

EasyTimeLine

**Illustrated Human Era HE Timeline
of
Human Achievements, Advancements,
Innovations, and Understanding in Science using
EMILIANI's HE Calendar Reform Idea**

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- I dedicate this book -

To the wonderful man who is my science thinking husband PAUL PREMACK, our adult children who grew up to both achieve college science degrees TIFFANY PREMACK and BENJAMIN PREMACK for their love, brains, attention to detail, laughter, and thoughtfulness.

To CESARE EMILIANI, who first had the idea for the Human Era (**HE**) calendar.

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

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About the HE Calendar and Formatting

This eBook, EasyTimeLine: *Illustrated Human Era (HE) Timeline of Human Achievements, Advancements, Innovations, and Understanding in Science using EMILIANI's HE Calendar Reform Idea*, uses the HE (Human Era) system to count years. The Human Era (**HE**) encompasses the growth, history, and impacts of the human species worldwide.

The *HE Calendar* was first proposed by scientist CESARE (Chay-se-ree) EMILIANI in 1993 (think **11993 HE**).

EMILIANI was an Italian American scientist, geologist, micropaleontologist, and founder of paleoceanography, developing the timescale of marine isotope stages, which despite modifications remains

in use as of 12024 HE and into the future. We want to help bring his flowing proposal into widespread 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. Holocene means “entirely recent”. 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 10000.

Conversion from AD/CE years into HE is done by adding 10000 to the AD/CE year. The year 2015 AD/CE is **12015 HE**. Conversion from BC/BCE years to HE is done by subtracting 10001 from the BC/BCE year. The year 2015 BCE would be **7986 HE**. My husband, PAUL PREMACK, the technological advisor for this undertaking, built an Excel calculator to do the math. Find it at: www.easytimeline.org

- 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 **10000 HE** and the year 1 AD/CE is **10001 HE**.
- The idea of “zero” had not even been defined until c 10600 HE.
- The years before recorded human history are “Before Human Era” (**BHE**). BHE begins with the Big Bang, and all 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...*, 12015 HE

Author / Compiler's Preface

I started a timeline on paper, in **12014 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 PAUL PREMACK who researched, sifted through, and presented to me all the different calendars from which we decided that CESARE EMILIANI'S HUMAN ERA **HE** CALENDAR reforming idea, which recognizes “ThenWasThen” and “NowIsNow” and was most fair and made the most sense *for every human!* Thank you, Paul!

After a year of compiling information our son BENJAMIN PREMACK 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 EasyTimeLine BHE/HE 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. You can use the calculator/converter at www.easytimeline.org to build your own quest!

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 EasyTimeLine ideas!

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

Chapter One Circa 1 HE: Still the Stone and Bone Age (lasting circa 6400 HE years)

The Human Era began about 12000 years before now.²

EMILIANI mathematically defined 10000 BCE as year **1 HE**, so that **1 HE** matches 10000 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 when the last ice age ended.³

² ISAAC ASIMOV: ASIMOV'S Chronology of the World

³ https://en.wikipedia.org/wiki/Holocene_calendar

Circa 1 HE: The world-wide population of humans was approximately 5 million.⁴

Circa 1 HE: France: The Magdalenian Culture (after having been around from **Circa 5300 BHE** / **Circa 4981 BHE** – **Circa 1 HE**) disappeared as the cool, near-glacial climate warmed at the end of the Fourth (Würm) Glacial Period, and herd animals became scarce.⁵

⇒ The Magdalenian Culture in France and later Magdalenian sites have been found from Portugal in the west to Poland in the east.

⁴ <https://www.worldometers.info/world-population/>

⁵ <https://www.britannica.com/topic/Magdalenian-culture>



“The Main Hall, Lascaux cave, photographer unknown.”⁶

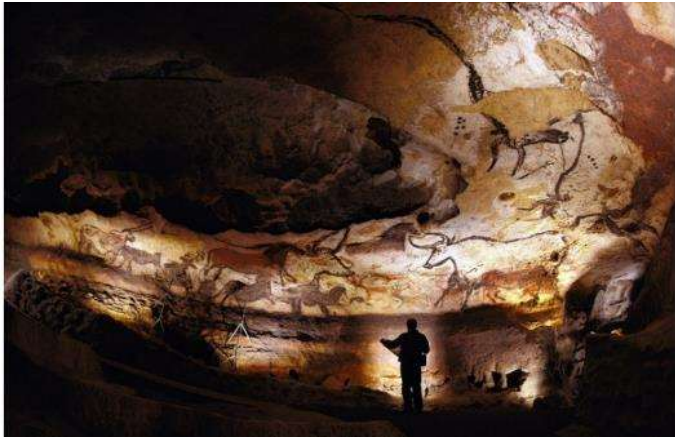
- ⇒ The Magdalenian epoch was a long one, represented by numerous stations, whose contents show progress in the arts and general culture. It was characterized by a cold and dry climate, the existence of humans in association with the reindeer, and the extinction of the mammoth.

⁶ <http://www.ancient-wisdom.com/francelascaux.htm>

- ⇒ 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.⁷
- ⇒ The Magdalenian Culture did the paintings at Lascaux Cave. 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, or which were dying because of the end of the last ice age, to once more become abundant.⁸

⁷ <https://en.wikipedia.org/wiki/Magdalenian>

⁸ <https://www.britannica.com/topic/Magdalenian-culture>



“The Hall of Bulls”, Lascaux cave, photographer unknown.”⁹

⁹ <http://www.ancient-wisdom.com/francelascaux.htm>



Photo of **11940 HE** entrance to Lascaux Cave, France.¹⁰

¹⁰ <http://www.ancient-wisdom.com/francelascaux.htm>

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 **12007 HE**.

⇒ There are more than 5000 recorded art sites illustrating Australian Ubirr Aboriginal culture over thousands of years. The archaeological sites demonstrate Aboriginal occupation for at least 20,000 and possibly up to 40,000 years¹¹ beginning **Circa 29999 BHE**.¹²

¹¹ https://en.wikipedia.org/wiki/Kakadu_National_Park

¹² https://en.wikipedia.org/wiki/Kakadu_National_Park



The Ubirr Aboriginal rock art site, photographer unknown.¹³

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

1 HE: Africa, San People inhabit the Kalahari Desert¹⁴ from Circa 29999 BHE – Current times HE:



circa 1 HE -Rock paintings in the Cederberg, Western Cape, photographer unknown.¹⁵

¹⁴ https://en.wikipedia.org/wiki/San_people

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



circa 1000 HE San paintings near Murewa, Zimbabwe, photographer unknown.¹⁶

¹⁶ https://en.wikipedia.org/wiki/San_people

Circa 1 HE: Japan: 4500 BHE – 9700 HE Japan Jōmon period Japan was inhabited by a hunter-gatherer culture, which reached a considerable degree of cultural complexity.¹⁷



Photo of example of *Earliest Incipient Jomon Pottery* Tokyo National Museum, Japan, photographer unknown.¹⁸

¹⁷ https://en.wikipedia.org/wiki/Jomon_period

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

⇒ 5th Century HE

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.¹⁹



⇒

Pre-Mediterranean Neolithic Ruins of Göbekli Tepe, photographer unknown.²⁰

¹⁹ https://en.wikipedia.org/wiki/Gobekli_Tepe

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

10th Century HE

Circa 1001 HE: Island of Cyprus, Greece. These examples make us think the ancient weavers understood basic principles of calculation and geometry because they could produce these

complicated patterns and indeed repeat them.



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photo of rare surviving circa 11000-year-old **circa 1001 HE** human made textile.

²¹ TIFFANY PREMACK pointed author / compiler to University of Cyprus Lecture:
<https://www.youtube.com/watch?v=RiQIz3S9zKE> with Dr. KALLIOPI SARRI



²² photo of rare textile restoration. Location and person in photo, unknown

²² TIFFANY PREMACK pointed author / compiler to University of Cyprus Lecture:
<https://www.youtube.com/watch?v=RiQIz3S9zKE> with Dr. KALLIOPI SARRI

13th Century HE

Circa 1301 HE: A copper pendant has been found in modern day Iraq that dates to **1301 HE**.²³ (Photo not found.)

20th Century HE

Circa 2000 HE: Scotland, Warren Field, Aerial survey reveals Lunar Calendar.²⁴

⇒ The Warren Field "calendar" is thousands of years older than the previously known formal time-measuring monuments created in

²³ DR. PAUL PARSONS and GAIL DIXON book: The Periodic Table: A Visual Guide to the Elements

²⁴ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>

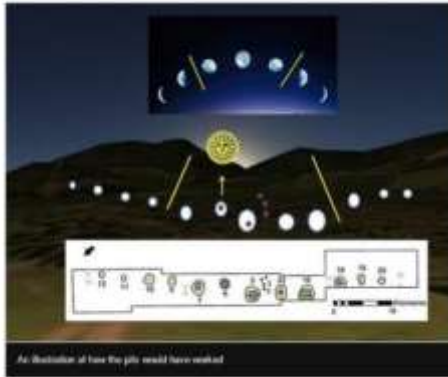
Mesopotamia. "The evidence suggests that hunter-gatherer societies in Scotland had both the need and the sophistication to track time across the years, to correct for seasonal drift of the lunar year and that this occurred nearly 5000 years before the first formal calendars known in the Near East. In doing so, this illustrates one important step towards the formal construction of time and therefore history itself" says DAVE COWLEY, RCAHMS.²⁵

²⁵ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>



Prof. VINCE GAFFNEY led the project to analyze **the circa 2020 HE** calendar pits at Warren Field.²⁶

²⁶ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>



An illustration of how the pits would have worked²⁷

²⁷ <http://www.bbc.com/news/uk-scotland-north-east-orkney-shetland-23286928>

Circa 2000 HE: Rivers are used for irrigation.²⁸

Circa 2000 HE: Xianren Cave, China.²⁹



Xianren Cave, China, photographer and date unknown.³⁰

²⁸ ISAAC ASIMOV: ASIMOV'S Chronology of the World

²⁹ <http://science.sciencemag.org/content/336/6089/1696>

³⁰ https://en.wikipedia.org/wiki/Xianren_Cave



Circa 2000 HE: Photo of Chinese pottery storage/cooking vessel found in the Xianren cave, around 10000 years old, photographer unknown.³¹

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

30th Century HE

Circa 3001 HE: China: The process of fermentation. The earliest archaeological evidence of the consumption of alcoholic beverages was discovered in Neolithic China dating from **3001 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.³²

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

Circa 3001 HE – 8501 HE: The Chinchorro preceramic culture³³
inhabited what is now the Pacific coastal region of current northern
Chile and southern Peru.³⁴

³³ <https://www.youtube.com/watch?v=czgOWmtGVGs>

³⁴ https://en.wikipedia.org/wiki/Chinchorro_culture



Circa 3001 HE – 8501 HE: The funeral rite is shown as a human skull with funeral helmet and various items, collection of the Anker Nielsen Museum in Iquique, Chile.³⁵

³⁵ https://en.wikipedia.org/wiki/Chinchorro_culture



The Chinchorro mummification practice is displayed in the Archaeology Museum of San Miguel de Azapa. **Circa 4951 HE** Chinchorro

mummies at the museum in San Miguel de Azapa in Chile, photographer unknown.³⁶

Circa 3001 HE: China: The first evidence of pottery urn comes from the early Jiahu site, where a total of 32 burial urns are found.³⁷

Circa 3001 HE: Baskets, pottery, and textiles.³⁸

40th Century HE

Circa 4001 HE: Linen cords used for nets, rafts invented, sickles invented.³⁹

³⁶ https://en.wikipedia.org/wiki/Chinchorro_mummies

³⁷ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

³⁸ ISAAC ASIMOV: ASIMOV'S Chronology of the World

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

Circa 4001 HE: China; Rowing oars have been used since the early Neolithic period; a canoe-shaped pottery and six wooden oars dating from the **4001 HE** has been discovered in a Hemudu culture site at Yuyao, Zhejiang.⁴⁰

Circa 4001 HE: The rise of Sumer or Sumeria, beginning of priest-kings and religion.⁴¹

43rd Century HE – 55th Century HE

⁴⁰ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of the World

Circa 4301 HE – 5501 HE: Vinca culture period Neolithic archaeological culture in present-day Serbia and smaller parts of Bulgaria and Romania (particularly Transylvania).⁴²



Circa 4301 HE – 5501 HE:
Smelting evidence in Pločnik, Serbia. An anthropomorphic

⁴² https://en.wikipedia.org/wiki/Vinca_culture

figurine with incised lines depicting clothing, photographer and location unknown.⁴³



Circa 4301 HE – 5501 HE:

The "*Lady of Vinča*", an iconic terracotta anthropomorphic figurine excavated in **11929 HE**, at the archaeological site of Vinča-Belo Brdo, in the municipality of Grocka, Belgrade. The

⁴³ https://en.wikipedia.org/wiki/Vinca_culture

figurine is housed in Belgrade's National Museum of Serbia, photographer unknown.⁴⁴

50th Century HE

5001 HE: Author / Compiler's Note: This HE date "**5001 HE**" is descriptive for me. "**5001 HE**" equals the outdated calendar number 5000 BCE. But where that BCE number leaves a reader speculating or calculating – the number "**5001 HE**" simply flows as it puts into perspective the "scale" of this huge timeline of human advancement and accomplishments. "**5001 HE**" shows the ThenWasThen and NowIsNow reality of human development and advancement based on what came before them. It is both circa

⁴⁴ https://en.wikipedia.org/wiki/Vinca_culture

5000 years after the start of the Human Era and circa 7000 years before our own time.

Circa 5001 HE – c 6501 HE: The Danube Valley; The Lost World of Old Europe: The Cucuteni-Trypillian culture.⁴⁵



DID WOMEN RULE?



WHAT WAS HE THINKING?



WHY DID THEY BURN
DOWN THEIR HOUSES?



WHY DID THEY VANISH?



Art from the Cucuteni-Trypillian culture.⁴⁶

⁴⁵ <http://isaw.nyu.edu/exhibitions/oldeurope/>

⁴⁶ <http://isaw.nyu.edu/exhibitions/oldeurope/>



Balta Popii, Romania, Pre-Cucuteni Clay Figures **circa 5101 HE - 5251 HE (51st -52nd Centuries HE)**, photographer unknown.⁴⁷

Circa 5001 HE: Scales for measurement developed, Irrigation used.⁴⁸

⁴⁷ https://en.wikipedia.org/wiki/Cucuteni-Trypillian_culture

⁴⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

60th Century HE

Circa 6001 HE: Greece: Sundial invented ⁴⁹; Greek name: gnomon: original sundial was a stick stuck into ground, so its shadow could be followed to give a rough estimate of time.⁵⁰

Circa 6001 HE: Copper obtained from ore.⁵¹

⇒ Author / Compiler Note: Although a copper pendant was found in modern day Iraq that dates back to the 13th Century HE or circa **1301 HE**⁵² it was not until the 60 Century HE or circa **6001 HE** that (according to ISAAC ASIMOV) copper was obtained

⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery p. 17

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

⁵² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

from ore. For that reason, we are including the description of the “Star Stuff” element copper at this point in the timeline.



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.⁵³ In the human body, Copper combines with proteins to 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.⁵⁴

Circa 6001 HE: Japan, a rowing oar measuring 63.4 cm (2 ft) in length, dating from **6001 HE**, has also been unearthed at Ishikawa Prefecture.⁵⁵

Circa 6001 HE: Polynesian colonization of South Pacific Islands.⁵⁶

⁵³ <http://images-of-elements.com/copper.php#a>

⁵⁴ DR. PAUL PARSONS /GAIL DIXON book: The Periodic Table: A Visual Guide to the Elements

⁵⁵ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery p.17

62nd Century HE

Circa 6241 HE: The Ancient Hebrew culture epoch,
“reference date: 1 Tishrei”.⁵⁷



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



Circa 62nd Century or circa 6200 HE: Map of Ancient Hebrew culture cosmology; Earth Quite Prominent – but flat and under a dome. Illustrated by George L. Robinson.⁵⁸

⁵⁸ SEAN CARROLL *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*

Chapter Two

THE BRONZE AGE:

Circa 6401 HE - Circa 9001 HE
(lasting circa 2600 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 2600 years.

64th Century HE

Circa 6401 HE: Bronze discovered, the wheel invented for horizontal use in making pottery, oars, plows⁵⁹

Circa 6401 HE: Malta - Ġgantija (Maltese pronunciation: [dʒɡan'tiːja], "Giants' Tower") is a megalithic temple complex from the Neolithic on the Mediterranean island of Gozo.⁶⁰

⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

⁶⁰ <https://en.wikipedia.org/wiki/Ggantija>



Entrance of the main temple of Ġgantija, photographer and date unknown⁶¹

65th Century HE

⁶¹ <https://en.wikipedia.org/wiki/Ggantija>

Circa 6501 HE: Wheeled carts invented – but not yet wheelbarrows; river boats used; writing developed.⁶²

Circa 6501 HE: China; Triangular-shaped stone ploughshares are found at the sites of Majiabang culture around Lake Taihu.⁶³



China, Ploughshares have also been discovered at the nearby Liangzhu and Maqiao sites.⁶⁴

⁶² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

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

⁶⁴ <http://www.cultural-china.com/chinaWH/Kaleidoscope/en/10Kaleidoscope2912.html>

Circa 6501 HE – Circa 8001 HE or circa the 65th Century HE through circa the 80th Century HE: Peru, The Norte Chico civilization (also Caral or Caral-Supe civilization).⁶⁵

⇒ 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 **6501 HE and 8001 HE** with the formation of the first city generally dated to circa **6501 HE**, at Huaricanga, in the Fortaleza area. It is from **6501 HE** onward that large-scale human settlement and communal construction become clearly apparent, which lasted until a period of decline.⁶⁶

⁶⁵ https://en.wikipedia.org/wiki/Norte_Chico_civilization

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



Remains of the two main Caral pyramids in the arid Supe Valley, date and photographer unknown.⁶⁷ **Circa 6501 HE –**

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

Circa 8001 HE or circa the 65th Century HE through circa the 80th Century HE:



Caral panorama, date and photographer unknown.⁶⁸

⁶⁸ https://en.wikipedia.org/wiki/Norte_Chico_civilization



Remains of **Circa 6501 HE – Circa 8001 HE or circa the 65th Century HE through circa the 80th Century HE**: platform mound structures at Caral.⁶⁹

⁶⁹ https://en.wikipedia.org/wiki/Norte_Chico_civilization

Circa 6501 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.⁷⁰



Clay tokens, from Susa, Uruk period, circa **6501 HE**.
Department of Oriental Antiquities, Louvre.⁷¹

⁷⁰ <https://en.wikipedia.org/wiki/Proto-Elamite>

⁷¹ <https://en.wikipedia.org/wiki/Proto-Elamite>

66th Century HE

Circa 6601 HE – 7501 HE: Circa the 66th Century HE through circa the 75th Century HE: Sumer or Sumeria further 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.⁷²
- ⇒ The civilization of Sumeria: first medical writing. ***“The Sumerian Clay Slab”*** that lists 250 plants for preparing medicines.⁷³

⁷² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 11

⁷³ Pharmacoplantae.org/MedHistory.aspx

⇒ Record of one of the oldest stories ever written: *The Epic of Gilgamesh* or Bilgamesh was made in this area.⁷⁴

⁷⁴ <https://en.wikipedia.org/wiki/Gilgamesh>



Tablet V of the *Epic of Gilgamesh*. The Sulaymaniyah Museum, Iraq⁷⁵

⁷⁵ <https://en.wikipedia.org/wiki/Gilgamesh>

⇒ **Circa 6601 HE- 7501 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 6501 HE:** China), sailing boats and copper metal working. Clay tablets with pictographic characters appeared in this period to record commercial transactions.⁷⁶

⇒ **67th Century HE**

Circa 6701 HE – circa 8901 HE: Circa the 67th Century HE through circa the 89th Century HE: The ancient Cycladic culture flourished in the islands of the Aegean Sea. 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

⁷⁶ <https://en.wikipedia.org/wiki/Proto-Elamite>



art.⁷⁷

c. **7001 HE** Cycladic figurine Female Figure, Brooklyn Museum.⁷⁸

⁷⁷ https://en.wikipedia.org/wiki/Cycladic_art

⁷⁸ https://en.wikipedia.org/wiki/Cycladic_art



Male harp player from Keros, National Archaeological Museum, Athens).⁷⁹

⁷⁹ https://en.wikipedia.org/wiki/Cycladic_art



Idol, Cycladic figurine, darker stone. Torso with a hole in the throat and dírkama thighs.⁸⁰

⁸⁰ https://en.wikipedia.org/wiki/Cycladic_art

68th Century HE

Circa 6800 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.⁸¹



Three examples of Scottish Carved Stone Balls, in Kelvingrove

⁸¹ https://en.wikipedia.org/wiki/Carved_Stone_Balls

Art Gallery and Museum, Glasgow, Scotland, photographer unknown.⁸²

Circa 6801 HE – Circa 7301 HE: Circa the 68th Century HE through circa the 73rd Century 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.⁸³

⁸² https://en.wikipedia.org/wiki/Carved_Stone_Balls

⁸³ <https://en.wikipedia.org/wiki/Proto-Elamite>



Circa **6801 HE to 7301 HE**: Tablet with numeric signs and script. From Tepe Sialk, Susa, Uruk period Department of Oriental Antiquities, Louvre.⁸⁴

⁸⁴ <https://en.wikipedia.org/wiki/Proto-Elamite>



Circa 6801 HE to 7301 HE: Economic tablet with numeric signs. Proto-Elamite script in clay, Susa, Uruk period. Department of Oriental Antiquities, Louvre.⁸⁵

⁸⁵ <https://en.wikipedia.org/wiki/Proto-Elamite>

Circa 6801 HE: circa the 68th Century HE: Newgrange, Ireland, *World Heritage Site*; The accuracy of Newgrange as a time-telling device is remarkable when one considers that it was built around 500 years before the Great Pyramids, more than 1000 years before Stonehenge and more than 2000 years before Karnak.⁸⁶

⁸⁶ <http://newgrange.com/>



The entrance to Newgrange in the late **118th Century HE** or the **11800 HEs**, when the mound had become largely overgrown ⁸⁷

⁸⁷ <https://en.wikipedia.org/wiki/Newgrange>



The passage and chamber are aligned with the rising sun at the Winter Solstice, photographer and date unknown.⁸⁸

⁸⁸ <http://newgrange.com/>

Circa 6821 HE – Circa 7501 HE: circa the 68th Century HE – circa the 75th Century HE: Scotland; Europe's most complete Neolithic village: Skara Brae UNESCO World Heritage Site.⁸⁹

- ⇒ 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.⁹⁰

⁸⁹ https://en.wikipedia.org/wiki/Skara_Brae

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



Evidence of home furnishings at Skara Brae⁹¹ including **circa the 68th Century HE – circa the 75th Century HE** indoor water toilets, photographer unknown.⁹²

⁹¹ https://en.wikipedia.org/wiki/Skara_Brae

⁹² https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation



Skara Brae circa the 68th Century HE – circa the 75th Century HE, looking north, photographer unknown.⁹³

⁹³ https://en.wikipedia.org/wiki/Skara_Brae



Excavated dwellings at **circa the 68th Century HE – circa the 75th Century HE** Skara Brae, photographer unknown.⁹⁴

⁹⁴ https://en.wikipedia.org/wiki/Skara_Brae

Circa 6851 HE: circa the 68th Century HE Malta, in the Mediterranean Sea, Tarxien Phase in Maltese prehistory; Traces of



a lost Civilization.⁹⁵

UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁹⁶

⁹⁵ http://www.maltacultureguide.com/index.php?page=article&article_id=25

⁹⁶ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁹⁷

⁹⁷ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁹⁸

⁹⁸ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.⁹⁹

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



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.¹⁰⁰

¹⁰⁰ https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta

Circa 6887 HE - 10250 HE: Circa 68th Century HE – circa 102nd Century HE Mayan Culture, Yucatan Peninsula



11892 HE photograph of El Castillo at Chichen Itza, by Teoberto Maler.¹⁰¹ (captures 118th Century HE then appearance)



El Castillo, at Chichen Itza.¹⁰² Photographer and more current date unknown. (Captures 120th Century HE ‘now’ appearance)

¹⁰¹ https://en.wikipedia.org/wiki/Maya_civilization

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

Circa 68th Century HE – circa 102nd Century HE Mayans had multiple calendars: Mayan “creation date:” **6877 HE**; Mayan Round Calendar: 52 years; Mayan Tzolk’in calendar: 260 days; Mayan Haab calendar: 365 days; **12012 HE**: end date of a 5126 -year-long cycle in the Mesoamerican Mayan long count calendar.¹⁰³

⇒ **Circa 68th Century HE – circa 102nd Century HE** Mayan Civilization included: People, Society, Languages, Writing, Religion Mythology, Human Sacrifice, Cities, Architecture, Astronomy, Calendar, Stelae, Art, Textiles, Trade, Music, Dance, Medicine, Cuisine.¹⁰⁴

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

¹⁰⁴ 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 Circa 68th Century HE – circa 102nd Century HE
Mayan Numerals¹⁰⁵

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

69th Century HE

Circa 6901 HE: Circa the 69th Century HE - The first “nation” united in Egypt¹⁰⁶, called the First Dynasty of Egypt.¹⁰⁷



Pottery jar with integral strainer, First Dynasty, Early Dynastic

¹⁰⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

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

Period, Egypt. The Petrie Museum of Egyptian Archaeology, London.¹⁰⁸

⇒ **Circa 6901 HE: Circa the 69th Century HE** - Egyptian hieroglyphs were fully developed by then, and their shapes would be used with little change for more than three thousand years.¹⁰⁹ This early writing of hieroglyphs was called cuneiform and consisted of making specific marks in wet clay with a reed implement.¹¹⁰

¹⁰⁸ https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt

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

¹¹⁰ <https://www.ancient.eu/writing/>

70th Century HE

Circa 7001 HE: It was in circa the 70th Century HE: First evidence of candles being used for artificial lighting.¹¹¹

Circa 7001 HE: : It was in circa the 70th Century HE Stonehenge, England, UNESCO World Heritage Site, is built.

¹¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Farm carts near Stonehenge **circa 11885 HE, 118th Century HE**
photo: photographer unknown.¹¹²

¹¹² <https://en.wikipedia.org/wiki/Stonehenge>



Post WWI Stonehenge 119th Century HE aerial photograph, photographer unknown.¹¹³

¹¹³ <https://en.wikipedia.org/wiki/Stonehenge>



A then contemporary newspaper depiction of the **11920 HE** restoration of Stonehenge.¹¹⁴

¹¹⁴ <https://en.wikipedia.org/wiki/Stonehenge>



Stonehenge in **12014 HE**, the **120th Century HE**, photographer unknown.¹¹⁵

¹¹⁵ <https://en.wikipedia.org/wiki/Stonehenge>

Circa 7051 HE: IMHOTEP, circa 70th Century HE Egyptian scholar,

2000 years after his death made into a god, architect of the first pyramid.¹¹⁶



Late Period statue of IMHOTEP, Musée du Louvre.¹¹⁷

74th Century HE

Circa 7401 HE: then circa the 74th century HE Sumer continues, (see **Circa 4001 HE circa the 40th century HE: The rise of Sumeria**)
“Sumer had now developed into 28 cities over these hundreds of years. Uruk was one city in Sumer.”¹¹⁸ “They call this place Uruk. We call it Iraq. It's a part of Mesopotamia, the land between the Tigris and the Euphrates rivers.”¹¹⁹

¹¹⁶ <https://en.wikipedia.org/wiki/Imhotep>

¹¹⁷ https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt

¹¹⁸ <https://en.wikipedia.org/wiki/Sumer>

¹¹⁹ COSMOS, A Space Time Odyssey, by Ann Druyan, Episode 11



Dated to **Circa 7401 HE — Circa 7501 HE**: An image showing fragments of the *Instructions of Shurruapak* Translation: "Shurruapak 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.¹²⁰

¹²⁰ Pharmacoplantae.org/MedHistory.aspx

Circa 7401 HE – Circa 8101 HE: What is now Pakistan: the Harappan Civilization Phase of the Indus Valley Civilization in the Indian Sub-continent.¹²¹



Excavated ruins of Mohenjo-Daro, Sindh province, Pakistan,

¹²¹ <https://en.wikipedia.org/wiki/Harappa>

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.¹²²

- ⇒ From a room that appears to have been set aside for bathing, wastewater was directed to covered drains, which lined the major streets.¹²³

¹²² https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

¹²³ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation



A large well and bathing platforms at Harappa, remains of the city's phase of occupation from **7801 HE to 8101 HE**.¹²⁴

- ⇒ **Circa the 74th Century HE to circa the 81st Century HE:**
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

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

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.¹²⁵

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



Dholavira Sophisticated Water Reservoir, evidence for hydraulic sewage systems in **Circa the 74th Century HE to circa the 81st Century HE** the ancient Indus Valley Civilization.¹²⁶

¹²⁶ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation

⇒ **Circa the 74th Century HE to circa the 81st Century HE**

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.¹²⁷

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



Circa the 74th Century HE to circa the 81st Century HE Indus Valley Pottery, photographer and location unknown.¹²⁸

¹²⁸ https://en.wikipedia.org/wiki/Indus_Valley_Civilisation



Circa the 74th Century HE to circa the 81st Century HE Indus

valley seals with Bull, Elephant, and Rhinoceros, photographer and location unknown.¹²⁹

⇒ 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.¹³⁰

Circa 7401 HE – 8901 HE: circa the 74th century HE – circa the 89th century 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

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

¹³⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

at the beginning of the **1900's HE** through the work of British archaeologist **ARTHUR EVANS**.^{131 132}

⇒ **circa the 74th century HE – circa the 89th century HE:**

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 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.¹³³

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

¹³² <https://www.youtube.com/watch?v=czgOWmtGVGs> en.wikipedia.org/wiki/Minoan_civilization

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



maybe late 119th to early 120th Century HE Restored model of a Minoan house found in Archanes, artist, photographer and location unknown.¹³⁴

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



Current day Map of **circa the 74th century HE – circa the 89th century HE** Minoan Crete, artist and location unknown.¹³⁵

¹³⁵ https://en.wikipedia.org/wiki/Minoan_civilization#/media/File:Map_Minoan_Crete-en.svg



Ruins of the **circa the 74th century HE – circa the 89th century HE** palace at Knossos, photographer and date unknown.¹³⁶

¹³⁶ https://en.wikipedia.org/wiki/Minoan_civilization



Sewers of the palace of Circa 7401 HE – 8901 HE: circa the 74th century HE – circa the 89th century HE Knossos¹³⁷

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



The partially-restored "campstool fresco" from **circa the 74th century HE – circa the 89th century HE** Knossos, photographer unknown.¹³⁸

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



The Dolphin Mural from Knossos, photographer unknown.¹³⁹

¹³⁹ www.touropia.com



circa 120th century HE photo of remains of Palace complex at Phaistos, Minoan Civilization at **circa the 74th century HE – circa the 89th century HE** Phaistos, Crete, photographer unknown.¹⁴⁰

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

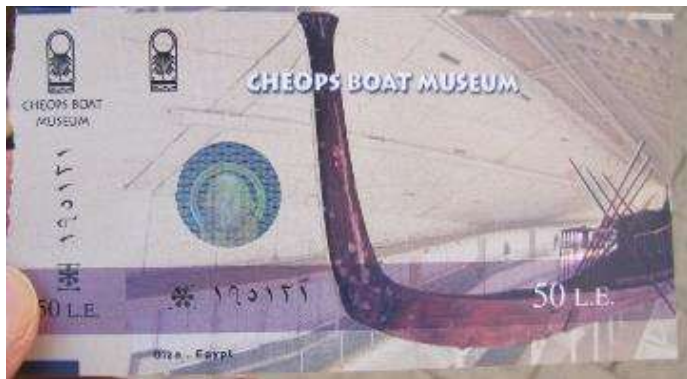
Circa **7412 HE: circa the 74th Century HE: Fourth Dynasty of Egypt;**
"the Age of the Pyramids."¹⁴¹

¹⁴¹ https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt



Circa 7412 HE: circa the 74th Century HE Statue of “Khufu” (AKA Cheops, Suphis, Chnoubos and Sofe) in the Cairo Museum.¹⁴²

¹⁴² https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt



Cairo, Egypt **12009 HE** ticket to Cheops Boat Museum.¹⁴³

¹⁴³ From author family **12010 HE** visit to Egypt



Cairo, Egypt; Boat excavation hole just to the side of the Cheops Pyramid.¹⁴⁴

¹⁴⁴ From author family **12010 HE** visit to Egypt



Cairo, Egypt, Cheops Boat Museum; excavated **circa 4605-year-old rope** used for Egyptian Cheops Boats (and ok, Author / Compiler, son and daughter).¹⁴⁵

¹⁴⁵ From author family **12010 HE** visit to Egypt, photographer PAUL PREMACK



Cairo, Egypt, Cheops Boat Museum; circa **4605-year-old** boat excavated from above photo/hole just to the side of the Cheops Pyramid.¹⁴⁶

¹⁴⁶ From author family visit to Egypt



Cairo, Egypt, Cheops Boat Museum; view of circa 4605-year-old paddles design from excavated boat.¹⁴⁷

¹⁴⁷ From author family **12010 HE** visit to Egypt

Circa 7421 HE: Construction of the Great Pyramid of Giza, Egypt.¹⁴⁸



The Great Pyramid of Giza, current times, photographer unknown.¹⁴⁹

¹⁴⁸ https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza

¹⁴⁹ https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza



Great Pyramid of Giza from a **11800s HE** or **118th Century HE** stereopticon card photo¹⁵⁰

¹⁵⁰ https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza

Circa 7441 HE: Egypt: The earliest archaeological evidence of papyrus was excavated in **12012 HE and 12013 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.¹⁵¹

- 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”¹⁵² Using the included HE conversion calculator to get to **11950 HE** then subtracting 4200 from it, was the calculation used to achieve the “**Circa 7450 HE**” for dating

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

¹⁵² <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

this upcoming entry. Now you as the reader can relate **7450 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 7450 HE: The Meghalayan Age of the Holocene Epoch.¹⁵³

⇒ 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 statement from Long Beach State

¹⁵³ <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

University. After the onset of this 200-year climatic event, the societies were forced to migrate worldwide.¹⁵⁴

75th Century HE

Circa 7501 HE: Glass used.¹⁵⁵

Circa 7501 HE: The civilization of Crete ends under the ashes of a volcanic explosion.¹⁵⁶

Circa 7501 HE – Circa 8001 HE: Horses tamed.¹⁵⁷ Some researchers do not consider an animal to be "domesticated" until it exhibits

¹⁵⁴ <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

¹⁵⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery PAGE 24

¹⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

physical changes consistent with selective breeding, or at least having been born and raised entirely in captivity. Until that point, they classify captive animals as merely "tamed".¹⁵⁸ 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 **7501 HE** in eastern Hungary in Bell-Beaker sites, and in later Bronze Age sites in the Russian steppes, Spain, and eastern Europe.¹⁵⁹

76th Century HE

Circa 7661 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

¹⁵⁸ https://en.wikipedia.org/wiki/Domestication_of_the_horse

¹⁵⁹ https://en.wikipedia.org/wiki/Domestication_of_the_horse

Akkad and Sumeria: peoples with different languages and different cultures.¹⁶⁰

77th Century HE

Circa 7701 HE – Circa 8401 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 swords, two axes, two spiral arm-rings and one bronze chisel circa 3600 years ago.

¹⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, pages 24-25

^[87] https://en.wikipedia.org/wiki/Unetice_culture

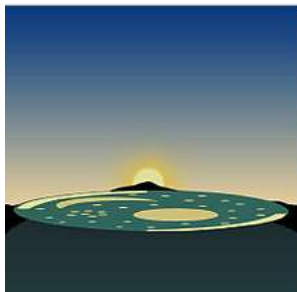
- ⇒ The Únětice culture bronze disc is considered to be one of the most important archaeological finds of the **11900's HE**. It contains an extraordinary comprehension of astronomical phenomena that enable unique glimpses into the early knowledge of the skies.¹⁶¹



- ⇒ **Circa 7701 HE – Circa 8401 HE** Únětice culture Nebra Sky

¹⁶¹ <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/>

Disk discovered in Saxony Anhalt, Germany, LDA Sachsen-Anhalt. Photo by J. Lipták.¹⁶²



Unknown artist rendering of **Circa 7701 HE – Circa 8401 HE** Nebra sky disk, position of the arcs at evening of summer solstice.¹⁶³

¹⁶² https://en.wikipedia.org/wiki/Unetice_culture

¹⁶³ https://en.wikipedia.org/wiki/Unetice_culture



Swords buried with the Únětice culture Nebra sky disk, location and photographer unknown.¹⁶⁴

¹⁶⁴ https://en.wikipedia.org/wiki/Unetice_culture

80th Century HE

Circa **8001 HE**: Copper sculpture of a bull-cart with vertical wheel and a rider, from a hoard at Daimabad, Maharashtra - Late Harappan, Indus Valley culture.¹⁶⁵

¹⁶⁵ https://en.wikipedia.org/wiki/Chariot#cite_note-Kuznetsov-2



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¹⁶⁶ https://en.wikipedia.org/wiki/Chariot#cite_note-Kuznetsov-2

81st Century HE

Circa 8151 HE – Circa 8201 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.¹⁶⁷



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A photo of a small section of the Length: 5.5 meters (18 ft)

Width: 3.8 to 7.6 cm (1.5 to 3 in) **Moscow Mathematical Papyrus** at Pushkin State Museum of Fine Arts in Moscow¹⁶⁹

⇒ **11930 HE** Solutions by the Soviet Orientalist Vasily Vasilievich Struve in, exist.¹⁷⁰

$$\text{Area} = \left(\frac{2 \times 8}{9} \right)^2 \times (\text{diameter})^2 = \frac{256}{81} (\text{diameter})^2$$

•

The solution to the 10th problem means the scribe of the **Moscow Papyrus** could approximate pi $258/81 = 3.16049$.¹⁷¹

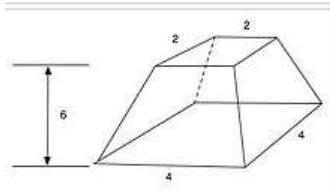
¹⁶⁷ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

¹⁶⁸ thematheoreticaltourist.wordpress.com

¹⁶⁹ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

¹⁷⁰ https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus

¹⁷¹ 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.¹⁷²

¹⁷² https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus



Circa 8151 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.¹⁷³

¹⁷³ https://en.wikipedia.org/wiki/Phaistos_Disc

82nd Century HE

Circa 8201 HE: Egypt, uses of fermentation for drink or bread is further discovered (see **3001 HE** in China); number system based on 60 developed; 7-day week devised; 5 planets and 12 constellations of zodiac named.¹⁷⁴

Circa 8201 HE: *The Kahun Gynecological Papyrus*¹⁷⁵ (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.¹⁷⁶

¹⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁷⁵ https://en.wikipedia.org/wiki/History_of_birth_control

¹⁷⁶ 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.¹⁷⁷

¹⁷⁷ 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" (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.¹⁷⁸

¹⁷⁸ https://en.wikipedia.org/wiki/History_of_birth_control

Circa 8247 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.¹⁷⁹
- ⇒ *Circa 8247 HE Code of Hammurabi*, The Babylonians established the first surviving law code.¹⁸⁰

¹⁷⁹ Liz Strachan *A Slice of Pi*

¹⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Code on clay tablets



Code on basalt stele



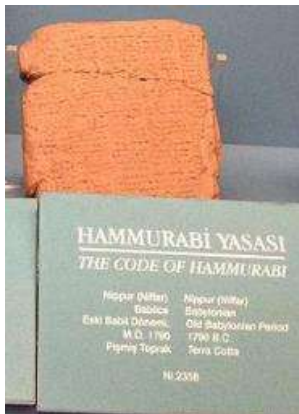
c 8250 HE Two versions of the *Code of Hammurabi* at the Louvre Museum.¹⁸¹

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



c 8250 HE Hammurabi stele at American Museum of Natural History, New York.¹⁸²

¹⁸² https://en.wikipedia.org/wiki/Code_of_Hammurabi



c 8250 HE A version of the code at the Istanbul Archaeological Museums.¹⁸³

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

⇒ **c 8250 HE** Numbers as we know them still did not exist. No concept of “zero”. Below are examples of early use of Babylonian numbers:

⇒

1	𐎶	11	𐎶𐎵	31	𐎶𐎵𐎶	31	𐎶𐎵𐎶	41	𐎶𐎵𐎶𐎵	51	𐎶𐎵𐎶𐎵
2	𐎶𐎶	12	𐎶𐎵𐎶𐎶	22	𐎶𐎵𐎶𐎶	32	𐎶𐎵𐎶𐎶𐎶	42	𐎶𐎵𐎶𐎶𐎶	52	𐎶𐎵𐎶𐎶𐎶
3	𐎶𐎶𐎶	13	𐎶𐎵𐎶𐎶𐎶	23	𐎶𐎵𐎶𐎶𐎶	33	𐎶𐎵𐎶𐎶𐎶𐎶	43	𐎶𐎵𐎶𐎶𐎶𐎶	53	𐎶𐎵𐎶𐎶𐎶𐎶
4	𐎶𐎶𐎶𐎶	14	𐎶𐎵𐎶𐎶𐎶𐎶	24	𐎶𐎵𐎶𐎶𐎶𐎶	34	𐎶𐎵𐎶𐎶𐎶𐎶𐎶	44	𐎶𐎵𐎶𐎶𐎶𐎶𐎶	54	𐎶𐎵𐎶𐎶𐎶𐎶𐎶
5	𐎶𐎶𐎶𐎶𐎶	15	𐎶𐎵𐎶𐎶𐎶𐎶𐎶	25	𐎶𐎵𐎶𐎶𐎶𐎶𐎶	35	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶	45	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶	55	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶
6	𐎶𐎶𐎶𐎶𐎶𐎶	16	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶	26	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶	36	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶	46	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶	56	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶
7	𐎶𐎶𐎶𐎶𐎶𐎶𐎶	17	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶	27	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶	37	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	47	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	57	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶
8	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	18	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	28	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	38	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	48	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	58	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶
9	𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	19	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	29	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	39	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	49	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶	59	𐎶𐎵𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶𐎶
10	𐎶𐎵	20	𐎶𐎵𐎵	30	𐎶𐎵𐎵𐎵	40	𐎶𐎵𐎵𐎵𐎵	50	𐎶𐎵𐎵𐎵𐎵𐎵	60	𐎶𐎵𐎵𐎵𐎵𐎵𐎵

Babylonian Cuneiform Numerals.¹⁸⁴

¹⁸⁴ http://www-history.mcs.st-and.ac.uk/HistTopics/Babylonian_numerals.html

- ⇒ **c 8250 HE** *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.¹⁸⁵
- ⇒ **Circa 8250 HE:** Babylonians first recorded oral hygiene by use of tooth cleaning sticks.¹⁸⁶

¹⁸⁵ <http://www.soaphistory.net/soap-history/first-soap/>

¹⁸⁶ <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).¹⁸⁷ (Author / Compiler sees two sticks in the picture. Maybe it is two halves of the same stick?)

