successful use of radioactive tracers outside the lab by HEVESY and how he had confronted his landlady with his suspicions of reuse of uneaten meat by the boarders. She had denied the accusation. HEVESY responded by secretly sprinkling radioactive lead, from his lab, on the leftover meat from his boarding house plate. Later that week, HEVESY used a new invention of his friend HANS GEIGER – the Geiger Counter – to test the goulash she served and showed his landlady that it contained the radioactive meat he had sprinkled earlier that week, thus proving she reused meat from his plate and re-served it. Kean said the landlady had

denied using leftovers but when caught by his clever science she was not angry. It was not known if she changed her ways.²⁵⁶¹

- Awards: **11,949 HE** HEVESY received the Copley Medal;
11,950 HE HEVESY received the Faraday Lectureship Prize;
11,958 HE: HEVESY received the Atoms for Peace Award.²⁵⁶²

²⁵⁶¹ SAM KEAN The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements

²⁵⁶² https://en.wikipedia.org/wiki/George_de_Hevesy



● **11,943 HE:** GEORG VON HEVESY, photographer and location unknown.²⁵⁶³

²⁵⁶³ https://en.wikipedia.org/wiki/George_de_Hevesy

⇒ **11,889 HE – 11,950 HE:** DIRK COSTER, chemist, political activist, and anti-Nazi. In **11,938 HE**, COSTER traveled to Berlin to convince LISE MEITNER (See above) that she had to leave Germany to escape the persecution of the Jews. Together they went by train to Groningen. At the Dutch border, COSTER persuaded German immigration officers that MEITNER had permission to travel to the Netherlands. From there MEITNER went on to Sweden by way of Copenhagen. During the German occupation of Holland, COSTER also helped Jews hide from the Nazis and listened to the BBC on a daily basis using a bicycle-powered radio. COSTER died in Groningen.²⁵⁶⁴

- The asteroid 10445 Coster is named after DIRK COSTER.²⁵⁶⁵

²⁵⁶⁴ https://en.wikipedia.org/wiki/Dirk_Coster

²⁵⁶⁵ https://en.wikipedia.org/wiki/Dirk_Coster



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DIRK COSTER, date, location and photographer unknown.²⁵⁶⁶

²⁵⁶⁶ https://en.wikipedia.org/wiki/Dirk_Coster

11,926 HE: It was this year, less than 100 years ago, that NIKOLA TESLA, legendary scientist and inventor, during an interview for Collier magazine, described a piece of technology (what we now know as the smart phone) that would revolutionize the lives of its users. Here's the quote:

⇒ NIKOLA TESLA said: “When wireless is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. Not only this, but through television and telephony we shall see and hear one another as perfectly as though we were face to face, despite intervening distances of thousands of miles; and the instruments through which we shall be able to do his will be

amazingly simple compared with our present telephone. A man will be able to carry one in his vest pocket.”²⁵⁶⁷

11,925 HE: Dot Matrix printing was invented by RUDOLF HELL, Germany, who invented the Hellschreiber, an early facsimile-like dot matrix-based teletypewriter device, patented in **11,929 HE**.²⁵⁶⁸

Born 11,927 HE: JOAN FEYNMAN, United States Astrophysicist who decided to go into science when she read a graph by CECILIA PAYNE-GAPOSCHKIN (see above) and after being influenced by her brother RICHARD FEYNMAN (see above).²⁵⁶⁹

⇒ JOAN FEYNMAN studied the science behind climate change. Along with her colleague, and husband, ALEXANDER

²⁵⁶⁷ <https://www.thoughtco.com/history-of-smartphones-4096585>

²⁵⁶⁸ https://en.wikipedia.org/wiki/Dot_matrix_printing

²⁵⁶⁹ https://en.wikipedia.org/wiki/Joan_Feynman

RUZMAIKIN, FEYNMAN found that periods of lower solar activity coincide with major cooling periods for certain parts of the world; for example, cooling was seen in Europe during a time known as the Little Ice Age.

- ⇒ FEYNMAN and her colleagues also discovered a link between solar variability and climate change in ancient water levels of the Nile River. During periods of high solar activity, conditions around the Nile were found to be drier, and when solar activity was low, conditions were wetter.²⁵⁷⁰
- ⇒ Other accomplishments: JOAN FEYNMAN became the first woman to be elected as an officer of the American Geophysical Union; FEYNMAN was named as one of the Jet Propulsion Laboratory's elite senior research scientists; FEYNMAN discovered that the periodic spouting of solar material known as a solar coronal

²⁵⁷⁰ https://en.wikipedia.org/wiki/Joan_Feynman

mass ejection (CME) could be identified by the presence of helium in the solar wind; FEYNMAN created a model that predicts the number of high-energy particles likely to hit a spacecraft over its lifetime, and FEYNMAN uncovered a method for predicting sun spot cycles.²⁵⁷¹

²⁵⁷¹ https://en.wikipedia.org/wiki/Joan_Feynman



JOAN FEYNMAN, date, location, and photographer unknown.²⁵⁷²

²⁵⁷² https://en.wikipedia.org/wiki/Joan_Feynman

11,928 HE – 12,016 HE: VERA COOPER RUBIN, United States astronomer who pioneered work on galaxy rotation rates. She uncovered the discrepancy between the predicted angular motion of galaxies and the observed motion, by studying galactic rotation curves. This phenomenon became known as the galaxy rotation problem. Although initially met with skepticism, RUBIN's results have been confirmed over the subsequent decades.²⁵⁷³

⇒ VERA COOPER RUBIN's attempts to explain the galaxy rotation problem led to the theory of dark matter.²⁵⁷⁴

²⁵⁷³ https://en.wikipedia.org/wiki/Vera_Rubin

²⁵⁷⁴ https://en.wikipedia.org/wiki/Vera_Rubin



VERA COOPER RUBIN, date, location, and photographer unknown.²⁵⁷⁵

²⁵⁷⁵ http://summer-astronomy-pc.wikispaces.com/file/view/vera_rubin.jpg/153326721/239x359/vera_rubin.jpg

11,928 HE – 11,997 HE: EUGENE SHOEMAKER, United States geologist and astronomer. SHOEMAKER became famous in **11,994** when, working with his wife CAROLYN S. SHOEMAKER and DAVID LEVY they discovered a comet destined to crash into Jupiter (**SEE 11,994**).²⁵⁷⁶

11,928 HE: Penicillin discovered.²⁵⁷⁷

⇒ The world's first antibiotic substance benzylpenicillin (Penicillin G) was discovered by Sir ALEXANDER FLEMING, Scottish Physician and Researcher.²⁵⁷⁸

²⁵⁷⁶ <https://www2.jpl.nasa.gov/sl9/sl9.html>

²⁵⁷⁷ <https://www.biography.com/people/alexander-fleming-9296894>

²⁵⁷⁸ https://en.wikipedia.org/wiki/Alexander_Fleming

⇒ In **11,945 HE FLEMMING** shared the Nobel Prize in Physiology or Medicine for the discovery and development of Penicillin with **HOWARD FLOREY** and **ERNST BORIS CHAIN**.²⁵⁷⁹

- Some of the legacies of **SIR ALEXANDER FLEMING: 11,881 HE – 11,955 HE, FRS FRSE FRCS**: an International Historic Chemical Landmark plaque at the Alexander Fleming Laboratory Museum in London; at least three large Swedish magazines ranked penicillin as the most important discovery of the millennium; he was named in the BBC's list of the 100 Greatest Britons following a nationwide vote; a statue of Alexander Fleming stands outside the main bullring in Madrid, Plaza de Toros de Las Ventas. Flemingovo náměstí is a square named after **FLEMING** in the university area of the Dejvice community in Prague; A secondary school is named after him in Sofia, Bulgaria; In Athens, a square in the downtown district of

²⁵⁷⁹ https://en.wikipedia.org/wiki/Alexander_Fleming

Votanikos is named after FLEMING and bears his bust. There are also a number of Streets in greater Athens and other towns in Greece named after either FLEMING or his Greek second wife Amalia; In mid-12,009 HE, FLEMING was commemorated on a new series of banknotes issued by the Clydesdale Bank; his image appears on the new issue of £5 notes and FLEMING was voted third greatest Scot in an opinion poll conducted by STV, behind only Scotland's national poet Robert Burns and national hero William Wallace; an asteroid in the Asteroid Belt: 91006 Fleming, is named after FLEMING; Fleming station, on the Thessaloniki Metro system, takes its name from Fleming Street on which it is located, which in term is named after him.²⁵⁸⁰

²⁵⁸⁰ https://en.wikipedia.org/wiki/Alexander_Fleming



- SIR ALEXANDER FLEMING: date, location, and photographer unknown.²⁵⁸¹

²⁵⁸¹ https://en.wikipedia.org/wiki/Alexander_Fleming



- Barcelona, Spain: to **SIR ALEXANDER FLEMING (11,956 HE)**, by Catalan sculptor Josep Manuel Benedicto. Barcelona: jardins del Doctor Fleming.²⁵⁸²

²⁵⁸² https://en.wikipedia.org/wiki/Alexander_Fleming



• Faroe Islands postage stamp commemorating FLEMING.²⁵⁸³

²⁵⁸³ https://en.wikipedia.org/wiki/Alexander_Fleming

⇒ **11,898 HE – 11,968 HE: HOWARD WALTER FLOREY,**²⁵⁸⁴
Baron Florey, OM, FRS, FRCP was an Australian pharmacologist and pathologist who said, “Developing penicillin was a team effort, as these things tend to be.”²⁵⁸⁵

- Some of FLOREY’s honors and legacies: His portrait appeared on the Australian \$50 note for 22 years (**11,973 HE – 11,995 HE**), and the suburb of Florey in the Australian Capital Territory is named after him. The Florey Institute of Neuroscience and Mental Health, located at the University of Melbourne, Victoria, and the largest lecture theatre in the University of Adelaide's medical school are also named after him. The federal government of Australia renamed the Australian Student Prize, given to outstanding high-school leaders, the "Lord Florey Student Prize", in recognition of

²⁵⁸⁴ https://en.wikipedia.org/wiki/Alexander_Fleming

²⁵⁸⁵ https://en.wikipedia.org/wiki/Howard_Florey

Florey. The Florey Unit of the Royal Berkshire Hospital in Reading, Berkshire, is named after him. The "Lord Florey Chair" in the Faculty of Medicine at the University of Sheffield is named in his honor.²⁵⁸⁶



● Florey Building, location, date and photographer unknown.²⁵⁸⁷

²⁵⁸⁶ https://en.wikipedia.org/wiki/Howard_Florey

²⁵⁸⁷ https://en.wikipedia.org/wiki/Howard_Florey



- Flasks used in the cultivation of penicillin mold for large-scale production. One of the first flasks (centre) made using a biscuit tin. Ceramic flasks (rear) were used in production of penicillin. (Historical Collections, National Museum of Health and Medicine).²⁵⁸⁸

²⁵⁸⁸ https://en.wikipedia.org/wiki/Howard_Florey



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Australian out of circulation \$50 note²⁵⁸⁹

²⁵⁸⁹ https://en.wikipedia.org/wiki/Howard_Florey



- Lord HOWARD WALTER FLOREY, date, location and photographer unknown.²⁵⁹⁰

²⁵⁹⁰ https://en.wikipedia.org/wiki/Howard_Florey

⇒ ERNST BORIS CHAIN (11,906 HE – 11,979 HE) German-born British biochemist and fellow by the Royal Society²⁵⁹¹ who began, with HOWARD WALTER FLOREY (now LORD FLOREY), a systematic study of antibacterial substances produced by micro-organisms.

- This led to his best known work, the reinvestigation of penicillin, which had been described by SIR ALEXANDER FLEMING nine years earlier, and to the discovery of its chemotherapeutic action. Later he worked on the isolation and elucidation of the chemical structure of penicillin and other natural antibiotics.

²⁵⁹¹ https://en.wikipedia.org/wiki/Alexander_Fleming

- Professor Chain is author or co-author of many scientific papers and contributor to important monographs on penicillin and antibiotics.²⁵⁹²
- CHAIN was awarded the Silver Berzelius Medal of the Swedish Medical Society, the Pasteur Medal of the Institut Pasteur and of the Société de Chimie Biologique, and a prize from the Harmsworth Memorial Fund. He was awarded the Paul Ehrlich Centenary Prize, and the Gold Medal for Therapeutics of the Worshipful Society of Apothecaries of London. He was awarded the Marotta Medal of the Società Chimica Italiana. He was elected a Fellow of the Royal Society and was a Commander of the Légion d'Honneur and Grande Ufficiale al Merito della Repubblica Italiana.²⁵⁹³

²⁵⁹² <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>

²⁵⁹³ <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>



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ERNST BORIS CHAIN in **11,945 HE**, photographer and location unknown.²⁵⁹⁴

²⁵⁹⁴ https://en.wikipedia.org/wiki/Ernst_Chain

Born 11,929 HE: PETER WARE HIGGS,²⁵⁹⁵ CH FRS FRSE, is a British theoretical physicist, emeritus professor in the University of Edinburgh, and **12,013** Nobel Prize laureate in physics, for his work on the mass of subatomic particles.²⁵⁹⁶

⇒ **Circa 11,964 HE:** PETER HIGGS proposed that broken symmetry in electroweak theory could explain the origin of mass of elementary particles in general.²⁵⁹⁷

⇒ According to modern physics, matter consists of a set of particles that act as building blocks. Between these particles lie forces that

²⁵⁹⁵ LAWRENCE M. KRAUSE The Greatest Story Ever Told: So Far

²⁵⁹⁶ https://en.wikipedia.org/wiki/Peter_Higgs

²⁵⁹⁷ https://en.wikipedia.org/wiki/Peter_Higgs

are mediated by another set of particles. A fundamental property of the majority of particles is that they have a mass.

- ⇒ Both PETER HIGGS and the team of FRANÇOIS ENGLERT and ROBERT BROUT proposed a theory about the existence of a particle that explains why other particles have a mass.²⁵⁹⁸
- ⇒ See **11,212 HE** entry on discovery of the Higgs Boson at CERN.
- ⇒ HIGGS Honors and Awards: Hughes Medal (**11,981 HE**); FRS (**11,983 HE**); Rutherford Medal (**11,984 HE**); Dirac Medal (**11,997 HE**); Wolf Prize in Physics (**12,004 HE**); Sakurai Prize (**12,010 HE**); Nobel Prize in Physics (**12,013 HE**); Copley Medal (**12,015 HE**).²⁵⁹⁹

²⁵⁹⁸ <https://www.nobelprize.org/prizes/physics/2013/higgs/facts/>

²⁵⁹⁹ https://en.wikipedia.org/wiki/Peter_Higgs



PETER HIGGS, date, place, photographer unknown.²⁶⁰⁰

²⁶⁰⁰ https://en.wikipedia.org/wiki/Peter_Higgs



PETER HIGGS; portrait by Lucinda Mackay hanging at James Clerk Maxwell Foundation.²⁶⁰¹

²⁶⁰¹ https://en.wikipedia.org/wiki/Peter_Higgs

Circa 11,930 HE: MARGARET HIGGINS SANGER SLEE's second husband, Noah Slee became the first legal manufacturer of diaphragms for use as birth control in the United States.²⁶⁰²

Born 11,930 HE: TU YOUYOU²⁶⁰³, Chinese pharmaceutical chemist and educator. TU is the first Chinese Nobel laureate in physiology or medicine and the first female citizen of the People's Republic of China to receive a Nobel Prize in any category, as well as the first Chinese person to receive the Lasker Award. TU YOUYOU was born and educated and carried out research exclusively in China.²⁶⁰⁴

²⁶⁰² *Margaret Sanger – 20th Century Hero*" (PDF). Planned Parenthood. p. 8. and https://en.wikipedia.org/wiki/Margaret_Sanger

²⁶⁰³ Benjamin and Kira Premack, White Elk Tamaskan **12,016 HE** Scientists Litter

²⁶⁰⁴ https://en.wikipedia.org/wiki/Tu_Youyou

- ⇒ TU YOUYOU discovered *Artemisinin* (also known as *Qinghaosu*) and *Dihydroartemisinin*, used to treat malaria, a significant breakthrough in **11,900s HE** century tropical medicine, saving millions of lives in developing countries in South Asia, Africa, and South America.²⁶⁰⁵
- ⇒ Awards received by TU YOUYOU: **11,978 HE**, National Science Congress Prize, P.R. China; **11,979 HE**, National Inventor's Prize, P.R. China; **11,992 HE**, (One of the) Ten Science and Technology Achievements in China, State Science Commission, P.R. China; **11,997 HE**, (One of the) Ten Great Public Health Achievements in New China, P.R. China; **12,011 HE**, GlaxoSmithKline Outstanding Achievement Award in Life Science; **12,011 HE**, Lasker-DeBakey Clinical Medical Research Award; **12,011 HE**, Outstanding Contribution Award, China Academy of Chinese Medical Sciences; **12,012 HE**, (One of the Ten) National Outstanding Females, P.R.

²⁶⁰⁵ https://en.wikipedia.org/wiki/Tu_Youyou

China; **12,015 HE**, Warren Alpert Foundation Prize (co-recipient); **12,015 HE**, Nobel Prize in Physiology or Medicine **12,015 HE** (co-recipient) for her discoveries concerning a novel therapy against Malaria, awarded one half of this prize; and William C. Campbell and Satoshi Ōmura jointly awarded another half for their discoveries concerning a novel therapy against infection with roundworm parasites; **12,016 HE**, Highest Science and Technology Award, China.²⁶⁰⁶

²⁶⁰⁶ https://en.wikipedia.org/wiki/Tu_Youyou



Photo of TU YOUYOU. Photographer, location and date unknown.²⁶⁰⁷

²⁶⁰⁷ https://en.wikipedia.org/wiki/Tu_Youyou

11,931 HE – 11,942 HE: Wind generator: The WIME D-30 in service in Balaklava, Yalta, USSR was a forerunner of modern horizontal-axis utility-scale wind generators.²⁶⁰⁸

11,934 HE – 11,996 HE: CARL SAGAN: United States astronomer, cosmologist, astrophysicist, astrobiologist, science educator.²⁶⁰⁹ CARL SAGAN wrote many popular science books, such as *The Dragons of Eden*, *Broca's Brain*, and *Pale Blue Dot*; the book *Cosmos* was published to accompany the series he narrated and co-wrote the award-winning **11,980 HE** television series *Cosmos: A Personal Voyage* where he told said we were all made of “Star Stuff”. CARL SAGAN also wrote the science fiction novel *Contact*. His

²⁶⁰⁸ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

²⁶⁰⁹ https://en.wikipedia.org/wiki/Carl_Sagan

papers, containing 595,000 items, are archived at The Library of Congress.²⁶¹⁰

⇒ In **11,960 HE**, CARL SAGAN's PhD thesis included the first calculation of the runaway greenhouse effect on Venus. This was part of a career-long interest in the atmospheres of the planets, including our own.²⁶¹¹

⇒ In the original Cosmos series, in **11,980 HE**, CARL SAGAN warned “We are releasing vast quantities of carbon dioxide, increasing the greenhouse effect. It may not take much to destabilize the Earth's climate, to convert this heaven, our only home in the cosmos, into a kind of hell.”²⁶¹²

²⁶¹⁰ https://en.wikipedia.org/wiki/Carl_Sagan

²⁶¹¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 12

²⁶¹² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 12

⇒ SAGAN was a professor at New York's Cornell University. A young NEIL DEGRASSE TYSON was mentored by SAGAN and modelled his career in science education on SAGAN's example. TYSON hosted the **12,014 HE** remake of the TV series COSMOS. One of SAGAN's children, NICK SAGAN, is a writer who has among other credits, written several scripts for Star Trek: The Next Generation and Star Trek: Voyager.²⁶¹³

- ISAAC ASIMOV described CARL SAGAN as one of only two people he ever met whose intellect surpassed his own. The other, he claimed, was the computer scientist and artificial intelligence expert MARVIN MINSKY.²⁶¹⁴

²⁶¹³ https://en.wikipedia.org/wiki/Carl_Sagan

²⁶¹⁴ ISAAC ASIMOV *In Joy Still Felt* The autobiography of ISAAC ASIMOV



11,980 HE: CARL SAGAN, photographer and location unknown.²⁶¹⁵

²⁶¹⁵ https://en.wikipedia.org/wiki/Carl_Sagan

11,939 HE – 11,942 HE: The world's first electronic-digital computer was built at Iowa State University by DR. JOHN V. ATANASOFF and CLIFFORD BERRY.



The Atanasoff-Berry Computer, photographer, location and date unknown.²⁶¹⁶

²⁶¹⁶ <https://www.thoughtco.com/john-atanasoff-and-clifford-berry-inventors-4078350>



11,903 HE – 11,995 HE: DR. JOHN V. ATANASOFF was an American physicist and inventor, best known for being credited with inventing the first electronic digital computer.²⁶¹⁷

²⁶¹⁷ https://en.wikipedia.org/wiki/John_Vincent_Atanasoff

⇒ **11,918 HE – 11,963 HE:** CLIFFORD EDWARD BERRY helped JOHN VINCENT ATANASOFF create the first digital electronic computer.²⁶¹⁸ (No photo found.)

Born 11,939 HE: GEORGE ROBERT CARRUTHERS,²⁶¹⁹ United States inventor, physicist, and space scientist.²⁶²⁰ CARRUTHERS invented: the ultraviolet camera/spectrograph which proved that molecular hydrogen exists in the interstellar medium, invented the first moon-based observatory, and invented the Far Ultraviolet Camera/Spectrograph which was used on the Apollo 16 mission. One of CARRUTHERS' inventions captured an ultraviolet image of

²⁶¹⁸ https://en.wikipedia.org/wiki/Clifford_Berry

²⁶¹⁹ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²⁶²⁰ https://en.wikipedia.org/wiki/George_Robert_Carruthers

Halley's Comet and he invented a camera that was used in the Space Shuttle Mission.²⁶²¹



Telescope developed by Dr. GEORGE CARRUTHERS on display at the National Air and Space Museum.²⁶²²

²⁶²¹ https://en.wikipedia.org/wiki/George_Robert_Carruthers

²⁶²² https://en.wikipedia.org/wiki/George_Robert_Carruthers



GEORGE CARRUTHERS, center, discusses the Lunar Surface Ultraviolet Camera with Apollo 16 Commander John Young, right. From left are Lunar Module Pilot Charles Duke and **ROCCO PETRONE**, Apollo Program Director.²⁶²³

²⁶²³ https://en.wikipedia.org/wiki/George_Robert_Carruthers

Born 11,940 HE: GEORGE EDWARD ALCORN, JR.,²⁶²⁴ United States physicist and inventor who worked primarily for IBM and NASA who in **12,015 HE** was inducted into the National Inventors Hall of Fame.²⁶²⁵

⇒ List of U.S. Patents issued to ALCORN: #3,986,912 Process for controlling the wall inclination of a plasma etched via hole; #4,062,720, Process for forming ledge-free aluminum copper silicon conductor structure; #4,172,004, Method for forming dense dry etched multi-level metallurgy with non-overlapped vias; #4,201,800, Hardened photoresist master image mask process; #4,289,834, Dense dry etched multi-level metallurgy with non-overlapped vias; #4,472,728 Imaging X-ray spectrometer; #4,543,442, GaAs Schottky barrier photo-responsive device and

²⁶²⁴ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²⁶²⁵ https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

method of fabrication; and #4,618,380, Method of fabricating an imaging X-ray spectrometer.²⁶²⁶



Photo of GEORGE EDWARD ALCORN JR. Date, location and photographer, unknown.²⁶²⁷

²⁶²⁶ https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

²⁶²⁷ https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

In **11,941 HE**: The world's first megawatt-size wind turbine was connected to the local electrical distribution system on the mountain known as Grandpa's Knob in Castleton, Vermont, United States.²⁶²⁸



Photo is of the world's first megawatt-sized wind turbine near Grandpa's Knob Summit, Castleton, Vermont.²⁶²⁹

²⁶²⁸ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

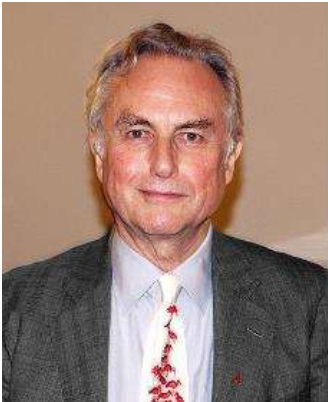
²⁶²⁹ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

Born 11,941 HE: RICHARD DAWKINS, English ethologist, evolutionary biologist, author, and public figure. DAWKINS defined and labelled the concept of the “meme”. The meme first appeared in DAWKINS’s first book “*The Selfish Gene*” and was an attempt to understand why some behaviors, from an evolutionary perspective, seemed to make no sense but, somehow or other, were found to be very common in human societies.²⁶³⁰ **11,995 HE** until **12,008 HE:** DAWKINS was emeritus fellow of New College, Oxford, and was the University of Oxford's Professor for Public Understanding of Science.²⁶³¹ At the website of the Foundation DAWKINS created, he says “You will not be surprised to learn that my personal priority is science as one of the highest and most aesthetically rewarding achievements of the human spirit.”²⁶³²

²⁶³⁰ <https://www.richarddawkins.net/2014/02/whats-in-a-meme>

²⁶³¹ https://en.wikipedia.org/wiki/Richard_Dawkins

²⁶³² <https://www.richarddawkins.net/>



12,010 HE: RICHARD DAWKINS at Cooper Union, New York City, photographer unknown.²⁶³³

²⁶³³ https://en.wikipedia.org/wiki/Richard_Dawkins

Born 11,942 HE: ROBERT DUANE BALLARD,²⁶³⁴ United States Explorer and Professor of Oceanography.²⁶³⁵

⇒ **ROBERT DUANE BALLARD** is most noted for his work in underwater archaeology, maritime archaeology, and the archeology of shipwrecks.²⁶³⁶ **11,973 – 11,975 HE BALLARD** dived 9,000 feet (2,750 meters) in *Alvin* and in a French submersible to explore the Mid-Atlantic Ridge, an underwater mountain chain in the Atlantic Ocean.²⁶³⁷ **11,977 HE and 11,979 HE BALLARD** was part of an expedition that uncovered thermal vents in the Galapagos Rift. The presence of plant and animal life within these deep-sea warm springs led to the discovery of chemosynthesis, the chemical

²⁶³⁴ Tiffany Premack, and Alien Deep documentary, Netflix.

²⁶³⁵ https://en.wikipedia.org/wiki/Robert_Ballard

²⁶³⁶ https://en.wikipecia.org/wiki/Robert_Ballard

²⁶³⁷ <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

synthesis of food energy.²⁶³⁸ **11,985 HE:** BALLARD's team located the wreck of the Titanic. BALLARD leads ocean exploration on E/V Nautilus. He is a powerful leader in responsible ocean treatment.²⁶³⁹ **ROBERT DUANE BALLARD Awards and Honors: 11,988 HE,** BALLARD was awarded an Honorary Degree (Doctor of Science) by the University of Bath; **11,990 HE,** he received the Academy of Achievement's Golden Plate Award; **11,994 HE** Kilby International Awards recipient; **11,996 HE** the U.S. Navy Memorial Foundation awarded Ballard its Lone Sailor Award for his naval service and his work on underwater archaeology; **12,002 HE** he received The Caird Medal of the National Maritime Museum; **12,003 HE** he was awarded The National Humanities Medal.²⁶⁴⁰

²⁶³⁸ <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

²⁶³⁹ Alien Deep documentary, Netflix.

²⁶⁴⁰ https://en.wikipecia.org/wiki/Robert_Ballard



ROBERT DUANE BALLARD, date, location, photographer unknown.²⁶⁴¹

²⁶⁴¹ https://en.wikipedia.org/wiki/Robert_Ballard

11,945 HE – 11,956 HE: The first general– purpose digital computer, the Electronic Numerical Integrator and Computer (ENIAC).²⁶⁴² ENIAC was a modular computer, composed of individual panels to perform different functions. Twenty of these modules were accumulators that could not only add and subtract but hold a ten-digit decimal number in memory. Numbers were passed between these units across several general-purpose buses (or trays, as they were called). In order to achieve its high speed, the panels had to send and receive numbers, compute, save the answer and trigger the next operation, all without any moving parts. Key to its versatility was the ability to branch; it could trigger different operations, depending on the sign of a computed result.²⁶⁴³

⇒ The team of design engineers assisting the development included ROBERT F. SHAW (function tables), JEFFREY CHUAN CHU

²⁶⁴² <http://www.computerhistory.org/timeline/computers/>

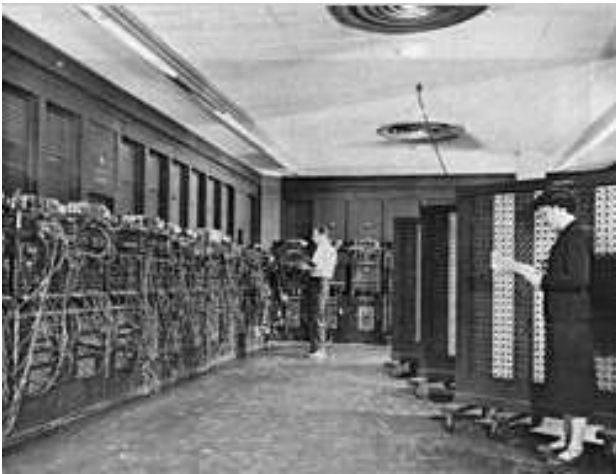
²⁶⁴³ <https://en.wikipedia.org/wiki/ENIAC>

(divider/square-rooter), THOMAS KITE SHARPLESS (master programmer), FRANK MURAL (master programmer), ARTHUR BURKS (multiplier), HARRY HUSKEY (reader/printer) and JACK DAVIS (accumulators). In **11,946 HE**, the researchers resigned from the University of Pennsylvania and formed the Eckert-Mauchly Computer Corporation.²⁶⁴⁴

⇒ **11,956 HE:** By the end of its operation, ENIAC contained 20,000 vacuum tubes, 7200 crystal diodes, 1500 relays, 70,000 resistors, 10,000 capacitors and approximately 5,000,000 hand-soldered joints. It weighed more than 30 short tons (27 t), was roughly 2.4 m × 0.9 m × 30 m (8 ft × 3 ft × 98 ft) in size, occupied 167m² (1,800 sq. ft) and consumed 150 kW of electricity.²⁶⁴⁵

²⁶⁴⁴ <https://en.wikipedia.org/wiki/ENIAC>

²⁶⁴⁵ <https://en.wikipedia.org/wiki/ENIAC>



ENIAC in BRL building 328. (U.S. Army photo).²⁶⁴⁶

²⁶⁴⁶ <https://en.wikipedia.org/wiki/ENIAC>



11,946 HE Photo is of ENIAC's 2 designers American physicist JOHN MAUCHLY (**11,907 HE – 11,980 HE**) and American engineer J. PRESPER ECKERT (**11,919 HE – 11,995 HE**) of the University of Pennsylvania, with Walter Cronkite.²⁶⁴⁷

²⁶⁴⁷ https://en.wikipedia.org/wiki/John_Mauchly

11,945 HE – 12,001 HE: JOSEPH MONROE JACKSON III, United States computer scientist.²⁶⁴⁸

⇒ **11,984 HE:** JOSEPH M. JACKSON III is the co-inventor of United States Patent 4,447,676: “An automatic dialer for controlling access to a long-distance telephone network” with WILLIAM J. HARRIS and DAVID C PETTY.

- The Patent request was filed Feb. 24, **11,983 HE** and granted May 8, **11,984 HE**.²⁶⁴⁹

²⁶⁴⁸ Our daughter-in-law's Father

²⁶⁴⁹ <http://patft.uspto.gov/netacgi/nph-Parser?Sect1=PTO1&Sect2=HITOFF&d=PALL&p=1&u=%2Fnethtml%2FPTO%2Fsrchnum.htm&r=1&f=G&l=50&s1=4447676.PN.&OS=PN/4447676&RS=PN/4447676>



JOSEPH MONROE JACKSON III, date, location, and
photographer unknown²⁶⁵⁰.

²⁶⁵⁰ Image from

<https://www.facebook.com/photo.php?fbid=10203579947792994&set=a.1186946627533&type=3&theater>

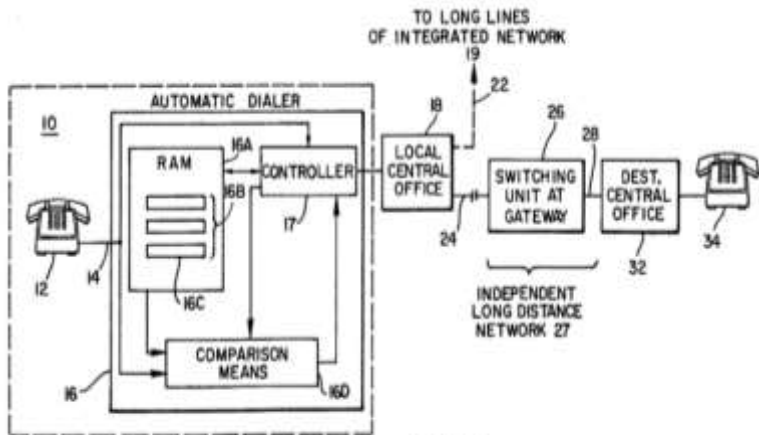


Fig. 1



11,950's HE: The first birth control pills were developed by GREGORY PINCUS and JOHN ROCK with help from the Planned Parenthood Federation of America.²⁶⁵²



Photo is of GREGORY PINCUS, (11,903 HE – 11,967 HE).

²⁶⁵¹pdfpiw.uspto.gov/.piw?PageNum=0&docid=04447676&IDKey=8EED3D54C92C%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-Parser%3FSect1%3DPTO1%2526Sect2%3DHITOFF%2526d%3DPALL%2526p%3D1%2526u%3D%25252Fnethtml%25252FPTO%25252Fsrchnum.htm%2526r%3D1%2526f%3DG%25261%3D50%2526s1%3D4447676.PN.%2526OS%3DPN%2F4447676%2526RS%3DPN%2F4447676

²⁶⁵²https://en.wikipedia.org/wiki/History_of_birth_control

American biologist and researcher. Location and photographer unknown.²⁶⁵³

⇒ Author / Compiler could find no photo of **JOHN ROCK (11,890 HE – 11,984 HE)**, American obstetrician and gynecologist.²⁶⁵⁴

11,951 HE: The first computer for commercial use was introduced to the public; the Universal Automatic Computer (UNIVAC).²⁶⁵⁵ ²⁶⁵⁶ **JOHN PRESPER ECKERT** and **JOHN MAUCHLY**, after leaving the academic environment of The Moore School of Engineering to start their own computer business, found their first client: the United States Census Bureau. The Bureau needed a new computer to deal with the

²⁶⁵³ https://en.wikipedia.org/wiki/Gregory_Goodwin_Pincus

²⁶⁵⁴ [https://en.wikipedia.org/wiki/John_Rock_\(American_scientist\)](https://en.wikipedia.org/wiki/John_Rock_(American_scientist))

²⁶⁵⁵ <http://www.computerhistory.org/timeline/computers/>

²⁶⁵⁶ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

exploding U.S. population (the beginning of the famous baby boom). In April **11,946 HE**, a \$300,000 deposit was given to ECKERT and MAUCLY for the research into a new computer called UNIVAC.²⁶⁵⁷

⇒ The fifth UNIVAC machine (built for the U.S. Atomic Energy Commission) was used by CBS to predict the result of the **11,952 HE** presidential election. With a sample of just 1% of the voting population it famously predicted an Eisenhower landslide while the conventional wisdom favored Stevenson. The CBS crew was so certain that UNIVAC was wrong they pretended it was not working. As the election continued and it became clear it was correct, the announcer admitted their sleight of hand and the machine became famous. The result was a greater public awareness

²⁶⁵⁷ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

of computing technology, and from then on computerized predictions became part of election night broadcasts.²⁶⁵⁸



UNIVAC displayed at unknown location, photographer unknown.²⁶⁵⁹

²⁶⁵⁸ https://en.wikipedia.org/wiki/UNIVAC_I

²⁶⁵⁹ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

11,953 HE: East German Postal service uses electric vehicles to deliver mail.



East German electric vans of the Deutsche Post, photographer unknown.²⁶⁶⁰

²⁶⁶⁰ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

Born 11,953 HE: CAROLYN PORCO, United States, NASA planetary scientist known for her work in the exploration of the outer solar system, beginning with her imaging work on the *Voyager* missions to Jupiter, Saturn, Uranus, and Neptune. She led the imaging science team on the *Cassini* mission in orbit around Saturn and led the team when *Cassini* was de-orbited to burn up in Saturn's upper atmosphere. She is an expert on planetary rings and the Saturnian moon, Enceladus. *Cassini* data confirmed a prediction by PORCO and MARK MARLEY that acoustic oscillations within the body of Saturn are responsible for creating particular features in the rings of Saturn.²⁶⁶¹

⇒ CAROLYN PORCO was founder of The Day the Earth Smiled and “Astronomers Without Borders” coordinated events internationally. NASA spearheaded a related event called 'Wave at Saturn' "to help

²⁶⁶¹ https://en.wikipedia.org/wiki/Carolyn_Porco

acknowledge the historic interplanetary portrait as it was being taken."²⁶⁶² ²⁶⁶³

⇒ Dr. CAROLYN PORCO has also won many awards and honors for her contributions to science and the public sphere, for instance: PORCO was awarded the Carl Sagan Medal, presented by the American Astronomical Society for Excellence in the Communication of Science to the Public and she was named one of the 25 most influential people in space by Time magazine. New Statesman named her as one of “The 50 People Who Matter Today.” PORCO and BABAK AMIN TAFRESHI were each awarded the Lennart Nilsson Award in recognition of their photographic work.

²⁶⁶² https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled

²⁶⁶³ https://en.wikipedia.org/wiki/Carolyn_Porco

- The award panel's citation for Dr. PORCO reads as follows:
“CAROLYN PORCO combines the finest techniques of planetary exploration and scientific research with aesthetic finesse and educational talent. While her images, which depict the heavenly bodies of the Saturn system with unique precision, serve as tools for the world's leading experts, they also reveal the beauty of the universe in a manner that is an inspiration to one and all.”²⁶⁶⁴

²⁶⁶⁴ https://en.wikipedia.org/wiki/Carolyn_Porco



CAROLYN PORCO, date, location and photographer unknown.²⁶⁶⁵

²⁶⁶⁵ https://en.wikipedia.org/wiki/Carolyn_Porco



July 19, **12,013 HE**: This image taken by *Cassini* is called “The Day the Earth Smiled.” Earth is a blue dot underneath the rings of Saturn.²⁶⁶⁶

²⁶⁶⁶ https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled

Born 11,953 HE: SIR ANDREW WILES, British Mathematician, professor at Princeton University.²⁶⁶⁷ In **19,995 HE WILES** published the correct proof to Fermat's Last Theorem.²⁶⁶⁸ Together, the two papers which contain the proof are 129 pages long, use standard constructions of modern algebraic geometry, such as the category of schemes and Iwasawa theory, and other techniques from the **11,900's HE** not available to previous mathematicians²⁶⁶⁹ such as **GERMAIN** or **FERMAT**. (See **11,776 HE – 11,831 HE MARIE-SOPHIE GERMAIN** and **11,607 HE – 11,665 HE: PIERRE DE FERMAT**.)

²⁶⁶⁷ Liz Strachan *[A Slice of Pi](#)*

²⁶⁶⁸ Liz Strachan *[A Slice of Pi](#)*

²⁶⁶⁹ https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem



12,005 HE SIR ANDREW WILES, photographer and location unknown²⁶⁷⁰

Born 11,954 HE: LAWRENCE M. KRAUSS is a United States-Canadian theoretical physicist, cosmologist, and founder of Arizona State University's Origins Project to investigate fundamental questions about the universe.²⁶⁷¹

²⁶⁷⁰ https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem

²⁶⁷¹ https://en.wikipedia.org/wiki/Lawrence_M._Krauss

⇒ LAWRENCE M. KRAUSS is an advocate of the public understanding of science, of public policy based on sound empirical data, of scientific skepticism, and of science education. He works to reduce the influence of what he regards as superstition and religious dogma in popular culture.²⁶⁷²



⇒ LAWRENCE M. KRAUSS at Ghent University, **12,013 HE**,
photographer unknown.²⁶⁷³

²⁶⁷² https://en.wikipedia.org/wiki/Lawrence_M._Krauss

²⁶⁷³ https://en.wikipedia.org/wiki/Lawrence_M._Krauss

Born **11,955 HE**: Dr. LUCILLE M. JONES, United States seismologist and public voice for earthquake science and earthquake safety in California. Dr. JONES said: “Earthquakes are inevitable, but disasters are not.”²⁶⁷⁴



Dr. LUCILLE M. JONES (photographer, location and date unknown.)²⁶⁷⁵

²⁶⁷⁴ https://en.wikipedia.org/wiki/Lucy_Jones

²⁶⁷⁵ Wikipedia suggested

11,955 HE – 11,966 HE: French wind turbine. The Station d'Etude de l'Energie du Vent at Nogent-le-Roi in France operated an experimental 800 KVA wind turbine.²⁶⁷⁶



11,955 HE: Photo is of the Experimental wind turbine at Nogent-le-Roi, France.²⁶⁷⁷

²⁶⁷⁶ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

²⁶⁷⁷ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

Born 11,955 HE: William Sanford Nye, popularly known as **BILL NYE THE SCIENCE GUY**, United States science communicator, television presenter, currently the CEO of the Planetary Society.