¹⁸⁷ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

83rd Century HE

Circa 8301 HE – 8801 HE: Ancient Egyptian Empire.¹⁸⁸

⇒ **Circa 8351 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.¹⁸⁹

¹⁸⁸ ISAAC ASIMOV’S Chronology of the World

¹⁸⁹ <https://www.britannica.com/biography/Ahmes>



Photo is of a portion of the *Rhind Mathematical Papyrus*, British Museum, London.¹⁹⁰

¹⁹⁰ https://en.wikipedia.org/wiki/Rhind_Mathematical_Papyrus

84th Century HE

Circa 8401 HE: First Egyptian medical text was on papyrus (named after the dealer, Edwin Smith, who bought it in **11862 HE**).¹⁹¹



¹⁹¹ https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus

Plates vi & vii of the *Edwin Smith Papyrus* at the Rare Book Room, New York Academy of Medicine.¹⁹²

Circa 8401 HE – 8955 HE: China, Shang Dynasty, first Chinese early written records were on bone¹⁹³

¹⁹² https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus

¹⁹³ https://en.wikipedia.org/wiki/Oracle_bone



A Shang dynasty oracle bone from the Shanghai Museum¹⁹⁴

¹⁹⁴ 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.”¹⁹⁵

¹⁹⁵ PBS Skunk Bear How Eclipses changed History youtube video:
https://www.youtube.com/watch?v=tTxz_d2q7Js

Circa 8401 HE – 8801 HE: Tumulus Culture of Central Europe. In **11902 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.¹⁹⁶

85th Century HE

Circa 8501 HE: The “Star Stuff” element Iron was first smelted by the Hittites of Asia Minor.¹⁹⁷

¹⁹⁶ https://en.wikipedia.org/wiki/Tumulus_culture

¹⁹⁷ 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.¹⁹⁸ 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.¹⁹⁹

¹⁹⁸ <http://images-of-elements.com/iron.php#a>

¹⁹⁹ PAUL PARSONS & GAIL DIXON, *The Periodic Table*

Circa 8501 HE: The Alphabet from which all western alphabets grew, was developed by some Canaanite or Phoenician as they were called by the Greeks.²⁰⁰

⇒ There is no record of what the Phoenicians called themselves. It is only through their reference by others do we know of the Phoenicians.²⁰¹

²⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁰¹ Stuff you missed in history class podcast <https://www.missedinhistory.com/podcasts/the-phoenician-alphabet.htm>



Phoenician Alphabet, The Alphabet from which all western alphabets grew²⁰²

²⁰² https://en.wikipedia.org/wiki/Phoenician_alphabet

⇒ 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 **11923 HE**, which revealed a number of Phoenician royal tombs. The tomb of Ahiiram was ten meters deep.²⁰³

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



The Sarcophagus of Ahiem in its current location at the National Museum of Beirut.²⁰⁴

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

Circa 8501 HE: The Ebers Papyrus,²⁰⁵ 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 **11873 HE–11874 HE** by Georg Ebers.²⁰⁶ 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;

²⁰⁵ https://en.wikipedia.org/wiki/History_of_birth_control AND HISTORY OF SOAP

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

- For Diabetes mellitus: Drink a mixture including elderberry, asit plant fibers, milk, beer-swill, cucumber flowers and green dates;
- For Guinea-worm disease: Wrap the emerging end of the worm around a stick and slowly pull it out. (3500 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.²⁰⁷

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

- 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.²⁰⁸ The first recorded evidence of induced abortion is from the Egyptian *Ebers Papyrus*²⁰⁹

⇒ 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.²¹⁰ SOAP and HYGENE! More detailed accounts of soap use came from Ancient Egypt, where soaps and aromatic oils were not only

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

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

²¹⁰ <http://www.soaphistory.net/soap-history/first-soap/>

used for washing but also as an important medical cure for many skin and muscle diseases.²¹¹



A photo of a piece of The **Ebers Papyrus**, c **8501 HE** from Ancient Egypt. It is currently kept at the library of the University of Leipzig, in Germany.²¹²

²¹¹ <http://www.soaphistory.net/soap-history/first-soap/>

²¹² https://en.wikipedia.org/wiki/Ebers_Papyrus

Circa 8601 HE to circa 8650 HE: Egypt, Karnak, UNESCO World Heritage Site²¹³

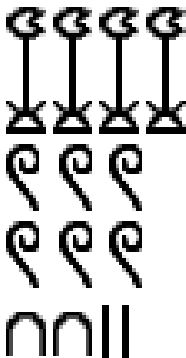
Value	1	10	100	1,000	10,000	100,000	1 million, or many
Hieroglyph	I	n	e	⌋	⌋	⌋	⌋



Numbers as we know them still did not exist. The image above shows the Ancient Hieroglyphs and matching current Hindu-Arabic number.²¹⁴

²¹³ <http://www.karnak.org/>

²¹⁴ https://en.wikipedia.org/wiki/Egyptian_numerals



A drawing of a stone carving from Karnak (artist and date unknown) shows the number 4622.²¹⁵

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



Karnak Gate built for Winter Solstice alignment.^{216 217}

²¹⁶ Tiffany Premack 12010 HE family trip to Egypt

²¹⁷ Photo from author **12010 HE** family trip to Egypt

- ⇒ **Circa 10323 HE:** When Constantine the Great recognized the Christian religion, the Karnak complex was closed and abandoned.²¹⁸
- ⇒ 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.²¹⁹
- ⇒ In Asia hygiene remained respected and enforced by tradition.²²⁰

Circa 8651 HE – Circa 8801 HE: *The Brugsch Papyrus (Pap. Berl. 3038)*, also known as *the Greater Berlin Papyrus*, or simply

²¹⁸ https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re

²¹⁹ <http://www.soaphistory.net/soap-facts/soap-benefits/>

²²⁰ <http://www.soaphistory.net/soap-facts/soap-benefits/>

Berlin 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 **11827 HE** for the Berlin Museum, where it is still housed. The style of writing is that of Egypt's 19th dynasty.²²¹

⇒ It deals with:

- women's health,
- contraception,
- gynecological diseases,
- fertility tests, pregnancy, etc.²²²

²²¹ https://en.wikipedia.org/wiki/Brugsch_Papyrus

²²² https://en.wikipedia.org/wiki/Brugsch_Papyrus

⇒ The papyrus was studied initially by HEINRICH KARL BRUGSCH but was translated and published by WALTER WRESZINSKI in **11909 HE**. Its only translation is in German. The papyrus contains twenty-four pages of writing. Much of it is parallel to the *Ebers Papyrus* (see: **Circa 8501 HE**). Some historians believe that this papyrus was used by GALEN (see: **Circa 10200 HE**: AELIUS OR CLAUDIUS GALENUS, Greek, GALEN of PERGAMON) in his writings.²²³

⇒ **86th Century HE**

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

Circa 8659 HE – circa 8677 HE: Egypt: King Tutankhamen



Wooden bust of the boy king, found in his tomb²²⁴

⇒ Tutankhamun's mummy was discovered by English Egyptologist Howard Carter and his team in **11925** HE in tomb KV62 of

²²⁴ <https://en.wikipedia.org/wiki/Tutankhamun>

Egypt's Valley of the Kings. **Circa 8659 HE – circa 8677 HE:** Tutankhamun was the 11th pharaoh of the 18th Dynasty of the New Kingdom of Egypt, making his mummy over 3300 years old.



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²²⁵ https://en.wikipedia.org/wiki/Tutankhamun's_mummy



HOWARD CARTER and associates opening the shrine doors in the burial chamber (**11924 HE** reenactment of the **11923 HE** event)²²⁶

²²⁶ https://en.wikipedia.org/wiki/KV62#/media/File:The_Moment_Carter_Opens_the_Tomb.JPG

⇒ 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 11730s HE. (See 11730 HE GEORG BRANDT).



⇒ Tutankhamun's death mask.²²⁷

²²⁷ <https://en.wikipedia.org/wiki/Tutankhamun>

87th Century HE

At this time there were approximately 45 Million people.²²⁸



²²⁹ Circa 8701

HE: Map of Eastern Hemisphere Human Population groups.

Circa 8701 HE – 9251 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.²³⁰ 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.^{231 232}

²³⁰ Chadwick and Corcoran, Nora and J.X.W.P. (11970 HE). *The Celts. Penguin Books. 28–29*

²³¹ Kruta, Venceslas (11991 HE). *The Celts* pp. 93–100.

²³² Gimbutas, Marija (11965 HE). Bronze age cultures in Central and Eastern Europe. 274–298.



Drawing of urns in a burial site, artist and location unknown.²³³

88th Century HE

Circa 8801 HE: In both Egypt and China dyes resistant to sun & to water developed.²³⁴

Circa 8801 HE: In India: The decimal Hindu-Arabic numeral system was invented.²³⁵ (Roman numerals still mostly in use.) (See **Circa 10830 HE:** SIND IBN ALI, Baghdad and **Circa 10825 HE:** AL-KHWARIZMI).

Circa 8801 HE – circa 9201 HE: Luristan (Western Iran).

²³⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²³⁵ https://en.wikipedia.org/wiki/Hindu%E2%80%93Arabic_numerals



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).²³⁶

Circa 8801 HE- circa 9601 HE: Mexico - the Aztec name for these people was “Olmecatl” or modern name is “Olmec people.”²³⁷

⇒ Olmec People used science to extract latex from Panama rubber trees (*Castilla elastica*) growing in the region and mixed it with

²³⁶ <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, 11988 HE, page 153. Fig. 272

²³⁷ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

the juice of a local vine (*Ipomoea alba*, moonflower) to create rubber.²³⁸

⇒ Olmec People carved large items from stone.²³⁹



⇒ Olmec colossal basalt head in the Museo de la Venta, an outdoor

²³⁸ <https://www.britannica.com/topic/Olmec>

²³⁹ <https://www.britannica.com/topic/Olmec>

museum near Villahermosa, Tabasco, Mexico. ranging in height from 1.47 to 3.4 meters (4.82 to 11.15 feet).²⁴⁰



The Olmec people built Earth mounds such as this one, which was part of the **11967 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.²⁴¹

²⁴⁰ <https://en.wikipedia.org/wiki/Olmec>

²⁴¹ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>



Circa 8801 HE – circa 9601 HE: Olmec mask; Jadeite mask, Olmec culture, Mexico, now in the Metropolitan Museum of Art, New York City, bequest of Alice K. Bache, **11977 HE**.²⁴²

²⁴² <https://www.britannica.com/topic/Olmec>



Circa 8801 HE – circa 9601 HE: Olmec figure; ceramic, cinnabar, red ochre from Mexico. $34 \times 31.8 \times 14.6$ cm. Photograph by Katie Chao. The Metropolitan Museum of Art, New York City, Michael C. Rockefeller Memorial Collection, bequest of Nelson A. Rockefeller in **11979 HE**.²⁴³

²⁴³ <https://www.britannica.com/topic/Olmec>



Circa 9401 HE: The major Formative Period (Pre-Classic Era) sites in present-day Mexico which show Olmec influences in the archaeological record.²⁴⁴

²⁴⁴ <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.²⁴⁵

Circa 8801 HE – circa 9201 HE: The Greek Dark Ages²⁴⁶ began because the Dorians used iron ore from meteorites to make their weapons and crushed the bronze weapon using Mycenaeans.²⁴⁷

- ⇒ 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?”²⁴⁸

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

²⁴⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁴⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁴⁸ 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.²⁴⁹

Circa 8901 HE: The Phoenicians first developed sea routes around the entire Mediterranean. They used oars.²⁵⁰

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

²⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Chapter Three

THE IRON AGE: Circa 9001 HE- **Circa 11543 HE** **(lasting circa 2760 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.

90th Century HE

Circa 9001 HE: Iron age began, Steel was developed.²⁵¹ **Circa 9001 HE** – Map of Eastern Hemisphere Human Population groups. At this time approximately there were about 50,000,000 people.²⁵²



Circa 9001 HE: Bronze was still in use in China.



China, A bronze ritual bell, Zhou Dynasty, photographer and location unknown.²⁵⁴

²⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁵² <http://www.worldometers.info/world-population/world-population-by-year/>

²⁵³ http://worldhistorymaps.info/images/East-Hem_1000bc.jpg Thomas Lessman

²⁵⁴ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 9022 HE – current times: Peoples of the Americas.

12022 HE: TEDxKC / Speaker: LYLA JUNE: Stanford Scholar, Indigenous musician, and community organizer of Diné (Navajo), Tsétsêhéstâhese (Cheyenne) and European lineages. Her current doctoral research focuses on humans as a keystone species and on Indigenous food systems revitalization: *3000-year-old Solutions to Modern Problems.*²⁵⁵



²⁵⁶ LYLA JUNE

²⁵⁵ <https://www.youtube.com/watch?v=eH5zJxQETI4>

²⁵⁶ 3000-year-old solutions to modern problems | LYLA JUNE | TEDxKC

Circa 9051 HE - current: Africa, Berber Agricultural Calendar started, Tuareg people. (Starting from the **11960s HE**, however, on the initiative of the Academie Berbere in Paris, some Berbers have begun computing the years starting from **9051 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.)²⁵⁷

²⁵⁷ https://en.wikipedia.org/wiki/Berber_calendar

91st Century HE

Circa 9101 HE: Camels domesticated in the southern Levant (Israel / Jordan area) in conjunction with expanding copper mining.²⁵⁸

Circa 9181 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.²⁵⁹

92nd Century HE

²⁵⁸ <https://www.sciencedaily.com/releases/2014/02/140203131518.htm>

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

Circa 9201 HE – Circa 10600 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.²⁶⁰

- ⇒ The single most effective method of birth control known in antiquity was probably coitus interruptus.²⁶¹
- ⇒ The ancient Greek philosopher ARISTOTLE (see Circa **9617 HE – 9678 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

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

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

sperm, but effectiveness would have been only occasional and highly variable.²⁶²

Circa 9201 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.²⁶³ (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 9201 HE – 9501 HE: Hallstatt Culture, named for a lakeside village in the Austrian Salzkammergut southeast of Salzburg where

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

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

there was a rich salt mine, and some 1300 burials are known, many with fine artefacts, was the was the predominant Western and Central European culture of the time.²⁶⁴

- ⇒ 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.²⁶⁵

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

²⁶⁵ https://en.wikipedia.org/wiki/Hallstatt_culture



c 9401 HE: Textile fragment recovered from the Hallstatt salt mine.²⁶⁶

²⁶⁶ https://en.wikipedia.org/wiki/Hallstatt_Museum



circa 9401 HE: Bronze container with stand, Hallstatt Ha C, photographer unknown.²⁶⁷

²⁶⁷ https://en.wikipedia.org/wiki/Hallstatt_Museum



Watercolor commissioned by JOHANN G. RAMSAUER documenting one of his cemetery digs at Hallstatt; unknown local artist.²⁶⁸

²⁶⁸ https://en.wikipedia.org/wiki/Hallstatt_culture



c 9401 HE: The Strettweg Cult Wagon, one of the most elaborate objects from the **Circa 9201 HE – 9501 HE** Hallstatt period. Location: Der Kultwagen von Strettweg im Archäologiemuseum in Graz, Österreich.²⁶⁹

²⁶⁹ https://en.wikipedia.org/wiki/Hallstatt_culture



Hallstatt Geographical Range was Europe, North of Current day Italy.²⁷⁰

²⁷⁰ https://en.wikipedia.org/wiki/Hallstatt_culture

Circa 9206 HE: AL-BATANI, Turkey, Astronomer and mathematician²⁷¹



A modern artist's impression of AL-BATANI holding an astrolabe.²⁷²

²⁷¹ <https://en.wikipedia.org/wiki/Al-Battani>

²⁷² <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.²⁷³

Circa 9225 HE - 10394 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 **10394 HE** as part of the campaign to impose Christianity as the state religion of Rome.²⁷⁴

²⁷³ <https://en.wikipedia.org/wiki/Al-Battani>

²⁷⁴ https://en.wikipedia.org/wiki/Ancient_Olympic_Games

Circa 9248 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.²⁷⁵

Circa 9251 HE – Circa 10080 HE: Etruscans built arches for the first time that could span a wider distance and hold more weight.²⁷⁶



This Etruscans arch is part of a massive set of walls which are 30 feet tall and 9500 feet long, made of travertine and set without

²⁷⁵ https://en.wikipedia.org/wiki/Ab_urbe_condita

²⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

mortar. It covers approximately a quarter of a square mile over three hills.²⁷⁷

Circa 9251 HE – circa 9501 HE: During this time span, Greece was lifting from its dark ages into the Archaic Greek era.²⁷⁸

Circa 9251 HE: Greece, Homer is credited with creation of the epic tales²⁷⁹ *Iliad* and *Odyssey*. These started as verbal accounts and were not written until many years later.²⁸⁰

93rd Century HE

²⁷⁷ https://en.wikipedia.org/wiki/Etruscan_Arch

²⁷⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁷⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁸⁰ <https://en.wikipedia.org/wiki/Homer>

Circa 9301 HE: Assyria and Jerusalem built aqueducts.²⁸¹ Egypt built Sundials.²⁸²

Circa 9301 HE – 9401 HE: MASTER TUNG-HSUAN, the Chinese physician, documented both coitus reservatus and coitus obstructus, which prevents the release of semen during intercourse. However, it 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 "*thousands 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.²⁸³ (Author / Compiler's note: evidently they

²⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁸³ Middleberg, Maurice I. (12003 HE). *Promoting reproductive security in developing countries*. Springer. p. 4. ISBN 978-0-306-47449-1.

did not know the toxic nature of quicksilver, i.e., the star-stuff element Mercury.)

Circa 9301 HE: Mogador Island, Essaouira, Morocco.



Phoenician plate with red slip; at Sidi Mohammed ben Abdallah Museum.²⁸⁴

²⁸⁴ http://www.digplanet.com/wiki/Sidi_Mohammed_ben_Abdallah_Museum

Circa 9341 HE: Japan, as a nation came under its first emperor Jimmu Tenno.²⁸⁵

Circa 9361 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)²⁸⁶

Circa 9361 HE: Nineveh, the monarch: “Ashurbanipal” arranged to have every cuneiform document in his kingdom to be copied for his personal library.^{287 288}

²⁸⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

²⁸⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

²⁸⁷ <https://en.wikipedia.org/wiki/Ashurbanipal>

²⁸⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

Circa 9361 HE: Bartering started to be replaced with the use of coins.²⁸⁹

94th Century HE

Circa 9401 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.²⁹⁰

²⁸⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

²⁹⁰ https://en.wikipedia.org/wiki/Greek_Baths and Françoise de Bonneville's ***The Book of the Bath***

Circa 9401 HE: Asia Minor, city of Magnesia, legend said a shepherd discovered that a certain type of ore which attracted iron.²⁹¹
Knowledge spread and...

⇒ ...**THALES** studied the fact in **Circa 9416 HE** (the dates are approximate) 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...²⁹²

⇒ ...eventually by **Circa 11800 HE**, English scholar **ALEXANDER NECKAM** was the first to refer to the directional ability of magnetism and Europeans put a magnetic needle on a

²⁹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

²⁹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 80

card marked with directions and called it the magnetic compass (the French word for “to go around”).²⁹³

Circa 9450 HE -9522 HE: CONFUCIUS, Latinized version of the CHINESE NAME KUNG FU-TZU:²⁹⁴ CONFUCIUS wrote about ethical-sociopolitical teachings, core family, social harmony, and humanistic values”²⁹⁵

²⁹³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 80

²⁹⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

²⁹⁵ <https://en.wikipedia.org/wiki/Confucius>



A portrait of CONFUCIUS by the Tang dynasty artist Wu Daozi, artist and location unknown.²⁹⁶

²⁹⁶ <https://en.wikipedia.org/wiki/Confucius>



Confucius Analects, artist and location unknown.²⁹⁷

²⁹⁷ <https://en.wikipedia.org/wiki/Analects>

Circa 9451 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.²⁹⁸

⇒ ALCMAEON OF CROTON was the first to discover part of the ear connecting the ear and the throat.²⁹⁹ (see **11552 HE** BARTOLOMMEO EUSTATCHIO)

Circa 9455 HE: THALES, Greek Scientist, Mathematician, Astronomer, Philosopher was the first to ask, “What was the universe made of?” THALES thought in terms of “elements.”³⁰⁰ It

²⁹⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

²⁹⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 112

³⁰⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

was THALES who realized the workings of nature could be explained without invoking the supernatural.³⁰¹

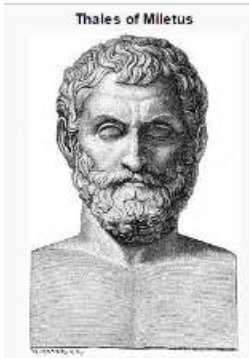
⇒ THALES studied the movements of the sun and the moon. THALES was one of the early astronomers who learned to predict when eclipses would take place. THALES made the first step toward defining eclipses as unavoidable and removed their ominous connotations.³⁰²

⇒ *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.³⁰³

³⁰¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

³⁰² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³⁰³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6



THALES, artist, date and location unknown.³⁰⁴

- ⇒ There was a moment when Humanity awakened to a new way of thinking and seeing. It happened about 2500 years ago, on the Greek islands that lie between the empires of the east and west.

³⁰⁴ <https://en.wikipedia.org/wiki/Thales>

But 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.³⁰⁵

Circa 9455 HE – 10400 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.³⁰⁶

³⁰⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

³⁰⁶ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



307

Circa 9481 HE: Athens was moving towards a democracy. Sparta was becoming more militaristic.³⁰⁸

Circa 9481 HE: PYTHAGORAS, Greek mathematician, scientist; Best known for the Pythagorean Theorem. Studied propositional geometry and vibrating lyre strings.³⁰⁹



Bust of PYTHAGORAS of Samos in the Capitoline Museums, Rome.³¹⁰

³⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³⁰⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³¹⁰ <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.³¹¹

Circa 9481 HE: China may have had a population of over 20,000,000 people.³¹²

³¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

Circa 9481 HE: The Persian Empire may have had a population of over 15,000,000 people.³¹³

Circa 9491 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".³¹⁴

⇒ ANAXAGORAS also gave a number of novel scientific accounts of natural phenomena. ANAXAGORAS produced another correct explanation for eclipses and described the sun as

³¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³¹⁴ <https://en.wikipedia.org/wiki/Anaxagoras>

a fiery mass larger than the Peloponnese, as well as attempting to explain rainbows and meteors.³¹⁵



ANAXAGORAS, part of a fresco in the portico of the National University of Athens.³¹⁶

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

³¹⁶ <https://en.wikipedia.org/wiki/Anaxagoras>

Circa 9491 HE: HECATAEUS OF MILETUS, Greek traveler³¹⁷ 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.³¹⁸

³¹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³¹⁸ https://en.wikipedia.org/wiki/Hecataeus_of_Miletus



Reconstruction of HECATAEUS's map, location unknown.³¹⁹

Circa 9494 HE – 9561 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.³²⁰ The kite may have been the first form of Human-made aircraft.³²¹

⇒ LU BAN’s wife was also credited with inventing the umbrella in order to permit him to work in inclement weather.³²²

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

³²⁰ https://en.wikipedia.org/wiki/Lu_Ban

³²¹ https://en.wikipedia.org/wiki/History_of_aviation

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

95th Century HE

Circa 9501 HE: Map of Eastern Hemisphere Human population groups. At this time the human population was about 100,000,000 people.³²³



Circa 9501 HE – 9901 HE: Ancient Greece Olympia Bathhouse:

⇒ A Greek bathhouse of circa **9501 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 **9601 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 **9901 HE** which saw an addition of a large apsidal room to the south along with a hypocaust system.³²⁵

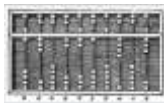
³²³ <http://www.worldometers.info/world-population/world-population-by-year/>

³²⁴ <http://worldhistorymaps.info>; Thomas Lessman

³²⁵ https://en.wikipedia.org/wiki/Greek_Baths; and Françoise de Bonneville's *The Book of the Bath*

Circa 9501 HE: The Abacus, Egypt, the first really important computing device worked out by humans.^{326 327}

⇒ The earliest known written documentation of the Chinese abacus dates to the **9801 HE**.³²⁸



⇒ A Chinese abacus (suanpan) (the number represented in the picture is 6302715408), artist unknown.³²⁹

³²⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³²⁷ <https://en.wikipedia.org/wiki/Abacus#Egyptian>

³²⁸ <https://en.wikipedia.org/wiki/Abacus#Chinese>

³²⁹ Encyclopædia Britannica - Article for "abacus", 9th edition Encyclopedia Britannica, volume 1 (11875 HE); scanned and uploaded by Malcolm Farmer Transferred from en.wikipedia to Commons.

Circa 9501 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.³³⁰

Circa 9501 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.³³¹

³³⁰ https://en.wikipedia.org/wiki/Hippocrates_of_Chios

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

Circa 9501 HE: PANINI, India, mathematician

⇒ PANINI's notations were similar to, (so may have launched?) modern mathematical notation, and PANINI used metarules, transformations, and recursion.^{332 333}

Circa 9501 HE – circa 9678 HE: 12 different Classical or Ancient Greek calendars based on regions were in use during this time.³³⁴

Circa 9521 HE: The Greeks further felt that the universe ran according to laws of nature that could be understood by observation and

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

³³³ Kadvany, John (2008-02-08). "Positional Value and Linguistic Recursion". Journal of Indian Philosophy

³³⁴ https://en.wikipedia.org/wiki/Hellenic_calendars

reasoning and did not require supernatural force or any force outside of or superior to the laws of nature.³³⁵

Circa 9531 HE – 9610 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)).³³⁶

⇒ In MOZI's writings could be found early stirrings of the scientific approach.³³⁷ By MO TZE's time, the Chinese had already been recording their thoughts in books for at least a

³³⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³³⁶ <https://en.wikipedia.org/wiki/Mozi>

³³⁷ <http://web.newworldencyclopedia.org/entry/Mozu>



thousand years.³³⁸

HE date unknown: line drawing of MO TZE, artist and location unknown.³³⁹

³³⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

³³⁹ <http://web.newworldencyclopedia.org/entry/Mozu>



c 9540 HE: A page from the Mozi, location unknown.³⁴⁰

³⁴⁰ <http://web.newworldencyclopedia.org/entry/Mozu>

⇒ Author / Compiler Note: See what happened to these works approximately 200 years later in the world's first book burning: Circa **9741 HE** – **9791 HE** by first emperor of China: Qin Shi Huang.³⁴¹

Circa 9541 HE: DEMOCRITUS: Greek, (/dɪ'mɒkrɪtəs/; Greek: Δημόκριτος, *Dēmókritos*, meaning "chosen of the people"³⁴² was an influential Ancient Greek pre-Socratic philosopher primarily remembered today for his formulation of an atomic theory of the universe.³⁴³

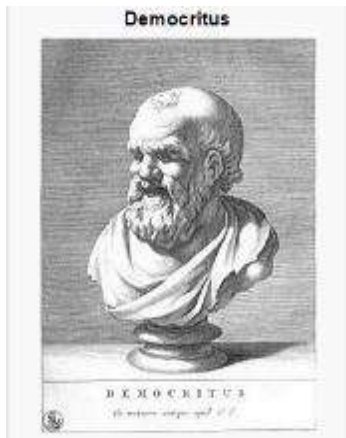
³⁴¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

³⁴² <https://en.wikipedia.org/wiki/Democritus>

³⁴³ <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 2300 years before atomistic views began to gain ascendancy.³⁴⁴
- ⇒ (See among others: **11627 HE – 11691 HE: ROBERT BOYLE** and the work he did circa 2140 years after DEMOCRITUS predicted atoms; and see **11893 HE – 11916 HE: the scientist ERNST MACH** who, more than 200 years even after BOYLE, declared, after an **11897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!" and then see **11922 HE: when NIELS HENRIK DAVID BOHR** got the Nobel Prize for defining the structure of an atom circa 2381 years after DEMOCRITUS' prediction.)

³⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



DEMOCRITUS, artist and location unknown.³⁴⁵

³⁴⁵ <https://en.wikipedia.org/wiki/Democritus>



Rembrandt, The Young Rembrandt as
Democritus the Laughing Philosopher (1628-
29)



Rembrandt as Democritus, The Laughing Philosopher **11628**
HE.³⁴⁶

³⁴⁶ <https://en.wikipedia.org/wiki/Democritus>

Circa 9567 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.³⁴⁷

⇒ 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.³⁴⁸

⇒ NOTE: HERODOTUS was not alone in doubting people could live south of the Equator. From the start of European people of

³⁴⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

³⁴⁸ <https://en.wikipedia.org/wiki/Herodotus>

that area – **circa 9851 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.³⁴⁹

Circa 9569 HE: EUCTEMON AND METON³⁵⁰: Athenian astronomers³⁵¹ who made records of the summer solstice of **9569 HE** which they observed³⁵² 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.³⁵³ Chris Parkin presents an

³⁴⁹ Dava Sobel's book: *Longitude*

³⁵⁰ <https://en.wikipedia.org/wiki/Timocharis>

³⁵¹ <https://en.wikipedia.org/wiki/Euctemon>

³⁵² <https://en.wikipedia.org/wiki/Euctemon>

³⁵³ <https://en.wikipedia.org/wiki/Timocharis>

animated explanation of the Armillary Sphere from the Museum of the History of Science collection.³⁵⁴

⇒ METON's further observations³⁵⁵ 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.³⁵⁶

³⁵⁴ <https://www.youtube.com/watch?v=AaWuJHQL-bQ>

³⁵⁵ https://en.wikipedia.org/wiki/Meton_of_Athens

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

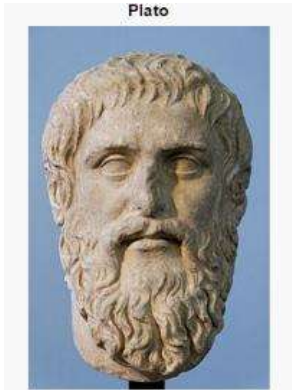


96th Century HE

Circa 9574 HE– 9654 HE: PLATO, Greek philosopher who laid the very foundations of Western philosophy and science.³⁵⁷ Some 250 known manuscripts of PLATO survive.³⁵⁸

³⁵⁷ "Plato". Encyclopedia Britannica. 2002

³⁵⁸ <https://en.wikipedia.org/wiki/Plato>



PLATO

Circa 9631 HE Roman Copy of a portrait bust by Silanion.
Photographer and location unknown.³⁵⁹

³⁵⁹ <https://en.wikipedia.org/wiki/Plato>



Papyrus Oxythynchus, with fragment of PLATO's **Republic**.³⁶⁰
 Photographer and location unknown.

³⁶⁰ <https://en.wikipedia.org/wiki/Plato>



PLATO'S CAVE³⁶¹

³⁶¹ 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.³⁶²

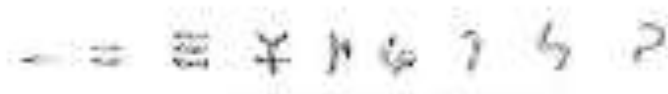
Circa 9601 HE: Greeks developed trade routes in the Mediterranean using the length of the day, corrected for the time of the year, to estimate latitude.³⁶³

Circa 9601 HE – 10200 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 fractions, simple equations, cubic

³⁶² https://en.wikipedia.org/wiki/Allegory_of_the_Cave

³⁶³ https://en.wikipedia.org/wiki/Ocean_exploration

equations, quartic equations, and permutations and combinations.^{364 365}



⇒

Jain first numerals; no zero yet³⁶⁶

⇒ The math book the “*Sthananga Sutra*” also gives classifications of five types of infinities.³⁶⁷

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

³⁶⁵ G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 1991 HE)

³⁶⁶ G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 1991 HE)

³⁶⁷ https://en.wikipedia.org/wiki/Sthananga_Sutra

⇒ The topics of mathematics, according to the Sthananga-sutra (sutra 747) are ten in numbers: Parikarma (four fundamental operations), 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).³⁶⁸

Circa 9617 HE – 9678 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.³⁶⁹

³⁶⁸ https://en.wikipedia.org/wiki/Sthananga_Sutra

³⁶⁹ <https://en.wikipedia.org/wiki/Aristotle>

- ⇒ Updated language by BBC Earth: ARISTOTLE said in his book "Again, our observations of the stars make it evident, not only that 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."³⁷⁰
- ⇒ ARISTOTLE classified and arranged over 500 animal species into hierarchies.³⁷¹
- ⇒ **Circa 9617 HE – 9678 HE:** 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.³⁷²

³⁷⁰ <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

³⁷¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

³⁷² Carlo Roveli's The Order of Time

- ARISTOTLE (**Circa 9600 HE**) concluded that time is measured by the changing of things and that if nothing changes, there is no time.³⁷³
- ISAAC NEWTON (see **11642 HE– 11727 HE**) concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.³⁷⁴
- ALBERT EINSTEIN (see **11879 HE – 11955 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.

³⁷³ Carlo Roveli’s *The Order of Time*

³⁷⁴ Carlo Roveli’s *The Order of Time*

Someone 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.³⁷⁵

- ⇒ Some of ARISTOTLE 's zoological observations, such as on the hectocotyli (reproductive) arm of the octopus, were not confirmed or refuted until the **11900's HE** (two thousand plus years later).³⁷⁶
- ⇒ Some of ARISTOTLE's works contain the earliest known formal study of logic, which was incorporated in the late **11800's HE** into modern formal logic.³⁷⁷

³⁷⁵ Carlo Roveli's *The Order of Time*

³⁷⁶ <https://en.wikipedia.org/wiki/Aristotle>

³⁷⁷ <https://en.wikipedia.org/wiki/Aristotle>

- ⇒ Circa **9663 HE**: ARISTOTLE began tutoring Alexander the Great.³⁷⁸
- ⇒ 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 **9921 HE** by soldiers of the Roman general Lucius Cornelius Sulla and they were taken to Rome and copied.³⁷⁹
- ⇒ ARISTOTLE recorded the use of diving bells "...they enable the divers to respire equally well by letting down a cauldron, for this

³⁷⁸ <https://en.wikipedia.org/wiki/Aristotle>

³⁷⁹ 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."³⁸⁰



Roman copy in marble of a Greek bronze bust of ARISTOTLE by Lysippus **Circa 9671 HE**. The alabaster mantle is modern.³⁸¹

³⁸⁰ https://en.wikipedia.org/wiki/Timeline_of_diving_technology

³⁸¹ <https://en.wikipedia.org/wiki/Aristotle>

Circa 9631 HE – 9701 HE: CALLIPPUS: Greek astronomer and mathematician³⁸² 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.³⁸³ (See **Circa 9796 HE – 9901 HE:** The Antikythera Mechanism.)

Circa 9631 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*

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

³⁸³ <https://en.wikipedia.org/wiki/Callippus>

Western Medicine” in recognition of his lasting contributions to the field as the founder of the Hippocratic School of Medicine.³⁸⁴



A fragment of HIPPOCRATIES Oath on circa **9631 HE** Papyrus Oxyrhynchus, location and photographer unknown.³⁸⁵

³⁸⁴ <https://en.wikipedia.org/wiki/Hippocrates>

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

Circa 9651 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.³⁸⁶

Circa 9678 HE – Circa 9855 HE: Hellenistic Greek period.

Circa 9681 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.³⁸⁷

Circa 9681 HE - 9741 HE TIMOCHARIS³⁸⁸ 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 ARISTILLUS in an astronomical observatory that was most likely

³⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

³⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 47

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

part of the Library of Alexandria. Their equipment would have been still the simple tools likely consisting of gnomons, sundials and an armillary sphere.³⁸⁹

Circa 9681 HE - 9741 HE: ARISTILLUS: Greek astronomer was among the earliest meridian-astronomy observers. Six of ARISTILLUS stellar declinations were preserved by CLAUDIUS PTOLEMY.³⁹⁰

Circa 9689 HE: Appian Way: The first roman built road, it was 132 miles long between Rome and Capua.³⁹¹

Circa 9689 HE: Another System of Chronology attempted; No political groupings among the ancients counted the years in the

³⁸⁹ <https://en.wikipedia.org/wiki/Timocharis>

³⁹⁰ <https://en.wikipedia.org/wiki/Aristyllus>

³⁹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 48

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.³⁹²

Circa 9696 HE: China, the world's earliest decimal multiplication table.³⁹³

³⁹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 54

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



The Tsinghua Bamboo Slips, containing the world's earliest decimal multiplication table, dated **9696 HE** during the Warring States period.³⁹⁴

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

Circa 9691 HE - 9771 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.^{395 396}

⇒ Like ANAXAGORAS before him, ARISTARCHUS OF SAMOS suspected and predicted that the stars were just other bodies like the Sun, albeit further away from Earth. But did not have the math or tools to prove it. (See **11473 HE - 11543 HE: NICOLAUS COPERNICUS**)

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

³⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 51



ARISTARCHUS OF SAMOS Statue at the Aristotle University of Thessaloniki.³⁹⁷

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

97th Century HE

Circa 9701 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.³⁹⁸

³⁹⁸ <https://en.wikipedia.org/wiki/Chankillo>



Circa 9701 HE: Thirteen Towers of Chankillo, viewed from the fortress, photographer and date unknown.³⁹⁹

³⁹⁹ <https://en.wikipedia.org/wiki/Chankillo>



Panorama of Chanquillo, photographer and date unknown.⁴⁰⁰

Circa 9701 HE: The Morocco area: Essaouira.



Roman coins excavated in Essaouira.⁴⁰¹

⁴⁰⁰ <https://en.wikipedia.org/wiki/Chankillo>

⁴⁰¹ <https://en.wikipedia.org/wiki/Essaouira>

Circa 9701 HE: PYTHIAS, Greek, observed the existence of true tides in the Atlantic Ocean and described them – and was disbelieved.⁴⁰²

Circa 9701 HE: Ptolemy I, Aka Ptolemy I Soter Greek Egyptian Ruler⁴⁰³ 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 Museum⁴⁰⁴ or Museum of Alexandria, or Alexandrian Museum, or The Greek Mouseion (“Seat of the Muses”).

⇒ **Built Circa 9721 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,

⁴⁰² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 49

⁴⁰³ Dava Sobel's book: Longitude

⁴⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 49

the Alexandrian Museum was built near the royal palace of Ptolemy I Soter (reigned Circa **9678 HE** –**Circa 9716 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.⁴⁰⁵



- Tetradrachm (Greek coin worth 4 drachmas) with portrait of Ptolemy I, in the British Museum, London.⁴⁰⁶

⁴⁰⁵ <https://www.britannica.com/topic/Alexandrian-Museum>

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



Bust of PTOLEMY I in the Louvre Museum.⁴⁰⁷

⁴⁰⁷ https://en.wikipedia.org/wiki/Ptolemy_I_Soter

Circa 9701 HE – 9801 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”.⁴⁰⁸ (See **Circa 11170 HE – 11250 HE:** LEONARDO BONACCI known as FIBONACCI.)

Circa 9725 HE - 9807 HE: ERATOSTHENES, Greek, mathematician, geographer, poet, astronomer, and music theorist.⁴⁰⁹

⁴⁰⁸ <https://en.wikipedia.org/wiki/Pingala>

⁴⁰⁹ MAX TEGMARK, Our Mathematical Universe

⇒ ERATOSTHENES correctly measured the Earth's circumference of 25000 miles / 40000 km in diameter.^{410 411}

- 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.