- ⇒ He has helped develop sundials for the Mars Exploration Rover missions and is a mechanical engineer.
- ⇒ He is best known as the host of the PBS and syndicated children's science show **BILL NYE THE SCIENCE GUY (11,993 HE–11,998 HE)**, the Netflix show **Bill Nye Saves the World (12,017 HE–present)**, and for his many subsequent appearances in popular media as a science educator.²⁶⁷⁸

²⁶⁷⁸ https://en.wikipedia.org/wiki/Bill_Nye

- ⇒ BILL NYE began his career as a mechanical engineer for Boeing Corporation in Seattle, where he invented a hydraulic resonance suppressor tube used on 747 airplanes.²⁶⁷⁹
- ⇒ BILL NYE holds four United States patents, including one for ballet pointe shoes, one for an educational magnifying glass created by filling a clear plastic bag with water, one for a device for training an athlete to throw a ball, and for a digital abacus.²⁶⁸⁰

²⁶⁷⁹ https://en.wikipedia.org/wiki/Bill_Nye

²⁶⁸⁰ https://en.wikipedia.org/wiki/Bill_Nye



12,016 HE BILL NYE speaking to a group about Mars, photographer and location unknown.²⁶⁸¹

²⁶⁸¹ https://en.wikipedia.org/wiki/Bill_Nye

Born 11,956 HE: Dr. MAE CAROL JEMISON,²⁶⁸² United States, physician, engineer, astronaut, and the first African-American woman in space.²⁶⁸³

⇒ **11,993 HE:** Yes, Star Trek fans, Dr. MAE JEMISON appeared as Lieutenant Palmer in "Second Chances," an episode of the science fiction television series Star Trek: The Next Generation, earning her the distinction of being the first real-life astronaut to appear on Star Trek.²⁶⁸⁴

⇒ Award and Honors to Dr. MAE JEMISON: Essence Science and Technology Award; Gamma Sigma Sigma Woman of the Year; McCall's 10 Outstanding Women for the 90s; Johnson Publications Black Achievement Trailblazers Award; Ebony Black Achievement

²⁶⁸² https://en.wikipedia.org/wiki/Roger_Arliner_Young

²⁶⁸³ https://en.wikipedia.org/wiki/Mae_Jemison

²⁶⁸⁴ https://en.wikipedia.org/wiki/Mae_Jemison

Award; National Women's Hall of Fame; Ebony magazine 50 Most Influential women; Kilby Science Award; Montgomery Fellow, Dartmouth College; People magazine's "50 Most Beautiful People in the World"; Turner Trumpet Award; Azerbaijan featured JEMISON on the 110m postage stamp; listed among the 100 Greatest African-Americans according to Molefi Kete Asante; Texas Women's Hall of Fame inductee; Intrepid Award by the National Organization for Girls; International Space Hall of Fame; The National Audubon Society, Rachel Carson Award; Buzz Aldrin Space Pioneer Award.²⁶⁸⁵

⇒ Institutions named after JEMISON: Mae C. Jemison Science and Space Museum, Wilbur Wright College, Chicago, Illinois; Mae C. Jemison Academy, an alternative public school in Detroit,

²⁶⁸⁵ https://en.wikipedia.org/wiki/Mae_Jemison

Michigan; Mae Jemison School, an elementary public school in Hazel Crest, Illinois; Jemison High School, Huntsville, Alabama.



11,992 HE: Dr. MAE JEMISON, photographer unknown.²⁶⁸⁶

²⁶⁸⁶ https://en.wikipedia.org/wiki/Mae_Jemison



Dr. MAE JEMISON aboard the Spacelab Japan (SLJ) science module on the Earth-orbiting *Endeavour*, date unknown.²⁶⁸⁷

²⁶⁸⁷ https://en.wikipedia.org/wiki/Mae_Jemison



⇒ Dr. MAE JEMISON with Nichelle Nichols on the set of Star Trek: The Next Generation. Photographer unknown.²⁶⁸⁸

²⁶⁸⁸ https://memory-alpha.fandom.com/wiki/Mae_Jemison

11,957 HE: The *B2FH Paper* was published and is a landmark paper on the origin of the chemical elements, published in *Reviews of Modern Physics*. Nicknamed after the initials of the Editors of the paper, MARGARET BURBIDGE, GEOFFREY BURBIDGE, WILLIAM A. FOWLER, and FRED HOYLE.

⇒ The actual title of the paper is "*Synthesis of the Elements in Stars*", but as the paper grew in influence it came to be referred to only as "B2FH". The B2FH group showed the famous result that all the elements (then known) except the very lightest, are produced by nuclear processes inside stars.²⁶⁸⁹ *The B2FH group first advanced the idea of "nucleosynthesis" or fusion of lighter elements into heavier ones, which occurs during stars explosive oxygen burning*

²⁶⁸⁹ https://en.wikipedia.org/wiki/B2FH_paper

and silicon burning events. For this they received the Warner Prize in **11,959 HE**.^{2690 2691}

- ⇒ **The B2FH Paper** says that stars evolve because of changes in the abundance of their constituent elements over their lifespans, first by burning Hydrogen (main sequence star), then by burning Helium (red giant star), and progressively burning higher elements. However, this does not by itself significantly alter the abundances of elements in the universe as the elements are contained within the star. Later in its stellar life a higher-mass star (12–35 times the mass of our sun) will eject mass via a sudden catastrophic event called a supernova. Gravitational collapse and its associated heating result in the subsequent nucleosynthesis of carbon, oxygen and silicon. However, nucleosynthesis of heavier elements is caused by the upper layers of the star collapsing onto the core, creating a

²⁶⁹⁰ https://en.wikipedia.org/wiki/Margaret_Burbidge

²⁶⁹¹ https://en.wikipedia.org/wiki/B2FH_paper

compressional shock wave rebounding outward. The shock front briefly raises temperatures by roughly 50%, called explosive nucleosynthesis or supernova nucleosynthesis, and is the final epoch of stellar nucleosynthesis.²⁶⁹²

⇒ **MARGARET BURBIDGE 11,919 HE – current**, British-born United States astrophysicist who was one of the first astrophysicists to measure the masses and rotation curves of galaxies and was one of the pioneers in the study of quasars. Among other positions held, she was Director of the Royal Greenwich Observatory, worked at Cavendish Laboratory in Cambridge, England, at Cal Tech, and was the first director of the Center for Astronomy and Space Sciences at the University of California at San Diego (UCSD).²⁶⁹³

²⁶⁹² https://en.wikipedia.org/wiki/Stellar_nucleosynthesis

²⁶⁹³ https://en.wikipedia.org/wiki/Margaret_Burbidge



●

ELEANOR MARGARET PEACHEY BURBIDGE, date, location, and photographer unknown.²⁶⁹⁴

²⁶⁹⁴ https://en.wikipedia.org/wiki/Margaret_Burbidge

⇒ **GEOFFREY RONALD BURBIDGE: 11,925 HE – 12,010 HE:**
English astronomy professor and theoretical astrophysicist.

- He worked at the Mount Wilson Observatory and Palomar Observatory and was the Director of Kitt Peak National Observatory from **11,978 HE** to **11,984 HE**.²⁶⁹⁵

²⁶⁹⁵ https://en.wikipedia.org/wiki/Geoffrey_Burbidge



-

GEOFFREY RONALD BURBIDGE, date, location, and
photographer unknown²⁶⁹⁶

²⁶⁹⁶ Image search from datuopinion.com

⇒ **11,911 HE – 11,995 HE: WILLIAM ALFRED FOWLER**, United States Scientist. In **11,983 HE FOWLER** was awarded the Nobel Prize in Physics.²⁶⁹⁷

- FOWLER was, among other honors, awarded the Medal for Merit by President Harry Truman, elected member of the National Academy of Sciences, Member of the National Science Board, Member of the Space Science Board, Designated Benjamin Franklin Fellow of the Royal Society of Arts, Awarded National Medal of Science by President Gerald Ford, Designated Associate of the Royal Astronomical Society, Elected President of the American Physical Society, Designated an Honorary Member of the Mark Twain Society, and elected to the Society of American Baseball Research.²⁶⁹⁸

²⁶⁹⁷ https://en.wikipedia.org/wiki/William_Alfred_Fowler

²⁶⁹⁸ <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>



-

WILLIAM ALFRED FOWLER, date and location unknown.²⁶⁹⁹

²⁶⁹⁹ https://en.wikipedia.org/wiki/William_Alfred_Fowler

⇒ **11,915 HE – 12,001 HE**: FRED HOYLE, British Astronomer who sarcastically coined the term the “Big Bang.” (See the other scientist who got credit for the term “Big Bang” **11,894 HE -11,996 HE**: GEORGES LEMAÎTRE). HOYLE promoted the idea of panspermia as the origin of life on Earth.²⁷⁰⁰

- In his biographical entry/speech for the Nobel Prize WILLIAM ALFRED FOWLER said “.....FRED HOYLE was the second great influence in my life. The grand concept of nucleosynthesis in stars was first definitely established by HOYLE.....”²⁷⁰¹

²⁷⁰⁰ https://en.wikipedia.org/wiki/Fred_Hoyle

²⁷⁰¹ <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>



SIR FRED HOYLE. Location, date and photographer unknown.²⁷⁰²

²⁷⁰² https://en.wikipedia.org/wiki/Fred_Hoyle

11,957 HE: The Soviets launched two orbital spacecraft, *Sputnik 1* and *Sputnik 2*.²⁷⁰³



A replica of Soviet *Sputnik 1* at the Smithsonian.²⁷⁰⁴

²⁷⁰³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁰⁴ https://en.wikipedia.org/wiki/Sputnik_1



This photo is of the metal arming key which is the last remaining piece of the *Sputnik 1*. It prevented contact between the batteries and the transmitter prior to launch. Currently on display at the Smithsonian National Air and Space Museum.²⁷⁰⁵

²⁷⁰⁵ https://en.wikipedia.org/wiki/Sputnik_1



Model of *Sputnik 2* at the Polytechnic Museum in Moscow.²⁷⁰⁶
Sputnik 2 was launched with a dog named Laika on board. Laika did not survive the voyage as the Soviets had no plan for keeping her alive.²⁷⁰⁷

²⁷⁰⁶ https://en.wikipedia.org/wiki/Sputnik_2

²⁷⁰⁷ <https://www.archives.gov/research/alic/reference/space-timeline.html>

Born 11,958 HE: your humble Author / Compiler and her Techno-Manager, too.

11,958 HE: *Explorer 1*, United States first successful launch of a US Satellite.²⁷⁰⁸



Photo is of WILLIAM HAYWARD PICKERING, JAMES VAN

²⁷⁰⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

ALLEN, and WERNHER VON BRAUN displaying a full-scale model of *Explorer 1* at a crowded news conference in Washington, DC after confirmation that the satellite was in orbit.²⁷⁰⁹

Born 11,958 HE: NEIL DEGRASSE TYSON, United States, astrophysicist, cosmologist, author, and science communicator.

- ⇒ **11,996 HE - present,** NEIL deGRASSE TYSON has been the Frederick P. Rose Director of the Hayden Planetarium at the Rose Center for Earth and Space in New York City.²⁷¹⁰
- ⇒ TYSON served on a **12,001 HE** government commission on the future of the U.S. aerospace industry, and on the **12,004 HE** Moon, Mars and Beyond commission.

²⁷⁰⁹ https://en.wikipedia.org/wiki/Explorer_1

²⁷¹⁰ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

- ⇒ **12,004 HE:** TYSON was awarded the NASA Distinguished Public Service Medal. The U.S. National Academy of Sciences awarded Tyson the Public Welfare Medal in **12,015 HE** for his "extraordinary role in exciting the public about the wonders of science".²⁷¹¹
- ⇒ **12,014 HE:** NEIL deGRASSE TYSON hosted the television series Cosmos: A Spacetime Odyssey, a successor to CARL SAGAN'S **11,980 HE** series Cosmos: A Personal Voyage.²⁷¹²

²⁷¹¹ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

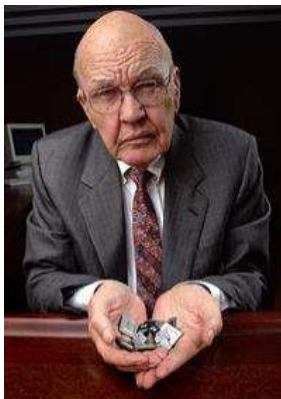
²⁷¹² https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson



12,009 HE NEIL deGRASSE TYSON, photographer and location unknown²⁷¹³

²⁷¹³ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

11,958 HE: Patent of integrated circuit at Texas Instruments.²⁷¹⁴



12,000 HE: JACK KILBY (11,923 HE – 12,005 HE) was a United States electrical engineer who was awarded the Nobel Prize in

²⁷¹⁴ https://en.wikipedia.org/wiki/Jack_Kilby

Physics for his patent and work with Integrated Circuits. To congratulate him, American President Bill Clinton wrote, "You can take pride in the knowledge that your work will help to improve lives for generations to come."²⁷¹⁵



11,958 HE: JACK KILBY'S original integrated circuit, photographer and location unknown.²⁷¹⁶

²⁷¹⁵ https://en.wikipedia.org/wiki/Jack_Kilby

²⁷¹⁶ https://en.wikipedia.org/wiki/Jack_Kilby

⇒ Some of JACK KILBY's Awards and Honors: Recognition of KILBY's outstanding achievements have been made by the Institute of Electrical and Electronic Engineers (IEEE). KILBY was co-recipient of the Franklin Institute's Stuart Ballantine Medal, and the Holley Medal from the American Society of Mechanical Engineers (ASME). He was elected to member of the National Academy of Engineering (NAE); he received the Academy's Vladimir K. Zworykin Award. The Kilby Award Foundation was founded in his honor. He was inducted into the National Inventors Hall of Fame. KILBY is also the recipient of the nation's most prestigious honors in science and engineering: The National Medal of Science and the National Medal of Technology. He was awarded the Kyoto Prize by the Inamori Foundation. The Jack Kilby Computer Centre at the Merchiston Campus of Edinburgh Napier University in Edinburgh, Scotland is also named in his honor.²⁷¹⁷

²⁷¹⁷ https://en.wikipedia.org/wiki/Jack_Kilby

11,959 HE – 11,960 HE:



The Henney Kilowatt was an electric car introduced in the US for two years.²⁷¹⁸

²⁷¹⁸ https://en.wikipedia.org/wiki/Henney_Kilowatt

Born circa 11,960 HE: SUE O'CONNOR,²⁷¹⁹ Australian Anthropologist Archeologist and Distinguished Professor in the School of Culture, History & Language at the University of New England (Australia).

- ⇒ O'CONNOR's research focuses primarily on the evidence of Pleistocene settlement and early human migration in the Indo-Pacific region.
- ⇒ Awards received by O'CONNOR: Australian Research Council QEII Fellowship; Rhys Jones Medal for Outstanding Contribution to Australian Archaeology; Australian Research Council Laureate Fellowship.²⁷²⁰
- ⇒ In **12,017 HE** O'CONNOR's research team recovered the world's oldest fish hooks from an ancient burial site in Indonesia. Five

²⁷¹⁹ http://archive.archaeology.org/1203/trenches/jerimalai_cave_east_timor_fish_hooks.html

²⁷²⁰ https://en.wikipedia.org/wiki/Sue_O'Connor

circular, rotating hooks, probably used for deep-sea fishing, were found under the chin and around the jaws of an adult female skeleton buried 12,000 years ago. (See also **circa 11,000 BHE – 4,000 BHE**: Jerimalai cave site in East Timor.)



SUE O'CONNOR, photographer, date and location unknown.²⁷²¹

²⁷²¹ <https://www.australianarchaeologicalassociation.com.au/awards/rhys-jones-medal/sue-oconnor/>

11,961 HE: YURI GARGARIN, Soviet Union, is the first human to orbit earth.²⁷²²



YURI GAGARIN (11,934 HE – 11,968 HE) in Helsinki, photographer unknown.²⁷²³

²⁷²² <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷²³ https://en.wikipedia.org/wiki/Yuri_Gagarin

11,961 HE: ALAN SHEPPARD, United States, first US Astronaut to be launched into space. SHEPPARD'S flight entered outer space, but his capsule re-entered the atmosphere without circumnavigating the globe.²⁷²⁴ Hence, his flight tends to be treated as though it was less historic than John Glenn's later orbital flight for the United States.



Ten years later in **11,971 HE:** This Photo is of ALAN SHEPPARD

²⁷²⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

on the moon. SHEPPARD was the only Mercury astronaut to become a moon walker.²⁷²⁵



Photo is of American Astronaut **ALAN SHEPPARD (11,923 HE – 11,998 HE)**, and his wife Louise meeting First Lady Jacqueline

²⁷²⁵ https://en.wikipedia.org/wiki/Alan_Shepard

Kennedy, President John F. Kennedy and Vice President Lyndon B. Johnson at the South Portico of the White House.²⁷²⁶

Circa 11,961 HE: United States, “Mercury 13”: Women aviation pilots who were on their way to being astronauts, but whom President Johnson, Congress, and John Glenn stopped because they were women.²⁷²⁷

⇒ The names of those accomplished female aviation pilots are: Myrtle Cagle, Jerrie Cobb, Janet Dietrich, Marion Dietrich, Wally Funk, Sarah Gorelick later Ratley, Jane “Janey” Briggs Hart, Jean Hixson, Rhea Hurrle Woltman, Gene Nora Stumbough Jessen, Irene

²⁷²⁶ https://en.wikipedia.org/wiki/Alan_Shepard

²⁷²⁷

<https://www.npr.org/templates/story/story.php?storyId=4770249&storyid=4770249?storyId=4770249&storyid=4770249>

Leverton, Jerri Sloan, Hamilton Sloan Truhill, Bernice Trimble Steadman.²⁷²⁸

11,962 HE: United States, Bell Laboratories *Telstar 1* – first commercial communications satellite launched.²⁷²⁹



Photo is of a Model of a *Telstar* satellite, on display at Conservatoire national des arts et métiers.²⁷³⁰

²⁷²⁸ https://en.wikipedia.org/wiki/Mercury_13

²⁷²⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷³⁰ <https://en.wikipedia.org/wiki/Telstar>



Photo is of a 177 ft. horn antenna at AT&T's satellite ground station in Andover, Maine, built to communicate with *Telstar*. (A similar but smaller Bell Labs antenna was used by PENZIAS and WILSON in **11,964 HE** to discover the Cosmic Microwave Background).²⁷³¹

²⁷³¹ <https://en.wikipedia.org/wiki/Telstar>

11,963 HE: VALENTINA TERESHKOVA, Soviet engineer, first woman in space.²⁷³²



11,963 HE photo of VALENTINA TERESHKOVA.²⁷³³

²⁷³² <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷³³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

<https://www.npr.org/templates/story/story.php?storyId=4770249&storyid=4770249?storyId=4770249&storyid=4770249>

11,964 HE; ARNO ALLAN PENZIAS, German Physicist who with ROBERT WOODROW WILSON, United States Physicist, discover the Cosmic Microwave Background.^{2734 2735}



ARNO ALLAN PENZIAS (right), German Physicist with

²⁷³⁴ https://en.wikipedia.org/wiki/Robert_Woodrow_Wilson

²⁷³⁵ https://en.wikipedia.org/wiki/Arno_Allan_Penzias

ROBERT WOODROW WILSON (left), United States Physicist, discoverers of the Cosmic Microwave Background. They are posing in front of the Bell Labs 20-foot horn antenna in Holmdel, NJ with which they stumbled upon the microwave background as radio interference.²⁷³⁶

11,964 HE: The first electrified high-speed rail *Tōkaidō Shinkansen* was introduced between Tokyo and Osaka in Japan. Since then, high-speed rail transport functioning at speeds up to and above 300 km/h has been built in Japan, Spain, France, Germany, Italy, the People's Republic of China, Taiwan (Republic of China), the United Kingdom, South Korea, Scandinavia, Belgium, and the Netherlands.²⁷³⁷

²⁷³⁶ https://en.wikipedia.org/wiki/Arno_Allan_Penzias

²⁷³⁷ https://en.wikipedia.org/wiki/History_of_rail_transport



11,964 HE: Photo is of a *0-Series Shinkansen*, which triggered the intercity train travel boom.²⁷³⁸

²⁷³⁸ https://en.wikipedia.org/wiki/History_of_rail_transport



12,016 HE: Shinkansen in Osaka.²⁷³⁹

²⁷³⁹ Image: Premack family photo

11,965 HE: ALEXI LEONOV, Soviet Cosmonaut – first spacewalker.
Three months later, United States Astronaut ED WHITE did a
spacewalk.²⁷⁴⁰



Photo of ALEXI LEONOV is from **11,974 HE.**²⁷⁴¹

²⁷⁴⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁴¹ https://en.wikipedia.org/wiki/Alexey_Leonov



Photo of ED WHITE is from **11,966 HE.**²⁷⁴²

11,966 HE: Television premier of Star Trek.²⁷⁴³

²⁷⁴² [https://en.wikipedia.org/wiki/Ed_White_\(astronaut\)](https://en.wikipedia.org/wiki/Ed_White_(astronaut))

²⁷⁴³ Paul Premack, personal witness to event.

Born 11,966 HE: SEAN MICHAEL CARROLL is a cosmologist and physics professor specializing in dark energy and general relativity. CARROLL research papers include models of, and experimental constraints on, violations of Lorentz invariance; the appearance of closed time-like curves in general relativity; varieties of topological defects in field theory; and cosmological dynamics of extra spacetime dimensions. In recent years he has written extensively on models of dark energy and its interactions with ordinary matter and dark matter, as well as modifications of general relativity in cosmology.

⇒ CARROLL has also worked on the arrow of time problem. He and JENNIFER CHEN posit that the Big Bang is not a unique occurrence, but rather one of many cosmic inflation events resulting from quantum fluctuations of vacuum energy. They claim that the universe is infinitely old, but never reaches thermodynamic equilibrium as entropy increases continuously without limit due to the decreasing matter and energy density attributable to recurrent

cosmic inflation. They assert that the universe is "statistically time-symmetric" insofar as it contains equal progressions of time "both forward and backward."



Twitter.com Photo of SEAN M. CARROLL, date, location and photographer unknown.²⁷⁴⁴

²⁷⁴⁴ https://en.wikipedia.org/wiki/Sean_M._Carroll

<https://www.bing.com/images/search?q=image%20sean%20m%20carroll&id=56979022668C2A97142571DBFE5DF6BD2DD74357&FORM=IQFRBA>

Born 11,967 HE: MAX TEGMARK is a Swedish - United States physicist and cosmologist whose research has focused on combining theoretical work with new measurements to place constraints on cosmological models and their free parameters. He has over 200 publications. He has developed data analysis tools based on information theory and applied them to cosmic microwave background experiments such as COBE, QMAP, and WMAP, and to galaxy redshift surveys such as the Las Campanas Redshift Survey, the 2dF Survey, and the Sloan Digital Sky Survey.²⁷⁴⁵ With DANIEL EISENSTEIN and WAYNE HU, TEGMARK introduced the idea of using baryon acoustic oscillations as a standard ruler. With ANGELICA DE OLIVEIRA-COSTA and ANDREW HAMILTON, he discovered the anomalous multipole alignment in the WMAP data sometimes referred to as the "axis of evil". With ANTHONY AGUIRRE, he developed the cosmological interpretation of quantum mechanics. TEGMARK has also formulated the "Ultimate Ensemble

²⁷⁴⁵ https://en.wikipedia.org/wiki/Max_Tegmark

theory of everything", whose only postulate is that "all structures that exist mathematically exist also physically".²⁷⁴⁶



Photo of MAX TEGMARK, photographer, date, location unknown.²⁷⁴⁷

²⁷⁴⁶ https://en.wikipedia.org/wiki/Max_Tegmark

²⁷⁴⁷ https://en.wikipedia.org/wiki/Max_Tegmark

11,968 HE: Seiko Epson, Japan, EP-101, the world's first miniprinter, is launched.²⁷⁴⁸



Photo of the world's first miniprinter. Dimensions and photographer unknown.²⁷⁴⁹

²⁷⁴⁸ <https://epson.com/company-history>

²⁷⁴⁹ <https://epson.com/company-history>

11,968 HE: ROBERT NORTON NOYCE, United States, founded Intel.²⁷⁵⁰



Photo is of ROBERT NORTON NOYCE (**11,927 HE – 11,990 HE**) in front of the Intel SC1 building in Santa Clara in **11,970 HE**. Nicknamed “the Mayor of Silicon Valley,” ROBERT NORTON NOYCE, along with JACK KILBY, are credited with the

²⁷⁵⁰ https://en.wikipedia.org/wiki/Robert_Noyce

realization of the first integrated circuit or microchip that fueled the personal computer revolution and gave Silicon Valley its name.²⁷⁵¹

⇒ ROBERT NORTON NOYCE was granted 15 patents: U.S. Patent 2,875,141 Method and apparatus for forming semiconductor structures; U.S. Patent 2,929,753 Transistor structure and method; U.S. Patent 2,959,681 Semiconductor scanning device; U.S. Patent 2,968,750 Transistor structure and method of making the same; U.S. Patent 2,971,139 Semiconductor switching device; U.S. Patent 2,981,877 Semiconductor Device and Lead Structure; U.S. Patent 3,010,033 Field effect transistor; U.S. Patent 3,098,160 Field controlled avalanche semiconductive device,; U.S. Patent 3,108,359 Method for fabricating transistors; U.S. Patent 3,111,590 Transistor structure controlled by an avalanche barrier; U.S. Patent 3,140,206 Method of making a transistor structure (coinventor WILLIAM SHOCKLEY); U.S. Patent 3,150,299 Semiconductor circuit

²⁷⁵¹ https://en.wikipedia.org/wiki/Robert_Noyce

complex having isolation means; U.S. Patent 3,183,129 Method of forming a semiconductor; U.S. Patent 3,199,002 Solid state circuit with crossing leads; U.S. Patent 3,325,787 Trainable system.²⁷⁵²

Born 11,968 HE: PROFESSOR BRIAN COX, English physicist who serves as professor of particle physics in the School of Physics and Astronomy at the University of Manchester.²⁷⁵³ COX works on the ATLAS experiment at the Large Hadron Collider (LHC) at CERN, near Geneva, Switzerland. He is working on the research and development project of the FP420 experiment in an international collaboration to upgrade the ATLAS and the Compact Muon Solenoid (CMS) experiment by installing additional, smaller detectors

²⁷⁵² https://en.wikipedia.org/wiki/Robert_Noyce

²⁷⁵³ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

at a distance of 420 meters from the interaction points of the main experiments.²⁷⁵⁴

- ⇒ PROFESSOR BRIAN COX awards for his efforts to publicize science: COX was elected an International Fellow of The Explorers Club and received the British Association's Lord Kelvin Award for this work. He held a prestigious Royal Society University Research Fellowship. A frequent lecturer, he was keynote speaker at the Australian Science Festival and won the Institute of Physics Kelvin Prize for his work in communicating the appeal and excitement of physics to the general public. He was appointed Officer of the Order of the British Empire (OBE).
- COX won Best Presenter and Best Science/Natural History programme by the Royal Television Society for Wonders of the Universe. COX won twice at the Broadcasting Press Guild

²⁷⁵⁴ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

Awards for “Best Performer” in a non-acting role, while Wonders of the Solar System was named best documentary series of **12,010 HE**.

- He was awarded the Institute of Physics President's medal by Sir Patrick Stewart, following which he gave a speech on the value of education in science and the need to invest more in future generations of scientists.
- COX also was awarded the Michael Faraday Prize of the Royal Society "for his excellent work in science communication". He was elected a Fellow of the Royal Society (FRS) in **12,016 HE**.²⁷⁵⁵

²⁷⁵⁵ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))



PROFESSOR BRIAN COX at the Royal Society admissions day in London, **12,016 HE.**²⁷⁵⁶

²⁷⁵⁶ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

11,968 HE: The first computer mouse was sold (but not widely adopted until **11,980s HE**).²⁷⁵⁷

⇒ **11,968 HE:** The GUI (graphical user interface) was actually the baby of DOUGLASS ENGELBART (**11,925 HE – 12,013 HE**) who demonstrated in **11,968 HE** an operating system with a mouse pointer being inspired by an essay written in **11,945 HE** (Author / Compiler wonders by whom?) about making a computer more interactive.²⁷⁵⁸

- From there, ENGELBART's ideas were picked up by XEROX which made the first computer with a GUI. APPLE saw the GUI idea and loved it but thought it was not suitable for business use.

²⁷⁵⁷ <http://www.computerhistory.org/timeline/computers/>

²⁷⁵⁸ SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions
<https://www.youtube.com/watch?v=g-KuigAQFp4>

Microsoft understood the GUI was the thing that would allow a user to interface with their computer using windows rather than typing lines of commands into prompts. Microsoft made the GUI suitable for business.²⁷⁵⁹

- He is best known for his work on founding the field of human-computer interaction, particularly while at his Augmentation Research Center Lab in SRI International, which resulted in creation of the computer mouse, and the development of hypertext, networked computers, and precursors to graphical user interfaces. These were demonstrated at The Mother of All Demos in **11,968 HE**. “Engelbart's Law”, the observation that the intrinsic rate of human performance is exponential, is named after him.

²⁷⁵⁹ SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*
<https://www.youtube.com/watch?v=g-KuigAQFp4>



DOUGLAS CARL ENGELBART. Date, location and photographer unknown.²⁷⁶⁰

²⁷⁶⁰ https://en.wikipedia.org/wiki/Douglas_Engelbart



ENGELBART'S prototype of a computer mouse, as designed by Bill English from ENGELBART'S sketches.²⁷⁶¹

²⁷⁶¹ Edwards, Benj (2008-12-09). "*The computer mouse turns 40*". Macworld. and https://en.wikipedia.org/wiki/Douglas_Engelbart

11,969 HE: First United States (NASA) moon landing, Apollo 11.²⁷⁶²



Eagle, the Lunar Module ascent stage of Apollo 11, in orbit above the Moon. Earth is visible in the distance.²⁷⁶³

²⁷⁶² <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁶³ https://en.wikipedia.org/wiki/Apollo_Lunar_Module

11,969 HE: ARPANET, the forerunner to the modern internet.²⁷⁶⁴ It was an early packet switching network and the first network to implement the protocol suite TCP/IP. Both technologies became the technical foundation of the Internet. ARPANET was initially funded by the Defense Advanced Research Projects Agency (DARPA) of the United States Department of Defense.²⁷⁶⁵

11,970 HE: DRAM memory introduced by Intel.²⁷⁶⁶ Dynamic random-access memory (DRAM) is a type of semiconductor memory that stores each bit of data in a separate tiny capacitor within an integrated circuit.²⁷⁶⁷

²⁷⁶⁴ <http://www.computerhistory.org/timeline/computers/>

²⁷⁶⁵ <https://en.wikipedia.org/wiki/ARPANET>

²⁷⁶⁶ <http://www.computerhistory.org/timeline/computers/>

²⁷⁶⁷ https://en.wikipedia.org/wiki/Dynamic_random-access_memory

Starting **11,970s HE**: More advancements in Birth Control. Medication abortion is a type of non-surgical abortion. An oral preparation for medical abortion is commonly referred to as an abortion pill.²⁷⁶⁸

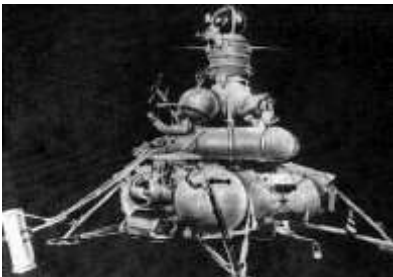
⇒ **11,980 HE**: Mifepristone, also known as RU-486, is a medication typically used in combination with misoprostol, is more than 95% effective during the first 50 days of pregnancy. It is also effective in the second trimester of pregnancy. It is taken by mouth.

- Mifepristone (RU-486) is on the World Health Organization's List of Essential Medicines and is one of the most effective and safe medicines needed in a health system.
- **11,987 HE**: Mifepristone became available France.
- **12,000 HE**: Mifepristone became available the United States.
- **12,017 HE**: Mifepristone became available in Canada.²⁷⁶⁹

²⁷⁶⁸ https://en.wikipedia.org/wiki/Medical_abortion

²⁷⁶⁹ <https://en.wikipedia.org/wiki/Mifepristone>

11,970 HE: United States *Apollo 13* and Soviet *Luna 16* (the first automatic spacecraft to return soil samples of the moon). The Soviet probe *Lunokhod 1* landed on the moon. Soviet *Venera 7* landed on Venus.²⁷⁷⁰



The Soviet *Luna 16*, location and date unknown.²⁷⁷¹

²⁷⁷⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁷¹ https://en.wikipedia.org/wiki/Luna_16

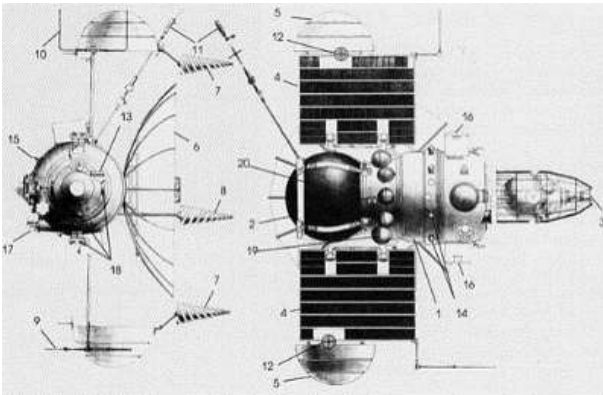


Launch of NASA Apollo 13, photographer unknown.²⁷⁷²



The Soviet *Lunokhod 1*, location and date unknown²⁷⁷³

²⁷⁷³ https://en.wikipedia.org/wiki/Lunokhod_1



The Soviet *Venera 7* was the first space probe to transmit data from another planet back to Earth²⁷⁷⁴

²⁷⁷⁴ https://en.wikipedia.org/wiki/Venera_7

11,971 HE: Email invented. The first computer program is written to send email messages between servers via the ARPANET. To achieve this, RAY TOMLINSON used the @ sign to separate the user name from the name of their machine, a scheme which has been used in email addresses ever since.²⁷⁷⁵

- ⇒ TOMLINSON is internationally known and credited as the inventor of email. Previously, email could be sent only to others who used the same computer.
- The Internet Hall of Fame in its account of his work commented "Tomlinson's email program brought about a complete

²⁷⁷⁵ <http://www.computerhistory.org/timeline/computers/>

revolution, fundamentally changing the way people communicate".^{2776 2777}



12,004 HE photo of RAY TOMLINSON (**11,941 HE – 12,016 HE**), photographer and location unknown.²⁷⁷⁸

²⁷⁷⁶ https://en.wikipedia.org/wiki/Ray_Tomlinson

²⁷⁷⁷ <http://www.computerhistory.org/timeline/computers/>

²⁷⁷⁸ https://en.wikipedia.org/wiki/Ray_Tomlinson

Circa 11,971 HE – circa 11,979 HE: GARY STARKWEATHER, United States engineer and inventor, who worked in Xerox's product development department, had the idea in **11,969 HE** of using a laser beam to "draw" an image of what was to be copied directly onto the copier drum. The *laser printer* was born and they were introduced for the office and then home markets in subsequent years by IBM, Canon, Xerox, Apple, Hewlett-Packard and many others. Over the decades, quality and speed have increased as price has fallen, and the once cutting-edge printing devices are now ubiquitous.²⁷⁷⁹

²⁷⁷⁹ https://en.wikipedia.org/wiki/Laser_printing

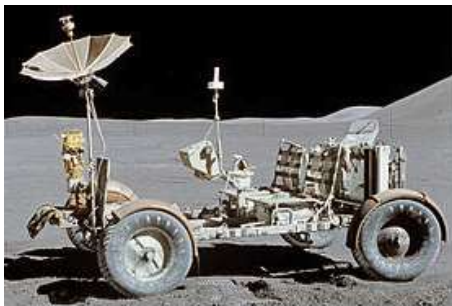


12,009 HE Photo of GARY STARKWEATHER (Born **11,938 HE**).²⁷⁸⁰

11,971 HE – 11,972 HE: Electric cars received the unique distinction of becoming the first manned vehicles to drive on the Moon. The first Moon electric car was the *Lunar Rover*, which was first deployed

²⁷⁸⁰ https://en.wikipedia.org/wiki/Gary_Starkweather

during the *Apollo 15* mission. The "moon buggy" was developed by Boeing and GM subsidiary Delco Electronics.²⁷⁸¹



11,971 HE: The U.S. *Apollo Lunar Rover* from *Apollo 15* on the Moon.²⁷⁸²

²⁷⁸¹ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

²⁷⁸² https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle



11,972 HE: JOHN YOUNG works at the *Lunar Rover* on *Apollo 16*.²⁷⁸³

²⁷⁸³ https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle

11,971 HE: Soviet space station *Salyut 1* was launched. United States *Mariner 9* probe became the first craft to orbit another world - Mars.²⁷⁸⁴



Photo of *Salyut 1* as seen from *Soyuz 1*.²⁷⁸⁵

²⁷⁸⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁸⁵ https://en.wikipedia.org/wiki/Salyut_1

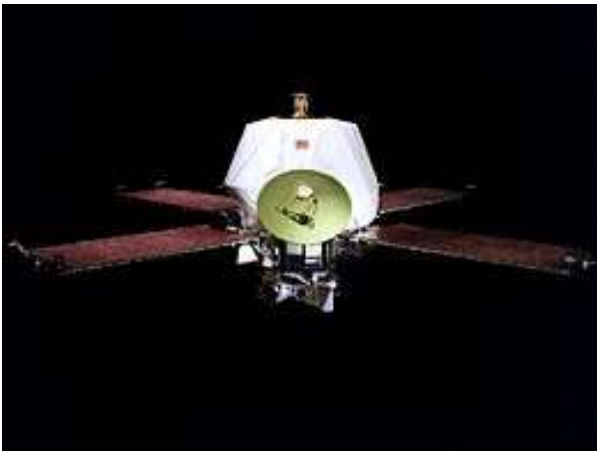
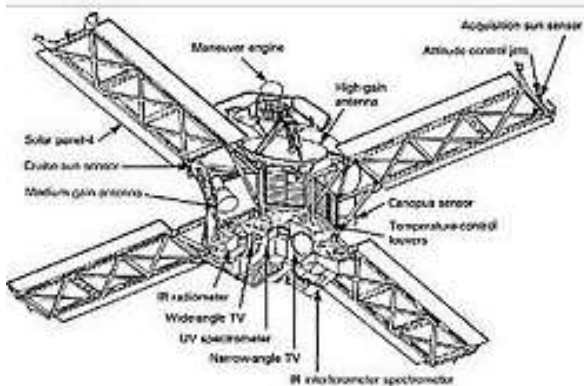


Photo of *Mariner 9*. Unknown location, photographer.²⁷⁸⁶

²⁷⁸⁶ <https://www.jpl.nasa.gov/missions/mariner-9-mariner-i/>



⇒ Note: Propulsion module and scan platform insulation blankets not shown.

A schematic of *Mariner 9*, showing the major components and features.²⁷⁸⁷

11,972 HE: United States Astronauts EUGENE CERNAN and HARRISON "JACK" SCHMITT became the last men to walk on the moon, to date.²⁷⁸⁸



11,971 HE Photo is of US Astronaut EUGENE CERNAN (11,934 HE - 12,017 HE).²⁷⁸⁹

²⁷⁸⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁸⁹ https://en.wikipedia.org/wiki/Gene_Cernan



11,971 HE Photo is of US Astronaut HARRISON SCHMITT (born **11,935 HE**)²⁷⁹⁰.

²⁷⁹⁰ https://en.wikipedia.org/wiki/Harrison_Schmitt

11,972 HE: NASA *Pioneer 10* is launched to Jupiter.²⁷⁹¹



Pioneer 10 in the final stages of construction.²⁷⁹²

²⁷⁹¹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁹² https://en.wikipedia.org/wiki/Pioneer_10

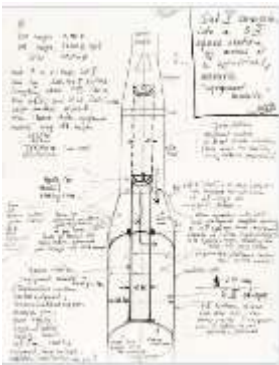
11,973 HE: United States *Skylab* is launched on board the modified *Saturn V* rocket. The space station is made from the upper stage of the *Saturn V* rocket.²⁷⁹³



Image of *Skylab* in Earth orbit. Unknown photographer or date.²⁷⁹⁴

²⁷⁹³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁷⁹⁴ www.washingtonpost.com image of Skylab



11,964 HE: WERNHER VON BRAUN (SEE 11,912 HE – 11,977 HE) sketch of a Space Station based on conversion of a Saturn V stage.²⁷⁹⁵

²⁷⁹⁵ <https://en.wikipedia.org/wiki/Skylab>

11,975 HE: The Nobel Prize in Physics was awarded jointly to AAGE NIELS BOHR (yes, reader, he was a son of NIELS BOHR definer of the atom see **11,922 HE**), BEN ROY MOTTELSON AND LEO JAMES RAINWATER "for the discovery of the connection between collective motion and particle motion in atomic nuclei and the development of the theory of the structure of the atomic nucleus based on this connection."²⁷⁹⁶

11,975 HE: Microsoft founded by BILL GATES III and PAUL ALLEN.²⁷⁹⁷ Microsoft's first operating system was a version of Unix called Xenix, released in **11,980 HE**. Microsoft's first wildly successful operating system was MS-DOS, which Microsoft wrote for IBM in **11,981 HE** and was based on Tim Paterson's QDOS. In the deal of the century, BILL GATES only *licensed* MS-DOS to IBM. By

²⁷⁹⁶ <https://www.nobelprize.org/prizes/physics/1975/summary/>

²⁷⁹⁷ <https://www.thoughtco.com/microsoft-history-of-a-computing-giant-1991140>

retaining the rights to the software, BILL GATES made a fortune for Microsoft and Microsoft became a major software vendor.²⁷⁹⁸

⇒ **11,985 HE – present HE:** Windows 95, Windows XP, Xbox, Microsoft Azure, Windows Vista, Windows 7, Microsoft stores, Windows 8, Xbox One, Outlook.com, Surface devices, Windows 10, Windows 10 Mobile, Microsoft Edge, and HoloLens.²⁷⁹⁹

²⁷⁹⁸ https://en.wikipedia.org/wiki/History_of_Microsoft

²⁷⁹⁹ https://en.wikipedia.org/wiki/History_of_Microsoft



12,018 HE: BILL GATES III (born **11,955 HE**) at the United States Department of Health and Human Services.²⁸⁰⁰ GATES has written two books: **11,995 HE:** *The Road Ahead*, written with Microsoft executive Nathan Myhrvold and journalist Peter

²⁸⁰⁰ https://en.wikipedia.org/wiki/Bill_Gates

Rinearson. It summarized the implications of the personal computing revolution and described a future profoundly changed by the arrival of a global information superhighway. **11,999 HE: *Business @ the Speed of Thought*** discusses how business and technology are integrated and shows how digital infrastructures and information networks can help get an edge on the competition.²⁸⁰¹

- **12,000 HE:** Bill & Melinda Gates Foundation is said to be the largest private foundation in the United States. The primary aims of the foundation are to enhance healthcare, to reduce extreme poverty, to expand educational opportunities, and to provide access to information technology.²⁸⁰²

²⁸⁰¹ https://en.wikipedia.org/wiki/Bill_Gates

²⁸⁰² https://en.wikipedia.org/wiki/Bill_and_Melinda_Gates_Foundation



12,013 HE: photo of PAUL ALLEN (**11,953 HE – 12,018 HE**) at Flying Heritage Collection.²⁸⁰³ ALLEN is the founder of Vulcan Inc, Allen Institute for Brain Science, Institute for Artificial

²⁸⁰³ https://en.wikipedia.org/wiki/Paul_Allen

Intelligence, Institute for Cell Science, and Stratolaunch Systems.²⁸⁰⁴

⇒ Among so much else about PAUL ALLEN:

- ALLEN has bankrolled a range of wildlife conservation projects. ALLEN provided more than \$7 million to fund the Great Elephant Census. He funded the University of British Columbia's Sea Around Us Project as a way to fight illegal fishing. He funded the Global FinPrint initiative, a three-year survey of sharks and rays in coral reef areas. ALLEN backed successful Washington state initiative 1401 to prohibit the purchase, sale and distribution of products made from 10 endangered species.