⁴¹⁰ <https://en.wikipedia.org/wiki/Eratosthenes>

⁴¹¹ 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.^{412 413}



⇒ ERATOSTHENES, artist and location unknown.⁴¹⁴

Circa 9731 HE: EUCLID⁴¹⁵, Egypt Greek mathematician, often referred to as the "founder of geometry" or the "*father of geometry*". EUCLID wrote *The Elements* (Ancient Greek:

⁴¹² <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

⁴¹³ MAX TEGMARK, Our Mathematical Universe

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

⁴¹⁵ MAX TEGMARK, Our Mathematical Universe

Στοιχεῖα Stoicheia) which is a mathematical treatise consisting of 13 books. He was active in Alexandria during the reign of Ptolemy I.⁴¹⁶



“EUCLID”; **11584 HE** colored woodcut- not his likeness because it was done circa 1800 years after he lived. Artist and location unknown.⁴¹⁷

⁴¹⁶ https://en.wikipedia.org/wiki/Euclid%27s_Elements

⁴¹⁷ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



Photo is of a fragment of the: Published circa **9701 HE**: A fragment of EUCLID'S *Elements* on part of the Oxyrhynchus papyri.⁴¹⁸

⁴¹⁸ https://en.wikipedia.org/wiki/Euclid%27s_Elements

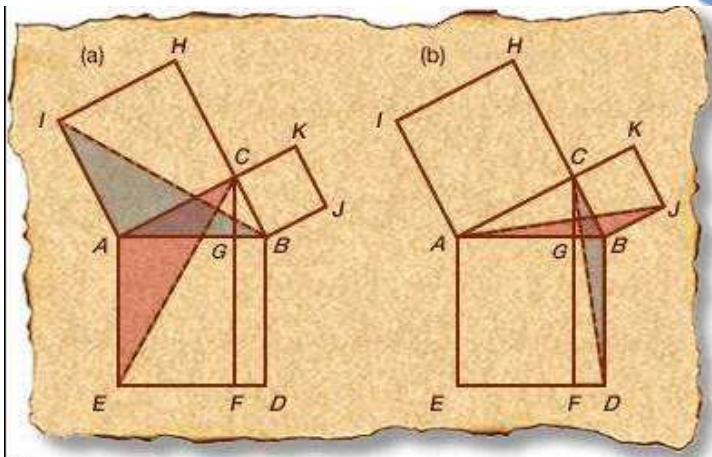
⇒ (Oxyrhynchus Papyri were written in Greek, Egyptian, Aramaic, Syrian and Pahlavi and are papyrus fragments the size of large cornflakes and are currently housed in institutions all over the world. A substantial number are housed in the Ashmolean Museum at Oxford University. There are estimated to be at least half a million papyri still remaining to be conserved, transcribed, deciphered and catalogued.⁴¹⁹)

⁴¹⁹ https://en.wikipedia.org/wiki/Oxyrhynchus_Papyri



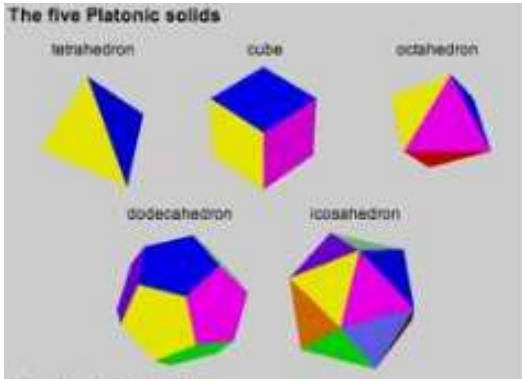
The frontispiece of Sir Henry Billingsley's first English version of EUCLID'S ***Elements***, **1570** HE reprint circa 1838 years after EUCLID wrote his book.⁴²⁰

⁴²⁰ https://en.wikipedia.org/wiki/Euclid%27s_Elements



EUCLID's Windmill proof.⁴²¹

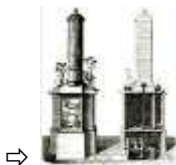
⁴²¹ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



Current drawing of **EUCLID's** five Platonic solids. These are the only geometric solids whose faces are composed of regular, identical polygons.⁴²²

⁴²² <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

Circa **9731 HE**: CTESIBIUS, Greek inventor and mathematician invented the first water clock. Until CTESIBIUS's water clock was invented, for circa 3730 years (See: **Circa 6001 HE**: Sundial invented), humans had marked the passage of time using sundials and other crude measures such as the hourglass or candles that burned.⁴²³



⇒ CTESIBIUS's water clock, as visualized by the **11600's HE** French architect Claude Perrault - dimensions unknown.⁴²⁴

⁴²³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 52

⁴²⁴ <https://en.wikipedia.org/wiki/Ctesibius>

Circa 9741 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.⁴²⁵

⁴²⁵ <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.⁴²⁶
- ⇒ 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.⁴²⁷
- ⇒ ARCHIMEDES died during the Siege of Syracuse when he was killed by a Roman soldier despite orders that he should not be harmed.⁴²⁸

⁴²⁶ <https://en.wikipedia.org/wiki/Archimedes>

⁴²⁷ <https://en.wikipedia.org/wiki/Archimedes>

⁴²⁸ <https://en.wikipedia.org/wiki/Archimedes>



This bronze statue of ARCHIMEDES is at the Archenhold Observatory in Berlin. It was sculpted by Gerhard Thieme.⁴²⁹

⇒ ARCHIMEDES Legacies: GALILEO praised ARCHIMEDES many times and referred to him as a "superhuman". LEIBNIZ said, "He who understands ARCHIMEDES AND

⁴²⁹https://upload.wikimedia.org/wikipedia/commons/2/25/Gerhard_Thieme_Archimedes.jpg

APOLLONIUS will 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 (**11973 HE**), Greece (**11983 HE**), Italy (**11983 HE**), Nicaragua (**11971 HE**), San Marino (**11982 HE**), and Spain (**11963 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 **11848 HE** which sparked the California Gold Rush.⁴³⁰

Circa 9741 HE – 9791 HE: Qin Shi Huang, first emperor of China. Most of us know Emperor Qin for the army of 7000 terra cotta warriors that guard his tomb⁴³¹ 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.⁴³²

⇒ However, Emperor Qin felt only his thoughts were important. He burned and destroyed the works of MO TZE (See Circa **9531**

⁴³⁰ <https://en.wikipedia.org/wiki/Archimedes>

⁴³¹ https://en.wikipedia.org/wiki/Qin_Shi_Huang

⁴³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 55

**HE – 9610 HE: MOZI) and CONFUCIUS (See Circa 9450 HE
-9522 HE: CONFUCIUS).**⁴³³

⇒ The works destroyed by him were victim of the world's first book burning.⁴³⁴



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⁴³³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁴³⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

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



Killing the Scholars and Burning the Books c 9788 HE Chinese

⇒ painting is 118th-century HE⁴³⁶

Circa 9796 HE – 9901 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 9569 HE: METON** and **Circa 9631 HE – 9701 HE: CALLIPPUS:**)⁴³⁷

⁴³⁶ https://en.wikipedia.org/wiki/Book_burning

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



The Antikythera mechanism (Fragment A – front). National Archaeological Museum, Athens.⁴³⁸

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



The Antikythera mechanism (Fragment A – back) National Archaeological Museum, Athens.⁴³⁹

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

Circa 9799 HE – 10200 HE: China: Some of the earliest evidence of water wells dug for retrieval of fresh water deeper in the ground.⁴⁴⁰



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.⁴⁴¹

⁴⁴⁰ https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation

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

98th Century HE

Circa 9831 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.⁴⁴²

Circa 9851 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.⁴⁴³

⁴⁴² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 56

⁴⁴³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57

HIPPARCHUS used the trigonometry he founded to calculate the distance from the Earth to the Moon.⁴⁴⁴

⇒ At its closest point (known as perigee) the Moon is only 363104 km (225622 miles) away. At its most distant point (called apogee) the Moon gets to a distance of 406696 km (252088 miles).⁴⁴⁵

⁴⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57

⁴⁴⁵ <https://www.universetoday.com/103206/what-is-the-distance-to-the-moon/>



Undated, unattributed drawing of HIPPARCHUS⁴⁴⁶

⁴⁴⁶ <https://en.wikipedia.org/wiki/Hipparchus>



Unattributed, HIPPARCHUS holding his celestial globe, in Raphael's The School of Athens (**circa 11510 HE**)⁴⁴⁷

⁴⁴⁷ <https://en.wikipedia.org/wiki/Hipparchus>

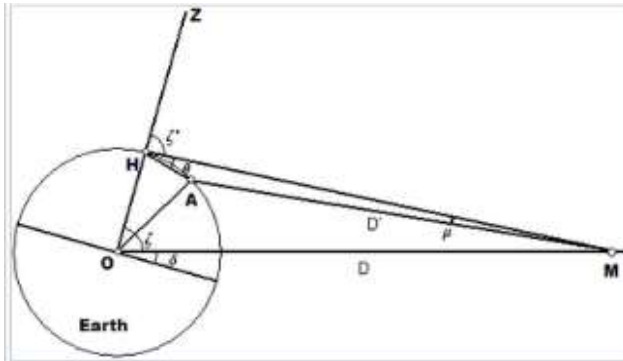


Diagram used in reconstructing one of HIPPARCHUS's methods of determining the distance to the moon. This represents the earth-moon system during a partial solar eclipse at A (Alexandria) and a total solar eclipse at H (Hellespont).⁴⁴⁸

⁴⁴⁸ <https://en.wikipedia.org/wiki/Hipparchus>

Circa 9855 HE – Circa 10529 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”:⁴⁴⁹
- ⇒ 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

⁴⁴⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

historians who believe that the widespread use of lead was a major cause in the decline and fall of the Roman Empire.⁴⁵⁰

- ⇒ 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.⁴⁵¹
- ⇒ See more about the “Star Stuff” element Lead: Scientist CLAIR CAMERON PATTERSON **11922 HE – 11995 HE.**

⁴⁵⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

⁴⁵¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

Circa 9871 HE: Slovenia: This Ljubljana Marshes Wheel with axle is the oldest wooden wheel yet discovered.⁴⁵²



Photo of the **Circa 9871 HE** Ljubljana Marshes Wheel. Photographer Petar Milošević, Present location: Ljubljana City Museum, Ljubljana, Slovenia⁴⁵³

⁴⁵² [https://en.wikipedia.org/wiki/Wheel#/media/File:Ljubljana_Marshes_Wheel_with_axle_\(oldest_wooden_wheel_yet_discovered\).jpg](https://en.wikipedia.org/wiki/Wheel#/media/File:Ljubljana_Marshes_Wheel_with_axle_(oldest_wooden_wheel_yet_discovered).jpg)

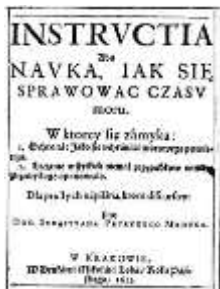
⁴⁵³ https://en.wikipedia.org/wiki/Ljubljana_Marshes_Wheel

99th Century HE

Beginning Circa 9900 HE – through circa 11800 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.⁴⁵⁴

⁴⁵⁴ https://en.wikipedia.org/wiki/Miasma_theory



11613 HE: Book by SEBASTIAN PETRYCY (**11554 HE–11626 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.⁴⁵⁵

⁴⁵⁵ https://en.wikipedia.org/wiki/Sebastian_Petrycy

- ⇒ **11674 HE:** Air, during these years, was considered homogenous, empty and inactive. *Suspensions about the Hidden Realities of the Air* (Author / Compiler could find no image) is a book on alchemy by ROBERT BOYLE (See **11627 HE – 11691 HE: ROBERT BOYLE**).⁴⁵⁶
- ⇒ **11880 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.⁴⁵⁷

⁴⁵⁶ https://en.wikipedia.org/wiki/Miasma_theory

⁴⁵⁷ https://en.wikipedia.org/wiki/Miasma_theory

Circa 9901 HE: Syria; Colored Glass blowing discovered. The art of producing clear glass was still not known.⁴⁵⁸

Circa 9901 HE: China Hemp paper invented.⁴⁵⁹



⇒ Fragments of hemp wrapping paper dated to the reign of Emperor Wu of Han (Circa **9860 HE – 9914 HE**).⁴⁶⁰

⁴⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁴⁵⁹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

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

Circa 9901 HE: India, the notion arose of having a leather loop suspended from the saddle for their horses. They invented the leather stirrup.⁴⁶¹

Circa 9902 HE – 9946 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*.⁴⁶²

⁴⁶¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 64

⁴⁶² <https://en.wikipedia.org/wiki/Lucretius>

Titus Lucretius Carus



Modern bust of Lucretius



Bust of TITUS LUCRETIUS CARUS, artist, date and location unknown.⁴⁶³

⁴⁶³ <https://en.wikipedia.org/wiki/Lucretius>



Piece of Manuscript of *De Re Natura* in Cambridge University Library Collection.⁴⁶⁴

⁴⁶⁴ <https://en.wikipedia.org/wiki/Lucretius>

Circa 9916 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.⁴⁶⁵

Circa 9953 HE: The Royal Library / The Museum of Alexandria 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 Alexandria, explained that "Caesar was forced to repel the danger by using fire, which spread from the dockyards and destroyed the Great Library."⁴⁶⁶

⁴⁶⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁴⁶⁶ <https://www.britannica.com/topic/Library-of-Alexandria>

Circa 9955 HE: Julian Calendar introduced.⁴⁶⁷

100th Century HE

Circa 10001 HE: Maps of peoples around the world.⁴⁶⁸

⁴⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 60

⁴⁶⁸ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10001 HE Map of Peoples in Northwest Hemisphere.⁴⁶⁹

⁴⁶⁹ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10001 HE Map of Peoples in Southwest Hemisphere.⁴⁷⁰

⁴⁷⁰ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10001 HE Map of Peoples African Continent.⁴⁷¹

⁴⁷¹ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10001 HE Map of Peoples in Euro Asia and the Malays.⁴⁷²

⁴⁷² https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG



Circa 10001 HE Map of Peoples in Australia.⁴⁷³

⁴⁷³ https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG

Circa 10080 HE: The Roman Colosseum was built. For some time, Roman numerals were in use.

Symbol	I	V	X	L	C	D	M
Value	1	5	10	50	100	500	1,000

⇒

474

⇒ No one is sure when they started but the Colosseum Entrance to section LII (52) has Roman Numerals still visible.⁴⁷⁵

⁴⁷⁴ https://en.wikipedia.org/wiki/Roman_numerals

⁴⁷⁵ https://en.wikipedia.org/wiki/Roman_numerals



Colosseum Entrance to section LII (52) with numerals still visible, photographer unknown.⁴⁷⁶

⁴⁷⁶ https://en.wikipedia.org/wiki/Roman_numerals

Circa 10050 HE: The first written mention of Japan is in Chinese written texts.⁴⁷⁷

Circa 10050 HE: PEDANIUS DIOSCORIDES, Greek physician, pharmacologist, botanist⁴⁷⁸ 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.⁴⁷⁹

⁴⁷⁷ <https://en.wikipedia.org/wiki/Japan>

⁴⁷⁸ https://en.wikipedia.org/wiki/Pedanius_Dioscorides

⁴⁷⁹ 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 **10600 HE Greek Juliana Anicia Codex**
 DIOSCORIDES receives a mandrake root.⁴⁸⁰

⁴⁸⁰ https://en.wikipedia.org/wiki/Pedanius_Dioscorides



⇒ **11554 HE:** Circa 1500 years after being written, this photo is of the cover of a re-printed version of PEDANIUS DIOSCORIDES *De Materia Medica*, Lyon.⁴⁸¹

⁴⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

Circa 10050 HE: HERO of ALEXANDRIA, Greek engineer invented the steam engine. The modern sprinkler system works in precisely the same design – without the heat.⁴⁸²

⇒ 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

⁴⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

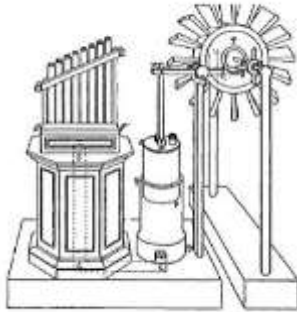
lengths, a work in which the odometer and the Dioptra, an apparatus which resembles the theodolite, are described; **Belopoeica**, a description of war machines; **Catoptrica**, about the progression of light, reflection and the use of mirrors.⁴⁸³



The book **About Automata** by HERO of ALEXANDRIA (circa

⁴⁸³ https://en.wikipedia.org/wiki/Hero_of_Alexandria

1500 years after HERO's book was written...**11589 HE** edition).⁴⁸⁴



This is an **11899 HE** drawing of HERO's wind-powered organ,

⁴⁸⁴ https://en.wikipedia.org/wiki/Hero_of_Alexandria

the earliest recorded machine powered by a windwheel, artist W. Schmidt, location unknown.⁴⁸⁵

Circa 10090 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.⁴⁸⁶



⁴⁸⁵ https://en.wikipedia.org/wiki/History_of_wind_power

⁴⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 73

101st Century HE

Circa 10100 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.⁴⁸⁷

⁴⁸⁷ "**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 12016 HE; Laurence M. V. (12009 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.⁴⁸⁸

⁴⁸⁸ https://en.wikipedia.org/wiki/History_of_abortion

Circa 10100 HE - Circa 10200 HE: SORANUS OF EPHESUS was an ancient Greek physician.⁴⁸⁹

- ⇒ SORANUS OF EPHESUS recommended abortion in cases involving health complications as well as emotional immaturity and provided detailed suggestions in his work *Gynecology*.⁴⁹⁰
- ⇒ 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, which he described

⁴⁸⁹ https://en.wikipedia.org/wiki/Soranus_of_Ephesus

⁴⁹⁰ https://en.wikipedia.org/wiki/History_of_abortion

as the "Lacedaemonian Leap". He also offered a number of recipes for herbal baths, rubs, and pessaries.⁴⁹¹

⇒ Although abortion was accepted in Rome, attitudes changed with the spread of Christianity and around **10211 HE** emperors Septimius Severus and Caracalla banned abortion as infringing on parental rights; temporary exile was the punishment.⁴⁹²

Circa 10100 HE: NICOMACHUS: ancient Greek mathematician influenced by ARISTOTLE⁴⁹³ is best known for his works *Introduction to Arithmetic* and *Manual of Harmonics* in Greek.⁴⁹⁴

⁴⁹¹ https://en.wikipedia.org/wiki/History_of_abortion#cite_note-Soranus-46

⁴⁹² Jeffrey H. Reiman, *Abortion and the Ways We Value Life* (Rowman and Littlefield 1998 ISBN 978-0-8476-9208-8), p, 19

⁴⁹³ <https://en.wikipedia.org/wiki/Nicomachus>

⁴⁹⁴ <https://en.wikipedia.org/wiki/Nicomachus>

Circa 10105 HE: TSAI LUN, China, invented *paper*: the smooth writing surface from cellulose. It took 1000 years for knowledge of paper to reach Europe.⁴⁹⁵

Circa 10105 HE: The Roman Empire may have had 40 million people.⁴⁹⁶

Circa 10105 HE: The population of China may have been around 50 million people.⁴⁹⁷

Circa 10129 HE – Circa 10210 HE: AELIUS OR CLAUDIUS GALENUS, Greek, GALEN of PERGAMON (sometimes spelled Pergamum), when anglicized, Rome, Greek/Roman physician.⁴⁹⁸

⁴⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

⁴⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

⁴⁹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

⁴⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

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.^{499 500}

- ⇒ 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.⁵⁰¹
- ⇒ 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

⁴⁹⁹ <https://en.wikipedia.org/wiki/Galen>

⁵⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

⁵⁰¹ <https://en.wikipedia.org/wiki/Galen>

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.⁵⁰²

⁵⁰² <https://en.wikipedia.org/wiki/Galen>



Modern statue of GALEN in his hometown, Pergamon.⁵⁰³

⁵⁰³ <https://en.wikipedia.org/wiki/Galen>

Circa 10150 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 and political rights of Roman citizenship.⁵⁰⁵ 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.⁵⁰⁶

⁵⁰⁵ <https://en.wikipedia.org/wiki/Ptolemy>

⁵⁰⁶ Dava Sobel's book: Longitude



Since no contemporary depictions or descriptions of **CLAUDIUS 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.⁵⁰⁷

⁵⁰⁷ <https://en.wikipedia.org/wiki/Ptolemy>



This **11476 HE** depiction of **CLAUDIUS PTOLEMY** with an armillary sphere Earth centric model, by Joos van Ghent and Pedro Berruguete is at The Louvre, Paris.⁵⁰⁸

⁵⁰⁸ <https://en.wikipedia.org/wiki/Ptolemy>

102nd Century HE

Circa 10200 HE: India: VATSYAYANA, wrote a classical text, which presented various contraceptive methods including coitus obstructus involving controlling the release of semen.⁵⁰⁹

Circa 10200 HE: China used tea leaves to flavor boiled water.⁵¹⁰

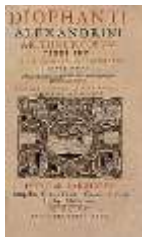
Circa 10200 HE: Human population had reached approximately 190,000,000 people.⁵¹¹

⁵⁰⁹ https://en.wikipedia.org/wiki/History_of_birth_control

⁵¹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

⁵¹¹ <http://www.worldometers.info/world-population/world-population-by-year/>

Circa 10250 HE: DIOPHANTUS, Greek mathematician. wrote an Algebra text.⁵¹² Author / Compiler Note: this is Circa 1069 years after circa **9181 HE:** when AL-MAHAINI, of Persia (see above) used the not yet named area of math we now call Algebra.⁵¹³



Title page of the **11621 HE** reprint edition **DIOPHANTUS's**

⁵¹² <https://en.wikipedia.org/wiki/Diophantus>

⁵¹³ https://en.wikipedia.org/wiki/Timeline_of_geometry

Arithmetica, translated into Latin by Claude Gaspard Bachet de Méziriac.⁵¹⁴

103rd Century HE

Circa 10300 HE: China expanded on the **9901 HE** India notion of the leather stirrup and made stirrups of metal.⁵¹⁵

Circa 10300 HE – 11150 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.⁵¹⁶

⁵¹⁴ <https://en.wikipedia.org/wiki/Diophantus>

⁵¹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

⁵¹⁶ https://en.wikipedia.org/wiki/Tiwanaku_empire

Circa 10323 HE: “Constantine the Great” recognized the Christian religion, and closed the Karnak complex, in Egypt.⁵¹⁷

Circa 10335 HE - 10405 HE: THEON of Alexandria, Greek of Alexandria, Egypt, mathematician⁵¹⁸ 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 **11808 HE**".⁵¹⁹

⇒ THEON made predictions and observances of solar and lunar eclipses in **10364 HE** which show he was active at that time.⁵²⁰

⁵¹⁷ https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re

⁵¹⁸ https://en.wikipedia.org/wiki/Theon_of_Alexandria

⁵¹⁹ Thomas Little Heath (11921HE). "*A history of Greek mathematics*".

⁵²⁰ https://en.wikipedia.org/wiki/Theon_of_Alexandria

⇒ THEON was the father of the mathematician HYPATIA.

Circa 10350 HE: China, invents carving a wooden block with a raised reverse symbol that can then be used to print on paper.⁵²¹

Circa 10370 HE - 10415 HE: HYPATIA, Greek, of Alexandria, Egypt, then part of the Eastern Roman Empire; was a Hellenistic Neoplatonist philosopher, astronomer, and mathematician.⁵²²

⇒ 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*

⁵²¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

⁵²² 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>

Arithmetica, which may survive in part, having been interpolated into Diophantus's original text, and another commentary on Apollonius 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.⁵²³

⇒ HYPATIA was killed by a Christian mob in **10415 HE** during a period of religious and sectarian conflict.⁵²⁴

⁵²³ <https://en.wikipedia.org/wiki/Hypatia>

⁵²⁴ https://en.wikipedia.org/wiki/Theon_of_Alexandria



Illustration by Louis Figuier from **11866 HE** representing the assault against Hypatia.⁵²⁵

Circa 10370 HE – c 10529 HE: The final phase of Antiquity Roman Greece Empire is the period of Christianization which closed the

⁵²⁵ <https://en.wikipedia.org/wiki/Hypatia>

physical Roman Empire with the closure of the Academy of Athens by Justinian.⁵²⁶

- ⇒ ISAAC ASIMOV wondered what would have happened if Greek science had continued uncrushed by the weight of Roman lack of interest?⁵²⁷
- ⇒ 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.

⁵²⁶ https://en.wikipedia.org/wiki/Ancient_Greece

⁵²⁷ 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.⁵²⁸

Circa 10370 HE - Circa 11500 HE: European DARK AGES.

Circa 10391 HE: The daughter library of the Great Museum of Alexandria protected by the Serapeum, subsisted another circa 438 years after the main library was a casualty of war and then was intentionally destroyed.

⇒ 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 **10391 HE**

⁵²⁸ <http://www.soaphistory.net/soap-facts/soap-benefits/>

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 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.⁵²⁹

104th Century HE

Circa 10400 HE: China, wheelbarrows invented⁵³⁰

⁵²⁹ <https://www.britannica.com/topic/Library-of-Alexandria>

⁵³⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

**Circa 10400 HE to 11100 HE: Native Petroglyphs at Canyonlands
National Park, Utah.**⁵³¹



⇒ 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.⁵³²

⁵³¹ <https://www.youtube.com/watch?v=CczH6P41nUs> (GoTraveler)

⁵³² [https://en.wikipedia.org/wiki/Horseshoe_Canyon_\(Utah\)](https://en.wikipedia.org/wiki/Horseshoe_Canyon_(Utah))

Circa 10450 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.⁵³³



Hawaiian navigators sailing multi-hulled canoe, c. **11781 HE**;
Artist: John Webber, artist aboard Cook's ship.

⁵³³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

Circa 10476 HE – 10550 HE: India, ARYABHATA aka ARYABHATA I aka ARYABHATTA.⁵³⁴ 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 daily⁵³⁵ was lost in the dark ages of Europe - so much so that when COPERNICUS (See **11473 HE - 11543 HE: NICOLAUS COPERNICUS**) finally revealed the fact, it was as if COPERNICUS was indeed the first human to prove it.⁵³⁶

⁵³⁴ Robert Green Ingersoll's **11869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation "*The gods and other lectures*"

⁵³⁵ <https://en.wikipedia.org/wiki/Aryabhata>

⁵³⁶ Robert Green Ingersoll's **11869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation "*The gods and other lectures*"

⇒ 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 chhatra-yantra, and water clocks of at least two types, bow-shaped and cylindrical.⁵³⁷

⁵³⁷ <https://en.wikipedia.org/wiki/Aryabhata>

- ⇒ 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-BĪRŪNĪ⁵³⁸ (See Circa **11148 HE**: ABURAYHAN AL-BIRUNI).⁵³⁹
- ⇒ 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 ($1 - \cos x$) tables, in 3.75° intervals from 0° to 90° , to an accuracy of 4 decimal places. In fact, modern names "sine"

⁵³⁸ <https://en.wikipedia.org/wiki/Aryabhata>

⁵³⁹ <https://en.wikipedia.org/wiki/Aryabhata>

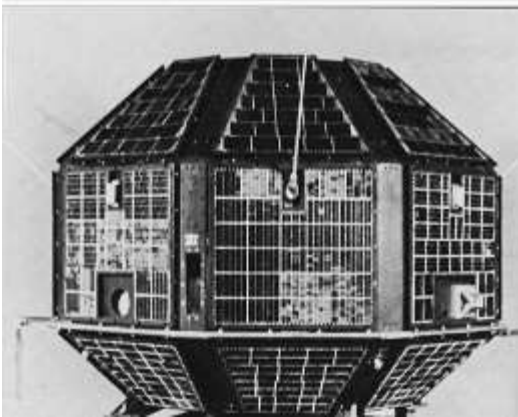
and "cosine" are mis-transcriptions of the words *jya* and *kojya* as introduced by ARYABHATA.⁵⁴⁰

⁵⁴⁰ <https://en.wikipedia.org/wiki/Aryabhata>



Statue of ARYABHATA on the grounds of IUCAA, Pune, India, photographer unknown.⁵⁴¹

⁵⁴¹ <https://en.wikipedia.org/wiki/Aryabhata>



India's first satellite named after ARYABHATA, photographer, date and location unknown.⁵⁴²

⁵⁴² <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.⁵⁴³

⁵⁴³ [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.⁵⁴⁴

⁵⁴⁴ [https://en.wikipedia.org/wiki/Aryabhata_\(crater\)](https://en.wikipedia.org/wiki/Aryabhata_(crater))

105th Century HE

Circa 10500 HE: Ancient Chumash Native American Tribe
pictographs in Simi Valley, United States, photographer
unknown.⁵⁴⁵



⁵⁴⁵ https://en.wikipedia.org/wiki/Chumash_people

Circa **10500 HE – 10570 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.^{546 547}

Circa **10505 HE –10587 HE**: VARAHAMIHIRA: was a Sub-Continent Indian astronomer, mathematician, and astrologer who lived in Ujjain.⁵⁴⁸

⇒ His contributions include Trigonometry and improved accuracy of the sine tables of ARYABHATA. He was among the first mathematicians to discover a version of what is now known as the PASCAL'S triangle which he used it to calculate the binomial coefficients. Among his contributions to physics is his

⁵⁴⁶ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

⁵⁴⁷ <https://en.wikipedia.org/wiki/Yativrṣabha>

⁵⁴⁸ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

optics statement that “reflection is caused by the back-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, a compendium of Greek, Egyptian, Roman and Indian astronomy, VARAHAMIHIRA’s knowledge of Western astronomy was thorough. In 5 sections, his monumental work 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.^{549 550}

⁵⁴⁹ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians and Encyclopedia Britannica (12007 HE) s.v. Varahamihira 2. E. C. Sachau, Alberuni's India (11910 HE), vol. I, p. 153

⁵⁵⁰ <https://en.wikipedia.org/wiki/Varāhamihira>

10598 HE – 10668 HE: BRAHMAGUPTA: Sub-Continent Indian mathematician and astronomer⁵⁵¹ was the Editor of two early works on mathematics and astronomy: a theoretical treatise, and a more practical text.⁵⁵²

- ⇒ **C 10650 HE: BRAHMAGUPTA** was the first to give rules to compute with zero.
- ⇒ The texts composed by him were composed in elliptical verse in Sanskrit, as was common practice in Indian mathematics. As no proofs are given, it is not known how his results were derived.⁵⁵³
 - Author / Compiler note: as I am editing, I see that ASIMOV, as well as Wikipedia, reference Circa **10810 HE** as the time

⁵⁵¹ https://en.wikipedia.org/wiki/List_of_Indian_mathematicians

⁵⁵² <https://en.wikipedia.org/wiki/Brahmagupta>

⁵⁵³ <https://en.wikipedia.org/wiki/Brahmagupta>

when the concept of “0” / ZERO as a digit in the decimal place value notation was developed in India.^{554 555} Author / Compiler wonders if circa **10810 HE** is when proofs began to be given?

106th Century HE

Circa 10600 HE: The population of the world was approximately 200,000,000 people.⁵⁵⁶

Circa 10600's HE – 10900'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

⁵⁵⁴ <https://en.wikipedia.org/wiki/Zero>

⁵⁵⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 71

⁵⁵⁶ <http://www.worldometers.info/world-population/world-population-by-year/>

vertical driveshafts with six to twelve rectangular sails covered in reed matting or cloth. These windmills were used to pump water, and in the gristmilling and sugarcane industries.⁵⁵⁷

Circa 10622 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 11976 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 11979 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*

⁵⁵⁷ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

calendar, Iranian Rule Based calendar; Jalali Rule Based calendar; Late Ottoman-era solar Hijri calendar; Afghanistan Rule Based calendar; The Tabular Islamic Rule Based calendar.⁵⁵⁸

Circa 10660 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 increased⁵⁵⁹ to approximately 200,000,000 people.⁵⁶⁰

Circa 10660 HE: China, Woodblock Printing.⁵⁶¹

⁵⁵⁸ https://en.wikipedia.org/wiki/Islamic_calendar

⁵⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

⁵⁶⁰ <http://www.worldometers.info/world-population/world-population-by-year/>

⁵⁶¹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions



10618 HE–10907 HE: Frontispiece of *The Diamond Sutra*, the oldest printed book, during the Tang Dynasty, photographer and location unknown.⁵⁶²

⁵⁶² https://en.wikipedia.org/wiki/List_of_Chinese_inventions

107th Century HE

Circa 10700 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”, after the country where it was invented.⁵⁶³

Circa 10700 HE: The population of the world was approximately 210,000,000 people.⁵⁶⁴

Circa 10700 HE: Persia, windmills use further developed in Middle East.⁵⁶⁵

⁵⁶³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 69

⁵⁶⁴ <http://www.worldometers.info/world-population/world-population-by-year/>

⁵⁶⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 79

Circa 10700s HE: HALAYUDHA, Indian sub-continent mathematician wrote a commentary on PINGALA's *Chandahśāstra* and expanded it and including a clear description of Pascal's triangle called meru-prastaara.^{566 567}

⇒ HALAYUDHA composed the following works: *Kavi-Rahasya*, a book on poetics; *Mrta-Sañjīvanī*, a commentary on PINGALA's *Chandah-śāstra* and *Abhidhana-ratna-mala*, a lexicon⁵⁶⁸ describing the vocabulary or language or branch of knowledge.⁵⁶⁹

⇒

⁵⁶⁶ <https://en.wikipedia.org/wiki/Pingala>

⁵⁶⁷ <https://en.wikipedia.org/wiki/Halayudha>

⁵⁶⁸ <https://en.wikipedia.org/wiki/Halayudha>

⁵⁶⁹ <https://en.wikipedia.org/wiki/Halayudha>

Circa 10733 HE – 11066 HE: Norse / Viking Age, Vikings explore and colonize Iceland, Greenland, Newfoundland.⁵⁷⁰



Longship on Tjängvide image stone, **10800 HE -11099 HE.**⁵⁷¹

⁵⁷⁰ https://en.wikipedia.org/wiki/History_of_Greenland

⁵⁷¹ https://en.wikipedia.org/wiki/Viking_Age

Circa 10750 HE - Circa 11300 HE: *The Islamic Golden Age*. Arab world contributions to science & math, and to the preservation of historical learning.

- ⇒ By this time on our *HE Timeline of Human Accomplishments, Advancements, Innovations and Understanding*, Greek learning had almost been forgotten in Europe.⁵⁷²
- ⇒ 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.⁵⁷³ Known as *The Islamic Golden Age*, in the history of Islam, during which much of the historically Islamic world was

⁵⁷² https://en.wikipedia.org/wiki/Islamic_Golden_Age

⁵⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69

ruled by various caliphates, and science, and economic development. Also, cultural works flourished.⁵⁷⁴



Circa 11237 HE art of Scholars at an Abbasid library, from the Maqamat of al-Hariri by Yahya ibn Mahmud al-Wasiti, Baghdad⁵⁷⁵

⁵⁷⁴ https://en.wikipedia.org/wiki/Islamic_Golden_Age

⁵⁷⁵ https://en.wikipedia.org/wiki/Islamic_Golden_Age

Circa 10750 HE: JABIR IBN HAYYAN aka GEBER, Persian chemist, polymath, pharmacist, physician⁵⁷⁶ who introduced the experimental method and controlled experiment in chemistry.⁵⁷⁷

⇒ 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.⁵⁷⁸

⁵⁷⁶ https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan

⁵⁷⁷ <http://sciencetimeline.blogspot.com/2009/11/timeline-of-scientific-experiments.html>

⁵⁷⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69



Circa 11600 HE European imagination portrait of "GEBER",
Codici Ashburnhamiani 11166 HE, Biblioteca Medicea
 Laurenziana, Florence, Italy.⁵⁷⁹

⁵⁷⁹ https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan

Circa 10770 HE: Iron horseshoes, but not yet harnesses, were coming into use.⁵⁸⁰

108th Century HE

Circa 10800 HE: China, (see **10350 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.⁵⁸¹

⁵⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 70

⁵⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

Circa 10825 HE: AL-KHWARIZMI, aka MUHAMMAD IBN MUSA
AL-KHWARIZMI: Persian mathematician^{582 583} wrote the book
On the Calculation with Hindu Numerals in Arabic.⁵⁸⁴

⇒ 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

⁵⁸² https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi

⁵⁸³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 71

⁵⁸⁴ https://en.wikipedia.org/wiki/Hindu_Arabic_numeral_system

democratized arithmetical computation, bringing it to within reach of everyone.⁵⁸⁵

- ⇒ **Circa 10833 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".⁵⁸⁶
- Author / Compiler Note: this is Circa 1069 years after circa **9181 HE:** when AL-MAHAINI, of Persia (see above) who conceived the idea of reducing geometrical problems such as

⁵⁸⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 71

⁵⁸⁶ https://en.wikipedia.org/wiki/Hindu_Arabic_numeral_system

doubling a cube in problems in the not yet named area of math we now call Algebra.⁵⁸⁷

- This is c583 years since see circa **10250 HE** when DIOPHANTUS wrote an Algebra text.⁵⁸⁸

⁵⁸⁷ https://en.wikipedia.org/wiki/Timeline_of_geometry

⁵⁸⁸ <https://en.wikipedia.org/wiki/Diophantus>



AL-KHWARIZMI statute in Amir Kabir University, Tehran,
date and artist unknown.⁵⁸⁹

⁵⁸⁹ https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi

- ⇒ **Circa 10825 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*.⁵⁹⁰



- ⇒ Imagination Portrait of AL-KINDI; date, location, and artist unknown.⁵⁹¹

⁵⁹⁰ https://en.wikipedia.org/wiki/Arabic_numerals

⁵⁹¹ <https://en.wikipedia.org/wiki/Al-Kindi>

Circa 10830 HE: SIND IBN ALI, Baghdad.⁵⁹² He introduced the Indian decimal point notation, and also wrote the earliest treatise on Arabic numerals.⁵⁹³

⇒ SIND IBN ALI is known to have translated and modified the first astronomical table ever introduced in the muslim world.⁵⁹⁴

⇒ 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.⁵⁹⁵

⁵⁹² https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁵⁹³ https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁵⁹⁴ https://en.wikipedia.org/wiki/Sind_ibn_Ali

⁵⁹⁵ https://en.wikipedia.org/wiki/Sind_ibn_Ali

Circa 10850 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.⁵⁹⁶

109th Century HE

Circa 10952 HE: ABU-HASAN-AL-UQLISDISI, Syrian mathematician wrote the treatise about Middle eastern mathematicians who extended the decimal numeral system to include fractions.⁵⁹⁷

⁵⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 72

⁵⁹⁷ https://en.wikipedia.org/wiki/Abu_Hasan_al-Uqlidisi

Circa 10960 HE – Circa 11279: 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.⁵⁹⁸

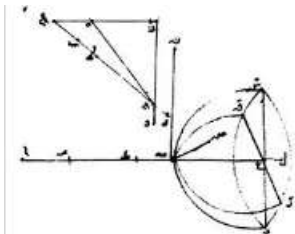
⁵⁹⁸ https://en.wikipedia.org/wiki/History_of_printing

Circa 10986 HE: IBN SAHL was a Persian mathematician, physicist and optics engineer of the Islamic Golden Age associated with the Abbasid court of Baghdad.⁵⁹⁹ IBN SAHL's circa **10986 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.⁶⁰⁰

⁵⁹⁹ https://en.wikipedia.org/wiki/Ibn_Sahl

⁶⁰⁰ https://en.wikipedia.org/wiki/Ibn_Sahl



سأفهم ان ما تراه على سطح مستوي يورثه لان هذا السطح ينشأ على سطح مستوي
 على نقطة تسمى نقطة مركز السطح احاطت على ب. ب. بعد ذلك
 الخط مستوي والفصل المستوي بين هذا السطح وبين سطح قطع ق. ر.
 خط مستوي لان هذا السطح ياتر من نقطة م على نقطة تسمى نقطة
 مستوية ق. ر. على نقطة تسمى نقطة م. وان خط مستوي على هذا
 فلان ياتر من نقطة تسمى نقطة مستوية غير على سطح مستوي



Reproduction of a page of IBN SAHL's manuscript showing his discovery of the law of refraction⁶⁰¹

⁶⁰¹ https://en.wikipedia.org/wiki/Ibn_Sahl

Circa 10900, HE – circa 11000 HE: MUHAMMAD IBN ZAKARIYA

AL-RAZI, Persian chemist and physician who introduced controlled experiment into the field of medicine and carried out the medical experiment in order to find the most hygienic place to build a hospital.⁶⁰²

- ⇒ 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.⁶⁰³
- ⇒ MUHAMMAD IBN ZAKARIYA AL-RAZI is said to be the first to produce acids such as sulfuric acid, writing up notes on diseases such as smallpox and chickenpox, a pioneer in

⁶⁰² https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

⁶⁰³ Bullough, Vern L., ed. (12001 HE). *Encyclopedia of Birth Control*. ABC-CLIO. p. 154. ISBN 978-1-57607-533-3.

ophthalmology, editor of the first book on pediatrics, making leading contributions in inorganic and organic chemistry, also the editor of several philosophical works.⁶⁰⁴

⇒ 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".⁶⁰⁵

⁶⁰⁴ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

⁶⁰⁵ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi



Imagination portrait MUHAMMAD IBN ZAKARIYA AL-RAZI, artist and location unknown.⁶⁰⁶

⁶⁰⁶ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi



Colophon of MUHAMMAD IBN ZAKARIYA AL-RAZI's
Book of Medicine.⁶⁰⁷

⁶⁰⁷ https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi

Circa 10900, HE or circa 11000 HE: ALI IBN ABBAS AL-MAJUSI, Persia, documented the use of pessaries made of rock salt for women for whom pregnancy may be dangerous.⁶⁰⁸

Circa 10900 HE: The population of the world was approximately 240,000,000 people.⁶⁰⁹

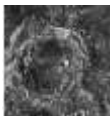
Circa 10973 HE: ABURAYHAN AL-BIRUNI, Persian chronicler of India, Geodesy and Earth scientist; astronomer; conversant in 7 languages. He conducted the first elaborate experiments related to astronomical phenomena since the Greeks. He introduced the experimental method into mechanics. He was conversant in

⁶⁰⁸ "*Definition of Birth control*". MedicineNet.