²⁸⁰⁴ https://en.wikipedia.org/wiki/Paul_Allen

- Alongside the US Department of Transportation, ALLEN and Vulcan Inc. launched the Smart City Challenge to transform city transportation systems. Columbus, Ohio won the challenge.
- ALLEN also has a long history of investing in Africa, including funding the building of microgrids in Kenya, which are small-scale power grids that can operate independently. ALLEN was an early investor in the Mawingu Networks, a wireless and solar-powered Internet provider which aims to connect rural Africa with the world. ALLEN's investment in Off Grid Electric, a company focused on providing solar energy to people in emerging nations, is giving Tanzanians the ability to access electrical service for very little cost.²⁸⁰⁵

²⁸⁰⁵ https://en.wikipedia.org/wiki/Paul_Allen

11,975 HE: US-Soviet space craft rendezvous and dock.²⁸⁰⁶



Photo is of US-Soviet space craft rendezvous and dock,
photographer unknown.²⁸⁰⁷

²⁸⁰⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁸⁰⁷ Getty images

11,976 HE: NASA's space shuttle *Enterprise* rolled out of the Palmdale manufacturing facilities and was greeted by NASA officials and cast members from the Star Trek television series.

⇒ The *Enterprise* was used in atmospheric testing of the *Shuttle* and did not go to space.

⇒ *Enterprise* was transferred to the Intrepid Sea, Air & Space Museum in New York City, where it has been on display since

12,012 HE.²⁸⁰⁸

²⁸⁰⁸ https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html



Enterprise with NASA Administrator Fletcher, and Star Trek cast members.²⁸⁰⁹

²⁸⁰⁹ https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html

11,976 HE: Both: 1) Apple Computer was founded by STEVE JOBS and STEVE WOZNIAK along with administrative supervisor Ronald Wayne, whose participation in the new venture was short lived, and 2) STEVE WOZNIAK'S Apple 1 computer was released.²⁸¹⁰



Photo is of an original **11,976 HE** Apple 1 Computer in a briefcase, from the Sydney Powerhouse Museum collection.²⁸¹¹

²⁸¹⁰ https://en.wikipedia.org/wiki/Steve_Wozniak

²⁸¹¹ <http://www.computerhistory.org/timeline/computers/>



12,017 HE: Photo of STEVE WOZNIAK (Born **11,950 HE**) United States inventor, electronics engineer, programmer, philanthropist, and technology entrepreneur.²⁸¹²

- WOZNIAK has credited watching Star Trek and attending Star Trek conventions while in his youth as a source of inspiration for his starting Apple, Inc.²⁸¹³

²⁸¹² https://en.wikipedia.org/wiki/Steve_Wozniak

²⁸¹³ https://en.wikipedia.org/wiki/Steve_Wozniak

- WOZNIAK alone designed the hardware, circuit board designs, and operating system for the Apple I. WOZNIAK originally offered the design to HP while working there but was denied by the company on five different occasions. JOBS instead had the idea to sell the Apple I with WOZNIAK as a fully assembled printed circuit board. WOZNIAK, at first skeptical, was later convinced by JOBS that even if they were not successful, they could at least say to their grandkids they had had their own company. Together they sold some of their possessions (such as WOZNIAK's HP scientific calculator and JOB'S Volkswagen van) raised \$1,300 and assembled the first boards in JOB'S bedroom and later (when there was no space left) in JOB'S garage. The Apple I sold for \$666.66. (WOZNIAK later said he had no idea about the relation between the number and superstition, and "I came up with [it] because I like repeating digits.") JOBS and WOZNIAK sold their first 50 system boards

to Paul Terrell, who was starting a new computer shop, called the Byte Shop, in Mountain View, California.^{2814 2815}



12,010 HE: photo at the Worldwide Developers Conference of STEVE JOBS (11,955 HE – 12,011 HE).²⁸¹⁶

²⁸¹⁴ https://en.wikipedia.org/wiki/Steve_Wozniak

²⁸¹⁵ Freiberger, Paul; Swaine, Michael (2000). *Fire in the Valley*. McGraw-Hill. ISBN 0-07-135892-7.

Jump up and https://en.wikipedia.org/wiki/Steve_Wozniak

[^] "Apple co-founder offered first computer design to HP 5 times". appleinsider.com.

²⁸¹⁶ https://en.wikipedia.org/wiki/Steve_Jobs

- Some facts on STEVE JOBS: His declassified FBI report states that he used marijuana and LSD while he was in college, and once told a reporter that taking LSD was "one of the two or three most important things" he had done in his life. He considered taking up monastic residence at Eihei-ji in Japan and maintained a lifelong appreciation for Zen. JOBS would later say that people around him who did not share his countercultural roots could not fully relate to his thinking. JOBS denied paternity of his DNA tested daughter, Lisa Brennan (eventually he recognized paternity), and was worth over \$1 million in **11,978 HE** when he was just 23 years old. This grew to over \$250 million by the time he was 25, according to estimates.²⁸¹⁷

²⁸¹⁷ https://en.wikipedia.org/wiki/Steve_Jobs

11,977 HE: *Voyager 1 and 2* are launched. They reach the edge of the solar system in **12,018 HE.**²⁸¹⁸

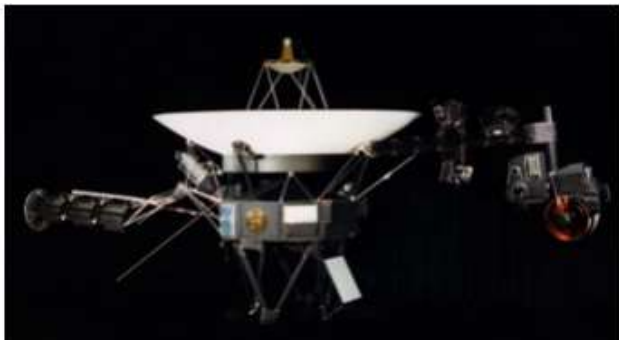


Image of *Voyager 1*. Location and artist unknown.²⁸¹⁹

²⁸¹⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁸¹⁹ <https://voyager.jpl.nasa.gov/>



Artist's concept of the *Voyager 2* spacecraft in space. Credit: NASA.²⁸²⁰

⇒ After completing its primary mission with the flyby of Saturn on November 12, **11,980 HE**, *Voyager 1* became the third of five

²⁸²⁰ <https://solarsystem.nasa.gov/missions/voyager-2/in-depth/>

artificial objects to achieve the escape velocity that will allow them to leave the Solar System. On August 25, **12,012 HE**, *Voyager 1* became the first spacecraft to cross the heliopause and enter the interstellar medium. Having operated for 41 years, 1 month and 20 days as of October 25, **12,018 HE**, the spacecraft still communicates with the Deep Space Network to receive routine commands and return data. At a distance of 142.31 astronomical units (21.289 billion kilometers; 13.229 billion miles) from the Sun as of June 4, **12,018 HE**, it is the most distant human-built object from Earth. The probe's objectives included flybys of Jupiter, Saturn, and Saturn's largest moon, Titan. While the spacecraft's course could have been altered to include a Pluto encounter by forgoing the Titan flyby, exploration of Titan (which was known to have a substantial atmosphere) took priority. It studied the weather,

magnetic fields and rings of the two planets and was the first probe to provide detailed images of their moons.²⁸²¹



Circa 11,979 HE: Screen Snips of 8 of the many photos of Jupiter and area taken by *Voyager 2*.²⁸²²

²⁸²¹ https://en.wikipedia.org/wiki/Voyager_1

²⁸²² https://en.wikipedia.org/wiki/Voyager_2

⇒ **12,270 HE:** *Voyager* famously and fictionally returns to our Solar System in the film *Star Trek: The Motion Picture* (released in **11,979 HE**).²⁸²³

11,979 HE: Visicalc is the first commercial software widely adopted.²⁸²⁴

11,979 HE: WordStar is first commercial word processor.²⁸²⁵

11,980 HE: Atari gaming console introduced.²⁸²⁶

²⁸²³ Paul Premack

²⁸²⁴ <http://www.computerhistory.org/timeline/computers/>

²⁸²⁵ <http://www.computerhistory.org/timeline/computers/>

²⁸²⁶ <http://www.computerhistory.org/timeline/computers/>



The third version of the Atari Video Computer System sold from **11,980 HE** to **11,982 HE**.²⁸²⁷

²⁸²⁷ <https://en.wikipedia.org/wiki/Atari>

11,980 HE: MS-DOS operating system first introduced.²⁸²⁸

Circa 11,980 HE: Daisy wheel and Dot matrix printers introduced.



Photo is of The Royal LetterMaster, a daisy-wheel printer²⁸²⁹

²⁸²⁸ <http://www.computerhistory.org/timeline/computers/>

²⁸²⁹ https://en.wikipedia.org/wiki/Daisy_wheel_printing



Photo is of the **11,980 HE** MX-80 Epson Dot matrix printer²⁸³⁰

11,981 HE: IBM 5150 PC with IBM 5151 monitor introduced.²⁸³¹

²⁸³⁰ <https://epson.com/company-history>

²⁸³¹ <http://www.computerhistory.org/timeline/computers/>



Photo is of the IBM PC, location, photographer unknown.²⁸³²

²⁸³² <http://www.computerhistory.org/timeline/computers/>

11,981 HE: RICHARD FEYNMAN introduces the idea for quantum computing.²⁸³³

11,981 HE: A new era in space flight began on April 12, **11,981 HE**, when Space Shuttle *Columbia*, or STS-1, launched from NASA's Kennedy Space Center in Florida. Astronaut JOHN YOUNG, a veteran of four previous spaceflights including a walk on the moon in **11,972 HE**, commanded the mission. Navy test pilot Bob Crippen piloted the mission and would go on to command three future shuttle missions. The shuttle was humankind's first re-usable spacecraft.²⁸³⁴

²⁸³³ <http://www.computerhistory.org/timeline/computers/>

²⁸³⁴ https://www.nasa.gov/multimedia/imagegallery/image_feature_2488.html



11,981 HE: Launch of STS-1, Space Shuttle *Columbia*,
photographer unknown.²⁸³⁵

²⁸³⁵ https://www.nasa.gov/mission_pages/shuttle/sts1/index.html

11,981 HE: The NASA/DOE 7.5-megawatt Mod-2 three turbine cluster in Goodnoe Hills, Washington, United States.²⁸³⁶



Image of the NASA/DOE 7.5-megawatt Mod-2 three turbine cluster.

²⁸³⁶ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

11,981 HE: The Canadarm remote manipulator system was delivered to NASA. In all, five Canadarms — Nos. 201, 202, 301, 302, and 303 — were built and delivered to NASA.



11,996 HE: Canadarm during Space Shuttle mission STS-72.²⁸³⁷

²⁸³⁷ <https://en.wikipedia.org/wiki/Canadarm>

11,981 HE: *Voyager 2* reached Saturn and began transmitting images.²⁸³⁸

11,986 HE: images arrive from Uranus, and in **11,989 HE** images arrive from Neptune.



Circa 11,981 HE: 8 of the many photos of Saturn and area taken by *Voyager 2*.²⁸³⁹

²⁸³⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁸³⁹ https://en.wikipedia.org/wiki/Voyager_2

Built between 11,983 HE and 11,998 HE: The Large Hadron Collider (LHC), built underground, crosses the border between Switzerland and France at four points, with most of it in France. It is the world's largest and most powerful particle collider and the largest machine in the world. It was built by the European Organization for Nuclear Research (CERN) between in collaboration with over 10,000 scientists and hundreds of universities and laboratories, as well as more than 100 countries.²⁸⁴⁰

⇒ On 4 July **12,012 HE:** At the LHC, both CERN ATLAS and CERN CMS experiments teams announced they had independently made the same discovery of the HIGGS Boson. Using the combined analysis of two interaction types (known as 'channels'), both experiments independently reached a result implying that the probability of getting at least as strong a result by chance alone is less than 1 in 3 million. The two teams had been working 'blinded'

²⁸⁴⁰ https://en.wikipedia.org/wiki/Large_Hadron_Collider

from each other from around late **12,011 HE** or early **12,012 HE**, meaning they did not discuss their results with each other, providing additional certainty that any common finding was genuine validation of a particle. This level of evidence, confirmed independently by two separate teams and experiments, meets the formal level of proof required to announce a confirmed discovery.²⁸⁴¹

- ⇒ **12,015 HE**: The LHC's experimental work since restarting in **12,015 HE** has included probing the Higgs field and boson to a greater level of detail and confirming whether or not less common predictions were correct. In particular, exploration since **12,015 HE** has provided strong evidence of the predicted direct decay into fermions such as pairs of bottom quarks (3.6 sigma) - described as an "important milestone" in understanding its short lifetime and other rare decays - and also to confirm decay into pairs of tau

²⁸⁴¹ https://en.wikipedia.org/wiki/Higgs_boson

leptons (5.9 sigma). This was described by CERN as being "of paramount importance to establishing the coupling of the Higgs boson to leptons and represents an important step towards measuring its couplings to third generation fermions, the very heavy copies of the electrons and quarks, whose role in nature is a profound mystery".²⁸⁴²

⇒ **12,017 HE**: The Large Hadron Collider has continued to produce findings that confirm the **12,013 HE** understanding of the Higgs field and particle. CERN confirmed that all measurements still agree with the predictions of the Standard Model and called the discovered particle simply "the Higgs boson".²⁸⁴³

²⁸⁴² https://en.wikipedia.org/wiki/Higgs_boson

²⁸⁴³ https://en.wikipedia.org/wiki/Higgs_boson

⇒ **12,018 HE:** Both the ATLAS and CMS experiments at CERN reported observing the Higgs boson decay into a pair of bottom quarks, which makes up approximately 60% of all of its decays.²⁸⁴⁴

11,983 HE: Nintendo introduced their first gaming console outside Japan.²⁸⁴⁵



The Nintendo Entertainment System.²⁸⁴⁶

²⁸⁴⁴ https://en.wikipedia.org/wiki/Higgs_boson

²⁸⁴⁵ <http://www.computerhistory.org/timeline/computers/>

²⁸⁴⁶ https://en.wikipedia.org/wiki/Nintendo_video_game_consoles

11,983 HE: GUION BLUFORD (Born **11,942 HE**) is the first United States African-American astronaut in space.²⁸⁴⁷



Photo of GUION BLUFORD, photographer unknown.²⁸⁴⁸

²⁸⁴⁷ https://en.wikipedia.org/wiki/Guion_Bluford

²⁸⁴⁸ https://en.wikipedia.org/wiki/Guion_Bluford

11,983 HE: SALLY RIDE (11,951 HE – 12,012 HE)²⁸⁴⁹ is the first United States female astronaut in space.



Photo of SALLY RIDE on Challenger's mid-deck during STS-7; photographer unknown.²⁸⁵⁰

²⁸⁴⁹ https://en.wikipedia.org/wiki/Sally_Ride

²⁸⁵⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>

11,984 HE: KATHRYN SULLIVAN (born **11,951 HE**²⁸⁵¹) is the first United States woman to do a spacewalk.

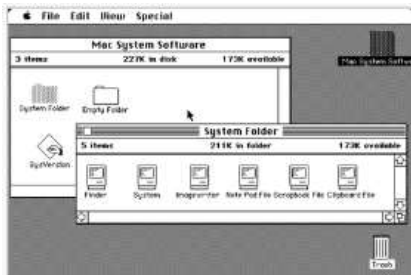


Photo of KATHRYN SULLIVAN; photographer unknown.²⁸⁵²

²⁸⁵¹ https://en.wikipedia.org/wiki/Kathryn_D._Sullivan

²⁸⁵² <https://www.archives.gov/research/alic/reference/space-timeline.html>

11,984 HE: Apple's Macintosh introduced the GUI (graphical user interface).²⁸⁵³



The Mac GUI was the first commercially successful product to use a multi-panel window interface.²⁸⁵⁴

²⁸⁵³ <http://www.computerhistory.org/timeline/computers/>

²⁸⁵⁴ https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC

11,985 HE: Microsoft Windows 1.01 including GUI introduced.²⁸⁵⁵

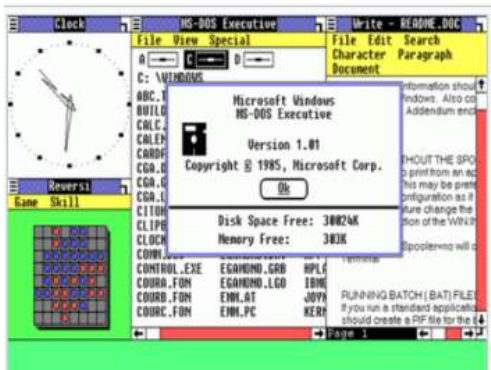
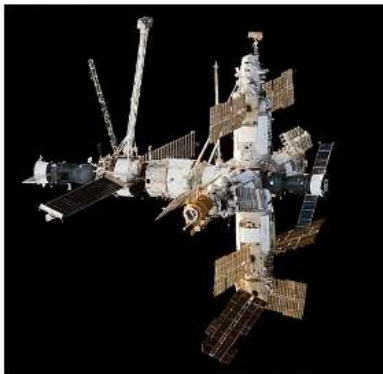


Photo is a screen snip of Windows 1.01.²⁸⁵⁶

²⁸⁵⁵ <http://www.computerhistory.org/timeline/computers/>

²⁸⁵⁶ https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC

11,986 HE – 12,001 HE: Soviet space station *Mir*.



11,998 HE: Soviet Union (and later Russia's) space station *Mir* seen from Space Shuttle *Endeavour* during STS-89.²⁸⁵⁷

²⁸⁵⁷ <https://en.wikipedia.org/wiki/Mir>

11,988 HE: The International Dark Sky Association was formed. 100 years after Vincent Van Gogh painted “Starry Night over the Rhone” in **11,888 HE**, almost 400 years to the date to the beginning of the Industrial Revolution which began around **11,589 HE**, light pollution was stealing the views of our night skies. Scientists DAVID CRAWFORD, professional astronomer and TIM HUNTER, physician / amateur astronomer incorporated The International Dark Sky Association.^{2858 2859}

⇒ The mission of the IDA is "to preserve and protect the night time environment and our heritage of dark skies through quality outdoor lighting." Light pollution is the result of outdoor lighting that is not properly shielded, allowing light to be directed into the eyes and the

²⁸⁵⁸ <http://darksky.org>

²⁸⁵⁹ Author / Compiler worked with DAVID CRAWFORD and many concerned Texans to enact the woefully inadequate Texas Dark Sky law, circa **11,996 HE– 12,000 HE**, sponsored by then Texas Congressman Pete Gallegos, which was a compromise- only legislating responsible shielded lighting on Texas roads, highways and parking lots. The law did not touch architecture, landscaping, etc.

night sky. Light that shines into the eyes is called glare and light shining into the night sky above the horizon causes skyglow. Lighting can also cause light trespass when it is directed into areas where it is not wanted, e.g., a neighbor's yard and windows. IDA was the first organization in the dark-sky movement and is currently the largest.²⁸⁶⁰

⇒ Any human can help bring back the view of the stars around our planet. Point outdoor lights toward the ground and / or use amber bulbs/lenses or lights.²⁸⁶¹

²⁸⁶⁰ <http://darksky.org>

²⁸⁶¹



DAVID CRAWFORD, photographer and date unknown.²⁸⁶²



For more about dark skies, visit www.darksky.org or visit www.mcdonaldobservatory.com/darkskies.²⁸⁶³

²⁸⁶² bing.com/images/search/idaquebec.org

²⁸⁶³ Little flashlights were distributed at the Star Parties at both McDonald Observatory and Kitt Peak Observatory. Everyone saw better at night with the red light instead of the white light. Further research determined amber lights on the outside of buildings or in outdoor fixtures are 1) Not a Political Statement 2) Not a sexual announcement 3) Yes quite effective for humans and other living creatures 4) Yes a protection of nature 5) Yes a protection of Health 6) Yes a security measure 7) Yes better for human, as well as other creatures eyes to see at night.