⁶⁰⁹ <http://www.worldometers.info/world-population/world-population-by-year/>

Khwarezmian, Persian, Arabic, Sanskrit, and also knew Greek, Hebrew and Syriac.⁶¹⁰

⇒ 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.⁶¹¹



⇒

Lunar crater Al-Biruni, on the far side of the Moon, as seen by Apollo 14.⁶¹²

⁶¹⁰ <https://en.wikipedia.org/wiki/Al-Biruni>

⁶¹¹ <https://en.wikipedia.org/wiki/Al-Biruni>

⁶¹² <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 ⁶¹³

⁶¹³ <https://en.wikipedia.org/wiki/Al-Biruni>

Circa 10990 HE – circa 10051 HE: BI SHENG, Chinese artisan who invented movable type.⁶¹⁴

110th Century HE

Circa 11006 HE: ALI IBN RIDWAN, Egyptian astronomer⁶¹⁵ who observed and wrote about Supernova SN 1006.⁶¹⁶

⁶¹⁴ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁶¹⁵ https://en.wikipedia.org/wiki/Ali_ibn_Ridwan

⁶¹⁶ <https://en.wikipedia.org/wiki/Star>



ALI IBN RIDWAN's, unknown artistic drawing.⁶¹⁷

Circa 11020 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.

⁶¹⁷ https://en.wikipedia.org/wiki/Ali_ibn_Ridwan

- ⇒ 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.⁶¹⁸



- ⇒ AVICENNA IBN SINA Conventional modern portrait (on a

⁶¹⁸ <https://en.wikipedia.org/wiki/Avicenna>

silver vase, Avicenna Mausoleum and Museum: Hamadan, Iran).⁶¹⁹

Circa 11021 HE: At the research institutes of Baghdad, Cairo, and other Islamic capitols:⁶²⁰

- ⇒ Christians, Jews, Doubters, and Skeptics – all scholars were honored guests.⁶²¹
- ⇒ Instead of burning books, the Caliphs sent emissaries around the world in search of books.⁶²²

⁶¹⁹ <https://en.wikipedia.org/wiki/Avicenna>

⁶²⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

- ⇒ **Circa 11021 HE:** The Caliphs lavishly funded projects to translate, study, and preserve the gathered books for future generations.⁶²³
- ⇒ Much of the light of Ancient Greek science would have been permanently extinguished without their efforts.⁶²⁴
- ⇒ 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.⁶²⁵
- ⇒ In Cosmos, author Druyan reminds us that the Arabs also imported ideas from India to the West, including the so-called

⁶²³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

Arabic numerals that we all use today, and the concept of zero which they adapted from the sub-continent Indians.⁶²⁶

- ⇒ **Circa 11021 HE:** Arabic astronomy was so influential, that we still call most of the bright stars by their Arabic names.⁶²⁷
- ⇒ 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.⁶²⁸

Circa 11021 HE: – IBN AL HAYTHAM, Cairo scientist, astronomer, mathematician. Abū ‘Alī al-Ḥasan ibn al-Ḥasan ibn al-Haytham

⁶²⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶²⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

(Arabic: أبو علي محمد بن الحسن بن الحسن بن الهيثم; Persian: ابوعلی محمد بن حسن بن الحسن بن الهيثم) also known by the Latinization Alhazen or Alhacen.⁶²⁹

- ⇒ Circa 1400 years after Emperor Qin (see Circa **9741 HE – 9791 HE**: Qin Shi Huang, first emperor of China) burned the optics works of MO TZE (See Circa **9531 HE – 9610 HE**: MOZI), and after the knowledge of the Ancient Greeks was lost and being rediscovered....
- ⇒ **Circa 11021 HE**: IBN AL-HAYTHAM made significant contributions to the principles of optics, astronomy, mathematics, visual perception, and the scientific method.

⁶²⁹ https://en.wikipedia.org/wiki/Ibn_al-Haytham

- ⇒ **Circa 11021 HE:** 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.⁶³⁰
- ⇒ 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.⁶³¹
- ⇒ 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 procedures or mathematical evidence—hence

⁶³⁰ Adamson, Peter (7 July 12016 HE). Philosophy in the Islamic World: A History of Philosophy Without Any Gaps.

⁶³¹ https://en.wikipedia.org/wiki/Ibn_al-Haytham

understanding the scientific method 200 years before Renaissance scientists.⁶³²

⇒ **Circa 11021 HE: IBN AL-HAYTHAM** wrote of his optics research, and further pioneered the experimental scientific method and experimental physics in his *Book of Optics*.⁶³³ 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 psychophysics. A camera obscura works best in bright light. The stars of the night sky are way too dim for this.⁶³⁴

⁶³² https://en.wikipedia.org/wiki/Ibn_al-Haytham

⁶³³ https://en.wikipedia.org/wiki/Ibn_al-Haytham

⁶³⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

- ⇒ **Circa 11021 HE:** IBN AL-HAYTHAM was one of the first people ever to set down the rules of science.⁶³⁵ IBN AL-HAYTHAM created an error-correcting mechanism, a systematic and relentless way to sift out misconceptions in our thinking.⁶³⁶
- ⇒ **Circa 11021 HE:** IBN AL-HAYTHAM said “Finding truth is difficult and the road to it is rough.”
- ⇒ **Circa 11021 HE:** 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 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

⁶³⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⁶³⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

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.”⁶³⁷

⁶³⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



IBN AL HAYTHAM; date, location, and artist unknown⁶³⁸

⁶³⁸ https://en.wikipedia.org/wiki/Ibn_al-Haytham



IBN AL-HAYTHAM *Book of Optics* reprint cover page
Friedrich Risner, reprint publ. **11572 HE** ⁶³⁹

⁶³⁹ Friedrich Risner, publ. 11572 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 11031 HE– circa 11095 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 **11088 HE**. SHEN KUO attributed the innovation of reusable fired clay characters to a little-known artisan named BI SHENG (see **Circa 10990 HE–10051 HE**).⁶⁴⁰

Circa 11071 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, and forks were then more widely used.⁶⁴¹

⁶⁴⁰ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

⁶⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 78

Circa 11080 HE: France expanded on EUCLID's and the Persian original windmill designs to mill grain and pump water.⁶⁴² (see Circa **9731 HE**, **EUCLID's** windmill design⁶⁴³ and Circa **10700 HE:** Persia, earliest windmills developed in Middle East⁶⁴⁴)

111th Century HE

Circa 11100 HE: Human population worldwide had reached approximately 320,000,000 million people.⁶⁴⁵

⁶⁴² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

⁶⁴³ <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

⁶⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

⁶⁴⁵ <http://www.worldometers.info/world-population/world-population-by-year/>

Circa 1111 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, collapsed the great age of enlightenment in the Islamic world. It has not recovered since.⁶⁴⁶

⇒ 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.

⁶⁴⁶ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

- ⇒ **Circa 1111 HE:** when the teachings of Al-Ghazali caused all scientific thinking to be stopped.⁶⁴⁷
- ⇒ The darkness fell at this time in the Arab world, because Al-Ghazali enforced the false premise that revelation must replace investigation.⁶⁴⁸

Circa 1119 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*).⁶⁴⁹

⁶⁴⁷ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⁶⁴⁸ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⁶⁴⁹ https://en.wikipedia.org/wiki/List_of_Chinese_inventions

Circa 11137 HE: Gothic architecture – specifically flying Buttresses invented.⁶⁵⁰ 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.

⁶⁵⁰ 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.⁶⁵¹

⁶⁵¹ https://en.wikipedia.org/wiki/Flying_buttress

Circa 11170 HE – 11250 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."⁶⁵²

- ⇒ FIBONACCI popularized the Hindu–Arabic numeral system and positional notation to the Western World primarily through his composition in **11202 HE of Liber Abaci (Book of Calculation)** where in it he also introduced to Europe the sequence of Fibonacci numbers.⁶⁵³
- ⇒ 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 sum of the two preceding ones. 1123581321345589144...,

⁶⁵² <https://en.wikipedia.org/wiki/Fibonacci>

⁶⁵³ <https://en.wikipedia.org/wiki/Fibonacci>

and often, especially in modern usage, the sequence is extended by one more initial term: 0,1123581321345589144...⁶⁵⁴

⇒ Fibonacci numbers appear unexpectedly often in mathematics, so much so that there is an entire journal dedicated to their study, the Fibonacci Quarterly.⁶⁵⁵

⁶⁵⁴ https://en.wikipedia.org/wiki/Fibonacci_number

⁶⁵⁵ <http://www.fq.math.ca/>



Statue of LEONARDO BONACCI known as FIBONACCI
(**11863 HE**) by Giovanni Paganucci in the Camposanto di Pisa ⁶⁵⁶

⁶⁵⁶ <https://en.wikipedia.org/wiki/Fibonacci>



A page of the LEONARDO BONACCI known as FIBONACCI's *Liber Abaci* from the Biblioteca Naxionale di Firenze showing on the right the numbers of the Fibonacci Sequence ⁶⁵⁷

⁶⁵⁷ https://en.wikipedia.org/wiki/Liber_Abaci

⇒ The wonderful youtube.com by VIHART shows how Fibonacci numbers also appear in biological settings.⁶⁵⁸

Circa beginning in the 11180s HE: The use of windmills became further widespread across the Middle East and Central Asia, and later spread to China and India.⁶⁵⁹

Circa 11185 HE: England: a windmill in England dates from **11185 HE** in Weedley, Yorkshire. In medieval England, rights to waterpower sites were often confined to nobility and clergy, so wind power was an important resource to a new middle class. In

⁶⁵⁸ViHart–YouTubevideoFibonacci

<https://www.bing.com/videos/search?q=vi+heart+fibonacci&view=detail&mid=C1B0A8F3C1E4D08B5087C1B0A8F3C1E4D08B5087&FORM=VIRE>

⁶⁵⁹ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

addition, windmills, unlike water mills, were not rendered inoperable by the freezing of water in the winter.⁶⁶⁰

112th Century HE

Circa 11200 HE: ABD-EL-LATIF-AL BAGHDADI, Bagdad, Iraq; physician, historian, Egyptologist, and traveler.

⇒ During the famine of Egypt, AL BAGHDADI observed and examined a large number of skeletons, and he discovered that GALEN (See Circa **10150 HE**) was incorrect regarding the formation of the bones of the lower jaw and sacrum.⁶⁶¹

⁶⁶⁰ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

⁶⁶¹ https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

⇒ Of the numerous works (mostly on medicine) which are ascribed to AL BAGHDADI, one only, his graphic and detailed Account of Egypt (in two parts), appeared to be known in Europe.⁶⁶² His *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.⁶⁶³

Circa 11200 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

⁶⁶² https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

⁶⁶³ https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi

prescriptions, mainly made up of herbs and other plants, are listed
Ratirahasya ("Secrets of Love"),⁶⁶⁴

Circa 11215 HE –11216 HE: China, Copperplate moveable type printing.



Copperplate printed 5000-cash Jin dynasty paper money with

⁶⁶⁴ https://en.wikipedia.org/wiki/History_of_birth_control

bronze movable type counterfeit markers, artist and location unknown.⁶⁶⁵

Circa 11223 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.⁶⁶⁶ (See **Circa 8247 HE:**

⁶⁶⁵ https://en.wikipedia.org/wiki/History_of_printing

⁶⁶⁶ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

Babylonians first recorded oral hygiene by use of tooth cleaning sticks.)⁶⁶⁷

Circa 11228 HE: China, then England, started to dig into the earth to mine coal.⁶⁶⁸

Circa 11242 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.⁶⁶⁹ IBN AL-NAFIS wrote a book (Author / Compiler could not find its name) (not known unto the West until **11924 HE**) in which IBN AL-NAFIS suggested the right and left ventricles of the heart were totally separate; explaining the double

⁶⁶⁷ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

⁶⁶⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 82

⁶⁶⁹ https://en.wikipedia.org/wiki/Ibn_al-Nafis

pump.⁶⁷⁰ IBN AL-NAFIS wrote treatises on eye diseases and diet and commentaries on medical writings of HIPPOCRATES, AVICENNA, AND ḤUNAYN IBN ISHĀQ.⁶⁷¹

⁶⁷⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 139, 140

⁶⁷¹ <https://www.britannica.com/biography/Ibn-an-Nafis>



IBN AL-NAFIS (artist, date and location of bronze bust are unmentioned).⁶⁷²

Circa 11249 HE: China and Europe both invent convex lenses used to help the aged who were becoming far sighted.⁶⁷³

⁶⁷² https://en.wikipedia.org/wiki/Ibn_al-Nafis

⁶⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 83

⇒ Author / Compiler wonders if these convex lenses were of colored glass because according to ISAAC ASIMOV himself: Circa **9901 HE** in Syria the blowing and making of colored glass had been invented⁶⁷⁴; while clear glass was not invented until **11291 HE** in Venice.⁶⁷⁵

Circa 11252 HE: Spain, Alfonso X of Castile sponsored updated Planetary Tables for nothing better than CLAUDIUS PTOLEMY's tables of planetary motion had been prepared in 11 centuries.⁶⁷⁶

⇒ Alfonso X of Castile and Leon assembled a team of scholars and created the Alfonsine Tables which provided data for computing

⁶⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

⁶⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 85

⁶⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 84

the position of the Sun, the Moon and the planets relative to the fixed stars.⁶⁷⁷



Alfonsine Tables, photographer and location unknown.⁶⁷⁸

⁶⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 84

⁶⁷⁸ https://en.wikipedia.org/wiki/Alfonsine_tables

11267 HE - 11319 HE: KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI OR ABU HASAN MUHAMMAD IBN HASAN, Persian, scientist in optics and numbers theory.⁶⁷⁹

⇒ AL-FARISI rewrote after much studying AL HAYTHAM's *Treatise/Book of Optics* which became known as *Tanqih*.⁶⁸⁰

⇒ 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.⁶⁸¹

⁶⁷⁹ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⁶⁸⁰ https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

⁶⁸¹ 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.



- ⇒ KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI (artist, date and location of bronze bust are unmentioned)⁶⁸²

⁶⁸² https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi

Circa 11269 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.⁶⁸³

Circa 11291 HE: Venice. Clear glass making invented 1390 years after circa **9901 HE** in Syria invented blowing and making of colored glass.⁶⁸⁴

⇒ **Circa 11291 HE:** Mirrors invented: Clear glass lead to invention of the first “something” besides water or polished metal for people to see their reflections.⁶⁸⁵

⁶⁸³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 84

⁶⁸⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

⁶⁸⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

Circa 11292 HE: North America, United States, Ancient Puebloan culture. Ancient Puebloan is their more accurate name. “Anasazi People” was a derogatory name.⁶⁸⁶

- ⇒ 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 Pueblos do not want this term used.⁶⁸⁷
- ⇒ The Ancestral Pueblos possessed a complex network that stretched across the now Colorado Plateau, United States linking hundreds of communities and population centers. They held a

⁶⁸⁶ https://en.wikipedia.org/wiki/Ancestral_Pueblos

⁶⁸⁷ https://en.wikipedia.org/wiki/Ancestral_Pueblos

distinct knowledge of celestial sciences that found form in their architecture.⁶⁸⁸



Photo is of Mesa Verde National Park, Cliff Palace, Colorado, United States, photographer unknown.⁶⁸⁹

⁶⁸⁸ https://en.wikipedia.org/wiki/Ancestral_Puebloans

⁶⁸⁹ https://en.wikipedia.org/wiki/Ancestral_Puebloans



Photo is of Spruce Tree House, Colorado, United States,
photographer unknown.⁶⁹⁰

⁶⁹⁰ https://en.wikipedia.org/wiki/Ancestral_Puebloans

Circa 11298 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.⁶⁹¹

113th Century HE

Circa 11300 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.⁶⁹²

⁶⁹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 86

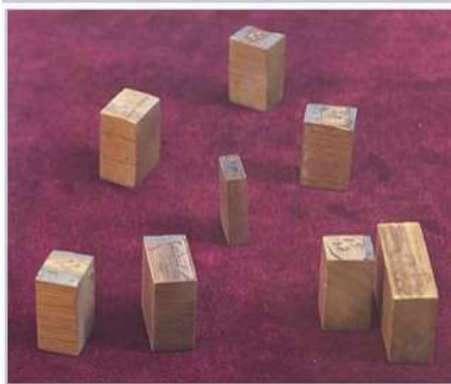
⁶⁹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 87

Circa 11313 HE: China, revolving type case for wooden type.



A revolving type case for wooden type in China, from Wang Zhen's book.⁶⁹³

⁶⁹³ https://en.wikipedia.org/wiki/History_of_printing



Wooden movable type for Old Uyghur alphabet, dated to the **11200's HE – 11300's HE**. Discovered in the Mogao caves.⁶⁹⁴

⁶⁹⁴ https://en.wikipedia.org/wiki/History_of_printing

Circa 11316 HE: MONDINO DE LUZZI, Italian anatomist
 MONDINO DE LUZZI taught at medical school of Bologna and did human cadaver dissection which lead to **11316 HE** publication of book *Anathomia corporis humani*⁶⁹⁵ entirely dedicated to anatomy.⁶⁹⁶ 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.⁶⁹⁷

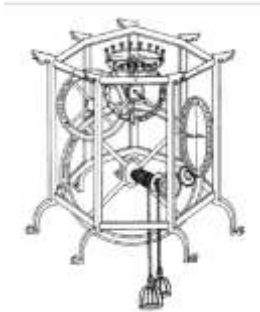
Circa 11330 HE – 11388 HE: GIOVANNI DE DONDI: Padua, Italy.
 Known for art design and construction, he built an astronomical clock which demonstrated an ambitious attempt to describe and

⁶⁹⁵ https://en.wikipedia.org/wiki/Mondino_de_Liuzzi

⁶⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 89

⁶⁹⁷ https://en.wikipedia.org/wiki/Mondino_de_Liuzzi

model the planetary system with mathematical precision and technological sophistication.⁶⁹⁸



Built in **11364 HE**: This tracing of an illustration from GIOVANNI DE DONDI'S **11364 HE** treatise, *Il Tractatus Astrarii* is perhaps the earliest existing drawing of a balance

⁶⁹⁸ https://en.wikipedia.org/wiki/Giovanni_Dondi_dell_Orologio

wheel. The balance wheel (crown shape, top) had a beat of 2 seconds.⁶⁹⁹

Circa 11333 HE – 11351 HE: By now, simple hygienic principles were lost or becoming unknown to European society.⁷⁰⁰ Thus, The Black Death is estimated to have killed 30–60% of Europe's total population.⁷⁰¹

Circa 11335 HE: Milan, Italy; Mechanical Clocks invented; the first advance over the water clock (see **9731 HE** - note it took circa 1600 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

⁶⁹⁹ https://en.wikipedia.org/wiki/Balance_wheel

⁷⁰⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 90

⁷⁰¹ https://en.wikipedia.org/wiki/Black_Death

approximate time by listening to the bell. the word “clock” is from the French word for “bell”.⁷⁰²

Circa 11335 HE: Mexico City, then known as Tenochtitlan by the rising Aztec empire, was founded.⁷⁰³

Circa 11352 HE – 11354 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.⁷⁰⁴ (See **Circa 9796 HE – 9901 HE:** The Antikythera Mechanism.)

⁷⁰² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 89

⁷⁰³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 90

⁷⁰⁴ https://en.wikipedia.org/wiki/Strasbourg_astronomical_mirror

114th Century HE

Circa 11400 HE: The population of the world was approximately 350,000,000 people.⁷⁰⁵

Circa starting: 11400's HE: Netherlands; Use of windmills to pump water from lowlands 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.⁷⁰⁶

⁷⁰⁵ <http://www.worldometers.info/world-population/world-population-by-year/>

⁷⁰⁶ 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. Archimedes' screws are clearly visible. Photographer unknown.⁷⁰⁷

⁷⁰⁷ https://en.wikipedia.org/wiki/Polder#Polders_and_the_Netherlands

Circa 11400 HE – 11468 HE: Germany, JOHANNES GUTENBERG gets historical credit for being the first European to use a Printing Press with moveable type.⁷⁰⁸

⇒ By **11450 HE**, the press was in operation, and a German poem had been printed, possibly the first item to be printed.⁷⁰⁹

⁷⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

⁷⁰⁹ https://en.wikipedia.org/wiki/Johannes_Gutenberg



JOHANNES GUTENBERG, date, artist and location
unknown.⁷¹⁰

⁷¹⁰ https://en.wikipedia.org/wiki/Johannes_Gutenberg



A Gutenberg press replica at the Featherbed Alley Printshop Museum in Bermuda.⁷¹¹

⁷¹¹ https://en.wikipedia.org/wiki/Johannes_Gutenberg

Circa 11403 HE: Venice. by this time the use of soap for hygiene or cleaning was lost as religion further 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”).⁷¹²

⇒ “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.)⁷¹³

⁷¹² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

⁷¹³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

Circa 11436 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.⁷¹⁴

⇒ *De re aedificatoria* (English: *On the Art of Building*) is a classic architectural treatise written by LEON BATTISTA ALBERTI between **11443 HE** and **11452 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 **11485 HE** it became the first printed book on architecture.⁷¹⁵

⁷¹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 94

⁷¹⁵ https://en.wikipedia.org/wiki/De_Re_Aedificatoria



Title page of **11550 HE** edition of *De re aedificatoria* (English: *On the Art of Building*) is a classic architectural treatise, Florence, photographer unknown.⁷¹⁶

⁷¹⁶ https://en.wikipedia.org/wiki/De_Re_Aedificatoria

Circa 11438 HE – circa 11572 HE: The Inca civilization⁷¹⁷ arose from the Andes Mountains in the highlands of Peru⁷¹⁸ and Ecuador.⁷¹⁹

⇒ 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", and yet they thrived.⁷²⁰

⇒ **Circa 11438 HE – circa 11572 HE:** The Inca civilization
Notable features of the Inca Empire include its monumental

⁷¹⁷ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

⁷¹⁸ https://en.wikipedia.org/wiki/Inca_Empire

⁷¹⁹ <https://www.youtube.com/watch?v=Nry1SO45RT4>

⁷²⁰ https://en.wikipedia.org/wiki/Inca_Empire

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.⁷²¹

⁷²¹ https://en.wikipedia.org/wiki/Inca_Empire



Circa 11438 HE – circa 11572 HE: Inca Civilization site, Ingapirca, Ecuador, photographer unknown.⁷²²

⁷²² Cultura Cañari: Ingapirca



Circa 11438 HE – circa 11572 HE: The Inca civilization

Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.⁷²³

⁷²³ <http://leoturismoecuador.blogspot.com/2015/12/ingapirca.html>



Circa 11438 HE – circa 11572 HE: The Inca civilization

Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.⁷²⁴



Circa 11438 HE – circa 11572 HE: Peru, Inca Civilization site:

⁷²⁴ <http://viajerosustentable.com/2012/05/08/ingapirca/>

Machu Picchu was declared a Peruvian Historic Sanctuary and a UNESCO World Heritage Site, photographer unknown.⁷²⁵

⁷²⁵ https://en.wikipedia.org/wiki/Machu_Picchu



The Inca Empire at its greatest extent.⁷²⁶

⁷²⁶ https://en.wikipedia.org/wiki/Inca_Empire

⇒ **Circa 11500 HE:** The Incas also committed ritual human sacrifices. Mummies known as The Children of Llullaillaco (Spanish: [ju.jai'ja.ko]), also known as the Mummies of Llullaillaco, are three rediscovered Inca child mummies DR. JOHAN REINHARD and his archaeological team near the summit of Llullaillaco, 6739 meters (22110 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.⁷²⁷



The mummy La Doncella on display at the Museum of High-Altitude Archaeology (es), a museum dedicated entirely to the

⁷²⁷ https://en.wikipedia.org/wiki/Children_of_Llullaillaco

display of the mummies, in Salta, Argentina, photographer unknown.⁷²⁸



Mummy called El Niño, photographer unknown.⁷²⁹

⁷²⁸ https://en.wikipedia.org/wiki/Children_of_Llullaillaco

⁷²⁹ https://en.wikipedia.org/wiki/Children_of_Llullaillaco

⇒ From **11438 HE to 11533 HE**, the Incas incorporated a large portion of western South America, centered on the Andean Mountains, using conquest and peaceful assimilation, among other methods.⁷³⁰

Circa 11450 HE: China, (see **10350 HE** for first step, and **10800 HE** for earlier stages in printing development) invented carving wooden blocks that can be arranged in a configuration to print on paper.⁷³¹

Circa 11451 HE: NICHOLAS OF CUSA AKA NICOLAUS CUSANUS, German scholar, astronomer⁷³² who suggested the use of concave glass for lenses to help those who were otherwise near

⁷³⁰ https://en.wikipedia.org/wiki/Inca_Empire

⁷³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

⁷³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

sighted.⁷³³ (See **Circa 11249 HE**: China and Europe both invent convex lenses used to help the aged who were becoming far sighted.⁷³⁴)

⇒ **Circa 11451 HE**: 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.⁷³⁵

⁷³³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

⁷³⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 83

⁷³⁵ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

- ⇒ 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*.⁷³⁶
- ⇒ NICOLAUS CUSANUS has remained an influential figure. During the period **12000 HE-12001 HE**, his sixth centennial of his birth was celebrated on four continents and commemorated by publications on his life and work.⁷³⁷ The lunar crater, “CUSANUS” was named after NICHOLAS.⁷³⁸

⁷³⁶ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

⁷³⁷ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

⁷³⁸ https://en.wikipedia.org/wiki/Nicholas_of_Cusa



NICHOLAS OF CUSA AKA NICOLAUS CUSANUS,
unknown current location⁷³⁹ by late Gothic German painter
working ca. **11463 HE** — **ca. 11490 HE**, working in Cologne,
one name known as the Master of Wilten.⁷⁴⁰

⁷³⁹ https://en.wikipedia.org/wiki/Nicholas_of_Cusa

⁷⁴⁰ https://en.wikipedia.org/wiki/Master_of_the_Life_of_the_Virgin

11452 HE– 11519 HE: LEONARDO DA VINCI, Italian, polymath,
born Leonardo di ser Piero da Vinci.⁷⁴¹



LEONARDO DA VINCI Portrait by Francesco Melzi.⁷⁴²

⁷⁴¹ https://en.wikipedia.org/wiki/Leonardo_da_Vinci

⁷⁴² https://en.wikipedia.org/wiki/Leonardo_da_Vinci



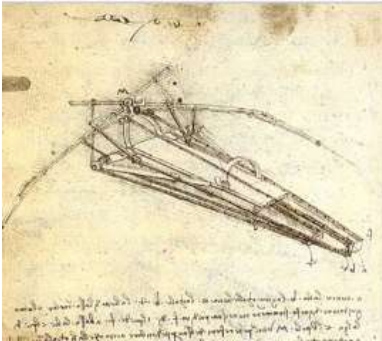
Profile bust "Leonardo da Vinci" created by LEONARDO DA VINCI.⁷⁴³

⁷⁴³ <http://self-portrait-leonardo.com/research/6>

- ⇒ **11452 HE– 11519 HE:** Among other scientific ideas LEONARDO DA VINCI conceptualized a type of armored fighting vehicle, concentrated solar power, and a rudimentary theory of plate tectonics.⁷⁴⁴
- ⇒ LEONARDO DA VINCI did create the automated bobbin winder and a machine for testing the tensile strength of wire.⁷⁴⁵

⁷⁴⁴ https://en.wikipedia.org/wiki/Leonardo_da_Vinci

⁷⁴⁵ https://en.wikipedia.org/wiki/Leonardo_da_Vinci



11488 HE: LEONARDO DA VINCI conceptualization of a flying machine, Institut de France, Paris, photographer unknown⁷⁴⁶

⁷⁴⁶ https://en.wikipedia.org/wiki/Leonardo_da_Vinci



One of LEONARDO DA VINCI 's flying machine sketches, photographer unknown.⁷⁴⁷

⁷⁴⁷ https://en.wikipedia.org/wiki/History_of_aviation

Circa 11459 HE – 11507 HE – MARTIN BEHAIM, German mariner, artist, cosmographer, astronomer, philosopher, geographer, and explorer.⁷⁴⁸ In **11492 HE MARTIN BEHAIM**, made the first globe, The Erdapfel (German: *lit. earth apple*).⁷⁴⁹

⇒ 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.⁷⁵⁰

⁷⁴⁸ https://en.wikipedia.org/wiki/Martin_Behaim

⁷⁴⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13

⁷⁵⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13



MARTIN BEHAIM with his Erdapfel, artist, date and location unknown.⁷⁵¹

⁷⁵¹ <https://en.wikipedia.org/wiki/Erdapfel>



MARTIN BEHAIMs Erdapfel at the German National Museum.⁷⁵²

⁷⁵² <https://en.wikipedia.org/wiki/Erdapfel>

Circa 11470 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.⁷⁵³

⁷⁵³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



Monument to PETER HENLEIN by Max Meisner, in Hefnersplatz, Nuremberg.⁷⁵⁴

⁷⁵⁴ https://en.wikipedia.org/wiki/Peter_Henlein



An early "clock-watch", photographer and location unknown.
(*Taschenuhr*)⁷⁵⁵

⁷⁵⁵ https://en.wikipedia.org/wiki/Peter_Henlein

115th Century HE

Circa 11502 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 Vespuccius because was impressed that:⁷⁵⁶ Amerigo Vespucci Aka Americus Vespuccius, Italian navigator derived that none of the lands he was seeing were the Asia lands described by Marco Polo or Christopher Columbus.⁷⁵⁷

⁷⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102

⁷⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



MARTIN WALDSEEMULLER, artist, date and location unknown.⁷⁵⁸

⁷⁵⁸ https://en.wikipedia.org/wiki/Martin_Waldseemuller



Universalis Cosmographia, MARTIN WALDSEEMULLER's
11507 HE world map which was the first to show the Americas
separate from Asia⁷⁵⁹

⁷⁵⁹ https://en.wikipedia.org/wiki/Martin_Waldseemuller



Detail of the map showing the name "America".⁷⁶⁰

⁷⁶⁰ https://en.wikipedia.org/wiki/Waldseemuller_map



Detail of the map showing the names "Catigara" and "Mallaqua".⁷⁶¹

⁷⁶¹ https://en.wikipedia.org/wiki/Waldseemuller_map

Circa 11523 HE: Circumnavigation of the Earth was completed. The Earth is proved round 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 25000 miles confirming the scientific prediction of Earth's circumference calculations done by ERATOSTHENES in circa **9761 HE**, (circa 1762 years earlier).⁷⁶²

Circa 11535 HE: This is the year when it became standard practice that Scientific discoveries do not belong to the discoverer – they belong to the world.⁷⁶³

⁷⁶² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 105

⁷⁶³ 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.⁷⁶⁴
- ⇒ 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 9601 HE – 10200 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.⁷⁶⁵

⁷⁶⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 106

⁷⁶⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 106

Circa 11538 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:*⁷⁶⁶

⇒ Book One Published on Comets: by GIROLAMO FRACASTORO, **circa 11478 HE – 11553 HE**, Italian physician, poet, and scholar in mathematics, geography and astronomy: saying the comet's tail always pointed away from the sun.⁷⁶⁷

⁷⁶⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

⁷⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



Portrait of GIROLAMO FRACASTORO by Titian, **circa 1528 HE**; in the collection of the National Gallery since **1924 HE**.⁷⁶⁸

⁷⁶⁸ https://en.wikipedia.org/wiki/Girolamo_Fracastoro



GIROLAMO FRACASTORO's *Hieronimi Fracastorii Poemata Omnia* (11718 HE Reprint).⁷⁶⁹

⁷⁶⁹ https://en.wikipedia.org/wiki/Girolamo_Fracastoro

- ⇒ Circa **11546 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.⁷⁷⁰
- ⇒ **11495 HE – 11552 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.⁷⁷¹

⁷⁷⁰ https://en.wikipedia.org/wiki/Girolamo_Fracastoro

⁷⁷¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



PETRUS APIANUS c. 1500 **HE.** Engraving by Theodor de Bry.⁷⁷²

⁷⁷² https://en.wikipedia.org/wiki/Petrus_Apianus



Non-Comet map by **PETRUS APIANUS 1524 HE**: Cordiform projection in a map of the world which is another early map that shows America separate from Asia.⁷⁷³

⁷⁷³ https://en.wikipedia.org/wiki/Petrus_Apianus

- ⇒ See list of other Non-Comet works by PETER BENNEWITZ also known as PETER BIENEWITZ AND PETRUS APIANUS⁷⁷⁴
- ⇒ Author / Compiler note: see Circa **9761 HE**, China, first surviving drawings of comets.

⁷⁷⁴ https://en.wikipedia.org/wiki/Historical_comet_observations_in_China

Chapter Four THE SCIENTIFIC REVOLUTION: Circa 11543 HE - Now (lasting, so far, less than 600 years)

The Scientific Revolution began with the printing of the two books: *De Revolutionibus Coelestium (Concerning the Revolution of Heavenly Bodies)* by NICOLAUS COPERNICUS⁷⁷⁵ and

De humani corporis fabrica (Concerning the Structure of the Human Body) by ANDREAS VESALIUS.⁷⁷⁶

⁷⁷⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

⁷⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

“One Scientific Breakthrough often enables another.” – Max Tegmark⁷⁷⁷

11473 HE - 11543 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.⁷⁷⁸

⇒ **11543 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,

⁷⁷⁷ Max Tegmark, Our Mathematical Universe

⁷⁷⁸ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

that the Sun is the center of the solar system, not the Earth.⁷⁷⁹ The Earth and the other planets orbit the Sun.⁷⁸⁰ COPERNICUS elaborated on the **9770 HE** predicted heliocentric theory of ARISTARCHUS OF SAMOS.⁷⁸¹ 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.⁷⁸²

⇒ COPERNICUS derived a quantity theory of money – a key concept in economics.⁷⁸³

⁷⁷⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

⁷⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

⁷⁸¹ https://en.wikipedia.org/wiki/Aristarchus_of_Samos

⁷⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

⁷⁸³ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

⇒ NICOLAUS COPERNICUS figured out the size and shape of our Solar System using geometric ingenuity,⁷⁸⁴ and proposed, an infinitely vaster cosmos.⁷⁸⁵ However, the overall scale of COPERNICUS's Solar System was about 20 times smaller than reality. That's like confusing a real house with a doll house.⁷⁸⁶

⁷⁸⁴ Max Tegmark, Our Mathematical Universe

⁷⁸⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

⁷⁸⁶ Max Tegmark, Our Mathematical Universe



NICOLAUS COPERNICUS The "Torun portrait", anonymous, circa 11580 HE, kept in Toruń town hall ⁷⁸⁷

11494 HE – 11555 HE: GEORG BAUER, whose pen name was the Latinized GEORGIUS AGRICOLAE was a German Mineralogist. ⁷⁸⁸ who also speculated on fossils. ⁷⁸⁹

⁷⁸⁷ https://en.wikipedia.org/wiki/Nicolaus_Copernicus

⁷⁸⁸ https://en.wikipedia.org/wiki/Georgius_Agricola

⁷⁸⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

- ⇒ **11912 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 multilingual mining engineer (and later President of the United States), and his multilingual wife, LOU HENRY HOOVER, a geologist and Latinist, and later First Lady of the United States.⁷⁹⁰
- ⇒ Author / Compiler found GEORG BAUER while researching the history of trains. The books written by GEORG BAUER 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

⁷⁹⁰ https://en.wikipedia.org/wiki/De_re_metallica

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.”⁷⁹¹

⁷⁹¹ <http://farlang.com/books/agricola-hoover-de-re-metallica>



GEORGIUS AGRICOLA AKA GEORG BAUER, date and artist unknown.⁷⁹²

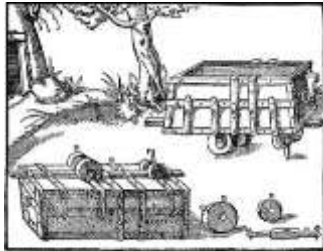
⁷⁹² https://en.wikipedia.org/wiki/Georgius_Agricola



11561 HE: Title page of one of GEORG BAUER's 12 books of *De Re Metallica*, Latin for: *On the Nature of Metals (Minerals)*.⁷⁹³ 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

⁷⁹³ https://en.wikipedia.org/wiki/Georgius_Agricola

discusses the extraction and preparation of substances such as salt, saltpeter, sulfur and glass.⁷⁹⁴



3—STANDARD WHEEL RIM IN TIER. 3—ITS END BRASS. 4—BACK ROLL.
5—WHEEL BRASS. 6—SMALL WHEEL RIM. 7—CABLE ROLL END FOR.
11—CABLE ROLL END FOR.

795

Circa 11556 HE: A drawing of GEORG BAUER's Minecart shown in one of the 12 books of *De Re Metallica*. The book remained the authoritative text on mining for years after its

⁷⁹⁴ <http://farlang.com/books/agricola-hoover-de-re-metallica>

⁷⁹⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

publication. It was also an important chemistry text for the period and is significant in the history of chemistry.⁷⁹⁶

Circa 11500 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.⁷⁹⁷

11515 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 operated by human or animal power, through a

⁷⁹⁶ https://en.wikipedia.org/wiki/De_re_metallica

⁷⁹⁷ https://en.wikipedia.org/wiki/History_of_birth_control

treadwheel. The line still exists and is operational, although in updated form and is possibly the oldest operational railway.⁷⁹⁸



Reisszug, as it appears today.⁷⁹⁹

⁷⁹⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

⁷⁹⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

11527 HE -11598 HE: ABRAHAM ORTELIUS, Flemish cartographer and geographer is conventionally recognized as the creator of the first modern atlas in **11570 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.⁸⁰⁰ 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 **11880 HE** ALFRED WEGENER.)

⁸⁰⁰ https://en.wikipedia.org/wiki/Abraham_Ortelius



ABRAHAM ORTELIUS by Peter Paul Rubens, date and location unknown.⁸⁰¹

⁸⁰¹ https://en.wikipedia.org/wiki/Abraham_Ortelius



In **11570** **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.⁸⁰²

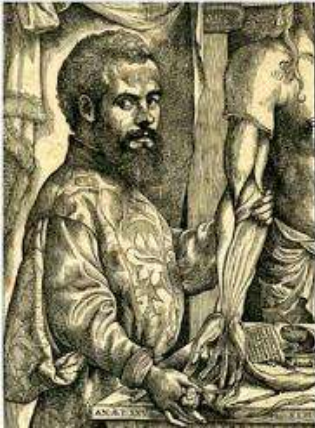
⁸⁰² https://en.wikipedia.org/wiki/Theatrum_Orbis_Terrarum

Circa 11543 HE: ANDREAS VESALIUS, Flemish/ Netherlands, anatomist⁸⁰³ **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 **GALEN**⁸⁰⁴ (See: **Circa 10200 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.⁸⁰⁵

⁸⁰³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

⁸⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

⁸⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109



Portrait of ANDREAS VESALIUS from *De humani corporis fabrica*.⁸⁰⁶

⁸⁰⁶ https://en.wikipedia.org/wiki/Andreas_Vesalius

Circa 11545 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.⁸⁰⁷

Circa 11545 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.⁸⁰⁸

⇒ 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 legal reports in relation to medicine. His

⁸⁰⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

⁸⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

writings and instructions Oeuvres are known to be the beginning of modern forensic pathology.



The title page of AMBROISE PARE's *Oeuvres*.⁸⁰⁹

⁸⁰⁹ https://en.wikipedia.org/wiki/Ambroise_Pare

11546 HE - 11601 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 **11577 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.⁸¹⁰

⁸¹⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117



TYCHO BRAHE wearing the Order of the Elephant, artist, date and location unknown.⁸¹¹

⁸¹¹ https://en.wikipedia.org/wiki/Tycho_Brahe

- **Circa 9851 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.⁸¹² 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.⁸¹³

11548 HE - 11600 HE: GIORDANO BRUNO, Italian philosopher, mathematician, poet,⁸¹⁴ was burned at the stake by the Roman Inquisition because, among other reasons BRUNO insisted that the

⁸¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

⁸¹³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

⁸¹⁴ https://en.wikipedia.org/wiki/Giordano_Bruno

universe - space - is in fact infinite and could have no celestial body at its "center".^{815 816}



GIORDANO BRUNO - Portrait from "Livre du recteur" made in **11578 HE**, location and artist unknown.⁸¹⁷

⁸¹⁵ Max Tegmark, Our Mathematical Universe

⁸¹⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode

⁸¹⁷ https://en.wikipedia.org/wiki/Giordano_Bruno

11550 HE – circa 11758 HE: Introduced from Germany to England: Wagon-ways made of wooden rails and horse-drawn traffic.⁸¹⁸

Circa 11551 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).⁸¹⁹ GEORGE JOACHIMs *Trigonometric Tables*, combined with NICOLAUS COPERNICUS's heliocentric view made it possible for computational astronomy to advance.⁸²⁰

⁸¹⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

⁸¹⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

⁸²⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

Circa 11551 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.⁸²¹

Circa 11552 HE: BARTOLOMMEO EUSTATCHIO, Italian anatomist described the tube that circa 2000 years earlier, see **Circa 9451 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.⁸²²

⁸²¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

⁸²² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 112

⇒ BARTOLOMMEO EUSTATCHIO was the first to describe the Adrenal Glands.⁸²³

Circa 11553 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.⁸²⁴ (see **Circa 11288 HE** IBN AL-NAFIS who was the first person to report on the “lesser circulation” of the heart.)⁸²⁵

⁸²³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 112

⁸²⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

⁸²⁵ 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 **11694 HE** that some unburned copies were found.⁸²⁶

Circa 11555 HE: PIERRE BELON, French, naturalist whose research encouraged evolutionary thought.⁸²⁷ 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.⁸²⁸

⁸²⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

⁸²⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113

⁸²⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113



PIERRE BELON, artist, date and location unknown⁸²⁹

⁸²⁹ https://en.wikipedia.org/wiki/Pierre_Belon

Circa 11556 HE: Native Americans introduced tobacco to Europeans and thus the rest of the world.⁸³⁰

Circa 11559 HE: REALDO COLUMBO, Italian anatomist.⁸³¹
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.⁸³² (see **circa 11288 HE** IBN AL-NAFIS and **circa 11533 HE** MIGUEL SERVETO aka MICHAEL SERVETUS).

Circa 11560 HE – 11612 HE: SIR JOHN HARRINGTON, ALSO SPELLED HARRINGTON: Kelston, England. English courtier,

⁸³⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

⁸³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

⁸³² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

author, translator and is known as the inventor of the flush toilet.⁸³³
We call toilets “johns” after Sir John Harrington.⁸³⁴

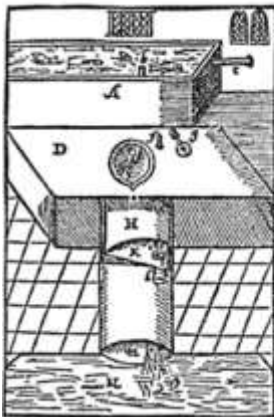


Circa 11590 HE – 11593 HE: Portrait of SIR JOHN HARINGTON by Hieronimo Custodis.⁸³⁵

⁸³³ [https://en.wikipedia.org/wiki/John_Harrington_\(writer\)](https://en.wikipedia.org/wiki/John_Harrington_(writer))

⁸³⁴ <https://pintsofhistory.com/2014/09/17/how-queen-elizabeth-i-held-back-the-toilet/>

⁸³⁵ [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 wart 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 stoolie pot,
- I. the stopple,
- K. the current,
- L. the sluce.

M.N. the vault into which it falls: alwayes remembers that () at noone and at night, emptye it, and leaue 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 stinking close stoolie easilie employed.

And by the like reason (other formes and proportions observed) all other places of your house may be kept sweet.

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Drawing from **11596 HE SIR JOHN HARINGTON**'s book: *A 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.⁸³⁷

Circa 11560 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.⁸³⁸

⁸³⁷ [https://en.wikipedia.org/wiki/John_Harington_\(writer\)](https://en.wikipedia.org/wiki/John_Harington_(writer))

⁸³⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115



GIAMBATTISTA DELLA PORTA, artist, date and location unknown⁸³⁹

⁸³⁹ https://en.wikipedia.org/wiki/Academia_Secretorum_Naturae

11561 HE – 11626 HE: FRANCIS BACON, English Philosopher.⁸⁴⁰

“The Scientific Method” is further and again defined.⁸⁴¹ **Circa**

11620 HE: *Novum Ogranum*‘s skeptical methodology makes 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.⁸⁴²

⇒ BACON had to re-invent the scientific method because:

⁸⁴⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

⁸⁴¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

⁸⁴² https://en.wikipedia.org/wiki/Francis_Bacon

- **See Circa 9741 HE – 9791 HE:** Emperor Qin of China burned the work of MO TZE and other scientists (SEE **Circa 9531 HE – 9610 HE: MOZI**);⁸⁴³ and
- **See Circa 11111 HE** Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. Al-Ghazali's destructive philosophy was that 1) "revelation replaced investigation"⁸⁴⁴ 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

⁸⁴³ https://en.wikipedia.org/wiki/Qin_Shi_Huang

⁸⁴⁴ Neil deGrasse Tyson speech "How The Islamic Civilization Fell"
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

forward momentum of the Persian scientific tradition, which has not recovered since.⁸⁴⁵

⇒ 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.⁸⁴⁶

⁸⁴⁵ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

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

⁸⁴⁶ 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 mallem*, Latin for "If one could but paint his mind". National Portrait Gallery, London.⁸⁴⁷

⁸⁴⁷ https://en.wikipedia.org/wiki/Francis_Bacon



11617 HE: Portrait of BACON by Frans Pourbus, location unknown.⁸⁴⁸

⁸⁴⁸ https://en.wikipedia.org/wiki/Francis_Bacon

11564 HE – 11616 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 **11605 HE**, the Bodleian Library in Oxford, England, possessed almost 6000 books. Of these, just 36 were in English.
- ⇒ Illiteracy was the usual condition in the **11500'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.⁸⁴⁹

⁸⁴⁹ Bill Bryson *Shakespeare (The Illustrated and Updated Edition)*

11564 HE - 11642 HE: GALILEO, Italian⁸⁵⁰ said, “If I move at a constant velocity, I do not know I am moving.”⁸⁵¹ GALILEO was satisfied that all bodies fell at equal rates, provided that air resistance didn’t complicate matters.⁸⁵² GALILEO proved PTOLEMY’s observation that not all celestial objects orbit the sun.⁸⁵³ GALILEO invented the brass telescope that fit over one’s head to do closer research on four of the moons of Jupiter (Galilean moons)⁸⁵⁴ 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

⁸⁵⁰ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 152

⁸⁵¹ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⁸⁵² ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 152

⁸⁵³ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⁸⁵⁴ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

planet Venus. His work on astronomy made him famous and he was appointed court mathematician in Florence.⁸⁵⁵

In **11589 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.⁸⁵⁶ In **11592 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.⁸⁵⁷ GALILEO's other discoveries: He did so many Author / Compiler could not include the whole list.) In **11612 HE: GALILEO** observed Saturn,

⁸⁵⁵ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⁸⁵⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 123

⁸⁵⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

saw its rings appear and disappear but because of scorn of those powers that be, he refused to look at it again.⁸⁵⁸

- ⇒ In **11614 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 **11616 HE**, GALILEO was forbidden by the church from teaching or advocating these theories.⁸⁵⁹
- ⇒ In **11632 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 ⁸⁶⁰) published. This set out the

⁸⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

⁸⁵⁹ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

⁸⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 141

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 **1638** HE, his '*Discourses Concerning Two New Sciences*' was published with Galileo's ideas on the laws of motion and the principles of mechanics.⁸⁶¹

⁸⁶¹ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml



GALILEO Portrait by Giusto Sustermans, location and date unknown⁸⁶²

⁸⁶² 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.⁸⁶³ GALILEO was the first person to turn a telescope to the sky, artist, date and location unknown.⁸⁶⁴

⁸⁶³ SciShow 5-2-12016HE youtube.com Video: *The Truth About 10 Famous Inventions*

⁸⁶⁴ http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml

Circa 11568 HE: GERHARD KREMER, aka GERARDUS MERCATOR, Flemish geographer⁸⁶⁵ who perfected his world map using cylindrical projection. Although very inaccurate in size of land mass depiction the Mercator Projection helped launch modern geography.⁸⁶⁶

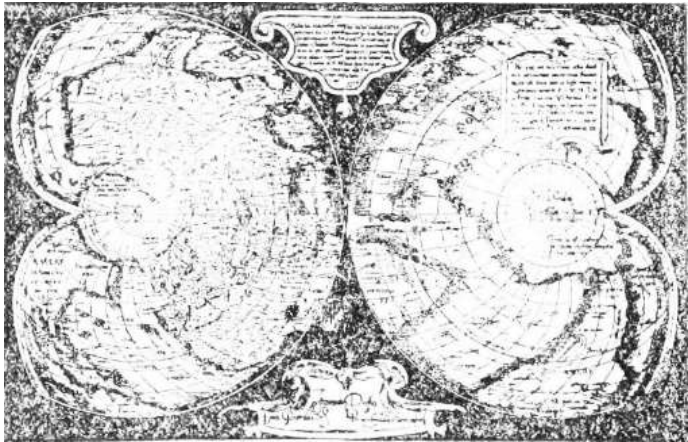


GERARDUS MERCATOR, artist, date, location unknown.⁸⁶⁷

⁸⁶⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

⁸⁶⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

⁸⁶⁷ https://en.wikipedia.org/wiki/Gerardus_Mercator



MERCATOR first map **11538 HE**, location unknown.⁸⁶⁸

⁸⁶⁸ https://commons.wikimedia.org/wiki/File:PSM_V16_D518_Mercator_first_map_1538_ad.jpg

Circa 11568 HE: Woodblock of current printing press process.



11568 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.⁸⁶⁹

⁸⁶⁹ https://en.wikipedia.org/wiki/History_of_printing

11570 HE – 11619 HE: HANS LIPPERSHEY, Dutch spectacle maker who in **11608 HE** filed a patent, and is known for, the earliest written record of a refracting telescope.⁸⁷⁰



HANS LIPPERSHEY, artist, location, date unknown.⁸⁷¹

⁸⁷⁰ https://en.wikipedia.org/wiki/Hans_Lippershey

⁸⁷¹ https://en.wikipedia.org/wiki/Hans_Lippershey

Circa 11571 HE – 11630 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.⁸⁷² (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.⁸⁷³

⁸⁷² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 131

⁸⁷³ PBS Skunk Bear How Eclipses changed History youtube video:

https://www.youtube.com/watch?v=tTxz_d2q7Js



11610 HE: Portrait of JOHANNES KEPLER by an unknown artist.⁸⁷⁴

⁸⁷⁴ 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.⁸⁷⁵ (2) A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.⁸⁷⁶ (3) The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.⁸⁷⁷

⁸⁷⁵ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

⁸⁷⁶ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

⁸⁷⁷ https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion

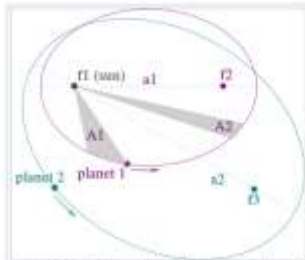


Figure 1: Illustration of Kepler's three laws with two planetary orbits

(1) The orbits are ellipses, with focal points f_1 and f_2 for the first planet and f_1 and f_3 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 $a_1^3 : a_2^3$.



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⇒ MAX TEGMARK, in his **11214 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.”⁸⁷⁹

11572 HE – 11633 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 **11620 HE** and an innovator who contributed to the development of measurement and control systems, optics and chemistry.⁸⁸⁰

⁸⁷⁹ MAX TEGMARK, Our Mathematical Universe

⁸⁸⁰ https://en.wikipedia.org/wiki/Cornelis_Drebbel



CORNELIS DREBBEL artist, date and location unknown.⁸⁸¹

⁸⁸¹ https://en.wikipedia.org/wiki/Cornelis_Drebbel



Reconstruction of the Drebbel: Richmond upon Thames. In **12002 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 **12002 HE**.⁸⁸²

⁸⁸² https://en.wikipedia.org/wiki/Cornelis_Drebbel

11578 HE – 11657 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.⁸⁸³ (see Circa **11288 HE** IBN AL-NAFIS and circa **11533 HE** MIGUEL SERVETO aka MICHAEL SERVETUS and see **circa 11559 HE:** REALDO COLUMBO).⁸⁸⁴
⁸⁸⁵ **11628 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.⁸⁸⁶

⁸⁸³ https://en.wikipedia.org/wiki/William_Harvey

⁸⁸⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

⁸⁸⁵ https://en.wikipedia.org/wiki/William_Harvey

⁸⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140



WILLIAM HARVEY, artist, date and location unknown.⁸⁸⁷

⁸⁸⁷ https://en.wikipedia.org/wiki/William_Harvey

11561 HE – 11636 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 metabolism⁸⁸⁸ 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.⁸⁸⁹

⁸⁸⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 134

⁸⁸⁹ 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.⁸⁹⁰

⁸⁹⁰ https://en.wikipedia.org/wiki/Santorio_Santorio

11580 HE – 11644 HE: JAN BAPTISTA VAN HELMONT, Flemish physician⁸⁹¹ 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^{892 893} and that he identified Carbon Dioxide⁸⁹⁴ VAN HELMONT also identified the “Star Stuff” element Magnesium.⁸⁹⁵

⁸⁹¹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

⁸⁹² https://en.wikipedia.org/wiki/Jan_Baptist_van_Helmont

⁸⁹³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

⁸⁹⁴ www.britannica.com/biography/Jan-Baptista-van-Helmont

⁸⁹⁵ https://en.wikipedia.org/wiki/Joseph_Black



11648 HE: JAN BAPTISTA VAN HELMONT (left) and his son Franciscus-Mercurius from the *Ortus medicinae*, artist and location unknown.⁸⁹⁶

⁸⁹⁶ 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.⁸⁹⁷

⁸⁹⁷ <http://images-of-elements.com/magnesium.php#a>

11580 HE–11650 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 dealing with communicating via a crude Aldis lamp – the predecessor to Morse Code⁸⁹⁸



Drawing of FRANZ KESSLER'S invention: a harness for diving

⁸⁹⁸ https://en.wikipedia.org/wiki/Franz_Kessler

below water, artist, location, date unknown.⁸⁹⁹ Author / Compiler did not find a book about his diving harness. But for a list of other of his books see the footnote:⁹⁰⁰

Circa 11582 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.⁹⁰¹

Circa 11583 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

⁸⁹⁹ https://en.wikipedia.org/wiki/Franz_Kessler

⁹⁰⁰ https://en.wikipedia.org/wiki/Franz_Kessler

⁹⁰¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

the liquid. This finding is considered to have founded the modern science of Hydrostatics.

⇒ Circa **11586 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 $2 \text{ and } 7/8$ would be 2.875 and $2 \frac{1}{2}$ would be 2.5 etc.

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Statue of Simon Stevin
by Eugène Simonis, 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.⁹⁰³

⁹⁰³ https://en.wikipedia.org/wiki/Simon_Stevin

Cover of SIMON STEVIN's *Oeuvres mathématiques*, reprint in 11634 HE.⁹⁰⁴

⁹⁰⁴ https://en.wikipedia.org/wiki/Simon_Stevin

Circa 11585 HE – 11632 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.⁹⁰⁵



ZARARIAS JANSSEN, artist, date, location unknown.⁹⁰⁶

⁹⁰⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

⁹⁰⁶ https://en.wikipedia.org/wiki/Zacharias_Janssen

11563 HE – 11614 HE: WILLIAM LEE, English. Circa **11589 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 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.⁹⁰⁷ (See circa **11298 HE:** Spinning wheels themselves were only invented only about 500 years ago.)

⁹⁰⁷ 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.⁹⁰⁸

⁹⁰⁸ https://en.wikipedia.org/wiki/Stocking_frame

Circa 11589 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.⁹⁰⁹



FRANCOIS VIETE, French mathematician, date, location, and artist unknown⁹¹⁰

⁹⁰⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 125

⁹¹⁰ https://en.wikipedia.org/wiki/Francois_Viete

Circa 11592 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 of Pompeii may be viewed as the beginning of modern archeology.*⁹¹¹

⁹¹¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 126

Circa 11592 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.⁹¹²



LUDOLF van CEULEN, date, location, and artist unknown.⁹¹³

⁹¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

⁹¹³ https://en.wikipedia.org/wiki/Ludolph_van_Ceulen

Circa 11597 HE: ANDREAS LIBAU, German alchemist 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.⁹¹⁴



ANDREAS LIBAU, date, location, and artist unknown.⁹¹⁵

⁹¹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

⁹¹⁵ https://en.wikipedia.org/wiki/Andreas_Libavius

116th Century HE

Circa 11600 HE: The population of the world was approximately 500,000,000 people.⁹¹⁶

Circa 11600 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.⁹¹⁷

⁹¹⁶ <http://www.worldometers.info/world-population/world-population-by-year/>

⁹¹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 128



WILLIAM GILBERT, date, location, and artist unknown.⁹¹⁸

⁹¹⁸ [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.⁹¹⁹

⁹¹⁹ [https://en.wikipedia.org/wiki/William_Gilbert_\(astronomer\)](https://en.wikipedia.org/wiki/William_Gilbert_(astronomer))

11607 HE – 11665 HE: PIERRE DE FERMAT⁹²⁰ (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 **11600'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 **11632 HE**), FERMAT made a significant contribution to the theory of probability. But FERMAT's crowning achievement was in the theory of numbers." Regarding FERMAT's work in analysis, circa **11687 HE** ISAAC NEWTON wrote that his own early ideas about calculus came

⁹²⁰ Liz Strachan *A Slice of Pi*

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.⁹²¹

⇒ 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 10250 HE** when DIOPHANTUS wrote an Algebra text) and included the statement that the margin was too small to include the proof.⁹²² It took circa 370 years for his statement in that margin to be mathematically proven.⁹²³ (See SIR ANDREW WILES **11995 HE**).

⁹²¹ https://en.wikipedia.org/wiki/Pierre_de_Fermat

⁹²² https://en.wikipedia.org/wiki/Pierre_de_Fermat

⁹²³ Liz Strachan **A Slice of Pi**



PIERRE DE FERMAT: Bust in the Salle des Illustres in Capitole de Toulouse, date unknown.⁹²⁴

⁹²⁴ https://en.wikipedia.org/wiki/Pierre_de_Fermat

Circa 11614 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”.⁹²⁵



JOHN NAPIER, artist, date, and location unknown.⁹²⁶

⁹²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, page 134

⁹²⁶ https://en.wikipedia.org/wiki/John_Napier

11616 HE – 11703 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 **11685 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.⁹²⁷



JOHN WALLIS, date, location, and artist unknown.⁹²⁸

⁹²⁷ https://en.wikipedia.org/wiki/John_Wallis

⁹²⁸ https://en.wikipedia.org/wiki/John_Wallis

Circa 11620 HE: Stagecoaches came into use.⁹²⁹

11620 HE – 11682 HE: JEAN-FELIX PICARD, French astronomer who was **11684 HE** published posthumously: although his observations were with telescopes, JEAN-FELIX PICARD correctly calculated the Earth's circumference as 24876 miles and its diameter as 7900 miles.⁹³⁰

⇒ Yes, Star Trek fans, Captain Jean-Luc Picard was named after this French astronomer!⁹³¹

⁹²⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 136

⁹³⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 170

⁹³¹ <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>



JEAN-FELIX PICARD, date, location, and artist unknown⁹³²

⁹³² <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>

Circa 11621 HE: WILLEBRORD SNEL VAN ROYAN or aka WILLEBRORD SNELIUS, Dutch mathematician known for “Snell’s Law”⁹³³ which was the law of refraction, which he *rediscovered* in **11621 HE**.⁹³⁴

⇒ As you remember, the understanding of how curved mirrors and lenses bend and focus light was already defined by IBN SAHL in his **10984 HE** treatise *On Burning Mirrors and Lenses*, which was lost when, in about **Circa 11111 HE**, Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. It took

⁹³³ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

⁹³⁴ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

approximately 637 years before SNELIUS rediscovered these ideas,⁹³⁵ and for that act got “naming rights.”⁹³⁶



WILLEBRORD SNEL VAN ROYAN (SNELIUS), artist, date, and location unknown.⁹³⁷

⁹³⁵ https://en.wikipedia.org/wiki/Ibn_Sahl

⁹³⁶ Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

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

⁹³⁷ https://en.wikipedia.org/wiki/Willebrord_Snellius

11623 HE to 11673 HE: MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, English aristocrat, philosopher, poet, scientist, fiction-writer, and playwright⁹³⁸ wrote the utopian romance *The Blazing World*, and it is one of the earliest examples of science fiction.⁹³⁹

⇒ 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

⁹³⁸ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

⁹³⁹ Audible 7-22-16 Podcast "Get Smart"

a dozen original works; inclusion of her revised works brings her total number of publications to twenty-one.⁹⁴⁰

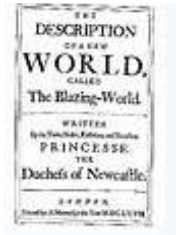
- ⇒ Writings by MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, include *Bell in Campo* and *The Sociable Companions*; *Observations upon Experimental Philosophy*; *Paper Bodies*; *Sociable Letters*; *The Convent of Pleasure and Other Plays*.⁹⁴¹
- ⇒ MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, was a “badass writer” according to Jennifer Sherman Roberts’s book *“Everyone, We Need to Talk About 17th-Century Badass Writer Margaret Cavendish”*.⁹⁴² (....author

⁹⁴⁰ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

⁹⁴¹ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

⁹⁴² https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne#Books

compiler here: does it make sense to you that her knowledge was based on what came before? Maybe the title of the book could now be seen as "Everyone, We Need to Talk About 116th-Century Badass Writer Margaret Cavendish".



11666 HE Cover to earliest example of Science Fiction Book *The Blazing World*.⁹⁴³

⁹⁴³ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne



MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, unknown artist and date⁹⁴⁴

⁹⁴⁴ https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne

11625 HE – 11712 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.⁹⁴⁵

⇒ **Circa 11665 HE: GIOVANNI DOMENICO CASSINI** also accurately measured the rotations of Mars and of Jupiter. **Circa 11671 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 11675 HE: GIOVANNI DOMENICO CASSINI** noted the dark line separating Saturn’s rings.⁹⁴⁶ **Circa 11672 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

⁹⁴⁵ https://en.wikipedia.org/wiki/Giovanni_Domenico_Cassini

⁹⁴⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 165

no 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 know planet at that time was estimated at 1.6 billion miles across.⁹⁴⁷

⇒ CASSINI I gave human beings their first exposure to how small they and their world were compared to the universe.⁹⁴⁸

⁹⁴⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

⁹⁴⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

Giovanni Domenico Cassini



GIOVANNI DOMENICO CASSINI, CASSINI I, artist,
location, and date unknown.⁹⁴⁹

⁹⁴⁹ https://en.wikipedia.org/wiki/Giovanni_Domenico_Cassini

11626 HE – 11697 HE: FRANCESCO REDI, Italian physician debunked the notion of spontaneous combustion.⁹⁵⁰

⇒ 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".⁹⁵¹

⇒ **Circa 11668 HE:** FRANCESCO REDI *set up the first clear case of using proper controls in an experiment by using 8 flasks*

⁹⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

⁹⁵¹ https://en.wikipedia.org/wiki/Francesco_Redi

holding different types of meat and of which 4 he sealed and 4 he left open to the air.⁹⁵²

- ⇒ His most famous experiments are described in his magnum opus *Esperienze Intorno alla Generazione degl'Insetti (Experiments on the Generation of Insects)*, published in **11668 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 **11685 HE** *Bacco in Toscana* (*'Bacchus in*

⁹⁵² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

Tuscany) is considered among the finest works of **11600s HE** Italian poetry, and for which the Grand Duke Cosimo III gave him a medal of honor.⁹⁵³



Statue of FRANCESCO REDI on the Uffizi Gallery (Piazzale

⁹⁵³ https://en.wikipedia.org/wiki/Francesco_Redi

degli Uffizi) in Florence. At his feet is a copy of **Bacco in Toscana.**⁹⁵⁴



11668 HE Esperienze Intorno alla Generazione degli Insetti front cover⁹⁵⁵

⁹⁵⁴ https://en.wikipedia.org/wiki/Francesco_Redi

⁹⁵⁵ 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 **11837 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 **11967 HE**; A scientific journal Redia, an Italian journal of zoology, is named in FRANCESCO REDI honor, which was first published in **11903 HE**. A European viper subspecies, *Vipera aspis francisciredi* Laurenti, **11768 HE**, is named after FRANCESCO REDI.⁹⁵⁶

⁹⁵⁶ https://en.wikipedia.org/wiki/Francesco_Redi

11627 HE – 11691 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.”⁹⁵⁷

⇒ **Circa 11662 HE ROBERT BOYLE** experimented with gas and mercury in a 17-foot glass tube and determined that air and other gases were atomic in nature. **BOYLE** was able to experimentally prove what circa 2121 years ago, **DEMOCRITUS (Circa 9541 HE)** had conjectured about atomic theory.⁹⁵⁸

⇒ **ROBERT BOYLE** published *The Skeptical Chymist*, the book that symbolized turning the back on medievalism. **BOYLE**

⁹⁵⁷ <https://www.chemicool.com/definition/element.html>

⁹⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

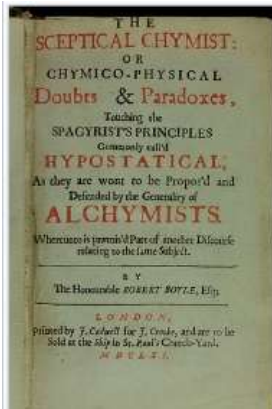
*dropped the prefix “al”, from the word alchemist, which in Arabic meant “the”. The very name was changed from alchemist to chemist in **The Skeptical Chymist**. He divorced chemistry from medicine making it a separate science. In **The Skeptical Chymist** BOYLE pushed for chemistry to be an experimental 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”.⁹⁵⁹*

⁹⁵⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 154



ROBERT BOYLE, date, location, and artist unknown.⁹⁶⁰

⁹⁶⁰ https://en.wikipedia.org/wiki/Robert_Boyle



Title page of *The Sceptical Chymist*, 11661 HE, photographer unknown.⁹⁶¹

⁹⁶¹ 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.⁹⁶²



⇒ 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, has been known and used since prehistoric time. Mineral oil consists

⁹⁶² <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

largely of hydrocarbons. The combustion of carbon produces carbon dioxide, CO₂. This is a greenhouse gas, which traps heat radiation.⁹⁶³ 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.⁹⁶⁴ 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.⁹⁶⁵

⁹⁶³ <http://images-of-elements.com/carbon.php#a>

⁹⁶⁴ <http://images-of-elements.com/carbon.php#a>

⁹⁶⁵ <http://images-of-elements.com/carbon.php#a>

- More about the “Star Stuff” Element Carbon: In **11770 HE**, **CARL WILHELM SCHEELE** showed that graphite also burned to form carbon dioxide and thereby discovered another form of Carbon.
- In **11985 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 **11967 HE** World's Fair. In **12004 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.⁹⁶⁶

11627 HE – 11705 HE: JOHN RAY, English naturalist who, circa **11686 HE** when he had access to so much more of the world than the ancient Greeks, (see THEOPHRATUS circa **9681 HE** who classified 550 different plants) published a painstaking three volume classification of 18600 different plant species. In **11691 HE** JOHN RAY started classifying animals on the basis of hooves, toes, and teeth, his system that persists to this day.⁹⁶⁷ 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"⁹⁶⁸ ISAAC ASIMOV said classifications such as

⁹⁶⁶ <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

⁹⁶⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

⁹⁶⁸ https://en.wikipedia.org/wiki/John_Ray

JOHN RAY's made the matter of biological evolution seem an overwhelming likelihood.⁹⁶⁹



Wood cut of JOHN RAY, artist, date, and location unknown.⁹⁷⁰

⁹⁶⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

⁹⁷⁰ https://en.wikipedia.org/wiki/John_Ray



Painting of JOHN RAY, artist, date, and location unknown.⁹⁷¹



Including the various editions, *there are 172 works by JOHN RAY.*⁹⁷²

⁹⁷¹ https://en.wikipedia.org/wiki/John_Ray

⁹⁷² https://en.wikipedia.org/wiki/John_Ray

11628 HE – 11694 HE: MARCELLO MALPIGHI, Italian physiologist who further pioneered the field of microscopes.

- ⇒ With the use of a more advanced microscope, MARCELLO MALPIGHI completed WILLIAM HARVEY's **11628 HE** theory of how blood flows and defined “capillaries”⁹⁷³
- MARCELLO MALPIGHI's treatise *De polypo cordis* (**11666 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

⁹⁷³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 153

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 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 11675 HE and 11679 HE. Another edition followed in 11687 HE, and a supplementary volume in 11697 HE. In his autobiography, MALPIGHI speaks of his Anatome Plantarum, as "the most elegant format in the whole literate world."*⁹⁷⁴
- ⇒ Several physiological features of the biological excretory system are named after MARCELLO MALPIGHI, such as the

⁹⁷⁴ https://en.wikipedia.org/wiki/Marcello_Malpighi

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 Malpighian corpuscles. The botanical family Malpighiaceae is also named after him.



MARCELLO MALPIGHI a lifetime portrait by Carlo Cignani, date and location unknown.⁹⁷⁵

⁹⁷⁵ https://en.wikipedia.org/wiki/Marcello_Malpighi

Circa **11629 HE – 11695 HE**: CHRISTIAAN HUYGENS, Dutch astronomer⁹⁷⁶ 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.⁹⁷⁷

⇒ HUYGENS along with Dutch philosopher and optician BENEDICT SPINOZA worked out a new and better method for grinding telescope lenses and did what in **11612 HE**: GALILEO was unable to do: HUYGENS and BENEDICT SPINOZA observed Saturn, its rings, and also discovered Titan – one of its moons.⁹⁷⁸

⁹⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

⁹⁷⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

⁹⁷⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

⇒ In **11673** **HE** CHRISTIAAN HUYGENS published *Horologium Oscillatorium sive de motu pendulorum*, his major work on pendulums and horology.



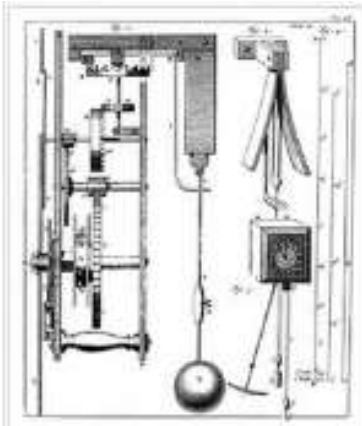
⇒ CHRISTIAAN HUYGENS, by Caspar Netscher, Museum Hofwijck, Voorburg⁹⁷⁹

⁹⁷⁹ https://en.wikipedia.org/wiki/Christiaan_Huygens



CHRISTIAAN HUYGENS clock, Rijksmuseum, Amsterdam⁹⁸⁰

⁹⁸⁰ https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology



Detail of illustration from *Horologium Oscillatorium* (11658 HE), by CHRISTIAAN HUYGENS⁹⁸¹

⁹⁸¹ https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology

11630 HE – 11702 HE: OLAUS RUDBECK aka OLOF RUDBECK
the Elder, Swedish naturalist demonstrated another system in the
body: The Lymphatic system.⁹⁸²



RUDBECK, painted in **11696 HE** by Martin Mijtens the Elder,
location unknown.⁹⁸³

⁹⁸² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

⁹⁸³ https://en.wikipedia.org/wiki/Olaus_Rudbeck

11632 HE – 11662 HE: BLAISE PASCAL, French mathematician⁹⁸⁴ physicist, inventor and writer.⁹⁸⁵ **Circa 11648 HE** BLAISE PASCAL studied fluid pressures and his work is the basis for the hydraulic press.⁹⁸⁶ **Circa 11648 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.⁹⁸⁷

⁹⁸⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

⁹⁸⁵ https://en.wikipedia.org/wiki/Blaise_Pascal

⁹⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

⁹⁸⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

- ⇒ **Circa 11654 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**.⁹⁸⁸
- ⇒ PASCAL invented the first adding and subtracting machine. It had wheels that were marked 1 to 10 marked off along its circumference.⁹⁸⁹
- ⇒ Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL amounted to the discovery of Outer Space.⁹⁹⁰

⁹⁸⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

⁹⁸⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

⁹⁹⁰ 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 **11691** **HE** is posthumous.⁹⁹¹

⁹⁹¹ https://en.wikipedia.org/wiki/Blaise_Pascal

Circa 11635 HE: HENRY GELLIBRAND, English astronomer, combined his experiments with notes from others, proving that although the earth was a magnet (see **11600 HE:** WILLIAM GILBERT) that the north pole had shifted approximately 7 degrees in direction in the previous 50 years.⁹⁹²

⁹⁹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142

11635 HE: First surviving drawing of a kite; see **Circa 9494 HE – 9561 HE:** LU BAN, (Gongshu Ban).⁹⁹³



First surviving woodcut print of a kite from John Bate's **11635 HE** book *The Mysteryes of Nature and Art*.⁹⁹⁴

⁹⁹³ https://en.wikipedia.org/wiki/History_of_aviation

⁹⁹⁴ https://en.wikipedia.org/wiki/History_of_aviation

11635 HE – 11703 HE: ROBERT HOOKE, English physicist⁹⁹⁵ who designed an air pump that worked much better than **Circa 11654 HE OTTO** von GUERICKE's. HOOKE made such a quality vacuum that he did the experiment that circa **11612 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.⁹⁹⁶

⇒ According to ISAAC ASIMOV, it was ROBERT BOYLE who hired ROBERT HOOKE to build the improved air pump.⁹⁹⁷

⇒ **Circa 11654 HE** ROBERT HOOKE noted the large red oval marking on Jupiter and named it the Great Red Spot.⁹⁹⁸

⁹⁹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

⁹⁹⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

⁹⁹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

⁹⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

- ⇒ ROBERT HOOKE argued for an attracting principle of gravitation in *Micrographia* of **11665 HE**. HOOKE'S **11666 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.⁹⁹⁹
- ⇒ In **11665 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 suggested by the resemblance of plant cells to cells of a honeycomb.¹⁰⁰⁰

⁹⁹⁹ https://en.wikipedia.org/wiki/Robert_Hooke

¹⁰⁰⁰ https://en.wikipedia.org/wiki/Robert_Hooke



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 display at the National Museum of Health and Medicine in Washington, DC.¹⁰⁰¹

¹⁰⁰¹ https://en.wikipedia.org/wiki/Robert_Hooke

Circa 11637 HE: RENE DESCARTES, French mathematician. 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.¹⁰⁰²



RENE DESCARTES at work, date and artist unknown.¹⁰⁰³

11637 HE – 11680 HE: JAN SWAMMERDAM, Dutch naturalist.
11658 HE: SWAMMERDAM used the improved microscope to study approximately 3000 insects. SWAMMERDAM is

¹⁰⁰² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142

¹⁰⁰³ https://en.wikipedia.org/wiki/Rene_Descartes

considered the *father of modern entomology*. SWAMMERDAM used the improved microscope to discover the red blood corpuscle.¹⁰⁰⁴



JAN SWAMMERDAM, date, location and artist unknown.¹⁰⁰⁵

11638 HE – 11686 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

¹⁰⁰⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

¹⁰⁰⁵ <http://janswammerdam.org/>

stone. ASIMOV notes this is the first scientifically recognized spectacular evidence of biological evolution.¹⁰⁰⁶ (See **11556 HE**: GEORG BAUER and how he speculated on fossils and **11799 HE** – **11847 HE** MARY ANNING.)

⇒ **11669 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

¹⁰⁰⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

HAÜY in **11801 HE**. This fundamental breakthrough formed the basis of all subsequent inquiries into crystal structure.¹⁰⁰⁷

⇒ **11669 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".

¹⁰⁰⁷ https://en.wikipedia.org/wiki/Nicolas_Steno

- 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 **11772 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 **11726 HE-**

11797 HE: JAMES HUTTON's theory of infinitely repeating cycles of seabed deposition, uplifting, erosion, and submersion.¹⁰⁰⁸

- Also see **11910 HE– 11994 HE:** DOROTHY MARY CROWFOOT HODGKIN OM FRS HonFRSC, British **11964 HE** Nobel Prize winning chemist who invented / developed Protein Crystallography: the technique which shines light at proteins to expose their 3-dimensional structure.¹⁰⁰⁹

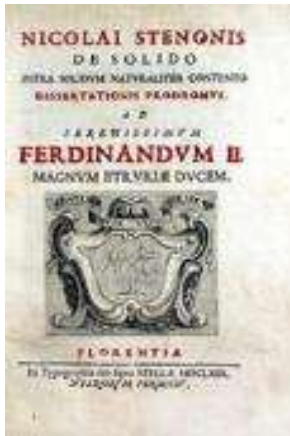
¹⁰⁰⁸ https://en.wikipedia.org/wiki/Nicolas_Steno

¹⁰⁰⁹ <https://www.youtube.com/watch?v=dCe9y053pqE> TimJamesScience



Portrait of NICHOLAS STENO Unsigned but attributed to court painter Justus Sustermans. (Uffizi Gallery, Florence, Italy)¹⁰¹⁰

¹⁰¹⁰ https://en.wikipedia.org/wiki/Nicolas_Steno



Cover of NICHOLAS STENO 11669 HE book "*De solido intra solidum naturaliter contento.*"¹⁰¹¹

11641 HE – 11712 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.¹⁰¹²



NEHEMIAH GREW, date, location, and artist unknown.¹⁰¹³

¹⁰¹¹ https://en.wikipedia.org/wiki/Nicolas_Steno

¹⁰¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 168

¹⁰¹³ https://en.wikipedia.org/wiki/Nehemiah_Grew

11642 HE– 11727 HE: SIR ISAAC NEWTON, English Physicist and Mathematician is widely recognized as one of the most influential scientists of all time. **11666 HE:** ISAAC NEWTON conducted the experiments on defining the visible light spectrum.¹⁰¹⁴ 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.¹⁰¹⁵

⇒ LAWRENCE M. KRAUSS helps us understand more about the influence of the time period and from what NEWTON helped us

¹⁰¹⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 158

¹⁰¹⁵ https://en.wikipedia.org/wiki/Isaac_Newton

to 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.”¹⁰¹⁶

⇒ 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...”¹⁰¹⁷

¹⁰¹⁶ LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

¹⁰¹⁷ LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

- ⇒ See **11267 HE -11319 HE: KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI** is known for giving the first mathematically satisfactory explanation of the rainbow.¹⁰¹⁸ Although because **Circa 1111 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.¹⁰¹⁹ So, NEWTON had to re-invent and thus get credit.
- ⇒ **11687 HE ISAAC NEWTON** wrote the book: *Principia: 'Mathematical Principles of Natural Philosophy'* in Latin, but

¹⁰¹⁸ https://en.wikipedia.org/wiki/Kamal_al-Din_al-Farisi

¹⁰¹⁹ Neil deGrasse Tyson speech "How The Islamic Civilization Fell"
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

ROBERT HOOKE opposed the publication of it and the Royal Society hesitated to become involved.

- 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.¹⁰²⁰ **11687**
HE: ISAAC NEWTON's *Philosophiæ Naturalis Principia Mathematica* (*'Mathematical Principles of Natural Philosophy'*), when first published, (in latin) laid the foundations for classical mechanics.¹⁰²¹

¹⁰²⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

¹⁰²¹ <http://www.bbc.co.uk/timelines/zwwgcdn>

- It was EDMOND HALLEY who privately paid for the publishing of *Principia*, what is thought to be the greatest science book of all time.¹⁰²²
- ⇒ ISAAC NEWTON concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.¹⁰²³
- ARISTOTLE (See Circa **9617 HE** – **9678 HE**) concluded that time is measured by the changing of things and that if nothing changes, there is no time.¹⁰²⁴
- ALBERT EINSTEIN (See **11879 HE** – **11955 HE**) concluded that both ARISTOTLE and ISAAC NEWTON were

¹⁰²² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 172

¹⁰²³ Carlo Roveli's *The Order of Time*

¹⁰²⁴ Carlo Roveli's *The Order of Time*

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 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.¹⁰²⁵

⇒ **11687 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 11665 HE** sending French astronomer JEAN RICHER on the expedition to Cayenne, French Guiana, which in **circa 11672 HE** RICHER helped determine the parallax of the planet Mars. While there, RICHER

¹⁰²⁵ Carlo Roveli’s *The Order of Time*

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, 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).¹⁰²⁶

¹⁰²⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 173



11689 HE SIR ISAAC NEWTON portrait by Godfrey Kneller,
location unknown.¹⁰²⁷

¹⁰²⁷ https://en.wikipedia.org/wiki/Isaac_Newton

Circa 11643 HE: EVANGINELISTA TORRICELLI, Italian physicist invented the first mercury column barometer by way of a vacuum.¹⁰²⁸ Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL (and BLAISE PASCAL's brother-in-law, See: **11632 HE – 11662 HE: BLAISE PASCAL**) amounted to the discovery of Outer Space.¹⁰²⁹

¹⁰²⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 146

¹⁰²⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148



TORRICELLI, date, location, and artist unknown.¹⁰³⁰

11644 HE – 11710 HE: OLE ROEMER (RØMER), 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 **11686 HE – 11736**

¹⁰³⁰ https://en.wikipedia.org/wiki/Evangelista_Torricelli

HE: FAHRENHEIT) relied as the basis for his temperature scale.¹⁰³¹



11700 HE OLE ROEMER (RÓMER), by Jacob Coning, location unknown.¹⁰³²

¹⁰³¹ https://en.wikipedia.org/wiki/ole_roemer

¹⁰³² https://en.wikipedia.org/wiki/ole_roemer

Circa 11645 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.¹⁰³³

⇒ **Circa 11654 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.¹⁰³⁴

⇒ **Circa 11660 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.¹⁰³⁵

¹⁰³³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 147

¹⁰³⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

¹⁰³⁵ 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.¹⁰³⁶

¹⁰³⁶ https://en.wikipedia.org/wiki/Otto_von_Guericke

11646 HE – 11716 HE: GOTTFRIED WILHELM LEIBNIZ, German mathematician who in **11693 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.
- ⇒ **11700 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.