11,989 HE: World Wide Web, invented by TIM BERNERS-LEE,²⁸⁶⁴ also known as TimBL, an English engineer and computer scientist.²⁸⁶⁵

⇒ **11,991 HE:** The first website was built and put online on for the first time at CERN. Despite this being an international organization hosted by Switzerland, the office that BERNERS-LEE used was just across the border in France.²⁸⁶⁶

- The first web page address was <http://info.cern.ch/hypertext/WWW/TheProject.html>, which centered on information regarding the WWW project. There are no screenshots of the original page and, in any case, changes

²⁸⁶⁴ <http://www.computerhistory.org/timeline/computers/>

²⁸⁶⁵ https://en.wikipedia.org/wiki/Tim_Berners-Lee

²⁸⁶⁶ <http://www.computerhistory.org/timeline/computers/>

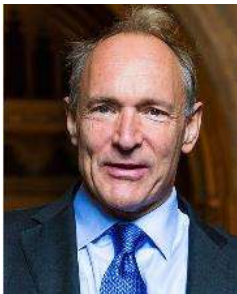
were made daily to the information available on the page as the WWW project developed.²⁸⁶⁷

- **11,992 HE:** BERNERS-LEE introduced the first web browser.²⁸⁶⁸
- BERNERS-LEE is one of the pioneer voices in favour of net neutrality and has expressed the view that ISPs should supply "connectivity with no strings attached" and should neither control nor monitor the browsing activities of customers without their expressed consent.²⁸⁶⁹

²⁸⁶⁷ <http://www.computerhistory.org/timeline/computers/>

²⁸⁶⁸ <http://www.computerhistory.org/timeline/computers/>

²⁸⁶⁹ https://en.wikipedia.org/wiki/Tim_Berners-Lee



12,015 HE Photo is of SIR TIMOTHY JOHN BERNERS-LEE
OM KBE FRS FREng FRSA FBCS (born **11,955 HE**).²⁸⁷⁰

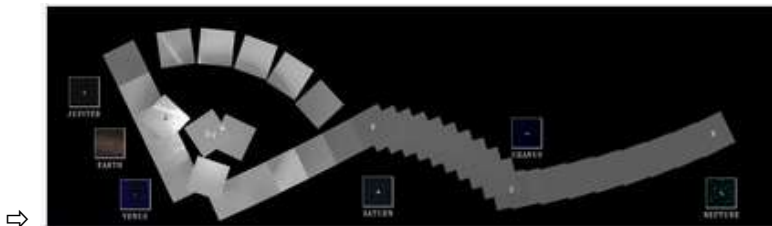
²⁸⁷⁰ https://en.wikipedia.org/wiki/Tim_Berners-Lee

11,990 HE: Two of the many photos taken by *Voyager 1*:



11,990 HE: Photo is *The Pale Blue Dot* photo, taken by *Voyager 1*. Seen from about 6 billion kilometers, Earth appears as a tiny dot

(the blueish-white speck approximately halfway down the brown band to the right) within the darkness of deep space.²⁸⁷¹



⇒ **11,990 HE:** The Family Portrait of our Solar System from *Voyager 1*.²⁸⁷²

²⁸⁷¹ https://en.wikipedia.org/wiki/Pale_Blue_Dot

²⁸⁷² https://en.wikipedia.org/wiki/Voyager_1

1,990 HE: TOYOHIRO AKIYAMA (born **11,942 HE**) was the first Japanese astronaut and was on the Soviet Union space ship *Soyuz TM-11*.



Photo is of TOYOHIRO AKIYAMA.²⁸⁷³

²⁸⁷³ https://en.wikipedia.org/wiki/List_of_Japanese_astronauts

11,990 HE: The *Magellan* spacecraft began mapping the surface of Venus using radar equipment. The Space Shuttle *Discovery* deployed the *Hubble Space Telescope*.²⁸⁷⁴



Photo is of *Magellan* being fixed into position inside the payload bay of shuttle *Atlantis* prior to launch.²⁸⁷⁵

²⁸⁷⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁸⁷⁵ [https://en.wikipedia.org/wiki/Magellan_\(spacecraft\)](https://en.wikipedia.org/wiki/Magellan_(spacecraft))



The Hubble Space Telescope in orbit as seen from the departing Space Shuttle *Atlantis*, flying Servicing Mission 4 (STS-125), the fifth and final Hubble mission.²⁸⁷⁶

²⁸⁷⁶ https://en.wikipedia.org/wiki/Hubble_Space_Telescope

11,992 HE: MAMORU MOHRI, Japan. Scientist who flew on the *Endeavour STS-47*.



Photo is of MAMORU MOHRI.²⁸⁷⁷

²⁸⁷⁷ https://en.wikipedia.org/wiki/List_of_Japanese_astronauts

11,994 HE: Dr. CHIAKI MUKAI (born **11,952 HE**) is a Japanese doctor and JAXA astronaut.

⇒ Dr. CHIAKI MUKAI was the first Japanese woman in space and was the first Japanese citizen to have two spaceflights. Both were Space Shuttle missions:

- Her first was STS-65 aboard Space Shuttle *Columbia* in July **11,994 HE**, which was a Spacelab mission.
- Her second spaceflight was STS-95 aboard Space Shuttle *Discovery* in **11,998 HE**. In total Dr. CHIAKI MUKAI has spent 23 days in space.²⁸⁷⁸

²⁸⁷⁸ https://en.wikipedia.org/wiki/Chiaki_Mukai



Photo of Dr. CHIAKI MUKAI.²⁸⁷⁹

²⁸⁷⁹ https://en.wikipedia.org/wiki/Chiaki_Mukai

11,993 HE: Epson reaches its 5-year goal to be CFC free.



2880

11,994 HE: Sony introduced the PlayStation.²⁸⁸¹



Photo of the Original PlayStation, photographer unknown.²⁸⁸²

²⁸⁸¹ <http://www.computerhistory.org/timeline/computers/>

²⁸⁸² <https://en.wikipedia.org/wiki/PlayStation>

11,994 HE – current: Gravitational Wave observatories. Until this time, electromagnetic radiation and particles (visible light, radio waves, x-rays, neutrinos, etc.) have been used to observe the universe. Gravitational waves are disruptions in spacetime itself, a new and different science exposing a wealth of discoveries. As EINSTEIN described in his General Theory of Relativity, “Gravitational waves spread at the speed of light, filling the universe.” The waves are always created when mass violently accelerates, like when pair of black holes orbit each other. Though EINSTEIN was convinced it would never be possible to measure Gravitational Waves, these new observatories can, as gravitational waves pass Earth, measure fluctuations thousands of times smaller than an atomic nucleus.²⁸⁸³

²⁸⁸³ <https://www.nobelprize.org/prizes/physics/2017/press-release/>

- ⇒ The Laser Interferometer Gravitational-Wave Observatory (*LIGO*) Hanford, WA, USA and Livingston, LA, USA is a large-scale physics experiment and astronomical observatory to detect cosmic gravitational waves and to develop gravitational-wave observations.



• The *LIGO* Livingston control room as it was during *LIGO*'s first observing run in **12,001 HE**. The initial *LIGO* observatories were funded by the National Science Foundation (NSF) and were conceived, built, and are operated by Caltech and MIT.²⁸⁸⁴

- ⇒ The European Gravitational Observatory (EGO) runs *VIRGO*, a 3-km long interferometer built by a French-Italian collaboration involving 19 laboratories and more than 250 scientists in France, Italy, the Netherlands, Poland, and Hungary.



- EGO is the European Gravitational Observatory *VIRGO*, photographer unknown.²⁸⁸⁵

²⁸⁸⁵ <https://www.ego-gw.it/public/about/whatIs.aspx>

- ⇒ **12,015 HE – 12,017 HE:** The *LIGO* and *VIRGO* collaboration announced they had made the first observation of gravitational waves, originating from a pair of merging black holes. *LIGO* instruments detected two more confirmed, and one potential, gravitational wave events. *LIGO* and *Virgo* observed a gravitational wave event from merging black holes, and a gravitational wave event from a binary neutron star merger.²⁸⁸⁶
- ⇒ **12,017 HE:** the Nobel Prize in Physics was awarded to RAINER WEISS, KIP THORNE, and BARRY C. BARISH "for decisive contributions to the *LIGO* detector and for the observation of gravitational waves."²⁸⁸⁷

²⁸⁸⁶ https://en.wikipedia.org/wiki/Gravitational_wave

²⁸⁸⁷ <https://en.wikipedia.org/wiki/LIGO>



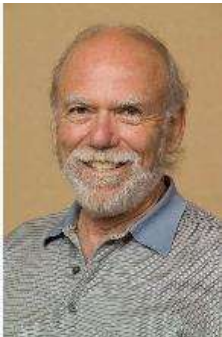
- RAINER WEISS, born **11,932 HE**, is a United States physicist, contributor in gravitational physics and astrophysics. He invented the laser interferometric technique which is the basic operation of *LIGO*.²⁸⁸⁸

²⁸⁸⁸ https://en.wikipedia.org/wiki/Rainer_Weiss



- KIP THORNE: born **11,940 HE** is a United States theoretical physicist and Nobel laureate, known for his contributions in gravitational physics and astrophysics. He continues to do scientific research and scientific consulting.²⁸⁸⁹

²⁸⁸⁹ https://en.wikipedia.org/wiki/Kip_Thorne



BARRY CLARK BARISH born **11,936 HE** is a United States experimental physicist and Nobel Laureate. He is a leading expert on gravitational waves, and is Linde Professor of Physics, emeritus at California Institute of Technology.²⁸⁹⁰

²⁸⁹⁰ https://en.wikipedia.org/wiki/Barry_Barish

⇒ Circa **12,017 HE**: SAMAYA NISSANKE, Dutch Astrophysicist from Radboud University and²⁸⁹¹ SHEILA ROWAN, Scottish Astrophysicist from University of Glasgow²⁸⁹² were on the podcast “Gravitational wave detectors and collision of neutron stars”. NISSANKE said:

- “Detecting a gravitational wave exactly a hundred years after ALBERT EINSTEIN came up with the idea is just mind blowing — imagine discovering light after the prediction of MAXWELL’s equations” and “We can observe the universe in a totally different way now through ripples in the fabric of spacetime itself! It enables us to test Einstein’s General Relativity Theory for the first time. For theoretical

²⁸⁹¹ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

²⁸⁹² [https://en.wikipedia.org/wiki/Sheila_Rowan_\(physicist\)](https://en.wikipedia.org/wiki/Sheila_Rowan_(physicist))

astrophysicists like us, the most exciting part is only just beginning”²⁸⁹³ and “The night skies are incredibly dynamic and time-varying - and some of these transient sources shine brightly in both gravitational and electromagnetic radiation.”²⁸⁹⁴



- SAMAYA NISSANKE, date, location, photographer unknown.²⁸⁹⁵

²⁸⁹³ Podcast: BBC Science Hour October 21, 12,017 HE

²⁸⁹⁴ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

²⁸⁹⁵ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

11,994 HE: First direct observation of a comet impacting Jupiter.



NASA/JPL composite image of fragments from comet SHOEMAKER-LEVY colliding with Jupiter. (See **11,928 HE**, EUGENE SHOEMAKER).²⁸⁹⁶

²⁸⁹⁶ <https://www2.jpl.nasa.gov/s19/s19.html>

11,995 HE: United States Astronaut Eileen Collins (born **11,956 HE**) became the first female Space Shuttle *Pilot*.²⁸⁹⁷



Photo of American Astronaut Eileen Collins with President

²⁸⁹⁷ <https://www.archives.gov/research/alic/reference/space-timeline.html>

William Jefferson Clinton, location: The White House. (Hillary Clinton was also present²⁸⁹⁸, but we could not find a photo including all their faces). [**See 11,999 HE** when Collins became first female Shuttle *Commander*.]

11,995 HE: CHRIS AUSTIN HADFIELD²⁸⁹⁹ OC OOnt MSC CD (born **11,959 HE**) - First Canadian in Space.

⇒ **12,001 HE:** CHRIS HADFIELD became the first Canadian to walk in space and helped to install the Canadarm2.²⁹⁰⁰

²⁸⁹⁸ Netflix documentary “Mercury 13”

²⁸⁹⁹ Multiple Great Youtube.com videos

²⁹⁰⁰ https://en.wikipedia.org/wiki/Chris_Hadfield

⇒ HADFIELD says that the secret to his success-and survival is an unconventional philosophy he learned at NASA: *prepare for the worst and enjoy every moment of it.*²⁹⁰¹



⇒

CHRIS AUSTIN HADFIELD, date unknown.²⁹⁰²

²⁹⁰¹ https://www.amazon.com/dp/0316253014/ref=cm_sw_r_cp_ep_dp_sCcFBb7FNTE7S

²⁹⁰² https://en.wikipedia.org/wiki/Chris_Hadfield

11,996 HE – 11,999 HE: General Motors introduces the EV1.



One of the cars introduced due to the California Air Resources Board mandate, the EV1 had a range of 260 km (160 miles) with NiMH batteries. It was available initially to residents of the cities of Los Angeles, California, and Phoenix and Tucson, Arizona, and only for lease. Through forced repossession and destruction of the majority of EV1s, the GM electric car program was forcibly

ended.²⁹⁰³ GM did not get back into electric car production until introduction of the Bolt, its first 100% electric vehicle, in **12,016 HE**. The **12.006 HE** documentary “*Who Killed the Electric Car*” decried GM’s decision to take the EV1 away from its adoring drivers.²⁹⁰⁴

11,996 HE: A Presidential Decision Directive was issued and later passed into law that transferred the "ownership" of the GPS system to an Interagency GPS Executive Board (IGEB), with representatives from the DOD, the U.S. Department of Transportation, and other government agencies. This transfer was done primarily to make sure GPS could be used effectively for both civil and military user needs.²⁹⁰⁵

²⁹⁰³ wikipedia.org/wiki/General_Motors_EV1

²⁹⁰⁴ <http://whokilledtheelectriccar.com>

²⁹⁰⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>

11,996 HE: The Author / Compiler and family wanted an electric car and the EV1 was not available in Texas, so we bought a VOLVO 950 and KEN BANCROFT converted it from an internal combustion engine vehicle to an electric car for us. We called it the Pioneer.²⁹⁰⁶



²⁹⁰⁶ Author / Compiler family photos

11,996 HE: *James Webb Space Telescope* is authorized.²⁹⁰⁷

- ⇒ **11,996 HE - today:** NASA, ESA and CSA have collaborated on the telescope. ESA's participation in construction and launch was approved by its members in **12,003 HE**, and an agreement was signed between ESA and NASA in **12,007 HE**.
- ⇒ In exchange for full partnership, representation, and access to the observatory for its astronomers, ESA is providing the NIRSpec instrument, the Optical Bench Assembly of the MIRI instrument, an Ariane 5 ECA launcher, and manpower to support operations. The CSA will provide the Fine Guidance Sensor and the Near-Infrared Imager Slitless Spectrograph plus manpower to support operations.²⁹⁰⁸

²⁹⁰⁷ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁹⁰⁸ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

⇒ Countries Participating with the *James Webb Space Telescope*:

-  Austria;  Belgium;  Canada;  Czech Republic;  Denmark;  Finland;  France;  Germany;  Greece;  Ireland;  Italy;  Luxembourg;  Netherlands;  Norway;  Portugal;  Spain;  Sweden;  Switzerland;  United Kingdom;  United States.²⁹⁰⁹

⇒ **12,021 HE:** *James Webb Space Telescope* planned launch date.²⁹¹⁰

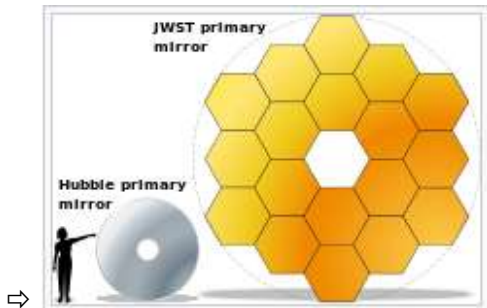
²⁹⁰⁹ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

²⁹¹⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>



12,016 HE: *James Webb Space Telescope* main mirror assembled at Goddard Space Flight Center. Primary mirror segments are made of star-stuff elements beryllium and gold.²⁹¹¹

²⁹¹¹ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope



James Webb Space Telescope primary mirror: Comparison with *Hubble Space Telescope* primary mirror.²⁹¹²

11,996 HE: Palm pilot introduced.²⁹¹³ Palm's first PDAs ran the Palm OS, were smaller than competing handhelds, and proved to the industry

²⁹¹² https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

²⁹¹³ <http://www.computerhistory.org/timeline/computers/>

that there was a market for a new category of portable computing device that could browse the internet wirelessly.



Photo is of The Palm IIIc which was the first Palm with a color screen, photographer unknown.²⁹¹⁴

²⁹¹⁴ [https://en.wikipedia.org/wiki/Palm_\(PDA\)#PalmPilot1000_and_5000_\(1996\)](https://en.wikipedia.org/wiki/Palm_(PDA)#PalmPilot1000_and_5000_(1996))

11,996 HE: *Mars Pathfinder*, the United States robotic spacecraft base station with the wheeled robotic rover *Sojourner*, is launched. In **11,997 HE** the *Mars Pathfinder* arrived on Mars and began transmitting images.²⁹¹⁵



11,995 HE: The *Pathfinder* air bags are tested.²⁹¹⁶

²⁹¹⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁹¹⁶ https://en.wikipedia.org/wiki/Mars_Pathfinder



11,996 HE: *Pathfinder* and *Sojourner* at JPL being 'folded' into their launch positions.²⁹¹⁷

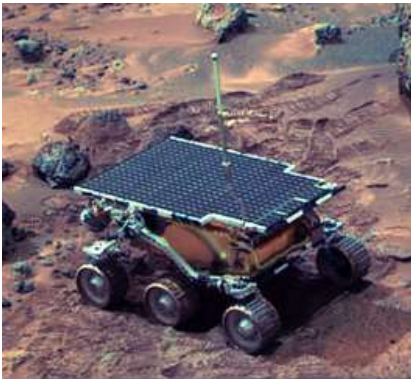
²⁹¹⁷ https://en.wikipedia.org/wiki/Mars_Pathfinder



Photo is of **11,997 HE** close-up of the Mars sky at sunset, by Mars *Pathfinder*.²⁹¹⁸ (Author / Compiler note: See how much smaller our sun looks in this photo than in sunsets we view from Earth?²⁹¹⁹)

²⁹¹⁸ https://en.wikipedia.org/wiki/Mars_Pathfinder

²⁹¹⁹ <https://www.universetoday.com/14822/how-far-is-mars-from-the-sun/>



Sojourner rover on Mars on sol 22.²⁹²⁰ (Author / Compiler note: “Sol 22” means the 22nd day on Mars).²⁹²¹

²⁹²⁰ https://en.wikipedia.org/wiki/Mars_Pathfinder

²⁹²¹ Paul Premack

11,997 HE: Toyota introduced the first mass produced Hybrid Electric Vehicle: the Prius. While other cars on the road were getting mpg ratings in the teens, Prius' range was about 50 mpg.²⁹²²



Prius Generation 1.²⁹²³

²⁹²² <http://www.cars-directory.net/history/toyota/prius/>

²⁹²³ www.bing.com/images/search?q=1997+Toyota+Prius&FORM=RESTAB

11,997 HE: Human Lifespan, according to CARL SAGAN²⁹²⁴:

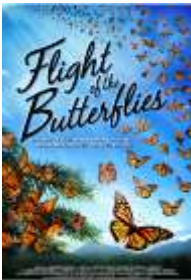
- **Circa 39,000 BHE:** In hunter gather, pre-agricultural times, the human life expectancy was about 20-30 years.
- **Circa 11,870 HE:** more than 50,000 years later, due to scientific advancement, human lifespan rose to about 40 years. (See LOUIS PASTEUR and ROBERT TYNDALL).
- **Circa 11,915 HE:** (circa 45 years later) Due to further scientific advancement, human age expectancy rose to about 50 years.
- **Circa 11,930 HE:** (Just 15 years later) Due to further scientific advancement human lifespan expectancy rose to about 60 years of age.

²⁹²⁴ CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

- **Circa 11,955 HE:** (Just 25 years later) Due to further scientific advancement human lifespan expectancy rose to about 70 years of age.
- **Circa 11,997 HE:** (Just 42 years later) Due to further scientific advancement human lifespan rose to about 80 years of age for males, 84 years of age for females.