⇒ 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.¹⁰³⁷



⇒ GOTTFRIED WILHELM LEIBNIZ, Portrait by Christoph Bernhard Francke, date unknown.¹⁰³⁸

¹⁰³⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰³⁸ https://en.wikipedia.org/wiki/Gottfried_Wilhelm_Leibniz

11647 HE – 11713 HE: DENIS PAPIN, French physicist, mathematician and inventor who in **11679 HE** developed the pressure steam cooker with a safety valve.¹⁰³⁹



11689 HE DENIS PAPIN, unknown artist and date.¹⁰⁴⁰

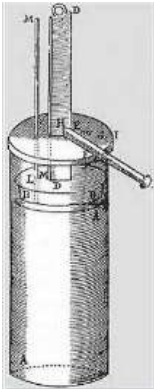
¹⁰³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰⁴⁰ https://en.wikipedia.org/wiki/Denis_Papin



11679 HE drawing of DENIS PAPIN's steam digester, artist and location unknown.¹⁰⁴¹

¹⁰⁴¹ https://en.wikipedia.org/wiki/Denis_Papin



11690 HE drawing of DENIS PAPIN's first piston steam engine,¹⁰⁴² (also see **Circa 10050 HE: HERO of ALEXANDRIA**).

¹⁰⁴² https://en.wikipedia.org/wiki/Denis_Papin

Circa 11650 HE: Timekeeping was still quite crude.



Circa 10050 years (see **6001 HE**) after the first recorded ground sundial, the above 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.¹⁰⁴³

¹⁰⁴³ <https://en.wikipedia.org/wiki/Sundial>

Circa **11650 HE** – **11715 HE**: THOMAS SAVERY, English, inventor¹⁰⁴⁴ created the first *European* steam engine, which he patented in **11698 HE** for the very specific purpose of pumping water from coal mines.¹⁰⁴⁵ (See **10500 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?).¹⁰⁴⁶

¹⁰⁴⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰⁴⁵ https://en.wikipedia.org/wiki/Thomas_Savery

¹⁰⁴⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



THOMAS SAVERY, date, location, and artist unknown¹⁰⁴⁷

¹⁰⁴⁷¹⁰⁴⁷ https://en.wikipedia.org/wiki/Thomas_Savery



The **11698 HE** patented *Savery Steam Engine* ¹⁰⁴⁸

¹⁰⁴⁸ https://en.wikipedia.org/wiki/Thomas_Savery

Circa **11651 HE**: GIAMBATTISTA RICCIOLI, Italian astronomer¹⁰⁴⁹ 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.¹⁰⁵⁰

- ⇒ In his **11651 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.¹⁰⁵¹
- ⇒ One of GIAMBATTISTA RICCIOLI's most significant works was his **11651 HE** *Almagestum Novum (New Almagest)*, an encyclopedic work consisting of over 1500 folio pages (38 cm x

¹⁰⁴⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹⁰⁵⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

¹⁰⁵¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

25 cm) densely packed with text, tables, and illustrations. It became a standard technical reference book for astronomers all over Europe: JOHN FLAMSTEED (**11646 HE –11719 HE**), the first English astronomer royal, a Copernican, used it for his Gresham lectures; JÉRÔME LANDE (**11732 HE–11807 HE**) of the Paris Observatory cited it extensively even though it was an old book at that point.¹⁰⁵²

- ⇒ 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 simply share the eastward rotational

¹⁰⁵² https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli

motion of Earth, which is now known as the "Coriolis Effect" Argument.



GIAMBATTISTA RICCIOLI, date, location, and artist unknown¹⁰⁵³

¹⁰⁵³ https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli

11656 HE – 11742 HE: EDMOND HALLEY, British; Scientist and member of the Royal Society¹⁰⁵⁴ 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.¹⁰⁵⁵

⇒ On his own, HALLEY computed the orbit of Halley's Comet, thus further removing fear in the masses of the celestial events.¹⁰⁵⁶ HALLEY was the second Astronomer Royal in Britain, succeeding JOHN FLAMSTEED.¹⁰⁵⁷

¹⁰⁵⁴ https://en.wikipedia.org/wiki/Edmond_Halley

¹⁰⁵⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹⁰⁵⁶ https://en.wikipedia.org/wiki/Edmond_Halley

¹⁰⁵⁷ https://en.wikipedia.org/wiki/Edmond_Halley

- ⇒ **11676 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.¹⁰⁵⁸
- ⇒ **Circa 11678 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.¹⁰⁵⁹
- ⇒ **11693 HE:** It occurred to HALLEY to look at the fact of death by statistical evaluation and wrote the first Mortality Tables.

¹⁰⁵⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹⁰⁵⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 166

Besides death being a result of age, careful Mortality tables show aspects of death that were not a result of age.¹⁰⁶⁰

⇒ **11698 HE – 11790 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.¹⁰⁶¹ His voyage, probably the first primarily scientific voyage to study the

¹⁰⁶⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

¹⁰⁶¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 176

variation of the magnetic compass, sailing as far as 52 deg S. in the Atlantic Ocean.¹⁰⁶²

⇒ **11715 HE:** It had been 23 centuries since **THALES** (see **Circa 9455HE: 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 **11715 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.¹⁰⁶³

¹⁰⁶² https://en.wikipedia.org/wiki/Edmond_Halley

¹⁰⁶³ **ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery** page 185

Edmond Halley



Circa 11722 HE Portrait by Richard Phillips¹⁰⁶⁴

¹⁰⁶⁴ https://en.wikipedia.org/wiki/Edmond_Halley

- Author / Compiler Note: The discoveries of EDMOND HALLEY rendered astrology moot. “Until the **11600**’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 **11600**’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.”¹⁰⁶⁵

¹⁰⁶⁵ https://en.wikipedia.org/wiki/History_of_astrology

- Author / Compiler asked: What returned the outdated astrology to public awareness? ...”In the **11900’s HE**, astrology gained broader consumer popularity through the influence of regular mass media products, such as newspaper horoscopes.”¹⁰⁶⁶
- Eric Idle made a Netflix movie called “What About Dick?” that includes a parody of astrology with a song called “Asstrology”.¹⁰⁶⁷

11660 HE: The Royal Society of London first met.¹⁰⁶⁸ The very first British ‘learned society’ meeting on 28 November **11660 HE** followed a lecture at Gresham College by CHRISTOPHER WREN. Joined by other leading polymaths including ROBERT

¹⁰⁶⁶ https://en.wikipedia.org/wiki/History_of_astrology

¹⁰⁶⁷ <https://www.netflix.com/ca/title/80235999> entitled “What about Dick?”

¹⁰⁶⁸ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 156

BOYLE and JOHN WILKINS, the group soon received royal approval¹⁰⁶⁹ ...and from **11662 HE** it would be known as 'The Royal Society' of London for Improving Natural Knowledge when Charles II gave it legal charter.¹⁰⁷⁰

⇒ 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.¹⁰⁷¹ (See **Circa 11560 HE:** GIAMBATTISTA DELLA PORTA, Italian physicist who founded the first Scientific Association designed particularly for

¹⁰⁶⁹ <https://royalsociety.org/about-us/history/>

¹⁰⁷⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

¹⁰⁷¹ <https://royalsociety.org/about-us/history/>

the exchange of information and ideas was shut down by the powers of the time / the Inquisition.)¹⁰⁷²



The Royal Society met at Crane Court. It was a newly formed

¹⁰⁷² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115

organization for men of learning to discuss their ideas. Artist,
date and location unknown.¹⁰⁷³

11660 HE– 11713 HE: FRANCIS HAWKSBEЕ¹⁰⁷⁴ aka Francis Hauksbee the Elder, is the English physicist scientist best known for his work on electricity and electrostatic repulsion.¹⁰⁷⁵

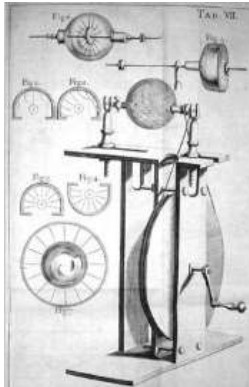
⇒ In **11706 HE: FRANCIS HAWKSBEЕ** constructed a glass sphere turned by a crank, which, through friction could build up a more intensive electric charge. This in turn stimulated further experimentation with static electricity.¹⁰⁷⁶

¹⁰⁷³ <https://royalsociety.org/about-us/history/>

¹⁰⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰⁷⁵ https://en.wikipedia.org/wiki/Francis_Hauksbee

¹⁰⁷⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Drawing of the Generator built by FRANCIS HAUKSBEЕ.
 From *Physico-Mechanical Experiments*, second Ed., London,
 posthumously published **11719 HE.**¹⁰⁷⁷

¹⁰⁷⁷ https://en.wikipedia.org/wiki/Francis_Hauksbee

Circa 11661 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.*¹⁰⁷⁸



FRANCISCUS SYLVIUS, date, location and artist unknown.¹⁰⁷⁹

¹⁰⁷⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

¹⁰⁷⁹ https://en.wikipedia.org/wiki/Franciscus_Sylvius

11663 HE – 11705 HE: GUILLAUME AMONTONS,¹⁰⁸⁰ 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.¹⁰⁸¹

⇒ In **11699 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 **11781 HE**.¹⁰⁸²

⇒ **11669 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

¹⁰⁸⁰ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

¹⁰⁸¹ https://en.wikipedia.org/wiki/Guillaume_Amontons

¹⁰⁸² [https://en.wikipedia.org/wiki/Amontons_\(crater\)](https://en.wikipedia.org/wiki/Amontons_(crater))

in 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.¹⁰⁸³



GUILLAUME AMONTONS, Luxembourg Garden, date and artist unknown.¹⁰⁸⁴

¹⁰⁸³ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

¹⁰⁸⁴ [https://en.wikipedia.org/wiki/Amontons_\(crater\)](https://en.wikipedia.org/wiki/Amontons_(crater))

Circa **11665 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.¹⁰⁸⁵ The crater Grimaldi on the Moon is named after him.¹⁰⁸⁶



GRIMALDI, artist, location, date unknown.¹⁰⁸⁷

¹⁰⁸⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹⁰⁸⁶ https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi

¹⁰⁸⁷ https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi

11666 HE – 11736 HE: STEPHEN GRAY, English experimenter¹⁰⁸⁸ who in **11729 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.¹⁰⁸⁹
- ⇒ There is no monument to STEPHEN GRAY, and little recognition of what he achieved in his scientific discoveries. He

¹⁰⁸⁸ ISAAC ASIMOV'S *Chronology of Science and Discovery*

¹⁰⁸⁹ [https://en.wikipedia.org/wiki/Stephen_Gray_\(scientist\)](https://en.wikipedia.org/wiki/Stephen_Gray_(scientist))

is believed to be buried in a common grave in an old London cemetery, in an area reserved for pauper pensioners.¹⁰⁹⁰

11667 HE – 11756 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*;¹⁰⁹¹

⇒ JACQUES CASSINI: CASSINI II defined the arc of meridian from Dunkirk to Perpignan – defining the radius of Earth.

¹⁰⁹⁰ [https://en.wikipedia.org/wiki/Stephen_Gray_\(scientist\)](https://en.wikipedia.org/wiki/Stephen_Gray_(scientist))

¹⁰⁹¹ https://en.wikipedia.org/wiki/Jacques_Cassini

Jacques Cassini



JACQUES CASSINI: CASSINI II, date, location, and artist unknown¹⁰⁹²

11669 HE: The year the “Star Stuff” element: Phosphorus was first isolated / made by HENNING BRANDT, German merchant and alchemist¹⁰⁹³ at Hamburg, Germany, when he evaporated urine and

¹⁰⁹² https://en.wikipedia.org/wiki/Jacques_Cassini

¹⁰⁹³ https://en.wikipedia.org/wiki/Hennig_Brandt

heated the residue until it was red hot, whereupon phosphorus vapor 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.¹⁰⁹⁴



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,

¹⁰⁹⁴ Phosphorus - Element information, properties and uses ... www.rsc.org/periodic-table/element/15/phosphorus

white, red, black and purple. The white phosphorus is infamous for its extreme 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.¹⁰⁹⁵

11669 HE: ISAAC ASIMOV notes two discoveries were made at this time, which took many additional years of general scientific advancement to be explained.¹⁰⁹⁶

⇒ 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

¹⁰⁹⁵ <http://images-of-elements.com/phosphorus.php#a>

¹⁰⁹⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 162

the other image rotates around it. It took circa 150 years for enough to be known about light for an explanation to become possible;¹⁰⁹⁷ 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.¹⁰⁹⁸

11670 HE – 11720 HE: MARIA MARGARETHE WINKELMANN KIRCH, German unpaid Astronomer¹⁰⁹⁹ was a famous astronomer of her period due to her writings on the conjunction of the sun with

¹⁰⁹⁷ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

¹⁰⁹⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

¹⁰⁹⁹ Author / Compiler does not record where she first learned of KIRCH

Saturn, Venus, and Jupiter in **11709 HE** and **11712 HE** respectively.¹¹⁰⁰

⇒ On **April 21 11702 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.¹¹⁰¹

¹¹⁰⁰ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

¹¹⁰¹ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

Verbreiteter Januarius. Sonnet.					
Sonnet.	1. Jan. 1701.	2. Jan. 1701.	3. Jan. 1701.	4. Jan. 1701.	5. Jan. 1701.
1. Sonntag	1. Jan. 1701.	2. Jan. 1701.	3. Jan. 1701.	4. Jan. 1701.	5. Jan. 1701.
2. Sonntag	6. Jan. 1701.	7. Jan. 1701.	8. Jan. 1701.	9. Jan. 1701.	10. Jan. 1701.
3. Sonntag	11. Jan. 1701.	12. Jan. 1701.	13. Jan. 1701.	14. Jan. 1701.	15. Jan. 1701.
4. Sonntag	16. Jan. 1701.	17. Jan. 1701.	18. Jan. 1701.	19. Jan. 1701.	20. Jan. 1701.
5. Sonntag	21. Jan. 1701.	22. Jan. 1701.	23. Jan. 1701.	24. Jan. 1701.	25. Jan. 1701.
6. Sonntag	26. Jan. 1701.	27. Jan. 1701.	28. Jan. 1701.	29. Jan. 1701.	30. Jan. 1701.
7. Sonntag	31. Jan. 1701.	1. Feb. 1701.	2. Feb. 1701.	3. Feb. 1701.	4. Feb. 1701.
8. Sonntag	5. Feb. 1701.	6. Feb. 1701.	7. Feb. 1701.	8. Feb. 1701.	9. Feb. 1701.
9. Sonntag	10. Feb. 1701.	11. Feb. 1701.	12. Feb. 1701.	13. Feb. 1701.	14. Feb. 1701.
10. Sonntag	15. Feb. 1701.	16. Feb. 1701.	17. Feb. 1701.	18. Feb. 1701.	19. Feb. 1701.
11. Sonntag	20. Feb. 1701.	21. Feb. 1701.	22. Feb. 1701.	23. Feb. 1701.	24. Feb. 1701.
12. Sonntag	25. Feb. 1701.	26. Feb. 1701.	27. Feb. 1701.	28. Feb. 1701.	29. Feb. 1701.
13. Sonntag	1. März 1701.	2. März 1701.	3. März 1701.	4. März 1701.	5. März 1701.
14. Sonntag	6. März 1701.	7. März 1701.	8. März 1701.	9. März 1701.	10. März 1701.
15. Sonntag	11. März 1701.	12. März 1701.	13. März 1701.	14. März 1701.	15. März 1701.
16. Sonntag	16. März 1701.	17. März 1701.	18. März 1701.	19. März 1701.	20. März 1701.
17. Sonntag	21. März 1701.	22. März 1701.	23. März 1701.	24. März 1701.	25. März 1701.
18. Sonntag	26. März 1701.	27. März 1701.	28. März 1701.	29. März 1701.	30. März 1701.
19. Sonntag	31. März 1701.	1. April 1701.	2. April 1701.	3. April 1701.	4. April 1701.
20. Sonntag	5. April 1701.	6. April 1701.	7. April 1701.	8. April 1701.	9. April 1701.
21. Sonntag	10. April 1701.	11. April 1701.	12. April 1701.	13. April 1701.	14. April 1701.
22. Sonntag	15. April 1701.	16. April 1701.	17. April 1701.	18. April 1701.	19. April 1701.
23. Sonntag	20. April 1701.	21. April 1701.	22. April 1701.	23. April 1701.	24. April 1701.
24. Sonntag	25. April 1701.	26. April 1701.	27. April 1701.	28. April 1701.	29. April 1701.
25. Sonntag	30. April 1701.	1. Mai 1701.	2. Mai 1701.	3. Mai 1701.	4. Mai 1701.
26. Sonntag	5. Mai 1701.	6. Mai 1701.	7. Mai 1701.	8. Mai 1701.	9. Mai 1701.
27. Sonntag	10. Mai 1701.	11. Mai 1701.	12. Mai 1701.	13. Mai 1701.	14. Mai 1701.
28. Sonntag	15. Mai 1701.	16. Mai 1701.	17. Mai 1701.	18. Mai 1701.	19. Mai 1701.
29. Sonntag	20. Mai 1701.	21. Mai 1701.	22. Mai 1701.	23. Mai 1701.	24. Mai 1701.
30. Sonntag	25. Mai 1701.	26. Mai 1701.	27. Mai 1701.	28. Mai 1701.	29. Mai 1701.
31. Sonntag	30. Mai 1701.	31. Mai 1701.	1. Juni 1701.	2. Juni 1701.	3. Juni 1701.
32. Sonntag	4. Juni 1701.	5. Juni 1701.	6. Juni 1701.	7. Juni 1701.	8. Juni 1701.
33. Sonntag	9. Juni 1701.	10. Juni 1701.	11. Juni 1701.	12. Juni 1701.	13. Juni 1701.
34. Sonntag	14. Juni 1701.	15. Juni 1701.	16. Juni 1701.	17. Juni 1701.	18. Juni 1701.
35. Sonntag	19. Juni 1701.	20. Juni 1701.	21. Juni 1701.	22. Juni 1701.	23. Juni 1701.
36. Sonntag	24. Juni 1701.	25. Juni 1701.	26. Juni 1701.	27. Juni 1701.	28. Juni 1701.
37. Sonntag	29. Juni 1701.	30. Juni 1701.	1. Juli 1701.	2. Juli 1701.	3. Juli 1701.
38. Sonntag	4. Juli 1701.	5. Juli 1701.	6. Juli 1701.	7. Juli 1701.	8. Juli 1701.
39. Sonntag	9. Juli 1701.	10. Juli 1701.	11. Juli 1701.	12. Juli 1701.	13. Juli 1701.
40. Sonntag	14. Juli 1701.	15. Juli 1701.	16. Juli 1701.	17. Juli 1701.	18. Juli 1701.
41. Sonntag	19. Juli 1701.	20. Juli 1701.	21. Juli 1701.	22. Juli 1701.	23. Juli 1701.
42. Sonntag	24. Juli 1701.	25. Juli 1701.	26. Juli 1701.	27. Juli 1701.	28. Juli 1701.
43. Sonntag	29. Juli 1701.	30. Juli 1701.	31. Juli 1701.	1. Aug. 1701.	2. Aug. 1701.
44. Sonntag	3. Aug. 1701.	4. Aug. 1701.	5. Aug. 1701.	6. Aug. 1701.	7. Aug. 1701.
45. Sonntag	8. Aug. 1701.	9. Aug. 1701.	10. Aug. 1701.	11. Aug. 1701.	12. Aug. 1701.
46. Sonntag	13. Aug. 1701.	14. Aug. 1701.	15. Aug. 1701.	16. Aug. 1701.	17. Aug. 1701.
47. Sonntag	18. Aug. 1701.	19. Aug. 1701.	20. Aug. 1701.	21. Aug. 1701.	22. Aug. 1701.
48. Sonntag	23. Aug. 1701.	24. Aug. 1701.	25. Aug. 1701.	26. Aug. 1701.	27. Aug. 1701.
49. Sonntag	28. Aug. 1701.	29. Aug. 1701.	30. Aug. 1701.	31. Aug. 1701.	1. Sept. 1701.
50. Sonntag	2. Sept. 1701.	3. Sept. 1701.	4. Sept. 1701.	5. Sept. 1701.	6. Sept. 1701.
51. Sonntag	7. Sept. 1701.	8. Sept. 1701.	9. Sept. 1701.	10. Sept. 1701.	11. Sept. 1701.
52. Sonntag	12. Sept. 1701.	13. Sept. 1701.	14. Sept. 1701.	15. Sept. 1701.	16. Sept. 1701.
53. Sonntag	17. Sept. 1701.	18. Sept. 1701.	19. Sept. 1701.	20. Sept. 1701.	21. Sept. 1701.
54. Sonntag	22. Sept. 1701.	23. Sept. 1701.	24. Sept. 1701.	25. Sept. 1701.	26. Sept. 1701.
55. Sonntag	27. Sept. 1701.	28. Sept. 1701.	29. Sept. 1701.	30. Sept. 1701.	1. Okt. 1701.
56. Sonntag	2. Okt. 1701.	3. Okt. 1701.	4. Okt. 1701.	5. Okt. 1701.	6. Okt. 1701.
57. Sonntag	7. Okt. 1701.	8. Okt. 1701.	9. Okt. 1701.	10. Okt. 1701.	11. Okt. 1701.
58. Sonntag	12. Okt. 1701.	13. Okt. 1701.	14. Okt. 1701.	15. Okt. 1701.	16. Okt. 1701.
59. Sonntag	17. Okt. 1701.	18. Okt. 1701.	19. Okt. 1701.	20. Okt. 1701.	21. Okt. 1701.
60. Sonntag	22. Okt. 1701.	23. Okt. 1701.	24. Okt. 1701.	25. Okt. 1701.	26. Okt. 1701.
61. Sonntag	27. Okt. 1701.	28. Okt. 1701.	29. Okt. 1701.	30. Okt. 1701.	31. Okt. 1701.
62. Sonntag	1. Nov. 1701.	2. Nov. 1701.	3. Nov. 1701.	4. Nov. 1701.	5. Nov. 1701.
63. Sonntag	6. Nov. 1701.	7. Nov. 1701.	8. Nov. 1701.	9. Nov. 1701.	10. Nov. 1701.
64. Sonntag	11. Nov. 1701.	12. Nov. 1701.	13. Nov. 1701.	14. Nov. 1701.	15. Nov. 1701.
65. Sonntag	16. Nov. 1701.	17. Nov. 1701.	18. Nov. 1701.	19. Nov. 1701.	20. Nov. 1701.
66. Sonntag	21. Nov. 1701.	22. Nov. 1701.	23. Nov. 1701.	24. Nov. 1701.	25. Nov. 1701.
67. Sonntag	26. Nov. 1701.	27. Nov. 1701.	28. Nov. 1701.	29. Nov. 1701.	30. Nov. 1701.
68. Sonntag	1. Dez. 1701.	2. Dez. 1701.	3. Dez. 1701.	4. Dez. 1701.	5. Dez. 1701.
69. Sonntag	6. Dez. 1701.	7. Dez. 1701.	8. Dez. 1701.	9. Dez. 1701.	10. Dez. 1701.
70. Sonntag	11. Dez. 1701.	12. Dez. 1701.	13. Dez. 1701.	14. Dez. 1701.	15. Dez. 1701.
71. Sonntag	16. Dez. 1701.	17. Dez. 1701.	18. Dez. 1701.	19. Dez. 1701.	20. Dez. 1701.
72. Sonntag	21. Dez. 1701.	22. Dez. 1701.	23. Dez. 1701.	24. Dez. 1701.	25. Dez. 1701.
73. Sonntag	26. Dez. 1701.	27. Dez. 1701.	28. Dez. 1701.	29. Dez. 1701.	30. Dez. 1701.
74. Sonntag	31. Dez. 1701.	1. Jan. 1702.	2. Jan. 1702.	3. Jan. 1702.	4. Jan. 1702.
75. Sonntag	5. Jan. 1702.	6. Jan. 1702.	7. Jan. 1702.	8. Jan. 1702.	9. Jan. 1702.
76. Sonntag	10. Jan. 1702.	11. Jan. 1702.	12. Jan. 1702.	13. Jan. 1702.	14. Jan. 1702.
77. Sonntag	15. Jan. 1702.	16. Jan. 1702.	17. Jan. 1702.	18. Jan. 1702.	19. Jan. 1702.
78. Sonntag	20. Jan. 1702.	21. Jan. 1702.	22. Jan. 1702.	23. Jan. 1702.	24. Jan. 1702.
79. Sonntag	25. Jan. 1702.	26. Jan. 1702.	27. Jan. 1702.	28. Jan. 1702.	29. Jan. 1702.
80. Sonntag	30. Jan. 1702.	31. Jan. 1702.	1. Feb. 1702.	2. Feb. 1702.	3. Feb. 1702.
81. Sonntag	4. Feb. 1702.	5. Feb. 1702.	6. Feb. 1702.	7. Feb. 1702.	8. Feb. 1702.
82. Sonntag	9. Feb. 1702.	10. Feb. 1702.	11. Feb. 1702.	12. Feb. 1702.	13. Feb. 1702.
83. Sonntag	14. Feb. 1702.	15. Feb. 1702.	16. Feb. 1702.	17. Feb. 1702.	18. Feb. 1702.
84. Sonntag	19. Feb. 1702.	20. Feb. 1702.	21. Feb. 1702.	22. Feb. 1702.	23. Feb. 1702.
85. Sonntag	24. Feb. 1702.	25. Feb. 1702.	26. Feb. 1702.	27. Feb. 1702.	28. Feb. 1702.
86. Sonntag	29. Feb. 1702.	1. März 1702.	2. März 1702.	3. März 1702.	4. März 1702.
87. Sonntag	5. März 1702.	6. März 1702.	7. März 1702.	8. März 1702.	9. März 1702.
88. Sonntag	10. März 1702.	11. März 1702.	12. März 1702.	13. März 1702.	14. März 1702.
89. Sonntag	15. März 1702.	16. März 1702.	17. März 1702.	18. März 1702.	19. März 1702.
90. Sonntag	20. März 1702.	21. März 1702.	22. März 1702.	23. März 1702.	24. März 1702.
91. Sonntag	25. März 1702.	26. März 1702.	27. März 1702.	28. März 1702.	29. März 1702.
92. Sonntag	30. März 1702.	31. März 1702.	1. April 1702.	2. April 1702.	3. April 1702.
93. Sonntag	4. April 1702.	5. April 1702.	6. April 1702.	7. April 1702.	8. April 1702.
94. Sonntag	9. April 1702.	10. April 1702.	11. April 1702.	12. April 1702.	13. April 1702.
95. Sonntag	14. April 1702.	15. April 1702.	16. April 1702.	17. April 1702.	18. April 1702.
96. Sonntag	19. April 1702.	20. April 1702.	21. April 1702.	22. April 1702.	23. April 1702.
97. Sonntag	24. April 1702.	25. April 1702.	26. April 1702.	27. April 1702.	28. April 1702.
98. Sonntag	29. April 1702.	30. April 1702.	1. Mai 1702.	2. Mai 1702.	3. Mai 1702.
99. Sonntag	4. Mai 1702.	5. Mai 1702.	6. Mai 1702.	7. Mai 1702.	8. Mai 1702.
100. Sonntag	9. Mai 1702.	10. Mai 1702.	11. Mai 1702.	12. Mai 1702.	13. Mai 1702.
101. Sonntag	14. Mai 1702.	15. Mai 1702.	16. Mai 1702.	17. Mai 1702.	18. Mai 1702.
102. Sonntag	19. Mai 1702.	20. Mai 1702.	21. Mai 1702.	22. Mai 1702.	23. Mai 1702.
103. Sonntag	24. Mai 1702.	25. Mai 1702.	26. Mai 1702.	27. Mai 1702.	28. Mai 1702.
104. Sonntag	29. Mai 1702.	30. Mai 1702.	31. Mai 1702.	1. Juni 1702.	2. Juni 1702.
105. Sonntag	3. Juni 1702.	4. Juni 1702.	5. Juni 1702.	6. Juni 1702.	7. Juni 1702.
106. Sonntag	8. Juni 1702.	9. Juni 1702.	10. Juni 1702.	11. Juni 1702.	12. Juni 1702.
107. Sonntag	13. Juni 1702.	14. Juni 1702.	15. Juni 1702.	16. Juni 1702.	17. Juni 1702.
108. Sonntag	18. Juni 1702.	19. Juni 1702.	20. Juni 1702.	21. Juni 1702.	22. Juni 1702.
109. Sonntag	23. Juni 1702.	24. Juni 1702.	25. Juni 1702.	26. Juni 1702.	27. Juni 1702.
110. Sonntag	28. Juni 1702.	29. Juni 1702.	30. Juni 1702.	1. Juli 1702.	2. Juli 1702.
111. Sonntag	3. Juli 1702.	4. Juli 1702.	5. Juli 1702.	6. Juli 1702.	7. Juli 1702.
112. Sonntag	8. Juli 1702.	9. Juli 1702.	10. Juli 1702.	11. Juli 1702.	12. Juli 1702.
113. Sonntag	13. Juli 1702.	14. Juli 1702.	15. Juli 1702.	16. Juli 1702.	17. Juli 1702.
114. Sonntag	18. Juli 1702.	19. Juli 1702.	20. Juli 1702.	21. Juli 1702.	22. Juli 1702.
115. Sonntag	23. Juli 1702.	24. Juli 1702.	25. Juli 1702.	26. Juli 1702.	27. Juli 1702.
116. Sonntag	28. Juli 1702.	29. Juli 1702.	30. Juli 1702.	31. Juli 1702.	1. Aug. 1702.
117. Sonntag	2. Aug. 1702.	3. Aug. 1702.	4. Aug. 1702.	5. Aug. 1702.	6. Aug. 1702.
118. Sonntag	7. Aug. 1702.	8. Aug. 1702.	9. Aug. 1702.	10. Aug. 1702.	11. Aug. 1702.
119. Sonntag	12. Aug. 1702.	13. Aug. 1702.	14. Aug. 1702.	15. Aug. 1702.	16. Aug. 1702.
120. Sonntag	17. Aug. 1702.	18. Aug. 1702.	19. Aug. 1702.	20. Aug. 1702.	21. Aug. 1702.
121. Sonntag	22. Aug. 1702.	23. Aug. 1702.	24. Aug. 1702.	25. Aug. 1702.	26. Aug. 1702.
122. Sonntag	27. Aug. 1702.	28. Aug. 1702.	29. Aug. 1702.	30. Aug. 1702.	31. Aug. 1702.
123. Sonntag	1. Sept. 1702.	2. Sept. 1702.	3. Sept. 1702.	4. Sept. 1702.	5. Sept. 1702.
124. Sonntag	6. Sept. 1702.	7. Sept. 1702.	8. Sept. 1702.	9. Sept. 1702.	10. Sept. 1702.
125. Sonntag	11. Sept. 1702.	12. Sept. 1702.	13. Sept. 1702.	14. Sept. 1702.	15. Sept. 1702.
126. Sonntag	16. Sept. 1702.	17. Sept. 1702.	18. Sept. 1702.	19. Sept. 1702.	20. Sept. 1702.
127. Sonntag	21. Sept. 1702.	22. Sept. 1702.	23. Sept. 1702.	24. Sept. 1702.	25. Sept. 1702.
128. Sonntag	26. Sept. 1702.	27. Sept. 1702.	28. Sept. 1702.	29. Sept. 1702.	30. Sept. 1702.
129. Sonntag	1. Okt. 1702.	2. Okt. 1702.	3. Okt. 1702.	4. Okt. 1702.	5. Okt. 1702.
130. Sonntag	6. Okt. 1702.	7. Okt. 1702.	8. Okt. 1702.	9. Okt. 1702.	10. Okt. 1702.
131. Sonntag	11. Okt. 1702.	12. Okt. 1702.	13. Okt. 1702.	14. Okt. 1702.	15. Okt. 1702.
132. Sonntag	16. Okt. 1702.	17. Okt. 1702.	18. Okt. 1702.	19. Okt. 1702.	20. Okt. 1702.
133. Sonntag	21. Okt. 1702.	22. Okt. 1702.	23. Okt. 1702.	24. Okt. 1702.	25. Okt. 1702.
134. Sonntag	26. Okt. 1702.	27. Okt. 1702.	28. Okt. 1702.	29. Okt. 1702.	30. Okt. 1702.
135. Sonntag	31. Okt. 1702.	1. Nov. 1702.	2. Nov. 1702.	3. Nov. 1702.	4. Nov. 1702.
136. Sonntag	5. Nov. 1702.	6. Nov. 1702.	7. Nov. 1702.	8. Nov. 1702.	9. Nov. 1702.
137. Sonntag	10. Nov. 1702.	11. Nov. 1702.	12. Nov. 1702.	13. Nov. 1702.	14. Nov. 1702.
138. Sonntag	15. Nov. 1702.	16. Nov. 1702.	17. Nov. 1702.	18. Nov. 1702.	19. Nov. 1702.
139. Sonntag	20. Nov. 1702.	21. Nov. 1702.	22. Nov. 1702.	23. Nov. 1702.	24. Nov. 1702.
140. Sonntag	25. Nov. 1702.	26. Nov. 1702.	27. Nov. 1702.	28. Nov. 1702.	29. Nov. 1702.
141. Sonntag	30. Nov. 1702.	1. Dez. 1702.	2. Dez. 1		

⇒ Details of January 1 -15 of the Chur-Brandenburgischer Calendar for **11701 HE** pictured above: 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.¹¹⁰³

11675 HE – 11759 HE: JOHN LETHBRIDGE, English wool merchant based in Newton Abbot (Devon, England) who invented a diving

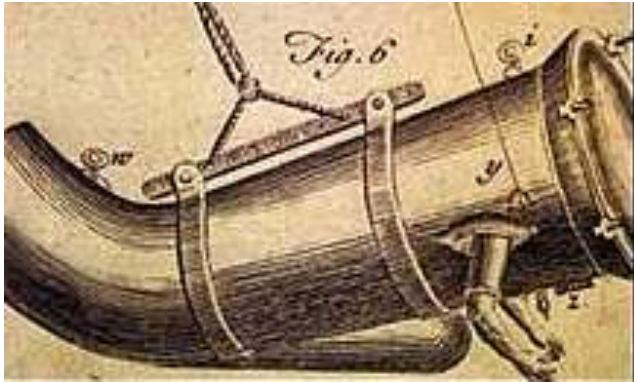
¹¹⁰³ https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch

barrel in **11715 HE** and successfully salvaged valuables from wrecks.¹¹⁰⁴

⇒ 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 have been 10 fathoms deep many a hundred times, and have been 12 fathoms, but with great difficulty."¹¹⁰⁵

¹¹⁰⁴ https://en.wikipedia.org/wiki/John_Lethbridge

¹¹⁰⁵ https://en.wikipedia.org/wiki/John_Lethbridge



JOHN LETHBRIDGE'S diving dress, artist, date and location not known.¹¹⁰⁶

¹¹⁰⁶ 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.¹¹⁰⁷

¹¹⁰⁷ https://en.wikipedia.org/wiki/John_Lethbridge

Circa 11676 HE: ANTONI VAN LEEUWENHOEK, Dutch microscopist¹¹⁰⁸ 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.¹¹⁰⁹
- ⇒ 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

¹¹⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹¹⁰⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

any books, his discoveries came to light through correspondence with the Royal Society, which published his letters.¹¹¹⁰



A portrait of ANTONIE VAN LEEUWENHOEK by Jan Verkolje, date and location unknown.¹¹¹¹

¹¹¹⁰ https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek

¹¹¹¹ https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek

11677 HE– 11761 HE: STEPHEN HALES, English, made major contributions to a range of scientific fields including botany, pneumatic chemistry, and physiology.¹¹¹²

- ⇒ 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.¹¹¹³
- ⇒ STEPHEN HALES was the first person to collect gases by bubbling them through water and trapping them in an upside-down vessel.¹¹¹⁴

¹¹¹² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹¹¹³ https://en.wikipedia.org/wiki/Stephen_Hales

¹¹¹⁴ 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.¹¹¹⁵



⇒ STEPHEN HALES, aged 82 by J. McArdell after T. Hudson, location unknown.¹¹¹⁶

¹¹¹⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹¹¹⁶ https://en.wikipedia.org/wiki/Stephen_Hales

11678 HE – 11761 HE: Dr. PIERRE FAUCHARD, French dentist who is considered the “*Father of Dentistry*”.¹¹¹⁷

- ⇒ In **11728 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.¹¹¹⁸
- ⇒ 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

¹¹¹⁷ ISAAC ASIMOV'S *Chronology of Science and Discovery*

¹¹¹⁸ ISAAC ASIMOV'S *Chronology of Science and Discovery*

physicians 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 gold, tin, and sometimes lead.¹¹¹⁹

- Author / Compiler note: Lead? ...because information of the horrors of lead in humans was lost. (See: **Circa 9855 HE** – **Circa 10529 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

¹¹¹⁹ https://en.wikipedia.org/wiki/Pierre_Fauchard

of the teeth roots; FAUCHARD was ahead of his time in medical practice and he 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.¹¹²⁰

¹¹²⁰ https://en.wikipedia.org/wiki/Pierre_Fauchard



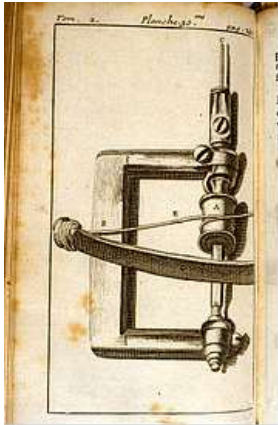
FAUCHARD by J. Le. Bel, location and date unknown.¹¹²¹

¹¹²¹ https://en.wikipedia.org/wiki/Pierre_Fauchard



Drawings of Late 1600's 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).¹¹²²

¹¹²² https://en.wikipedia.org/wiki/Pierre_Fauchard



Drawing of Dr. PIERRE FAUCHARD's late **11600's HE** bigger dentist's drill.¹¹²³

¹¹²³ https://en.wikipedia.org/wiki/Pierre_Fauchard

Circa 11600's HE – 11999's HE:

⇒ Vaginal Douching: a method of birth control



Phot from Museum of Contraception and Abortion, Vienna¹¹²⁴

¹¹²⁴ <https://www.bbc.com/news/uk-47815960>

Circa 11680 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.¹¹²⁵



GIOVANNI ALFONSO BORELLI, date, location, and artist unknown.¹¹²⁶

¹¹²⁵ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 167

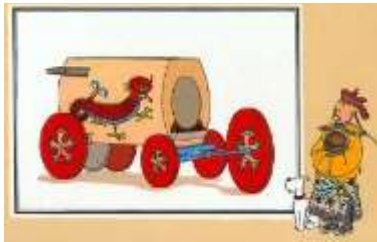
¹¹²⁶ https://en.wikipedia.org/wiki/Giovanni_Alfonso_Borelli

Circa 11681 HE: Disputably the first steam powered vehicle was invented by RP VERBIEST, missionary, who lived in China from **11672 HE** to **11686 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 **11681 HE**. But, according to no less reliable Chinese texts, the test took place in **11679 HE**.¹¹²⁷

⇒ 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

¹¹²⁷ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

of the rear wheels, a very flexible drawbar was connected to a wheel of a larger diameter easy to maneuver. The cart went around in the courtyard of the Palais Impérial to the great enthusiasm of the spectators.¹¹²⁸



Modern depiction of the ancient disputed first steam powered vehicle with five vertical wheels. Artist and date unknown.¹¹²⁹

¹¹²⁸ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

¹¹²⁹ <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

11686 HE – 11736 HE: DANIEL GABRIEL FAHRENHEIT:

Polish/Dutch physicist, engineer, and glass blower who is known for inventing, in **11714 HE**, the mercury-in-glass thermometer, and for developing a temperature scale now named after him.



FAHRENHEIT, artist, date and location unknown.¹¹³⁰

¹¹³⁰ https://en.wikipedia.org/wiki/Daniel_Gabriel_Fahrenheit

Circa 11688 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 4187 years after the luxury item of clear glass was first *used* (see **7501 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.¹¹³¹

11693 HE - 11776 HE: JOHN HARRISON, British, carpenter and clockmaker¹¹³² 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

¹¹³¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

¹¹³² Dava Sobel's book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*

worldwide 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.