11,998 HE: FRED (11,911 HE– 12,002 HE) AND NORAH RODEN URQUART (11,918 HE – 12,009 HE) were presented with Canada's highest civilian award, the Order of Canada. FRED URQUART was a Canadian PhD zoologist who studied the migration of Monarch Butterflies, *Danaus plexippus* L. Together they identified the migration routes and discovered that the migration spans multiple generations of Monarch butterflies. After many years of searching and with the help of CATALINA TRAIL and KEN BRUGGER, the URQUHARTS found the location in Mexico where the butterflies

spend their winter, far away from their summer residence areas in Canada and the United States.²⁹²⁵



Poster for the 3D IMAX Film documentary film with Mike Slee as director took 5 years from funding to release in **12,012 HE.**²⁹²⁶

²⁹²⁵ https://en.wikipedia.org/wiki/Fred_Urquhart

²⁹²⁶ https://en.wikipedia.org/wiki/Flight_of_the_Butterflies

11,998 HE: Google is founded.²⁹²⁷ Google was officially launched by LARRY PAGE, United States computer scientist and Internet entrepreneur, and SERGEY BRIN, United States computer scientist and internet entrepreneur.²⁹²⁸

⇒ PAGE is an investor in Tesla Motors. He has invested in renewable energy technology, and with the help of Google.org, Google's philanthropic arm, promotes the adoption of plug-in hybrid electric cars, and other alternative energy investments. He is also a strategic backer in the Opener startup which is developing aerial vehicles for consumer travel. PAGE also helped to set up Singularity University, a transhumanist think-tank. Google funds scholarships at Singularity University.²⁹²⁹

²⁹²⁷ <http://www.computerhistory.org/timeline/computers/>

²⁹²⁸ https://en.wikipedia.org/wiki/History_of_Google

²⁹²⁹ https://en.wikipedia.org/wiki/Larry_Page



- Photo is of LARRY PAGE (**Born 11,971 HE**) speaking at the European Parliament in **12,009 HE**.²⁹³⁰

⇒ *The Economist* referred to SERGEY BRIN as an "Enlightenment Man" and as someone who believes that "knowledge is always good, and certainly always better than ignorance," a philosophy that is summed up by Google's mission statement: "Organize the world's information and make it universally accessible and useful."²⁹³¹

²⁹³⁰ https://en.wikipedia.org/wiki/Larry_Page

²⁹³¹ https://en.wikipedia.org/wiki/Sergey_Brin

BRIN is a supporter of lab-grown meat and kite-energy systems. BRIN is an investor in Tesla Motors. In **12,005 HE** BRIN was nominated to be one of the World Economic Forum's "Young Global Leaders". BRIN was involved in the Google driverless car project and attended the signing of the California Driverless Vehicle Bill.²⁹³²

²⁹³² https://en.wikipedia.org/wiki/Sergey_Brin



12,008 HE Photo is of SERGEY BRIN (Born: **11,973 HE**)
Photographer and location unknown.²⁹³³

11,998 HE: First Modules of *The International Space Station* are
launched.²⁹³⁴

²⁹³³ https://en.wikipedia.org/wiki/Sergey_Brin

²⁹³⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

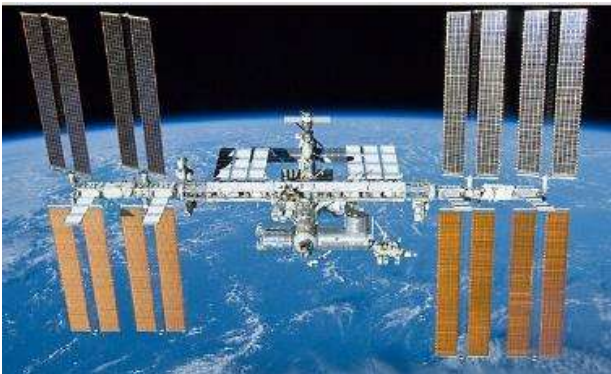


Photo is of *The International Space Station* on 23 May **12,010 HE** as seen from the departing Space Shuttle *Atlantis* during STS-132.²⁹³⁵

²⁹³⁵ https://en.wikipedia.org/wiki/International_Space_Station

⇒ The International Space Station programme is a joint project among five participating space agencies²⁹³⁶ (Author / Compiler note: these cooperating scientific agencies are listed alphabetically):

- **CSA:** The Canadian Space Agency is located at the John H. Chapman Space Centre in Longueuil, Quebec. The CSA also has offices in Ottawa, Ontario, at the David Florida Laboratory, and small liaison offices in Houston, Washington, D.C., and Paris.²⁹³⁷
- **ESA:** European Space Agency (French: Agence spatiale européenne, ASE; German: Europäische Weltraumorganisation) The ESA is an intergovernmental organisation of 22 member states dedicated to the exploration of space. Established in

²⁹³⁶ https://en.wikipedia.org/wiki/International_Space_Station

²⁹³⁷ https://en.wikipedia.org/wiki/Canadian_Space_Agency

11,975 HE and headquartered in Paris, France, ESA has a worldwide staff of about 2,000 people.²⁹³⁸

- **JAXA:** The Japanese Aerospace Exploration Agency is responsible for research, technology development and launch of satellites, and in asteroid exploration and possible human exploration of the Moon.²⁹³⁹
- **NASA, United States.**²⁹⁴⁰ As of **12,018, HE**, the United States portion of ISS is funded through **12,025 HE**.²⁹⁴¹

²⁹³⁸ https://en.wikipedia.org/wiki/European_Space_Agency

²⁹³⁹ <https://en.wikipedia.org/wiki/JAXA>

²⁹⁴⁰ https://www.nasa.gov/offices/ogc/about/space_act1.html

²⁹⁴¹ https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station

- **Roscosmos:** The Russian Roscosmos State Corporation for Space Activities responsible for the space flight and cosmonautics program for the Russian Federation.²⁹⁴² Roscosmos has endorsed the continued operation of ISS through **12,024 HE** but has proposed using elements of the Russian Orbital Segment to construct a new Russian space station to be called OPSEK.²⁹⁴³
- In addition to the *Canadarm*,²⁹⁴⁴ the ISS is shared by many nations. The ISS is made up of 16 pressurized modules: five Russian modules (Zarya, Pirs, Zvezda, Poisk, and Rassvet), eight US modules (BEAM, Leonardo, Harmony, Quest, Tranquility, Unity, Cupola, and Destiny), two Japanese modules (the JEM-ELM-PS and JEM-PM) and one European module

²⁹⁴² <https://en.wikipedia.org/wiki/Roscosmos>

²⁹⁴³ https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station

²⁹⁴⁴ https://en.wikipedia.org/wiki/Mobile_Servicing_System#Canadarm2

(Columbus). One more Russian pressurized module (Nauka) is scheduled to be added to the station.



Image is of Construction of the International Space Station flying over New Zealand. Date and photographer unknown.²⁹⁴⁵

²⁹⁴⁵ https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station



View of the Aurora Borealis from south of Australia, photo by Canadian Astronaut CHRIS HADFIELD outside the International Space Station. Date unknown.²⁹⁴⁶

²⁹⁴⁶ <https://www.youtube.com/watch?v=6YOz9Pxnzho>, Veritasium Interview

11,999 HE: Eileen Collins, United States, became the first female Shuttle Commander.^{2947 2948}



Mission Commander Eileen Collins and STS-114 crew on their way to the launch pad.²⁹⁴⁹

²⁹⁴⁷ Netflix documentary “Mercury 13”

²⁹⁴⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁹⁴⁹ https://en.wikipedia.org/wiki/Eileen_Collins



Image is of Eileen Collins speaking at the 2016 Republican National Convention²⁹⁵⁰

- Author / Compiler note: I have been trying to keep politics and religion out of this Holocene Era Timeline of Science. But the research and photo for the above entry shocked and baffled me when I discovered the information. Privacy in private life is good with me. However, Collins has a public life and got to

²⁹⁵⁰ https://en.wikipedia.org/wiki/Eileen_Collins

where she is, as an employee of the public tax payer, because she stood on the shoulders of women who came before her.

- Some of the women on whose shoulders she stood were giants: women who historically were starved, who were jailed, who were humiliated, who were denied the vote and denied educations,²⁹⁵¹ women denied right to their own children, women denied the right to own land, denied salary because of their sex,²⁹⁵² or women denied jobs in their field because of their sex,²⁹⁵³ or women denied rights to her own body,²⁹⁵⁴ or women who fought to get Collins the right to vote and to even be

²⁹⁵¹ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

²⁹⁵² SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

²⁹⁵³ Stuff You Missed In History Class podcast: <https://www.missedinhistory.com/podcasts/three-astonishing-belles.htm>

²⁹⁵⁴ https://en.wikipedia.org/wiki/Margaret_Sanger

educated, or to be in the military of the United States,²⁹⁵⁵ or to be a pilot in the USA military like United States “Mercury 13,”²⁹⁵⁶ and so much more.

- Granted, all these women may have supported for president a man who seemed the opposite of the rights for which they fought and lived, but they did so *privately*. When Collins herself had the opportunity to publicly support a woman for president of the United States, she made the choice, even had the choice because of those who came before her, to publicly speak at the convention that nominated a man who seems the opposite of the kind of person all those women who launched Collins stood for and represented. In my mind Collins stood on the shoulders of giants and then, well, peed on their heads.

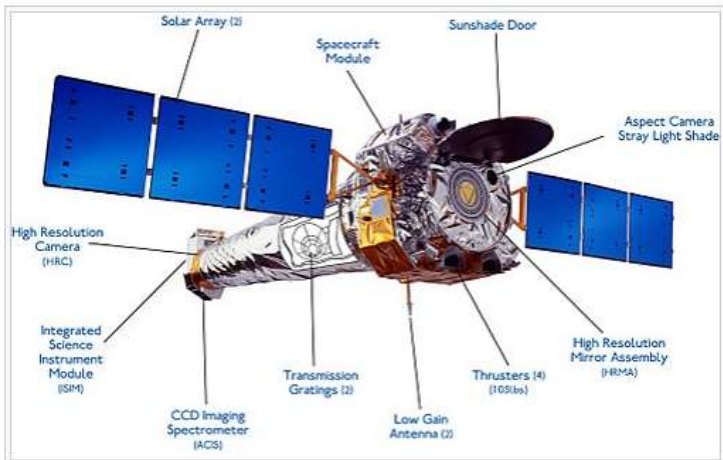
²⁹⁵⁵ https://en.wikipedia.org/wiki/Grace_Hopper

²⁹⁵⁶ https://en.wikipedia.org/wiki/Mercury_13

- I could have just deleted Collins (and to be honest, I wanted to delete her name) from this timeline like the Texas Board of Education has done to Hillary Clinton when they specifically excluded Secretary Clinton in the Texas **12,018 HE** school books. But I did not.
- What COLLINS did professionally was monumental. It is too bad Collins, in her private life, didn't help forward the women's effort when it was her turn.

11,999 HE: Chandra X-ray Observatory telescope is launched.²⁹⁵⁷

²⁹⁵⁷ <https://www.archives.gov/research/alic/reference/space-timeline.html>



Labeled diagram of CXO²⁹⁵⁸

²⁹⁵⁸ https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory

⇒ The data gathered by *Chandra* has greatly advanced the field of X-ray astronomy. Here are some examples of discoveries supported by observations from *Chandra*:

- The first light image, of supernova remnant Cassiopeia A, gave astronomers their first glimpse of the compact object at the center of the remnant, probably a neutron star or black hole. (Pavlov, et al., **12,000 HE**);
- In the Crab Nebula, another supernova remnant, *Chandra* showed a never-before-seen ring around the central pulsar and jets that had only been partially seen by earlier telescopes. (Weisskopf, et al., **12,000 HE**);
- The first X-ray emission was seen from the supermassive black hole, Sagittarius A, at the center of the Milky Way. (Baganoff, et al., **12,001 HE**);

- The X-ray shadow of Titan was seen when it transited the Crab Nebula; X-ray emissions from materials falling from a protoplanetary disc into a star. (Kastner, et al., **12,004 HE**);
- On January 5, **12,015 HE**, NASA reported that *CXO* observed an X-ray flare 400 times brighter than usual, a record-breaker, from Sagittarius A, a supermassive black hole in the center of the Milky Way galaxy;
- In September **12,016 HE**, it was announced that *Chandra* had detected X-ray emissions from Pluto, the first detection of X-rays from a Kuiper belt object. *Chandra* had made the observations in **12,014 HE** and **12,015 HE**, supporting the *New Horizons* spacecraft for its July **12,015 HE** encounter.²⁹⁵⁹

²⁹⁵⁹ https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory

12,000 HE: Humanity survived Y2K (also called Year 2000 bug or Millennium bug) a problem in the coding of computerized systems that was projected to create havoc in computers and computer networks around the world at the beginning of the year **12,000 HE**. (in metric measurements K stands for thousand). After more than a year of international alarm, feverish preparations, and programming corrections, few major failures occurred in the transition from December 31, **11,999 HE**, to January 1, **12,000 HE**.²⁹⁶⁰

Circa 12,000 HE: The population of the world was approximately 6,145,000,000 people.²⁹⁶¹

12,000 HE: Microsoft Windows mobile (pocket PC) introduced.²⁹⁶²

²⁹⁶⁰ <https://www.britannica.com/technology/Y2K-bug>

²⁹⁶¹ <http://www.worldometers.info/world-population/world-population-by-year/>

²⁹⁶² <http://www.computerhistory.org/timeline/computers/>



Photo is of The Windows Mobile Device Center in Windows Vista, photographer unknown.²⁹⁶³

²⁹⁶³ https://en.wikipedia.org/wiki/Windows_Mobile_Device_Center

12,001 HE: Wikipedia is established²⁹⁶⁴ by JIMMY WALES and LARRY SANGER and quickly became a global project in multiple languages inspiring a wide range of online reference projects. In **12,018 HE**, it was the world's fifth-most-visited website.²⁹⁶⁵

⇒ JIMMY WALES, United States, but who as of **12,012 HE** lives in England, is a former co-chair of the World Economic Forum on the Middle East and a former board member of Socialtext. WALES is a member of the Berkman Center for Internet & Society at Harvard Law School, the advisory board of the MIT Center for Collective Intelligence, the board of directors at Creative Commons and Hunch.com. In **12,006 HE**, WALES was listed in the "Scientists & Thinkers" section of the TIME 100 and number 12 in Forbes "The Web Celebs 25". **12,013 HE**, WALES was awarded the UNESCO Niels Bohr Medal in Copenhagen, Denmark at a conference on "An

²⁹⁶⁴ <http://www.computerhistory.org/timeline/computers/>

²⁹⁶⁵ https://en.wikipedia.org/wiki/History_of_Wikipedia

Open World" to celebrate the 100th anniversary of Niels Bohr's atomic theory. WALES' presentation on "Wikipedia, Democracy and the Internet" emphasized the need to expand Wikipedia into virtually all the languages of the world.²⁹⁶⁶



12,016 HE: JIMMY WALES at the Wikimania conference, photographer unknown.²⁹⁶⁷

²⁹⁶⁶ https://en.wikipedia.org/wiki/Jimmy_Wales

²⁹⁶⁷ https://en.wikipedia.org/wiki/Jimmy_Wales



12,006 HE: photo of LARRY SANGER (Born **11,968 HE**) (photographer and location unknown).²⁹⁶⁸ In **12,002 HE** SANGER left Wikipedia and has since been critical of the project.²⁹⁶⁹

²⁹⁶⁸ https://en.wikipedia.org/wiki/Larry_Sanger

²⁹⁶⁹ https://en.wikipedia.org/wiki/Larry_Sanger

12,001 HE: *NEAR (Near Earth Asteroid Rendezvous) Shoemaker* lands on asteroid Eros.²⁹⁷⁰ The mission is named after EUGENE SHOEMAKER who died in an automobile accident in **11,997 HE.**²⁹⁷¹

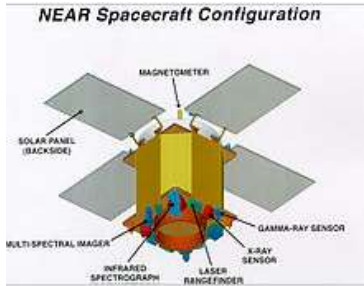


Diagram showing location of *NEAR* science instruments.²⁹⁷²

²⁹⁷⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁹⁷¹ <https://www2.jpl.nasa.gov/sl9/news81.html>

²⁹⁷² https://en.wikipedia.org/wiki/NEAR_Shoemaker

⇒ The primary scientific objective of *NEAR Shoemaker* was to return data on the bulk properties, composition, mineralogy, morphology, internal mass distribution, and magnetic field of Eros. This data will be used to help understand the characteristics of asteroids in general, their relationship to meteoroids and comets, and the conditions in the early Solar System.²⁹⁷³

12,001 HE: Canadarm 2 is launched to the ISS.²⁹⁷⁴ The Mobile Servicing System (MSS), also known as Canadarm2, is a robotic system on board the International Space Station (ISS).

²⁹⁷³ https://en.wikipedia.org/wiki/NEAR_Shoemaker

²⁹⁷⁴ https://en.wikipedia.org/wiki/Mobile_Servicing_System



The photo is of Astronaut **STEPHEN K. ROBINSON** anchored to the end of Canadarm2 during STS-114, **12,005 HE.**²⁹⁷⁵

²⁹⁷⁵ https://en.wikipedia.org/wiki/Mobile_Servicing_System

12,002 HE:



2976

After public protests by EV1 drivers' groups upset by the repossession of their electric cars, Toyota offered the last 328 RAV4-EVs for sale to the public during six months in **12,002 HE** and continues to support the several hundred Toyota RAV4-EVs in the hands of the general public and in fleet usage.²⁹⁷⁷

²⁹⁷⁶ <https://www.bing.com/images/search?q=image+toyota+rav4->

²⁹⁷⁷ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12,002 HE: SpaceX was founded by entrepreneur ELON MUSK. Space Exploration Technologies Corp., doing business as SpaceX, is a private United States aerospace manufacturer and space transportation services company headquartered in Hawthorne, California with the goal of reducing space transportation costs and enabling the colonization of Mars.²⁹⁷⁸

⇒ ELON MUSK holds South African, Canadian, and U.S. citizenship and is the founder, CEO, and lead designer of SpaceX; co-founder, CEO, and product architect of Tesla, Inc.; co-founder and CEO of Neuralink; and co-founder of PayPal. Born and raised in Pretoria, South Africa, MUSK moved to Canada when he was 17 to attend Queen's University. He transferred to the University of Pennsylvania two years later, where he received an economics degree from the Wharton School and a degree in physics from the College of Arts and Sciences. He began a Ph.D. in applied physics

²⁹⁷⁸ <https://en.wikipedia.org/wiki/SpaceX>

and material sciences at Stanford University in **11,995 HE** but dropped out after two days to pursue an entrepreneurial career. **12,017 HE:** Tesla sent hundreds of Powerwall battery systems that can be paired with solar panels to the devastated island of Puerto Rico in an effort to restore electric power.²⁹⁷⁹



ELON MUSK in **12,015 HE**. Photographer and location unknown.²⁹⁸⁰

²⁹⁷⁹ <http://fortune.com/2017/09/28/tesla-battery-puerto-rico-power/>

²⁹⁸⁰ https://en.wikipedia.org/wiki/Elon_Musk

12,003 HE:

- ⇒ *Spirit* and *Opportunity* Mars rovers;
- ⇒ February 1: the Space Shuttle *Columbia* broke up on re-entry into the Earth's atmosphere;
- ⇒ August 25: NASA launched the largest-diameter infrared telescope ever in space, *the Spitzer Space Telescope*;
- ⇒ September 21: NASA's Galileo mission ended a 14-year exploration of the solar system's largest planet and its moons with the spacecraft crashing by design into Jupiter at 108,000 mph.²⁹⁸¹

²⁹⁸¹ <https://www.archives.gov/research/alic/reference/space-timeline.html>



● *Opportunity*, also known as MER-B (*Mars Exploration Rover – B*) or *MER-1*, is a robotic rover active on Mars since **12,004 HE**. Photographer and location unknown, but clearly a lab on Earth not on Mars.²⁹⁸²

²⁹⁸² [https://en.wikipedia.org/wiki/Opportunity_\(rover\)](https://en.wikipedia.org/wiki/Opportunity_(rover))

12,004 HE -12,017 HE: *Cassini-Huygens* missions to Saturn and Titan.²⁹⁸³

- ⇒ The *Cassini-Huygens* mission commonly called *Cassini*, was a collaboration between NASA, the European Space Agency (ESA), and the Italian Space Agency (ASI) to send a probe to study the planet Saturn and its system, including its rings and natural satellites. (See **11,953 HE: CAROLYN PORCO**)
- *Cassini* was the fourth space probe to visit Saturn and the first to enter its orbit. The craft were named after astronomers GIOVANNI CASSINI (See **11,625 HE – 11,712 HE:**) and CHRISTIAAN HUYGENS. (See **11,629 HE – 11,695 HE**).
 - The mission is widely perceived to have been successful beyond expectation. *Cassini-Huygens* has been described by NASA's Planetary Science Division Director as a "mission of firsts" that

²⁹⁸³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

has revolutionized human understanding of the Saturn system, including its moons and rings, and our understanding of where life might be found in the Solar System.

- *Cassini's* original mission was planned to last for four years, from June **12,004 HE** to May **12,008 HE**. The mission was extended for another two years until September **12,010 HE**, branded the *Cassini Equinox Mission*. The mission was extended a second and final time with the *Cassini Solstice Mission*, lasting another seven years until September 15, **12,017 HE**, on which date *Cassini* was de-orbited to burn up in Saturn's upper atmosphere.²⁹⁸⁴

12,005 HE - current: SpaceX announced plans to pursue a human-rated commercial space program. SpaceX's *Dragon* is a conventional blunt-cone ballistic capsule which is capable of carrying cargo or up

²⁹⁸⁴ <https://en.wikipedia.org/wiki/Cassini-Huygens>

to seven astronauts into orbit and beyond. In **12,012 HE**, *Dragon* became the first commercial spacecraft to deliver cargo to the International Space Station and has since been conducting regular resupply services to the ISS.²⁹⁸⁵



Image is of the *Dragon* spacecraft approaching the ISS (photographer, and date unknown).²⁹⁸⁶

²⁹⁸⁵ <https://en.wikipedia.org/wiki/SpaceX>

²⁹⁸⁶ <https://en.wikipedia.org/wiki/SpaceX>



Photo is of the *Dragon* is berthed to the ISS by Canadarm2, date and photographer unknown.²⁹⁸⁷

²⁹⁸⁷ <https://en.wikipedia.org/wiki/SpaceX>

12,006 HE: The Cloud concept is established, evolving user's data storage and computing online.²⁹⁸⁸

⇒ Cloud storage is made up of many distributed resources, but still acts as one, either in a federated or a cooperative storage cloud architecture, highly fault tolerant through redundancy and distribution of data, and highly durable through the creation of versioned copies.²⁹⁸⁹

12,007 HE: Earth Hour began. Sydney, Australia started Earth Hour as a symbolic lights-out event where all lights were turned off to see the night sky and to save funds.