⇒ **11761 HE:** JOHN HARRISON awarded the prize from the Royal 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”.¹¹³³

¹¹³³ 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 **11767** **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.¹¹³⁴

¹¹³⁴ 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.¹¹³⁵

¹¹³⁵ <https://www.youtube.com/watch?v=T-g27KS0yiY>



Harrison's "The Watch" No.1 (H4), with winding crank, location and photographer unknown.¹¹³⁶

¹¹³⁶ https://en.wikipedia.org/wiki/John_Harrison



JOHN HARRISON's first sea clock (H1) at the Royal Observatory, Greenwich¹¹³⁷

¹¹³⁷ https://en.wikipedia.org/wiki/John_Harrison



Harrison's Chronometer H5 (Collection of the Worshipful Company of Clockmakers), in the Science Museum, London.¹¹³⁸

¹¹³⁸ https://en.wikipedia.org/wiki/John_Harrison

11693 HE – 11762 HE: JAMES BRADLEY¹¹³⁹, FRS, English astronomer who served as Astronomer Royal from **11742 HE**, succeeding EDMOND HALLEY.¹¹⁴⁰ BRADLEY is best known for two fundamental discoveries in astronomy:

- ⇒ JAMES BRADLEY discovered *The Aberration of Light*¹¹⁴¹ which ASIMOV says, “is a more accurate way of calculating the speed of light” (See **11644 HE – 11710 HE:** OLE ROEMER).
- ⇒ JAMES BRADLEY discovered the *Nutation of the Earth's Axis*, which is a phenomenon which causes the orientation of the axis

¹¹³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 188

¹¹⁴⁰ https://en.wikipedia.org/wiki/James_Bradley

¹¹⁴¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 188

of rotation of a spinning astronomical object (like our planet Earth) to vary over time.¹¹⁴²



JAMES BRADLEY, date, location, and artist unknown.¹¹⁴³

¹¹⁴² https://en.wikipedia.org/wiki/Astronomical_nutation

¹¹⁴³ https://en.wikipedia.org/wiki/James_Bradley

11703 HE – 11771 HE: CHESTER MOOR HALL (MOOR may also be spelled MOORE), British lawyer and inventor who noticed what ISAAC NEWTON (see **11642 HE– 11727 HE:** SIR ISAAC NEWTON) had missed:

- That different kinds of glass produced different spectra of different widths.¹¹⁴⁴ ¹¹⁴⁵ **11729 HE or 11733 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

¹¹⁴⁴ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

¹¹⁴⁵ https://en.wikipedia.org/wiki/Chester_Moore_Hall

built the first refracting telescope free from chromatic aberration (free from color distortion).^{1146 1147}

- **11757 HE:** Since CHESTER MOOR HALL did not publicize his invention properly, and in **11757 HE** JOHN DOLLOND did publicize his achromatic lens, DOLLOND got more credit. (SEE **Circa 11021 HE**, IBN AL-HAYTHAM.)¹¹⁴⁸

¹¹⁴⁶ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

¹¹⁴⁷ https://en.wikipedia.org/wiki/Chester_Moore_Hall

¹¹⁴⁸ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

Chapter Five

THE INDUSTRIAL REVOLUTION: Circa 11760 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 **11760 HE** in Great Britain and later in other countries. Wikipedia places the Industrial Revolution as beginning in about **11760 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.¹¹⁴⁹

⇒ “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.”¹¹⁵⁰

117th Century HE

¹¹⁴⁹ https://en.wikipedia.org/wiki/Industrial_Age

¹¹⁵⁰ SciShow 5-2-12016 HE youtube.com Video: *The Truth About 10 Famous Inventions*

Circa 11700 HE: The world population was approximately 610000,000 people.¹¹⁵¹

11705 HE: MARIA SIBYLLA MERIAN wrote “*Metamorphosis of the Insects of Surinam*,” recording how slave and Indian populations in Surinam used the seeds of the Poinciana plant as an abortifacient. It is currently known as the Spruce Flame Tree or the Royal Poinciana. MERIAN wrote, “The Indians and Africans, who are not treated well by their Dutch masters, use the seeds [of this plant] to abort their children, so that their children will not become slaves like they are They told me this themselves.”¹¹⁵²

¹¹⁵¹ <http://www.worldometers.info/world-population/world-population-by-year/>

¹¹⁵² LONDA SCHIEBINGER, *Agnotology and Exotic Abortifacients: The Cultural Production of Ignorance in the Eighteenth-Century Atlantic World*,

https://www.princeton.edu/~hos/Workshop%20II%20papers/Shiebinger_paper.doc.pdf

- ⇒ Author/Compiler could not find information on dosage, safety, or other effects. Do not ingest this plant without further education and professional guidance.



1153

¹¹⁵³ Currently known as the Spruce Flame Tree or Royal Poinciana.
<https://www.thespruce.com/royal-poinciana-growing-profile-3269287>

11704 HE – 11764 HE: JOHN KAY, British machinist was the inventor of the flying shuttle, which was another key contribution to the Industrial Revolution.¹¹⁵⁴ In July **11733 HE**, JOHN KAY received a patent for his most revolutionary device: a "wheeled shuttle" for the hand weaving loom.¹¹⁵⁵ (See **11563 HE – 11614 HE:** WILLIAM LEE and the first mechanical knitting machine.) But by September **11733 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 account, but instead because of his inability to enforce (or profit from) his patent rights.¹¹⁵⁶ **11747 HE:** JOHN KAY left England, went to Paris, and negotiated with the

¹¹⁵⁴ ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

¹¹⁵⁵ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹¹⁵⁶ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

French Government (in English) to sell them his hand weaving loom technology.¹¹⁵⁷

⇒ **11753 HE:** The beginning of mechanization in French textile production is traditionally dated to this year, with the widespread adoption of the flying shuttle there.¹¹⁵⁸ **11760 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.¹¹⁵⁹

¹¹⁵⁷ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹¹⁵⁸ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

¹¹⁵⁹ [https://en.wikipedia.org/wiki/John_Kay_\(flying_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))



Portrait on the JOHN KAY Memorial.¹¹⁶⁰

¹¹⁶⁰ [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 pirl of weft thread; photographer, location and date unknown.¹¹⁶¹

11706 HE: Although he does not say where, or by whom, ISAAC ASIMOV says that it was this year when springs were added to carriages to make their jolting and uneven ride easier. To be sure, ISAAC ASIMOV says, this induced swaying, but springs were

¹¹⁶¹ [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.¹¹⁶²

11706 HE - 11749 HE: GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL, MARQUISE DU CHÂTELET,¹¹⁶³ French natural philosopher, mathematician, physicist, editor, and member of the Academy of Sciences of the Institute of Bologna.¹¹⁶⁴ DU CHÂTELET introduced the idea of “Conservation of Energy” where “energy cannot be created or destroyed”.¹¹⁶⁵

⇒ **11737 HE:** DU CHÂTELET published a paper entitled *Dissertation sur la nature et la propagation du feu*, based upon

¹¹⁶² ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 180

¹¹⁶³ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹¹⁶⁴ <https://en.wikipedia.org> Emelie Du Chatelet

¹¹⁶⁵ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

her research into the science of fire, which predicted what is today known as infrared radiation and the nature of light.

- ⇒ **11740 HE:** DU CHÂTELET's book *Institutions 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 **11746 HE**.¹¹⁶⁶
- ⇒ 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

¹¹⁶⁶ <https://en.wikipedia.org> Emelie Du Chatelet

physics. DU CHÂTELET's French translation, published posthumously in **11759 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.¹¹⁶⁷

¹¹⁶⁷ [https://en.wikipedia.org/Emelie Du Chatelet](https://en.wikipedia.org/Emelie_Du_Chatelet)



MARQUISE DU CHÂTELET, Portrait by Maurice Quentin de La Tour, date and location unknown.¹¹⁶⁸

¹¹⁶⁸ <https://en.wikipedia.org> Emelie Du Chatelet



11741 HE book entitled *Réponse de Madame la Marquise du Châtelet, à 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.¹¹⁶⁹

¹¹⁶⁹ <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*, 11744 HE¹¹⁷⁰

¹¹⁷⁰ <https://en.wikipedia.org> Emelie Du Chatelet

11706 HE – 11790 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.¹¹⁷¹ 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.¹¹⁷²

¹¹⁷¹ https://en.wikipedia.org/wiki/Benjamin_Franklin

¹¹⁷² 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.¹¹⁷³

¹¹⁷³ https://en.wikipedia.org/wiki/Benjamin_Franklin

11707 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.¹¹⁷⁴ (See Circa **11451 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.)¹¹⁷⁵

¹¹⁷⁴ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 180

¹¹⁷⁵ https://en.wikipedia.org/wiki/Nicholas_of_Cusa



JOHN FLOYER. Credit: Wellcome Library, date unknown.¹¹⁷⁶

¹¹⁷⁶ [https://en.wikipedia.org/wiki/John_Floyer_\(physician\)](https://en.wikipedia.org/wiki/John_Floyer_(physician))

11707 HE – 11788 HE: GEORGES-LOUIS LECLERC, COMTE de BUFFON, French Naturalist¹¹⁷⁷ wrote *Histoire Naturelle, Générale et Particulière* (**11749 HE–11788 HE**) in 36 volumes; an additional volume based on his notes appeared in **11789 HE**. The *Histoire Naturelle* ended up focusing on the animal and mineral kingdoms.¹¹⁷⁸

⇒ 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..."¹¹⁷⁹

¹¹⁷⁷ Jennifer Ouellete, The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack

¹¹⁷⁸ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon

¹¹⁷⁹ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon



GEORGES-LOUIS LECLERC, COMTE de BUFFON, date, location, and artist unknown.¹¹⁸⁰

¹¹⁸⁰ https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon

11709 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.^{1181 1182}

⇒ 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 **11800's HE**. Only with coke smelting could there be produced the great quantities of iron made to meet the requirements of the Industrial Revolution.¹¹⁸³

¹¹⁸¹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 181

¹¹⁸² https://en.wikipedia.org/wiki/Abraham_Darby_I

¹¹⁸³ https://en.wikipedia.org/wiki/Abraham_Darby_I

Circa 11712 HE: THOMAS NEWCOMEN, English inventor. Based on THOMAS SAVERY's patent, NEWCOMEN enhanced another Steam Engine for lifting water from mines.¹¹⁸⁴ (See Circa **10050 HE:** HERO of ALEXANDRIA.)



THOMAS NEWCOMEN, Memorial Steam Engine in

¹¹⁸⁴ https://en.wikipedia.org/wiki/Thomas_Newcomen

Dartmouth. The Atmospheric Steam Engine kept failing.
Photographer unknown.¹¹⁸⁵

11713 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.¹¹⁸⁶

¹¹⁸⁵ SciShow 5-2-12016HE youtube.com Video: *The Truth About 10 Famous Inventions*

¹¹⁸⁶ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 183



Circa 11756 HE: LADY MONTAGU in Turkish dress by Jean-Étienne Liotard, Palace on the Water in Warsaw.¹¹⁸⁷

¹¹⁸⁷ https://en.wikipedia.org/wiki/Lady_Mary_Wortley_Montagu

11714 HE – 11784 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.¹¹⁸⁸

¹¹⁸⁸ 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.¹¹⁸⁹

¹¹⁸⁹ 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 **11745 HE** to **11748 HE**, location unknown.¹¹⁹⁰

¹¹⁹⁰ https://en.wikipedia.org/wiki/French_cartography#Cassini_maps

Circa 11715 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 **11675 HE – 11759 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.¹¹⁹¹

¹¹⁹¹ https://en.wikipedia.org/wiki/Timeline_of_diving_technology

11718 HE – 11799 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 13.¹¹⁹²

¹¹⁹² 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
unknown¹¹⁹³

¹¹⁹³ https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi



11748 HE: First page of MARIA GAETANA AGNESI's *Instituzioni analitiche*¹¹⁹⁴

¹¹⁹⁴ https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi

11725 HE – 11804 HE: NICOLAS-JOSEPH CUGNOT,¹¹⁹⁵ French inventor who built disputably (see Circa **11680 HE:** RP VERBIEST) the first working self-propelled land-based mechanical vehicle with three vertical wheels: the world's first automobile¹¹⁹⁶ fueled by hydrogen.¹¹⁹⁷

¹¹⁹⁵ https://en.wikipedia.org/wiki/History_of_the_automobile

¹¹⁹⁶ https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot

¹¹⁹⁷ https://en.wikipedia.org/wiki/History_of_the_automobile



NICOLAS-JOSEPH CUGNOT's **11770 HE** fardier à vapeur, as preserved at the Musée des Arts et Métiers, Paris.¹¹⁹⁸

¹¹⁹⁸ https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot

Circa 11725 HE – 11798 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.¹¹⁹⁹
¹²⁰⁰ 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.¹²⁰¹

¹¹⁹⁹ https://en.wikipedia.org/wiki/History_of_birth_control

¹²⁰⁰ https://en.wikipedia.org/wiki/Giacomo_Casanova; Fryer, Peter (11965 HE). **The Birth Controllers**. London: Secker & Warburg and Dingwall EJ (11953 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.

¹²⁰¹ <http://www.futurescopes.com/romance/love-and-sex/3245/10-unusual-contraceptive-methods-history>

11726 HE- 11797 HE: JAMES HUTTON, was a Scottish geologist, naturalist, experimental agriculturalist,¹²⁰² physician, and chemical manufacturer.

⇒ HUTTON was a Fellow of the Royal Society of Edinburgh.¹²⁰³ 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*".¹²⁰⁴

⇒ Through observation and carefully reasoned geological arguments, JAMES HUTTON came to believe that the Earth

¹²⁰² BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹²⁰³ https://en.wikipedia.org/wiki/James_Hutton

¹²⁰⁴ https://en.wikipedia.org/wiki/James_Hutton

was perpetually being formed; he recognized that the history of Earth could be determined by understanding how processes such as erosion and 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.¹²⁰⁵

⇒ JAMES HUTTON knew JAMES WATT (see **11736 HE-11819 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

¹²⁰⁵ https://en.wikipedia.org/wiki/James_Hutton

heat source.¹²⁰⁶ See list of interesting works by JAMES
HUTTON¹²⁰⁷

¹²⁰⁶ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹²⁰⁷ https://en.wikipedia.org/wiki/James_Hutton



11776 HE: JAMES HUTTON painted by Sir Henry Raeburn,
location unknown.¹²⁰⁸

¹²⁰⁸ https://en.wikipedia.org/wiki/James_Hutton

11728 HE – 11799 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.



JOSEPH BLACK by James Tassie. Hunterian Museum, Glasgow.¹²⁰⁹

¹²⁰⁹ https://en.wikipedia.org/wiki/Joseph_Black

11730 HE: GEORG BRANDT, Swedish chemist, defined and named the “Star Stuff” element Cobalt.¹²¹⁰



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 colorants for glass and ceramics. Also, Cobalt is

¹²¹⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

part of the vitamin B12 and therefore is needed in small amounts in our food.¹²¹¹

11731 HE - 11810 HE: HENRY CAVENDISH, British, natural philosopher, magnificently shy and retiring¹²¹² scientist, and an important experimental, theoretical chemist and physicist¹²¹³ 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. **11766 HE CAVENDISH** isolated the “Star Stuff” element Hydrogen.^{1214 1215} He made a string of signal discoveries- among which he was the first person to combine

¹²¹¹ <http://images-of-elements.com/cobalt.php#a>

¹²¹² Bill Bryson Short History of Nearly Everything ebook

¹²¹³ https://en.wikipedia.org/wiki/Henry_Cavendish

¹²¹⁴ https://en.wikipedia.org/wiki/Henry_Cavendish

¹²¹⁵ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

hydrogen and oxygen to make water. Bill Bryson says CAVENDISH 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 **11800'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.¹²¹⁶ Historian J.G. Crowther said CAVENDISH also foreshadowed “the work of KELVIN and G.H. Darwin on the effect of tidal friction on slowing the rotation of the Earth, and LARMOR’S discovery, published in **11915 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”.¹²¹⁷

⇒ **11797 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*.¹²¹⁸

¹²¹⁶ Bill Bryson Short History of Nearly Everything ebook

¹²¹⁷ Bill Bryson Short History of Nearly Everything ebook

¹²¹⁸ https://en.wikipedia.org/wiki/Henry_Cavendish

- 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 **11700's HE** version of the late **12004 HE** Nautilus weight training machine, incorporating weights, counterweights, pendulums, shafts and torsion wires at the heart of which were 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 13000,000,000,000 or six billion trillion metric tons. Bryson further says even the **12004 HE** scientists using their equipment which can detect

the weight of a single bacterium have not significantly improved on CAVENDISH's measurements of **11797 HE**.¹²¹⁹



- Photo is Vial of glowing ultrapure hydrogen, H_2 . “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

¹²¹⁹ Bill Bryson Short History of Nearly Everything ebook

whole universe is below 1% ¹²²⁰). 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 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. ¹²²¹

⇒ 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

¹²²⁰ 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

¹²²¹ <http://images-of-elements.com/hydrogen.php#a>

of fundamental things, and seeing what they could do with them, often with more enthusiasm than sense.”¹²²²



HENRY CAVENDISH, date, location, and artist unknown.¹²²³

¹²²² Bill Bryson Short History of Nearly Everything ebook

¹²²³ https://en.wikipedia.org/wiki/Henry_Cavendish

11732 HE – 11808 HE: JOSÉ CELESTINO MUTIS¹²²⁴ in Bogotá, now Columbia: Spanish personal physician to the Viceroy, botanist, and mathematician was a significant scientific figure in the Spanish American Enlightenment.



JOSÉ CELESTINO MUTIS, date, place, and artist unknown;¹²²⁵

¹²²⁴ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹²²⁵ 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.¹²²⁶
- ⇒ 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 5000 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.¹²²⁷

¹²²⁶ https://en.wikipedia.org/wiki/José_Celestino_Mutis

¹²²⁷ https://en.wikipedia.org/wiki/José_Celestino_Mutis

Circa 11733 HE – 11814 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 11560 HE – 11612 HE: SIR JOHN HARRINGTON**, but without HARRINGTON solving the problem of foul smells.¹²²⁸

⇒ **11775 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.¹²²⁹

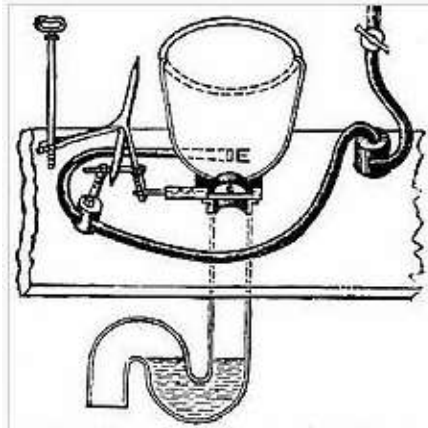
¹²²⁸ https://en.wikipedia.org/wiki/Alexander_Cumming

¹²²⁹ https://en.wikipedia.org/wiki/Alexander_Cumming



Portrait of ALEXHANDER CUMMING; date, location, artist unknown.¹²³⁰

¹²³⁰ https://en.wikipedia.org/wiki/Alexander_Cumming



11775 HE: CUMMING's patent for the S-trap laid the foundations for the modern flush toilet.¹²³¹

¹²³¹ https://en.wikipedia.org/wiki/Alexander_Cumming

11736 HE - 11819 HE: JAMES WATT, Scottish Inventor, Fellow of the Royal Society of Edinburgh, Fellow of the Royal Society,¹²³² Circa **11781 HE** JAMES WATT gets credit for inventing the steam engine because he took the steam engine designed first by (see circa **10050 HE:** HERO of ALEXANDRIA and (see circa **11698 HE** THOMAS SAVERY, and Circa **11712 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 1731 to 60 years.¹²³³

⇒ JAMES WATT developed the concept of horsepower, and the SI unit of power. The Watt (the power in a circuit in which a

¹²³² https://en.wikipedia.org/wiki/James_Watt

¹²³³ SciShow 5-2-12016HE youtube.com Video: *The Truth About 10 Famous Inventions*

current of one ampere flows across a potential difference of one volt) was named after him.¹²³⁴



JAMES WATT Portrait by Carl Frederik von Breda, date and location unknown.¹²³⁵

¹²³⁴ https://en.wikipedia.org/wiki/James_Watt

¹²³⁵ https://en.wikipedia.org/wiki/James_Watt

11738 HE – 11822 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.¹²³⁶

⇒ HERSCHEL was the first person to understand that a telescope is a time machine.¹²³⁷

¹²³⁶ https://en.wikipedia.org/wiki/William_Herschel

¹²³⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 4

William Herschel



11785 HE WILLIAM HERSCHEL portrait by Lemuel Francis Abbott, location unknown.¹²³⁸

¹²³⁸ https://en.wikipedia.org/wiki/William_Herschel

11742 HE – 11786 HE: CARL WILHELM SCHEELE was a Swedish Pomeranian and German pharmaceutical chemist. 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.¹²³⁹

⇒ 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 first¹²⁴⁰), 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 his discoveries. SCHEELE discovered organic acids

¹²³⁹ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

¹²⁴⁰ Sam Kean: *Caesar’s Last Breath: Decoding the Secrets of the Air Around Us*

Tartaric Acid, Oxalic Acid, Uric Acid, Lactic Acid, and Citric Acid, as well as Hydrofluoric Acid, Hydrocyanic Acid, and Arsenic Acid.¹²⁴¹ CARL WILHELM SCHEELE preferred speaking German to Swedish his whole life, as German was commonly spoken among Swedish pharmacists.¹²⁴²

¹²⁴¹ Richard Myers, *The Basics of Chemistry* (12003 HE)

¹²⁴² Fors, Hjalmar 12008 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
unknown¹²⁴³

¹²⁴³ https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele

- **11777 HE:** Author / Compiler includes “Star Stuff” Element Arsenic (the deadly element known to humans since ancient 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.¹²⁴⁵

¹²⁴⁵ <http://images-of-elements.com/arsenic.php#a>

- ⇒ There is evidence that chickens benefit from ingesting low doses of Arsenic. Arsenic, which is known since ancient times, sometimes 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.¹²⁴⁶
- ⇒ Parsons and Dixon wrote that there was a 5000-year-old ice mummy- named “Otzi” discovered in **1991** **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

¹²⁴⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

Napoleon may have died because his wallpaper used “Paris Green Dye” – which included Arsenic in the green color.¹²⁴⁷

11743 HE -11820 HE: SIR JOSEPH BANKS¹²⁴⁸ first Baronet, GCB, PRS; English naturalist, botanist, and patron of the natural sciences¹²⁴⁹ made his name on the **11766 HE** natural history expedition to Newfoundland and Labrador. BANKS took part in Captain James Cook's first great voyage (**11768 HE–11771 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

¹²⁴⁷ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹²⁴⁸ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹²⁴⁹ https://en.wikipedia.org/wiki/Joseph_Banks

leading botanical gardens.¹²⁵⁰ 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. 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.¹²⁵¹ 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

¹²⁵⁰ https://en.wikipedia.org/wiki/Joseph_Banks

¹²⁵¹ https://en.wikipedia.org/wiki/Joseph_Banks

scientists during the Napoleonic Wars, and in introducing the British people to the wonders of the wider world.¹²⁵²



SIR JOSEPH BANKS, as painted by Sir Joshua Reynolds in **11773 HE.**¹²⁵³

¹²⁵² https://en.wikipedia.org/wiki/Joseph_Banks

¹²⁵³ https://en.wikipedia.org/wiki/Joseph_Banks

⇒ 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.¹²⁵⁴

11743 HE – 11817 HE: MARTIN HEINRICH KLAPROTH, German Chemist. Discovered the “Star Stuff” Elements: Uranium (**11789 HE**), Zirconium (**11789 HE**),¹²⁵⁵ and Titanium (**11795 HE**).¹²⁵⁶

⇒ See list of MARTIN HEINRICH KLAPROTH's papers, over 200 in number.¹²⁵⁷

¹²⁵⁴ https://en.wikipedia.org/wiki/Joseph_Banks

¹²⁵⁵ https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth

¹²⁵⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹²⁵⁷ https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth



MARTIN HEINRICH KLAPROTH, date, location and artist
unknown¹²⁵⁸

¹²⁵⁸ 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.¹²⁵⁹

⇒ **11789 HE:** “Star Stuff” Element Zirconium was discovered and named by KLAPROTH.¹²⁶⁰

¹²⁵⁹ <http://images-of-elements.com/uranium.php#a>

¹²⁶⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements



● 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 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.¹²⁶¹

¹²⁶¹ <http://images-of-elements.com/zirconium.php#a>

⇒ **11795 HE:** “Star Stuff Element: Titanium was discovered and named by KLAPROTH.”¹²⁶²



• 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 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.¹²⁶³ Much

¹²⁶² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹²⁶³ <http://images-of-elements.com/titanium.php#a>

better available than the element Titanium metal itself is titanium dioxide, TiO_2 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.¹²⁶⁴

11744 HE – 11829 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 proceeded in accordance with natural laws.¹²⁶⁵ ¹²⁶⁶ LAMARK began as an essentialist who believed species were unchanging; however, after working on the mollusks of the Paris Basin, he grew

¹²⁶⁴ <http://images-of-elements.com/titanium.php#a>

¹²⁶⁵ <https://www.perotmuseum.org>

¹²⁶⁶ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

convinced that transmutation or change in the nature of a species occurred over time.¹²⁶⁷

⇒ 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."¹²⁶⁸ LAMARCK *published* *Système des animaux sans vertèbres*, a major work on the classification of "invertebrates," a term LAMARCK coined.¹²⁶⁹

¹²⁶⁷ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹²⁶⁸ CHARLES DARWIN The Origin of Species

¹²⁶⁹ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck



⇒

LAMARCK by Charles Thévenin (**circa 11802 HE**)¹²⁷⁰

⇒ See more on LAMARCK's publications.¹²⁷¹

¹²⁷⁰ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

¹²⁷¹ https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck

11746 HE: ANDREAS SIGISMUND MARGGRAF, German Chemist, is credited with discovering the pure metallic “Star Stuff” Element Zinc.¹²⁷²



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 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,

¹²⁷² <https://en.wikipedia.org/wiki/Zinc>

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 metabolism, and which occurs in many foods.¹²⁷³

⇒ In the **11860s HE** rolled Zinc sheeting became mandatory for roofing in Paris and this created the city's silvery patina.¹²⁷⁴

11746 HE – 11830 HE: JOHANN HELFRICH VON MÜLLER: an engineer in the Hessian army who conceived the difference engine in **11786 HE** an idea that later evolved into modern computers. In **11784 HE**, MÜLLER was responsible for an improved adding machine based on principles of see **11693 HE: GOTTFRIED WILHELM LEIBNIZ'S** stepped reckoner.¹²⁷⁵

¹²⁷³ <http://images-of-elements.com/zinc.php#a>

¹²⁷⁴ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹²⁷⁵ https://en.wikipedia.org/wiki/Johann_Helfrich_von_Muller



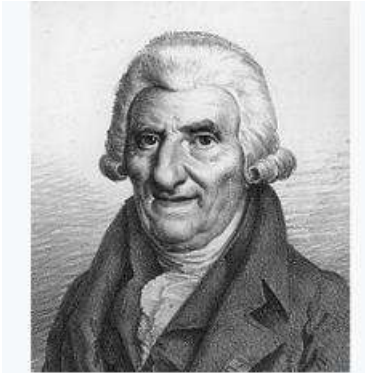
Adding machine by JOHANN HELFRICH VON MÜLLER,
11784 HE, in the Hessisches Landesmuseum Darmstadt.¹²⁷⁶

11748 HE – 11845 HE: JEAN-DOMINIQUE, COMTE DE CASSINI,
 (Cassini IV); French; JEAN-DOMINIQUE, COMTE DE
 CASSINI succeeded Cassini III as Director at Paris Observatory,

¹²⁷⁶ https://en.wikipedia.org/wiki/Johann_Helfrich_von_Müller

but it had gone into decay. He was imprisoned in **11794 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 **11791 HE**.¹²⁷⁷

¹²⁷⁷ https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini



JEAN-DOMINIQUE, COMTE DE CASSINI, **11820 HE**.
Lithograph by Julien-Léopold Boilly.¹²⁷⁸

¹²⁷⁸ https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini

11749 HE – 11819 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.¹²⁷⁹



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

¹²⁷⁹ <https://en.wikipedia.org/wiki/Nitrogen>

protein. Our air consists to 78% of N₂. The chemical bond between the two 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.¹²⁸⁰ 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.¹²⁸¹ (See **11868 HE – 11934 HE**: FRITZ HABER.)

¹²⁸⁰ <http://images-of-elements.com/nitrogen.php#a>

¹²⁸¹ <http://images-of-elements.com/nitrogen.php#a>



DANIEL RUTHERFORD, date, lithographer and location unknown.¹²⁸²

¹²⁸² <https://en.wikipedia.org/wiki/Nitrogen>

Circa 11750s HE: The introduction of steam engines for powering blast air to blast furnaces led to a large increase in British iron production.¹²⁸³

11750 HE – 11848 HE: CAROLINE LECRETIA HERSCHEL, German Astronomer working in England with her brother WILLIAM HERSCHEL.¹²⁸⁴ From **11786 HE–11797 HE** CAROLINE LECRETIA HERSCHEL discovered eight comets.¹²⁸⁵

⇒ In **11787 HE**, CAROLINE LECRETIA HERSCHEL was granted an annual salary of £50 (equivalent to £5700 in **12017 HE**) by George III for her work as WILLIAM HERSCHEL's assistant. Her appointment made her the first woman in England

¹²⁸³ https://en.wikipedia.org/wiki/History_of_rail_transport

¹²⁸⁴ Podcast: Stuff You Missed in History Class

¹²⁸⁵ Podcast: Stuff You Missed in History Class

with an official government position, and the first woman to be paid for her work in astronomy.^{1286 1287}

⇒ In **11802 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.¹²⁸⁸

¹²⁸⁶https://en.wikipedia.org/wiki/Caroline_Herschel

¹²⁸⁷ Podcast: Stuff You Missed in History Class

¹²⁸⁸ https://en.wikipedia.org/wiki/Caroline_Herschel

⇒ **CAROLINE LECRETIA HERSCHEL Honors:** The gold medal from the Astronomical Society was awarded to her in **11828 HE**. The Royal Astronomical Society elected her an Honorary Member in **11835 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 **11838 HE**. In **11846 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".¹²⁸⁹

¹²⁸⁹ https://en.wikipedia.org/wiki/Caroline_Herschel

⇒ Asteroid 281 Lecretia is named in her honor.



⇒

11847 HE Lithograph of CAROLINE LECRETIA HERSCHEL,
artist and location unknown.¹²⁹⁰

¹²⁹⁰ https://en.wikipedia.org/wiki/Caroline_Herschel



A telescope that WILLIAM HERSCHEL made for CAROLINE HERSCHEL, **11795 HE**, location unknown.¹²⁹¹

¹²⁹¹ 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 **11981 HE**. It is located in a preserved town house that was formerly the home of **WILLIAM HERSCHEL** and **CAROLINE HERSCHEL**.¹²⁹²

¹²⁹² https://en.wikipedia.org/wiki/Herschel_Museum_of_Astronomy

11751 HE: AXEL FREDRIK, Swedish Chemist discovered/defined “Star Stuff” Element Nickel. It took 4 years for his discovery to be recognized.¹²⁹³



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. Nickel is ferromagnetic and, together with iron, forms the

¹²⁹³ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

inner core of the Earth, which is a big magnet. The rather rare Ni^{62} is the most stable isotope, the one with the highest binding energy.¹²⁹⁴ 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.¹²⁹⁵

11752 HE – 11828 HE: FRANÇOIS ISAAC DE RIVAZ,¹²⁹⁶ 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 **11807 HE**. In **11808 HE**, he fitted

¹²⁹⁴ <http://images-of-elements.com/nickel.php#a>

¹²⁹⁵ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹²⁹⁶ https://en.wikipedia.org/wiki/History_of_the_automobile

it into a primitive working vehicle – "the world's first internal combustion powered automobile".¹²⁹⁷

- ⇒ 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.¹²⁹⁸

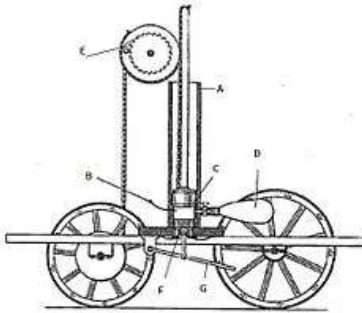
¹²⁹⁷ https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz

¹²⁹⁸ https://en.wikipedia.org/wiki/De_Rivaz_engine



ISAAC DE RIVAZ, date, location, and artist unknown.¹²⁹⁹

¹²⁹⁹ https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz



The **11807 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.¹³⁰⁰

¹³⁰⁰ https://en.wikipedia.org/wiki/De_Rivaz_engine

Circa 11760 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.¹³⁰¹

11763 HE – 11829 HE: LOUIS NICOLAS VAUQUELIN: French pharmacist and chemist¹³⁰² who discovered the “star stuff” element Beryllium by extracting it from an emerald (a beryl variety)¹³⁰³ and discovered the “Star Stuff” element Chromium in a red lead ore from Siberia.¹³⁰⁴ 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

¹³⁰¹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹³⁰² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹³⁰³ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

¹³⁰⁴ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

to be discovered.¹³⁰⁵ VAUQUELIN also discovered pectin and malic acid in apples, and 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."¹³⁰⁶

¹³⁰⁵ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin

¹³⁰⁶ https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin



LOUIS NICOLAS VAUQUELIN, artist, date and location unknown.¹³⁰⁷

¹³⁰⁷ 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.¹³⁰⁸

¹³⁰⁸ <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.¹³⁰⁹

¹³⁰⁹ <http://images-of-elements.com/beryllium.php#a>

11764 HE: The first railway in United States was built in Lewiston, New York.¹³¹⁰

11765 HE – 11850 HE: ROBERT FULTON, United States Engineer¹³¹¹ who designed the *Nautilus* while living in the French First Republic. The *Nautilus* is often considered to be the first practical submarine.¹³¹² FULTON and ROBERT R. LIVINGSTON¹³¹³ built the first commercially successful steamboat, North River Steamboat later known as the Clermont.¹³¹⁴

¹³¹⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

¹³¹¹ https://en.wikipedia.org/wiki/Robert_Fulton

¹³¹² [https://en.wikipedia.org/wiki/Nautilus_\(1800_submarine\)](https://en.wikipedia.org/wiki/Nautilus_(1800_submarine))

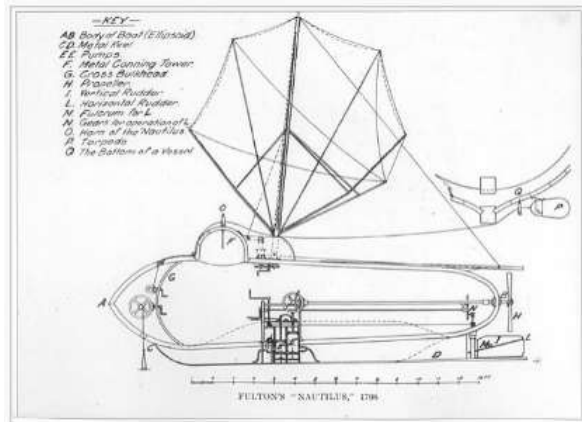
¹³¹³ [https://en.wikipedia.org/wiki/Robert_R._Livingston_\(chancellor\)](https://en.wikipedia.org/wiki/Robert_R._Livingston_(chancellor))

¹³¹⁴ https://en.wikipedia.org/wiki/Robert_Fulton



11803 HE: ROBERT FULTON, bust by Jean-Antoine Houdon,
location unknown.¹³¹⁵

¹³¹⁵ https://en.wikipedia.org/wiki/Robert_Fulton



● **11798 HE: FULTON's** design for the submarine Nautilus, location unknown.¹³¹⁶

¹³¹⁶ https://en.wikipedia.org/wiki/Robert_Fulton



● Full-sized section model for the submarine *Nautilus* at Cité de la Mer, Cherbourg, France.¹³¹⁷

¹³¹⁷ <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



FIG. 41.—The "Clermont," 1807.



11807 HE: Drawing is of ROBERT FULTON's and ROBERT R. LIVINGSTON's Steamboat called the "Clermont".¹³¹⁸



Yes, Jules Verne fans! Jules Verne based the name of his iconic incarnation upon the **11800 HE**, ROBERT FULTON submarine invention the *Nautilus*.¹³¹⁹

¹³¹⁸ <https://www.bing.com/images/search?q=image+robert+fulton+steamship+clermont&id=53777F7C39EAB1D702595BB3893B874A34363B47&FORM=IQFRBA>

¹³¹⁹ <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



The **11878 HE** – **11883 HE** marble statue by Howard Roberts in Statuary Hall of the United States Capitol.¹³²⁰

¹³²⁰ https://en.wikipedia.org/wiki/Robert_Fulton



11896 HE: ROBERT FULTON (with SAMUEL F. B. MORSE (see: **11791 HE**– **11872 HE:** SAMUEL FINLEY BREESE MORSE) depicted on the reverse of the \$2 Silver Certificate from the United States Treasury.¹³²¹

⇒ Some of the Places in the United States named for ROBERT FULTON, including: Fulton Township, Lancaster County,

¹³²¹ 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.¹³²²

¹³²² https://en.wikipedia.org/wiki/Robert_Fulton



11909 HE: Hudson-Fulton Celebration commemorative stamp.



11965 HE: 200th Anniversary ROBERT FULTON commemorative stamp, based on the Houdon bust.¹³²³

¹³²³ https://en.wikipedia.org/wiki/Robert_Fulton

11766 HE -11828 HE: WILLIAM HYDE WOLLASTON, English chemist and physicist¹³²⁴ 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 **11787 HE – 11826 HE:** FRAUNHOFER) to have specific fingerprints, or bar codes,

¹³²⁴ RICHARD DAWKINS *Unweaving the Rainbow*

which is specific to the chemical nature of the substance through which the light passed.¹³²⁵

⇒ 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.¹³²⁶

¹³²⁵ RICHARD DAWKINS, *Unweaving the Rainbow*

¹³²⁶ https://en.wikipedia.org/wiki/William_Hyde_Wollaston



Painting of WILLIAM HYDE WOLLASTON, artist, date and location unknown.¹³²⁷

¹³²⁷ 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.¹³²⁸



Photo of bead of pure “Star Stuff” Element Atomic Number 45

¹³²⁸ <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.¹³²⁹

¹³²⁹ <http://images-of-elements.com/rhodium.php#a>

11769 HE - 11859 HE: ALEXANDER VON HUMBOLDT, born in Prussian/Germany¹³³⁰ but as his knowledge increased others considered him a citizen of all countries, and he thought of himself as “half an American”.¹³³¹

⇒ Already in **11807 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.¹³³²

¹³³⁰ Author/Compiler’s son BENJAMIN PREMACK actually introduced author to knowledge of ALEXANDER VON HUMBOLDT

¹³³¹ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹³³² 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, students and teachers, artists and musicians, scientists and politicians.¹³³³
- ⇒ 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.¹³³⁴
- ⇒ HUMBOLDT resurrected the use of the word *cosmos* from the ancient Greek and assigned it to his **Multi-Volume Treatise:**

¹³³³ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³³⁴ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

Kosmos, in which he sought to unify diverse branches of scientific knowledge and culture.¹³³⁵

- ⇒ HUMBOLDT was the first person who specifically highlighted the human threat to nature.¹³³⁶
- ⇒ HUMBOLDT has strong abolitionist feelings which reflect how he truly believed that race did not influence intellect or ability.^{1337 1338}
- ⇒ HUMBOLDT's quantitative work on botanical geography laid the foundation for the field of biogeography.

¹³³⁵ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

¹³³⁶ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³³⁷ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³³⁸ Eleanor Jones Harvey

- ⇒ HUMBOLDT's advocacy of long-term systematic geophysical measurement laid the foundation for modern geomagnetic and meteorological monitoring.¹³³⁹
- ⇒ 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 works¹³⁴⁰ including: *Personal Narrative, Views of Nature, or, Contemplations on the sublime*

¹³³⁹ Love, J.J. (12008 HE). "Magnetic monitoring of Earth and space" (PDF). Physics Today. February: 31–37. doi:10.1063/1.2883907. Retrieved 29 June 12015 HE; Jump Up; Thomson, A., "Von Humboldt and the establishment of geomagnetic observatories", IAEA-INI

¹³⁴⁰ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

*phenomena of creation: with scientific illustrations*¹³⁴¹ *Essay*
on the Geography of Plants.^{1342 1343}

¹³⁴¹ Smile.amazon.com list of books

¹³⁴² Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³⁴³ Andrea Wulf, lecture at Washington College:

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



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HUMBOLDT's *Multi-Volume Treatise: Kosmos* also motivated a holistic perception of the universe as one interacting entity.¹³⁴⁵

¹³⁴⁴ Andrea Wulf, lecture at Washington College:

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

¹³⁴⁵ Walls, L.D. "Introducing Humboldt's Cosmos". *Minding Nature*. August 2009: 3–15.