²⁹⁸⁸ <http://www.computerhistory.org/timeline/computers/>

²⁹⁸⁹ https://en.wikipedia.org/wiki/Cloud_storage

- ⇒ The following year, people and places around the world started voluntarily turning off their lights. EARTH HOUR is now the world's largest grassroots movement for the environment, inspiring millions of people to take action for our planet and nature.²⁹⁹⁰
- ⇒ Every March 30, 8:30 pm - 9:30 pm, no matter where you are on the planet, see your stars by turning off your lights and by urging your community to turn off their lights.²⁹⁹¹

²⁹⁹⁰ <https://www.earthhour.org/what-is-earth-hour>

²⁹⁹¹ <https://www.earthhour.org/celebrate-the-hour>

12,007 HE: The first Kindle book reader is released²⁹⁹²



Image is of a first generation Kindle Paperwhite.²⁹⁹³

²⁹⁹² <http://www.computerhistory.org/timeline/computers/>

12,007 HE: The Apple iPhone first released.²⁹⁹⁴



iPhone OS 1 running on a first generation iPhone.²⁹⁹⁵

²⁹⁹³ https://en.wikipedia.org/wiki/Amazon_Kindle

²⁹⁹⁴ <http://www.computerhistory.org/timeline/computers/>

²⁹⁹⁵ https://en.wikipedia.org/wiki/IPhone_OS_1

12,008 HE: Android operating system is first released.²⁹⁹⁶ Android is continually developed by Google and the Open Handset Alliance, and it has seen a number of updates to its base operating system since the initial release.

⇒ Android code names are confectionery-themed and have been in alphabetical order since **12,009 HE's** Android 1.5 Cupcake. The most recent version of Android is Android 9 Pie, which was released in August **12,018 HE.**²⁹⁹⁷

12,008 HE – 12,012 HE: The Tesla Roadster is a battery electric vehicle (BEV) sports car that was produced in California, USA. It was the first highway legal serial production all-electric car to use lithium-ion battery cells and the first production all-electric car to travel more than 320 kilometers (200 mi) per charge. Elon Musk's vehicle is also

²⁹⁹⁶ <http://www.computerhistory.org/timeline/computers/>

²⁹⁹⁷ https://en.wikipedia.org/wiki/Android_version_history

the first production car to be launched into orbit and beyond, carried by a Falcon Heavy rocket in a test flight launched on February 6, **12,018 HE**.²⁹⁹⁸ As of November **12.018 HE** the Roadster was nearing the orbit of Mars.



The **12,008 HE** Tesla Roadster...on Earth. Photographer unknown.²⁹⁹⁹

²⁹⁹⁸ [https://en.wikipedia.org/wiki/Tesla_Roadster_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))

²⁹⁹⁹ [https://en.wikipedia.org/wiki/Tesla_Roadster_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))



12,018 HE photo of the Tesla **12,008 HE** Roadster.... in space.³⁰⁰⁰

3000

<https://www.bing.com/images/search?q=images+of+tesla+roadster+in+space&qpv=images+of+tesla+roadster+in+space&FORM=IGRE>

Circa 12,009 HE: In the North Sea off Norway, offshore wind power began to expand beyond fixed-bottom, shallow-water turbines. The world's first operational deep-water large-capacity floating wind turbine, *Hywind*, became operational.³⁰⁰¹



12,009 HE: The world's first full-scale floating wind turbine,

³⁰⁰¹ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

Hywind, being assembled in the Åmøy Fjord near Stavanger, Norway, before deployment in the North Sea.³⁰⁰²

Circa 12,009 HE: Biologists began to move away from the latin binomial naming system and began to label species by their genetic code chromosomal DNA bar codes.³⁰⁰³

⇒ Goodbye “Homo Sapiens” / “The Knowing Ape”

⇒ Hello “TCATCGGTCATTGG”.³⁰⁰⁴

- Author / Compiler Note: “????!!!”

³⁰⁰² https://en.wikipedia.org/wiki/Floating_wind_turbine

³⁰⁰³ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

³⁰⁰⁴ SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

12,010 HE – 12,018 HE:



First generation Nissan electric LEAF sold in Japan, United States, Australia, Canada and 17 European countries.³⁰⁰⁵

³⁰⁰⁵ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12,010 HE: Private Sector SpaceX first commercial launch.³⁰⁰⁶



From left to right scale graphics of SpaceX's spaceships: Falcon 1, Falcon 9 v1.0, three versions of Falcon 9 v1.1, three versions of

³⁰⁰⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

Falcon 9 v1.2 (Full Thrust), two versions of Falcon 9 Block 5, and Falcon Heavy.³⁰⁰⁷

12,011 HE: The United States *Space Shuttle Program* is decommissioned.³⁰⁰⁸ After this date, NASA relies entirely on Russia's *Sputnik* to transport astronauts to the ISS. Private United States contractors, like the SpaceX *Dragon* spacecraft, should become active in transferring crew members sometime after **12,018 HE**.³⁰⁰⁹

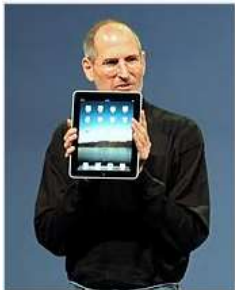
12,011 HE: The Apple iPad is released³⁰¹⁰

³⁰⁰⁷ <https://en.wikipedia.org/wiki/SpaceX>

³⁰⁰⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>

³⁰⁰⁹ <https://en.wikipedia.org/wiki/SpaceX>

³⁰¹⁰ <http://www.computerhistory.org/timeline/computers/>



STEVE JOBS, Apple's then CEO, introducing the iPad.³⁰¹¹ He said “... our strategy is really simple. What we want to do is we want to put an incredibly great computer in a book that you can carry around with you and learn how to use in 20 minutes...”³⁰¹²

³⁰¹¹ <https://en.wikipedia.org/wiki/iPad>

³⁰¹² <https://en.wikipedia.org/wiki/iPad>

12,012 HE: This date is about 34 years since launch of *Voyager 1*,³⁰¹³ and about 22 years since *the Pale Blue Dot* photo and the *Family Portrait of the Solar System* photo. At this year, the *Voyager 1* probe reached the interstellar medium at the edge of the solar system.³⁰¹⁴

- ⇒ Travelling at about 17 kilometers per second (11 mi/s) *Voyager 1* has the fastest heliocentric recession speed of any spacecraft.³⁰¹⁵
- ⇒ While *Voyager 1* is commonly spoken of as having left the Solar System simultaneously with having left the heliosphere, the two are not the same.

³⁰¹³https://en.wikipedia.org/wiki/Voyager_1

³⁰¹⁴<https://www.archives.gov/research/alic/reference/space-timeline.html>

³⁰¹⁵https://en.wikipedia.org/wiki/Voyager_1

- ⇒ The Solar System is usually defined as the vastly larger region of space populated by bodies that orbit our Sun.
- The craft is presently less than one-seventh the distance to the aphelion of Sedna, and it has not yet entered the Oort cloud, the source region of long-period comets, regarded by astronomers as the outermost zone of the Solar System.³⁰¹⁶

³⁰¹⁶ https://en.wikipedia.org/wiki/Voyager_1

12,012 HE:



Global sales of the Renault electric Zoe, released in **12,012 HE**, achieved the 50,000-unit milestone in **12,016 HE**.³⁰¹⁷

³⁰¹⁷ https://en.wikipedia.org/wiki/History_of_the_automobile or https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12,012 HE:



TESLA Model S fully electric, long range driving vehicle began deliveries, photographer unknown.³⁰¹⁸

³⁰¹⁸ https://en.wikipedia.org/wiki/Tesla,_Inc.

12,013 HE:



Retail deliveries of the BMW electric i3 began in Europe in **12,013 HE**. The electric i3 ranked as the third bestselling all-electric car in **12,014 HE**. The range of the vehicle is about 80 miles. An optional internal combustion engine can be added, which uses gasoline to

generate electricity and extends the range of the vehicle to about 150 miles.³⁰¹⁹ Photographer unknown.

12,014 HE: Solar Roadways Incorporated (founded in **12,006 HE**), United States company based in Sandpoint, Idaho started a crowdfunding campaign at Indiegogo to raise money so they could develop their idea for solar powered road panels to bring a smart highway into production.

- The campaign raised \$2.2 million and became Indiegogo's most popular campaign ever in terms of the number of backers it attracted.³⁰²⁰

³⁰¹⁹ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

³⁰²⁰ https://en.wikipedia.org/wiki/Solar_Roadways



Solar Roadway founders Julie Brusaw and SCOTT BRUSAW³⁰²¹ with solar road panel prototypes in Idaho, USA.³⁰²² Photographer and date unknown.

³⁰²¹ <http://solarroadways.com/About/Team>

³⁰²² https://en.wikipedia.org/wiki/Solar_Roadways

<u>SURFACE FEATURES</u>	<u>SOLAR ROADWAYS</u>	<u>CONCRETE</u>	<u>ASPHALT</u>
Flat place to walk and drive	●	●	●
Provides parking	●	●	●
Provides traction	●	●	●
Doesn't soften at high temperatures	●	●	
Generates energy	●		
Intelligent	●		
LED lights for lines and signage	●		
Remains snow/ice free	●		
Impervious to potholes	●		
Can protect animals	●		
Modular for faster maintenance	●		
Requires no paint	●		
Aesthetic benefits	●		
Has ROI	●		
Facilitates energy independence	●		
Can charge EVs with clean energy	●		
Water can be stored, treated or moved	●		
Provides a "home" for cables, wires	●		
Can provide emergency warning system	●		
Expandable Technology Package	●		



Features of Solar Roadways³⁰²³

³⁰²³ <http://www.solarroadways.com/>

12,015 HE: United States probe *New Horizons* passed Pluto.³⁰²⁴



New Horizons at Kennedy Space Center, **12,005 HE.**³⁰²⁵

³⁰²⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

³⁰²⁵ https://en.wikipedia.org/wiki/New_Horizons

12,015 HE: JEDIDAH C. ISLER, United States Observational Astrophysicist, first Black Woman to Graduate from Yale with a PhD in Astrophysics.³⁰²⁶ ISLER studies supermassive, hyperactive black holes called blazars and is interested in understanding where the highest energy light is emitted by particle jets that are spewed out in the very near vicinity to these black holes.



JEDIDAH C. ISLER, Ph.D.³⁰²⁷

³⁰²⁶ *TED Fellows Talks*. <https://youtu.be/XzZJuEDQ1a0>

³⁰²⁷ <http://jedidahislerphd.com/research-interest/>

12,015 HE:



3028

12,015 HE: The Tesla Model X, a full-size electric crossover SUV, started deliveries.³⁰²⁹

³⁰²⁸ <https://www.bing.com/search?q=image+tesla+model+x&PC=U316&FORM=CHROMN>

³⁰²⁹ https://en.wikipedia.org/wiki/Tesla,_Inc.

12,016 HE:



The first Chevrolet Bolt EVs were delivered to customers in the San Francisco Bay Area in **12,016 HE**.³⁰³⁰

³⁰³⁰https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12,016 HE: Youtube.com video “How Earth Moves” including further calendar explanations.³⁰³¹



By MICHAEL STEVENS, Vsauce Host.³⁰³²

12,016 HE: MIT scientists build the first 5-atom quantum computer³⁰³³ with the potential to crack the security of traditional encryption schemes.³⁰³⁴

³⁰³¹ <https://www.youtube.com/watch?v=IJhgZBn-LHg>

³⁰³² <https://www.youtube.com/watch?v=IJhgZBn-LHg>

³⁰³³ <http://www.computerhistory.org/timeline/computers/>

³⁰³⁴ https://en.wikipedia.org/wiki/Timeline_of_computing_2010-19 and “*MIT's new 5-atom quantum computer could make today's encryption obsolete*”.

12,017 HE:



³⁰³⁵

Official launch and delivery started of the TESLA Model 3- mid-size (US) / compact executive (EU) luxury all-electric four-door sedan.³⁰³⁶

³⁰³⁵ <https://www.bing.com/search?q=image+tesla+model+3&pc=MOZI&form=MOZLBR>

³⁰³⁶ https://en.wikipedia.org/wiki/Tesla_Model_3

12,018 HE:



Second generation Nissan electric LEAF introduced.³⁰³⁷

³⁰³⁷ <https://www.nissanusa.com/leaf>

12,018 HE: Methods of Birth Control.³⁰³⁸

- Abstinence
- Sponge (Today Sponge)
- The Patch
- Vaginal Ring (NuvaRing)
- Birth Control Pills
- Shot (Depo-Provera)
- Implant (Implanon and Nexplanon)
- Birth Control App
- Female Condom
- Breastfeeding as Birth Control
- Cervical Cap (FemCap)
- Outercourse
- Vasectomy

³⁰³⁸ <https://www.birthcontrol.com/>

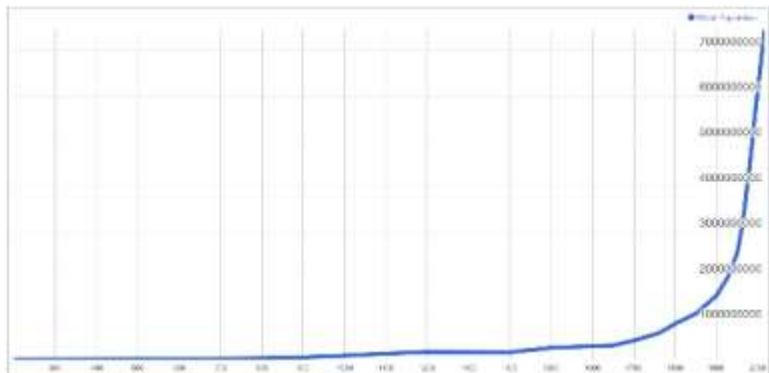
- Diaphragm
- Fertility Awareness-Based Methods (FAMs)
- Pull Out Method (Withdrawal)
- Morning-After Pill (RU-486 Emergency Contraception)
- Condom
- Spermicide
- Sterilization for Women (Tubal Sterilization)
- IUD

12,018 HE: Updating CARL SAGAN's numbers on population - Most Populous Countries & Numbers, based on United Nations Estimates, comparing to the **11,950 HE** populations. (Information retrieved October 22 - 24 **12,018 HE.**)^{3039 3040}

³⁰³⁹ <https://www.worldometers.info/world-population/>

³⁰⁴⁰ <http://www.worldometers.info/population/most-populous-countries/#past>

Thailand:	69,228,466 people, not one of the most populous nations in 11,950 HE
Iran:	82,271,115 people, not one of the most populous nations in 11,950 HE
Turkey:	82,271,851 people, increase from 21,408,401 people in 11,950 HE
Germany:	82,349,181 people, increase from 69,966,243 people in 11,950 HE
Congo:	84,781,426 people, founded: 11,960 HE
Viet Nam:	96,779,230 people, increase from 24,809,906 people in 11,950 HE
Egypt:	99,918,032 people, not one of the most populous nations in 11,950 HE
Philippines:	106,989,899 people not one of the most populous nations in 11,950 HE
Ethiopia:	108,292,163 people, not one of the most populous nations in 11,950 HE
Japan:	127,092,269 people, increase from 82,802,084 people in 11,950 HE
Mexico:	131,240,346 people, increase from 28,012,561 people in 11,950 HE
Russia:	143,964,709 people, increase from 102,798,657 people in 11,950 HE
Bangladesh:	166,882,594 people, increase from 37,894,681 people in 11,950 HE
Nigeria:	197,336,063 people, increase from 37,859,744 people in 11,950 HE
Pakistan:	201,942,393 people, increase from 37,542,376 people in 11,950 HE
Brazil:	211,349,257 people, increase from 53,974,729 people in 11,950 HE
Indonesia:	267,643,638 people, increase from 69,543,316 people in 11,950 HE
USA:	327,470,395 people, increase from 158,804,395 people in 11,950 HE
India:	1,358,548,924 people, increase from 376,325,200 people in 11,950 HE
China:	1,416,743,377 people, increase from 554,419,275 people in 11,950 HE



⇒ World population of humans is increasing dramatically, expected to reach approximately 11 billion before it stabilizes (barring disaster).³⁰⁴¹

³⁰⁴¹ <https://www.worldometers.info/world-population/>

As of **12,018 HE**: China has Electric High-speed trains and rail (HSR). HSR in China is the country's network of passenger-dedicated railways designed for speeds of 250–350 km/h (155–217 mph).

⇒ China's HSR is the world's longest high-speed railway network and is also the most extensively used. It reaches 27,000 km (17,000 mi) in total length.³⁰⁴²

³⁰⁴² https://en.wikipedia.org/wiki/High-speed_rail_in_China



China's Electric Railway network map.³⁰⁴³

³⁰⁴³ https://en.wikipedia.org/wiki/High-speed_rail_in_China



Shanghai Maglev Train connecting the Pudong Airport with the city. Photographer unknown.³⁰⁴⁴

³⁰⁴⁴ https://en.wikipedia.org/wiki/High-speed_rail_in_China



A CRH2C train (left) based on the E2-1000 Series Shinkansen of Japan. Photographer unknown.³⁰⁴⁵

³⁰⁴⁵ https://en.wikipedia.org/wiki/High-speed_rail_in_China



Chinese designed CRH380AL train at Shanghai Hongqiao Railway Station. Photographer unknown.³⁰⁴⁶

³⁰⁴⁶ https://en.wikipedia.org/wiki/High-speed_rail_in_China

12,018 HE: In May, NASA launched the international effort *InSight*, a mission to land a stationary science probe near the equator on Mars. The probe landed successfully on November 26, **12,018 HE**.³⁰⁴⁷

⇒ *InSight's* objectives are to place a seismometer called SEIS produced by the French space agency CNES, and to measure heat transfer with a heat probe called HP3 produced by the German space agency DLR in order to study the planet's early geological evolution. This could bring new understanding of the Solar System's terrestrial planets — Mercury, Venus, Earth, Mars — and Earth's Moon. By reusing technology from the Mars *Phoenix* lander, which successfully landed on Mars in **12,008 HE**, the cost and risk were reduced.³⁰⁴⁸

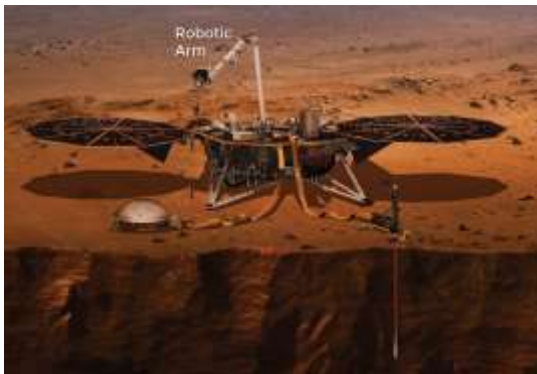
⇒ Major contributing agencies and institutions:

³⁰⁴⁷ <https://mars.nasa.gov/insight/>

³⁰⁴⁸ <https://en.wikipedia.org/wiki/InSight>

- National Aeronautics and Space Administration (NASA)
- Centre National d'Études Spatiales (CNES)
- Deutsches Zentrum für Luft- und Raumfahrt (DLR)
- Italian Space Agency (ASI)
- Jet Propulsion Laboratory (NASA/JPL)
- Lockheed Martin
- Institut de Physique du Globe de Paris (IPGP)
- Swiss Federal Institute of Technology in Zurich (ETHZ)
- Max Planck Institute for Solar System Research (MPS)
- Imperial College London
- Institut supérieur de l'aéronautique et de l'espace (ISAE-SUPAERO)
- University of Oxford
- Centro de Astrobiología Spain (CAB)

- Centrum Badań Kosmicznych (CBK)³⁰⁴⁹



Artist's Rendering of *InSight* on Mars, credit JPL.³⁰⁵⁰

³⁰⁴⁹ <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

³⁰⁵⁰ <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

12,019 HE to the Future: We must end this ebook here. The Word file is full! Author / Compiler hopes, because it makes sense for all humanity, that people on their own, use the free BC/AD to HE conversion calculator so that EMILIANI's Holocene Era (**HE**) calendar system becomes the standard worldwide calendaring system.

About the Author / Compiler



Wife, Mom, Daughter, Law Office Business Manager, **11,990 HE** White House Honoree, Artist, Freedoms Foundation of Valley Forge Honoree, homeowner, EV driver, Recycling enthusiast, Starry Skies / Dark Skies enthusiast, Certified Laughter Yoga Leader, Ballroom dancer, Struggling author, friend to a few, acquaintance to a few more, SA Life Sunday Woman Honoree, sewing enthusiast, retired teacher for Junior Achievement – Favorite classes taught: “Enterprise in Action” and “Personal Economics”, and more!.....