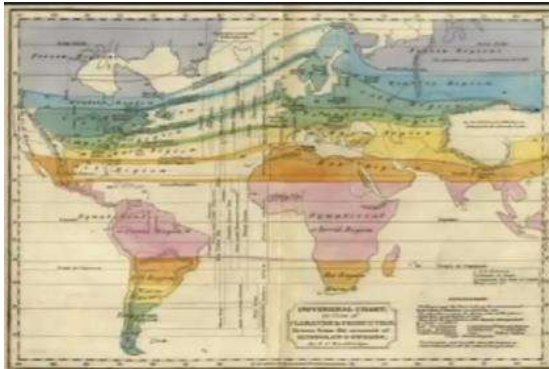


ALEXANDER VON HUMBOLDT's three-foot by two-foot *Naturgemälde* depicted Chimborazo, a volcano in Ecuador that he climbed, in cross-section and on it, HUMBOLDT showed plants distributed according to their altitudes.¹³⁴⁶ To the left and right of the mountain he placed several columns that provided

¹³⁴⁶ 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>

related 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’.¹³⁴⁷

¹³⁴⁷ Andrea Wulf, lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>



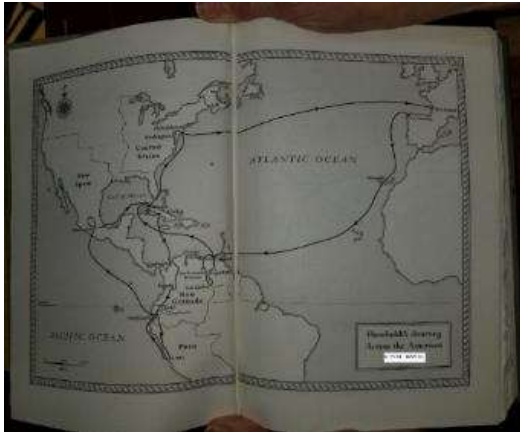
Still in use today - ALEXANDER VON HUMBOLDT's map of Isotherms and Endotherms in the world-wide geographical regions.¹³⁴⁸

¹³⁴⁸ 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 HUMBOLDT's map. Before anyone knew of tectonic plates, he shows how volcanos and earthquakes are somehow related.¹³⁴⁹

¹³⁴⁹ 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>



11799 HE – 11804 HE - ALEXANDER VON HUMBOLDT's
 5-year journey across the Americas.¹³⁵⁰

¹³⁵⁰ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- ⇒ On 14 September **11869 HE**: One hundred years after his birth, ALEXANDER VON HUMBOLDT'S centennial was celebrated across the world by 100s of thousands of people: "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 **11869 HE** in Boston.
- ⇒ 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.
- 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 8000 people took to the streets and in Syracuse another 15000 joined a march that was more than a mile long. President Ulysses Grant (The same president who unfortunately signed the Comstock Acts: see **11776 HE - 11870s HE**: In the United States) attended the Humboldt celebrations in Pittsburgh together with 10000 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, 25000 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 15000 people set out along the streets, walking beneath colorful Chinese lanterns.¹³⁵¹

⇒ Places named after ALEXANDER VON HUMBOLDT:¹³⁵²

- 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,

¹³⁵¹ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³⁵² https://en.wikipedia.org/wiki/Alexander_von_Humboldt

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) - 4287 m mountain in Custer County, Colorado, United States, Pico Humboldt - 4940 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 - 1617 m (5308 ft), New Caledonia, Humboldt Mountains, Antarctic mountains discovered and mapped by the Third German Antarctic Expedition (**11938 HE–11939 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.¹³⁵³

¹³⁵³ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

⇒ People who were personally influenced by HUMBOLDT:



- United States President THOMAS JEFFERSON¹³⁵⁴
- In a **11883 HE** letter from President Jefferson to ALEXANDER VON HUMBOLDT, JEFFERSON said: “MY DEAR FRIEND AND BARON, ...History, I believe,

¹³⁵⁴ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>

furnishes no example of a 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."¹³⁵⁵

- 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.^{1356 1357}

¹³⁵⁵ <http://www.let.rug.nl/usa/presidents/thomas-jefferson/letters-of-thomas-jefferson/jefl224.php>

¹³⁵⁶ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹³⁵⁷ Andrea Wulf as part of the Lecture at Washington College:

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



- JAMES SMITHSON¹³⁵⁸; English chemist and mineralogist, who had no family, met ALEXANDER VON HUMBOLDT at a cocktail party in Paris. Eleanor Jones Harvey is led to believe that the idea for the Museums of the Smithsonian Institute in Washington, DC can be circled back to ALEXANDER VON HUMBOLDT¹³⁵⁹ because Smithson's Will stipulated that: "his estate be used "to found in

¹³⁵⁸ James Smithson by Henri-Joseph Johns, 11816 HE

¹³⁵⁹ 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>

Washington, under the name of the 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.¹³⁶⁰



• United States President James Madison¹³⁶¹

¹³⁶⁰ https://en.wikipedia.org/wiki/James_Smithson

¹³⁶¹ 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>



Goethe¹³⁶²



Simon Bolivar¹³⁶³

¹³⁶² Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹³⁶³ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>



• CHARLES DARWIN¹³⁶⁴



• Henry David Thoreau¹³⁶⁵

¹³⁶⁴ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>

¹³⁶⁵ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>



- Ernst Haeckel¹³⁶⁶



- JOHN MUIR; and among all his important work with nature

¹³⁶⁶ Andrea Wulf as part of the Lecture at Washington College:
<https://www.youtube.com/watch?v=XeHGGgEfCes>

at some point declared “oh how I long to be a HUMBOLDT”.¹³⁶⁷



● GEORGE PERKINS MARSH¹³⁶⁸

¹³⁶⁷ Andrea Wulf as part of the Lecture at Washington College:

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

¹³⁶⁸ Andrea Wulf as part of the Lecture at Washington College:

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



-

Charles Willson Peale based his whole museum on ALEXANDER VON HUMBOLDT's "Web of Life".¹³⁶⁹



-

(B);

John Fremont (A)



John Fremont

¹³⁶⁹ 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>

- (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.¹³⁷⁰
- STEPHEN LONG, who mapped the middle of the United States continent with Titian Ramsey Peale as the artist¹³⁷¹

¹³⁷⁰ 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>

¹³⁷¹ 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>



- Albert Galatian wrote the ethnography of the Indians of the United States due to ALEXANDER VON HUMBOLDT'S urging.¹³⁷²

¹³⁷² 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 HUMBOLDT funded JOHANN CARL BODMER's trip across the United States with Prince Maximilian to paint American Indians¹³⁷³

¹³⁷³ 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 Emerson¹³⁷⁴



• Walt Whitman¹³⁷⁵

¹³⁷⁴ 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>

¹³⁷⁵ 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 HUMBOLDT's letters about his Abolitionist feelings were published by Wendell Phillips Garrison in "*The Liberator*".¹³⁷⁶

¹³⁷⁶ 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 HUMBOLDT's letters in *The Liberator* are read by Frederick Douglass and become the basis for American Abolitionism.¹³⁷⁷

¹³⁷⁷ 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 **11807 HE – 11873 HE**) his job at Harvard.¹³⁷⁸

¹³⁷⁸ 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.¹³⁷⁹

¹³⁷⁹ 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 **11838 HE- 11842 HE** surveys reports.¹³⁸⁰

¹³⁸⁰ 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.¹³⁸¹

¹³⁸¹ 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>



● **11903 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 HUMBOLDT.¹³⁸²

¹³⁸² 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.¹³⁸³

¹³⁸³ 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>



11843 HE ALEXANDER VON HUMBOLDT portrait by Joseph Stieler, location unknown¹³⁸⁴

¹³⁸⁴ https://en.wikipedia.org/wiki/Alexander_von_Humboldt

11773 HE – 11857 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*".¹³⁸⁵

⇒ 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

¹³⁸⁵ https://en.wikipedia.org/wiki/History_of_aviation

comprising a fixed wing, fuselage and tail assembly; Demonstrations of manned, gliding flight; Setting out the 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.¹³⁸⁶

- ⇒ In **11848 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.¹³⁸⁷ In **11852 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 version capable of launching from the top of a hill,

¹³⁸⁶ https://en.wikipedia.org/wiki/History_of_aviation

¹³⁸⁷ https://en.wikipedia.org/wiki/History_of_aviation

which carried the first adult aviator (name unknown) across Brompton Dale.¹³⁸⁸

¹³⁸⁸ https://en.wikipedia.org/wiki/History_of_aviation



SIR GEORGE CAYLEY, 6th Baronet, location, date and artist
unknown¹³⁹⁰

¹³⁹⁰ https://en.wikipedia.org/wiki/George_Cayley

11774 HE: Pure Manganese was discovered by JOHAN GOTTLIEB GAHN, Swedish scientist.¹³⁹¹



JOHAN GOTTLIEB GAHN, artist and location unknown.¹³⁹²

¹³⁹¹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹³⁹² 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. Its probably most famous compound is the strong oxidizing agent potassium permanganate. Every life form needs small amounts of Manganese.¹³⁹³ Exposure to large amounts or certain forms of Manganese can be hazardous.¹³⁹⁴

¹³⁹³ <http://images-of-elements.com/manganese.php#a>

¹³⁹⁴ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

11775 HE - 11800 HE: ANTOINE-LAURENT LAVOISIER; French chemist¹³⁹⁵ ¹³⁹⁶ ANTOINE-LAURENT LAVOISIER one of the founders of modern chemistry.¹³⁹⁷ He defined the “Law of the Conservation of Mass.”¹³⁹⁸ 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.¹³⁹⁹ **11777 HE:** ANTOINE-LAURENT LAVOISIER also coined the name for the “Star Stuff” element: Oxygen. **11777 HE:**

¹³⁹⁵ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

¹³⁹⁶ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

¹³⁹⁷ https://en.wikipedia.org/wiki/Antoine_Lavoisier

¹³⁹⁸ Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

¹³⁹⁹ <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

The “Star Stuff” element Sulfur was discovered and known since ancient times. However, it was officially isolated and recognized as an element by ANTOINE-LAURENT LAVOISIER.¹⁴⁰⁰



Line engraving of ANTOINE-LAURENT LAVOISIER by Louis Jean Desire Delaistre, after a design by Julien Leopold

¹⁴⁰⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

Boilly, location and date unknown.¹⁴⁰¹ A French aristocrat, LAVOISIER was arrested and beheaded during the French Revolution.¹⁴⁰²



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

¹⁴⁰¹ https://en.wikipedia.org/wiki/Antoine_Lavoisier

¹⁴⁰² Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

photosynthesis, most of it by algae in the sea and by forests on land. ¹⁴⁰³O₃ is ozone, a poisonous gas, which in a high atmospheric layer blocks otherwise deadly UV rays from the Sun. ¹⁴⁰⁴



• 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

¹⁴⁰³ <http://images-of-elements.com/oxygen.php#a>

¹⁴⁰⁴ <http://images-of-elements.com/oxygen.php#a>

hydrogen sulfide, which gives rotten eggs their smell and sulfur dioxide and trioxide, which, when dissolved in water, give sulfurous acid and sulfuric acid.¹⁴⁰⁵

11776 HE – 11831 HE: MARIE-SOPHIE GERMAIN, French, Mathematician, physicist, and philosopher¹⁴⁰⁶ 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 **11777 HE – 11855 HE:** KARL FRIEDRICH GAUSS) had recommended that

¹⁴⁰⁵ <http://images-of-elements.com/sulfur.php#a>

¹⁴⁰⁶ Jennifer Ouellete, The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack

GERMAIN be awarded an honorary degree, 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.



MARIE-SOPHIE GERMAIN, artist, date and location unknown.¹⁴⁰⁷

¹⁴⁰⁷ https://en.wikipedia.org/wiki/Sophie_Germain

11777 HE – 11851 HE: HANS CHRISTIAN ØRSTED was a Danish physicist and chemist.¹⁴⁰⁸ 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.¹⁴⁰⁹ ØRSTED was the first modern thinker to explicitly describe and name the “thought experiment”.¹⁴¹⁰ **In 11825 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.

¹⁴⁰⁸ HANS CHRISTIAN ØRSTED was 1st introduced to Author / Compiler by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

¹⁴⁰⁹ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁴¹⁰ https://en.wikipedia.org/wiki/Hans_Christian_Orsted



HANS CHRISTIAN ØRSTED, date, location and artist unknown.¹⁴¹¹

¹⁴¹¹ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

⇒ 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 **11879 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 **11999 HE**, was named after HANS CHRISTIAN ØRSTED.¹⁴¹⁴ Monuments and memorials re HANS CHRISTIAN ØRSTED: Statue of Ørsted in Ørstedsparken, in Copenhagen. A statue of HANS CHRISTIAN ØRSTED was

¹⁴¹⁴ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

installed in the Ørsted Park in **11880 HE**. A commemorative plaque is located above the gate on the building in Studiestræde where he lived and worked. The 100 danske kroner note issued from **11950 HE to 11970 HE** carried an engraving of HANS CHRISTIAN ØRSTED.¹⁴¹⁵ 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.¹⁴¹⁶



- The photo is a chunk of aluminium, 2.6 grams, 1 x 2 cm. “Star Stuff” Element Atomic Number 13 Aluminum, Al, is

¹⁴¹⁵ https://en.wikipedia.org/wiki/Hans_Christian_Orsted

¹⁴¹⁶ <https://en.wikipedia.org/wiki/Oersted>

very abundant and is used in pure form for a lot of different things, 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.¹⁴¹⁷

11777 HE – 11855 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 **11798 HE** at the age of 21 although it was not published until **11801 HE**. GAUSS contributed significantly to many fields, including number

¹⁴¹⁷ <http://images-of-elements.com/aluminium.php#a>

theory, algebra, statistics, analysis, differential geometry, geodesy, geophysics, mechanics, electrostatics, magnetic fields, astronomy, matrix theory, and optics.



KARL FRIEDRICH GAUSS, painted by Christian Albrecht Jensen, date and location unknown.¹⁴¹⁸

¹⁴¹⁸ https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss

11778 HE – 11850 HE: JOSEPH LOUIS GAY-LUSSAC,¹⁴¹⁹ 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.¹⁴²⁰

⇒ 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.¹⁴²¹

¹⁴¹⁹ Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

¹⁴²⁰ https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac

¹⁴²¹ 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, **11804 HE**. Illustration from the late **11800's HE**.¹⁴²²

¹⁴²² https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac



JOSEPH LOUIS GAY-LUSSAC, date, location and artist unknown.¹⁴²³

¹⁴²³ https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac

11778 HE – 11829 HE: SIR HUMPHRY DAVY, BT, Cornish chemist.¹⁴²⁴ “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’.”¹⁴²⁵ In **11808 HE** SIR HUMPHRY DAVY invented the first lightbulb which was called an arc lamp – but it burned through quickly and was too bright.¹⁴²⁶ SIR HUMPHRY DAVY also invented the Davy Lamp and a very early form of

¹⁴²⁴ https://en.wikipedia.org/wiki/Humphry_Davy

¹⁴²⁵ Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

¹⁴²⁶ https://en.wikipedia.org/wiki/Humphry_Davy

incandescent light bulb.¹⁴²⁷ In **11808 HE SIR HUMPHRY DAVY** also isolated for the first time the “star stuff” elements Potassium and Sodium¹⁴²⁸ 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 **11806 HE Bakerian Lecture On Some Chemical Agencies of Electricity** “one of the best memoirs which has ever enriched the theory of chemistry.” In **11809 HE DAVY** isolated / defined the “Star Stuff” elements Calcium, Strontium, Barium, Magnesium (discovery also credited to JOSEPH BLACK¹⁴²⁹), and Boron.¹⁴³⁰

¹⁴²⁷ https://en.wikipedia.org/wiki/Humphry_Davy

¹⁴²⁸ https://en.wikipedia.org/wiki/Humphry_Davy

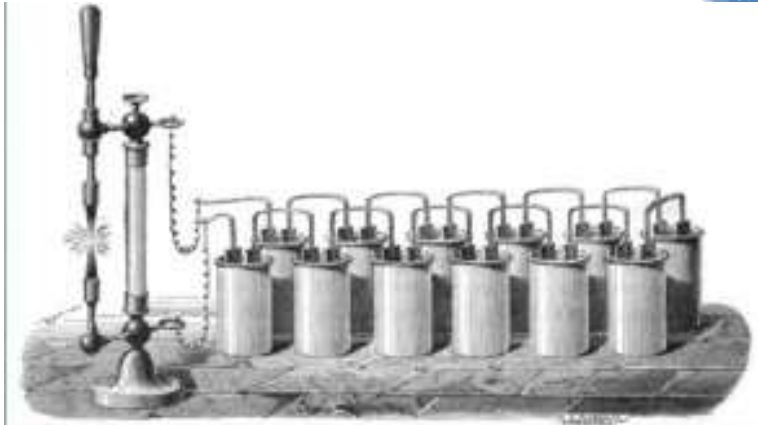
¹⁴²⁹ https://en.wikipedia.org/wiki/Joseph_Black

¹⁴³⁰ https://en.wikipedia.org/wiki/Humphry_Davy



SIR HUMPHRY DAVY, BT, by Thomas Phillips; National Portrait Gallery, London.¹⁴³¹

¹⁴³¹ https://en.wikipedia.org/wiki/Humphry_Davy



First lightbulb, artist, date and location unknown.¹⁴³²

¹⁴³² SciShow 5-2-12016 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.¹⁴³³ In compounds, Potassium is essential to animals and plants, and several natural minerals contain it.¹⁴³⁴ The rare natural isotope potassium 40, a beta

¹⁴³³ <http://images-of-elements.com/potassium.php#a>

¹⁴³⁴ <http://images-of-elements.com/potassium.php#a>

emitter, has a half-life of 1.25 billion years. It is responsible for the largest part of the normal radioactive exposure.¹⁴³⁵



- A photo of sodium. “Star Stuff” Element Atomic Number 11 Sodium, Na. Sodium is a very abundant element, which 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),

¹⁴³⁵ <http://images-of-elements.com/potassium.php#a>

but not with dry air.¹⁴³⁶ The element Sodium glows in a very specific yellow. 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.¹⁴³⁷



• 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

¹⁴³⁶ <http://images-of-elements.com/sodium.php#a>

¹⁴³⁷ <http://images-of-elements.com/sodium.php#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.¹⁴³⁸



• 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.¹⁴³⁹ Elemental Calcium which in

¹⁴³⁸ <http://images-of-elements.com/magnesium.php#a>

¹⁴³⁹ <http://images-of-elements.com/calcium.php#a>

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, because bones, teeth and exoskeletons to a large part consist of calcium compounds like tricalcium phosphate and calcium carbonate.¹⁴⁴⁰

¹⁴⁴⁰ <http://images-of-elements.com/calcium.php#a>



- A seashell is largely made of CaCO_3 .¹⁴⁴¹



- The photo is 0.4 grams strontium with a dark layer of strontium nitride (Sr_3N_2), stored under paraffin oil. Original

¹⁴⁴¹ <http://images-of-elements.com/calcium.php#a>

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.¹⁴⁴²



- 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

¹⁴⁴² <http://images-of-elements.com/strontium.php>

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.¹⁴⁴³



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

¹⁴⁴³ <http://images-of-elements.com/barium.php>

and is toxic for every creature.¹⁴⁴⁴ 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.¹⁴⁴⁵

11779 HE – 11848 HE: BARON JÖNS JACOB BERZELIUS¹⁴⁴⁶ who was known as JACOB BERZELIUS, was a Swedish physician and chemist¹⁴⁴⁷ and is considered, along with ROBERT BOYLE, JOHN DALTON, and ANTOINE LAVOISIER, and SIR HUMPHRY DAVY¹⁴⁴⁸ to be one of the founders of modern

¹⁴⁴⁴ <http://images-of-elements.com/chlorine.php#a>

¹⁴⁴⁵ <http://images-of-elements.com/chlorine.php#a>

¹⁴⁴⁶ BARON JÖNS JACOB BERZELIUS 1st introduced by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

¹⁴⁴⁷ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

¹⁴⁴⁸ https://en.wikipedia.org/wiki/Humphry_Davy

chemistry. BERZELIUS discovered the “Star Stuff” elements: Silicon, Selenium, Thorium, Cerium; and his laboratory discovered “Star Stuff” Elements: Lithium (see also **11792 HE -111841 HE** JOHAN AUGUST ARFWEDSON, Swedish chemist) and Vanadium.¹⁴⁴⁹

¹⁴⁴⁹ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius



Daguerreotype of JACOB BERZELIUS date, location, and artist unknown.¹⁴⁵⁰

¹⁴⁵⁰ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius



⇒

Photo of the statue of JACOB BERZELIUS in the center of Berzelii Park, Stockholm.¹⁴⁵¹

⇒ Named after BERZELIUS: Berzeliussskolan, a school situated next to his alma mater, Katedralskolan, is named for BARON

¹⁴⁵¹ https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

JÖNS JACOB BERZELIUS. In **11939 HE** BERZELIUS's portrait appeared on a series of postage stamps commemorating the bicentenary of the founding of the Swedish Academy of Sciences.¹⁴⁵²



- 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 (SiO_2). The latter is the chief ingredient of quartz and sand and is used as raw material for glass since ages. Elemental

¹⁴⁵² https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius

silicon is an important industrial material, where it is used in huge amounts for semiconductors, computer chips, in electronics, for solar energy and photovoltaics.¹⁴⁵³



- 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

¹⁴⁵³ <http://images-of-elements.com/silicon.php#a>

amino acids. However, if the dose is too high, Selenium quickly becomes poisonous.¹⁴⁵⁴ (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.)



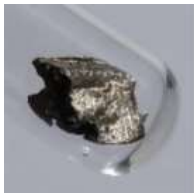
• Photo is of glass vial containing a square of “Star Stuff”

¹⁴⁵⁴ <http://images-of-elements.com/selenium.php#a>

Element Atomic Number 90 Thorium.¹⁴⁵⁵ Thorium by far is the 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.¹⁴⁵⁶

¹⁴⁵⁵ <https://en.wikipedia.org/wiki/Thorium>

¹⁴⁵⁶ <http://images-of-elements.com/thorium.php#a>



- Photo of this “Star Stuff” Element Atomic Number 58 Cerium. Cerium is the most frequent of the lanthanoids, most of it occurs 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, whereby hard and fast friction sparks can be produced.¹⁴⁵⁷



- 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 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

¹⁴⁵⁷ <http://images-of-elements.com/cerium.php#a>

appears in different, often colorful minerals, but only rarely in high concentration.¹⁴⁵⁸

11780 HE – 11872 HE: MARY FAIRFAX SOMERVILLE, Scottish scientist, science writer and polymath¹⁴⁵⁹ was nominated to be jointly the first female member of the Royal Astronomical Society at the same time as **CAROLINE HERSCHEL**.¹⁴⁶⁰ 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, and she continued her studies upon returning to her childhood home. Later, she married again. Her second husband, Dr William Somerville (**11771 HE – 11860 HE**) inspector of the Army Medical Board. He encouraged, and greatly

¹⁴⁵⁸ <http://images-of-elements.com/vanadium.php#a>

¹⁴⁵⁹ <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

¹⁴⁶⁰ https://en.wikipedia.org/wiki/Mary_Somerville

aided her studies of sciences.¹⁴⁶¹ 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 diophantine problem for which she was awarded a silver medal in **11811 HE**. Wallace suggested that she

¹⁴⁶¹ https://en.wikipedia.org/wiki/Mary_Somerville

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.¹⁴⁶² 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 *Françæur'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*

¹⁴⁶² https://en.wikipedia.org/wiki/Mary_Somerville

Algebra and Isoperimetrical Problems, ALEXIS CLAIRAUT'S
Figure of the Earth, GASPARD MONGE'S *Application of*
Analysis to Geometry, and FRANÇOIS CALLET'S
Logarithmus.¹⁴⁶³

- ⇒ 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.¹⁴⁶⁴
- ⇒ MARY FAIRFAX SOMERVILLE and her oldest brother Sam Fairfax would refuse to take sugar in their tea, in protest against the institution of slavery.

¹⁴⁶³ https://en.wikipedia.org/wiki/Mary_Somerville

¹⁴⁶⁴ https://en.wikipedia.org/wiki/Mary_Somerville



MARY FAIRFAX SOMERVILLE, date, location and artist unknown.¹⁴⁶⁵

¹⁴⁶⁵ https://en.wikipedia.org/wiki/Mary_Somerville



Royal Bank of Scotland plans to depict pioneering astronomer **MARY FAIRFAX SOMERVILLE** on £10 polymer note¹⁴⁶⁶

¹⁴⁶⁶ <https://www.coinworld.com/news/paper-money/2016/02/bank-in-scotland-to-depict-pioneering-woman-on-note.html>

Circa 11780 HE: England: A system was introduced in which unflanged wheels ran on L-shaped metal plates – these became known as plateways.¹⁴⁶⁷



Photo is of a replica of a "Little Eaton Tramway" wagon. The tracks are plateways.¹⁴⁶⁸

¹⁴⁶⁷ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁴⁶⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

11780 HE – 11849 HE: JOHANN WOLFGANG DÖBEREINER was the German chemist¹⁴⁶⁹ who invented a portable lighter, known as Döbereiner's lamp. It was the first portable held-in-your-pocket lighter.¹⁴⁷⁰

⇒ DÖBEREINER is best known for work that foreshadowed the periodic law, where he grouped together elements into triads according to their weight.¹⁴⁷¹

¹⁴⁶⁹ 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.

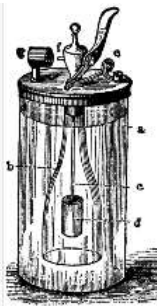
¹⁴⁷⁰ https://en.wikipedia.org/wiki/Johann_Wolfgang_Döbereiner

¹⁴⁷¹ 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 unknown¹⁴⁷²

¹⁴⁷² https://en.wikipedia.org/wiki/Johann_Wolfgang_Döbereiner



• DÖBEREINER's Lamp.¹⁴⁷³ By **11828 HE** hundreds of thousands of these lighters had been mass produced by the German manufacturer Gottfried Piegler in Schleiz.^{1474 1475}

¹⁴⁷³ [https://en.wikipedia.org/wiki/](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner) https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner

¹⁴⁷⁴ 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.

¹⁴⁷⁵ [https://en.wikipedia.org/wiki/](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner) https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner

11781 HE – 11832 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.¹⁴⁷⁶

11781 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 **11996 HE** and continues as of **12018 HE**.¹⁴⁷⁷

¹⁴⁷⁶ https://en.wikipedia.org/wiki/Henri_Cassini

¹⁴⁷⁷ [https://en.wikipedia.org/wiki/William_Addis_\(entrepreneur\)](https://en.wikipedia.org/wiki/William_Addis_(entrepreneur))

Circa 11787 HE: England: JOHN CURR, a Sheffield colliery manager, invented the flanged rail for wagons / early train cars.¹⁴⁷⁸

11787 HE – 11826 HE: JOSEPH VON FRAUNHOFER, German physicist and lens expert is known for making excellent optical glass and achromatic telescope objectives.¹⁴⁷⁹

⇒ 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.¹⁴⁸⁰

¹⁴⁷⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁴⁷⁹ https://en.wikipedia.org/wiki/Joseph_von_Fraunhofer

¹⁴⁸⁰ https://en.wikipedia.org/wiki/Optical_spectrometer

Joseph von Fraunhofer

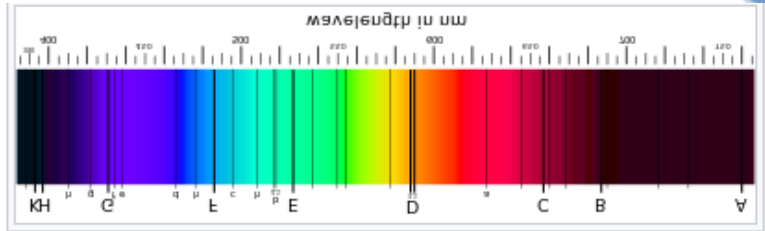


JOSEPH VON FRAUNHOFER unknown date; unknown artist¹⁴⁸¹

¹⁴⁸¹ 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.¹⁴⁸²

¹⁴⁸² https://en.wikipedia.org/wiki/Fraunhofer_lines



Solar spectrum with Fraunhofer lines as it appears visually.¹⁴⁸³

⇒ 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.

¹⁴⁸³ https://en.wikipedia.org/wiki/Fraunhofer_lines

- 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.¹⁴⁸⁴

¹⁴⁸⁴ https://en.wikipedia.org/wiki/Spectral_line



- Continuous spectrum¹⁴⁸⁵



- Example of Emission lines.¹⁴⁸⁶

¹⁴⁸⁵ https://en.wikipedia.org/wiki/Spectral_line

¹⁴⁸⁶ https://en.wikipedia.org/wiki/Spectral_line



● Example of Absorption lines.¹⁴⁸⁷

Circa **11789 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.¹⁴⁸⁸ In **11790 HE**: JESSOP and his partner OUTRAM began to manufacture edge-rails.¹⁴⁸⁹

¹⁴⁸⁷ https://en.wikipedia.org/wiki/Spectral_line

¹⁴⁸⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁴⁸⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

11791 HE – 11867 HE: MICHAEL FARADAY,¹⁴⁹⁰ 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.¹⁴⁹¹

⇒ 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 **11700 HE**.¹⁴⁹²

¹⁴⁹⁰ BRIAN COX, BBC show The Science of Dr. Who

¹⁴⁹¹ https://en.wikipedia.org/wiki/Michael_Faraday

¹⁴⁹² 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, which 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.¹⁴⁹³
- ⇒ 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

¹⁴⁹³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

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 couldn't do the math to prove his discoveries/theories. He had finally hit a wall that he could not overcome.¹⁴⁹⁴

⇒ But later, **11831 HE – 11879 HE: JAMES CLERK MAXWELL** was able to do the maths to bring mathematical proofs to FARADAY's efforts.¹⁴⁹⁵

¹⁴⁹⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

¹⁴⁹⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10



11842 HE: MICHAEL FARADAY portrait by Thomas Phillips,
location unknown.¹⁴⁹⁶

¹⁴⁹⁶ https://en.wikipedia.org/wiki/Michael_Faraday

11791 HE – 11871 HE: CHARLES BABBAGE¹⁴⁹⁷ English polymath:

A mathematician, philosopher, inventor, and mechanical engineer.¹⁴⁹⁸ The notion of a mechanical calculator for mathematical functions can be traced back to the Antikythera mechanism; **11819 HE – 11822 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.¹⁴⁹⁹

⇒ **11833 HE: Lady Byron** (See **11815 HE – 11852 HE: ADA LOVELACE** aka AUGUSTA ADA BYRON KING-NOEL, COUNTESS OF LOVELACE) described seeing the working prototype:

¹⁴⁹⁷ PAUL PREMACK suggested including

¹⁴⁹⁸ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁴⁹⁹ 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."¹⁵⁰⁰

- ⇒ LEGACIES: Due to his association with the town Babbage was chosen in **12007 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 **12015 HE**.¹⁵⁰¹
- ⇒ Half of BABBAGE's brain is preserved at the Hunterian Museum in the Royal College of Surgeons in London.¹⁵⁰²

¹⁵⁰⁰ https://en.wikipedia.org/wiki/Difference_engine

¹⁵⁰¹ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁵⁰² https://en.wikipedia.org/wiki/Charles_Babbage

⇒ The other half of BABBAGE's brain is on display in the Science Museum, London.¹⁵⁰³



⇒ A portion of the Difference Engine, artist CHARLES BABBAGE, date and location unknown.¹⁵⁰⁴

¹⁵⁰³ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁵⁰⁴ https://en.wikipedia.org/wiki/Charles_Babbage



CHARLES BABBAGE, circa **11850 HE**, photographer and location unknown.¹⁵⁰⁵

¹⁵⁰⁵ 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.¹⁵⁰⁶

¹⁵⁰⁶ https://en.wikipedia.org/wiki/Charles_Babbage

⇒ List of Publications by BABBAGE, CHARLES can be seen online.¹⁵⁰⁷

11791 HE– 11872 HE: SAMUEL FINLEY BREESE MORSE was a United States painter and inventor.¹⁵⁰⁸ 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.¹⁵⁰⁹ (See **11580 HE–11650 HE:** FRANZ KESSLER **11616 HE:** The first five chapters of this FRANZ KESSLER book

¹⁵⁰⁷ https://en.wikipedia.org/wiki/Charles_Babbage

¹⁵⁰⁸ https://en.wikipedia.org/wiki/Samuel_Morse

¹⁵⁰⁹ https://en.wikipedia.org/wiki/Samuel_Morse

deal with communicating via a crude Aldis lamp – the predecessor to Morse Code).¹⁵¹⁰



11840 HE SAMUEL FINLEY BREESE MORSE, artist and location unknown,¹⁵¹¹

¹⁵¹⁰ https://en.wikipedia.org/wiki/Franz_Kessler

¹⁵¹¹ https://en.wikipedia.org/wiki/Samuel_Morse



Chart of the Morse code letters and numerals, artist and location unknown.¹⁵¹²

¹⁵¹² https://en.wikipedia.org/wiki/Morse_code

11792 HE -111841 HE: JOHAN AUGUST ARFWEDSON, Swedish chemist discovered the element Lithium in by isolating it as a salt.¹⁵¹³



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

¹⁵¹³ https://en.wikipedia.org/wiki/Johan_August_Arfwedson

salts are used in medicine as treatment for mental disorders.¹⁵¹⁴



JOHAN AUGUST ARFWEDSON, date, location, and artist unknown.¹⁵¹⁵

¹⁵¹⁴ <http://images-of-elements.com/lithium.php#a>

¹⁵¹⁵ https://en.wikipedia.org/wiki/Johan_August_Arfwedson

Circa **11793 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.¹⁵¹⁶



11822 HE: ELI WHITNEY, by Samuel F. B. Morse, Yale University Art Gallery.¹⁵¹⁷

¹⁵¹⁶ SciShow 5-2-12016 HE youtube.com Video: *The Truth About 10 Famous Inventions*

¹⁵¹⁷ https://en.wikipedia.org/wiki/Eli_Whitney

11796 HE: Wakefield, West Yorkshire England: The first public edgeway, thus also *The First Public Railway*, was an early narrow gauge railway¹⁵¹⁸ called the *Lake Lock Rail Road*. Although the primary purpose of the line was to carry coal, it also carried passengers.¹⁵¹⁹

11796 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.¹⁵²⁰

¹⁵¹⁸ https://en.wikipedia.org/wiki/Lake_Lock_Rail_Road

¹⁵¹⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁵²⁰ <https://en.wikipedia.org/wiki/Lithography>

11796 HE: L'Intrépide is the oldest existing flying device.



L'Intrépide, in the Heeresgeschichtliches Museum, Vienna, date, and photographer unknown.¹⁵²¹

¹⁵²¹ https://en.wikipedia.org/wiki/History_of_aviation

11797 HE – 11875 HE: SIR CHARLES LYELL, first BARONET,
British, foremost geologist of his day and a British Lawyer^{1522 1523}
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.¹⁵²⁴

⇒ 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 currently-used names for geological eras, Paleozoic, Mesozoic and Cenozoic.¹⁵²⁵

¹⁵²² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

¹⁵²³ https://en.wikipedia.org/wiki/Charles_Lyell

¹⁵²⁴ https://en.wikipedia.org/wiki/Charles_Lyell

¹⁵²⁵ https://en.wikipedia.org/wiki/Charles_Lyell

- ⇒ LYELL was one of the first to believe that the world is older than 300 million years, on the basis of its geological anomalies.¹⁵²⁶
- ⇒ 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 **11858 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.

¹⁵²⁶ https://en.wikipedia.org/wiki/Charles_Lyell



SIR CHARLES LYELL, BT, date, location, and artist
unknown.¹⁵²⁷

¹⁵²⁷ https://en.wikipedia.org/wiki/Charles_Lyell

Circa 11799 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 **11800's HE**, a span of almost 2000 years.¹⁵²⁸

¹⁵²⁸ <https://en.wikipedia.org/wiki/Bloodletting>



11790s HE “The Many-Bladed Fleam” was a tool having several different sized blades for opening a vein for bloodletting in various parts of the body¹⁵²⁹ This photo from the Fort

¹⁵²⁹ Photo by Tiffany Premack during a family trip to the Ft. Ticonderoga museum in upstate New York, USA

Ticonderoga museum says it was like the one used on George Washington.¹⁵³⁰



Author / Compiler chose this date to include this entry because

¹⁵³⁰ <https://www.pbs.org/newshour/show/bloodletting-blisters-solving-medical-mystery-george-washingtons-death>

history reports that George Washington died of bloodletting in **11797 HE**. Painting is of his deathbed and those with him. Artist and location unknown.¹⁵³¹



Bloodletting-Set of a Barber Surgeon, beginning of the **11800's HE**, Märkisches Museum Berlin.¹⁵³²

¹⁵³¹ [https://www.bing.com/images/search; practicallyhistorical.files.wordpress.com](https://www.bing.com/images/search;practicallyhistorical.files.wordpress.com)

¹⁵³² <https://en.wikipedia.org/wiki/Bloodletting>



12018 HE: current technology for bloodletting (phlebotomy).¹⁵³³

¹⁵³³ Photo by author/compiler

11799 HE – 11847 HE – MARY ANNING, Great Britain¹⁵³⁴ fossil collector, dealer, and renowned paleontologist¹⁵³⁵ 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.¹⁵³⁶

⇒ The king's physician and aide, Carl Gustav Carus, wrote in his journal: “We had alighted from the carriage and were proceeding

¹⁵³⁴ https://en.wikipedia.org/wiki/Louis_Agassiz

¹⁵³⁵ https://en.wikipedia.org/wiki/Mary_Anning

¹⁵³⁶ https://en.wikipedia.org/wiki/Mary_Anning

on foot, when we fell in with MARY ANNING's shop in which the 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.”¹⁵³⁷

- ⇒ Lady Harriet Silvester, the widow of the former Recorder of the City of London, visited Lyme in **11824 HE** and described MARY ANNING in her diary: “The extraordinary thing in this young woman is that she has made herself so thoroughly

¹⁵³⁷ https://en.wikipedia.org/wiki/Mary_Anning

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 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”¹⁵³⁸ (See Circa 250 years ago when in **11556 HE: GEORG BAUER AKA GEORGIUS AGRICOLA** began to speculate on fossils.¹⁵³⁹)

¹⁵³⁸ https://en.wikipedia.org/wiki/Mary_Anning

¹⁵³⁹ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

⇒ In the early **1840s** **HE: JEAN LOUIS RODOLPHE AGASSIZ** named two fossil fish species after **MARY ANNING** —*Acrodus anningiae*, and *Belenostomus anningiae*.¹⁵⁴⁰

¹⁵⁴⁰ https://en.wikipedia.org/wiki/Louis_Agassiz



MARY ANNING with her dog, Tray, painted before **11842 HE**; the Golden Cap outcrop can be seen in the background, artist and location unknown.¹⁵⁴¹

¹⁵⁴¹ 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 **11823 HE**.¹⁵⁴²

¹⁵⁴² https://en.wikipedia.org/wiki/Mary_Anning

11799 HE – 11868 HE: PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE¹⁵⁴³ was a German-Swiss chemist who is best known for inventing the fuel cell in **11838 HE.**¹⁵⁴⁴



PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE, date, location, and artist unknown.¹⁵⁴⁵

¹⁵⁴³ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁵⁴⁴ https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein

¹⁵⁴⁵ https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein

118th Century HE

Circa 11800 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”).¹⁵⁴⁶ (See **9401 HE** for more.)

Circa 11800 HE: The population of the world was approximately 1000,000,000 people.¹⁵⁴⁷

11800 HE – 11895 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

¹⁵⁴⁶ ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 80

¹⁵⁴⁷ <http://www.worldometers.info/world-population/world-population-by-year/>

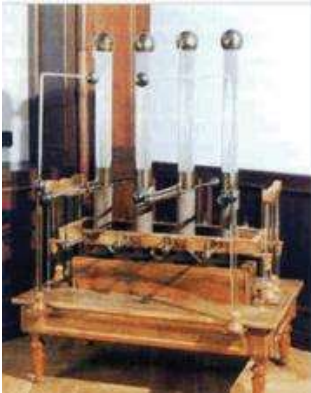
JEDLIK.) He was an inventor, engineer, physicist, and benedictine priest.¹⁵⁴⁸



JEDLIK'S "lightning-magnetic self-rotor" **11827 HE**; the world's first electric motor.¹⁵⁴⁹

¹⁵⁴⁸ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁵⁴⁹ https://en.wikipedia.org/wiki/Anyos_Jedlik



JEDLIK'S tubular voltage generator, which was successfully displayed at the Vienna World Exposition in **11873 HE** is probably the earliest impulse generator¹⁵⁵⁰

¹⁵⁵⁰ https://en.wikipedia.org/wiki/Anyos_Jedlik



ÁNYOS ISTVÁN JEDLIK, date and photographer unknown¹⁵⁵¹

¹⁵⁵¹ https://en.wikipedia.org/wiki/Anyos_Jedlik

Circa 11804 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.



Photo is of a replica of TREVITHICK's engine at the National Waterfront Museum, Swansea, photographer unknown.¹⁵⁵²

¹⁵⁵² https://en.wikipedia.org/wiki/History_of_rail_transport

11806 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 (**11783 HE –11824 HE**) and published with the title "*The Star*" by Jane Taylor.¹⁵⁵³

⇒ 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.

¹⁵⁵³ 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.”¹⁵⁵⁴

¹⁵⁵⁴ https://en.wikipedia.org/wiki/Twinkle,_Twinkle,_Little_Star

- ⇒ Author / Compiler note: Maybe the poem should be updated? We now know what those stars are and thus perpetuating the idea of “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."¹⁵⁵⁵

11807 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.¹⁵⁵⁶

11807 HE – 11840 HE: “Star Stuff” Element Ruthenium, Atomic Number 44 is discovered over time.

¹⁵⁵⁵ The updated sad version of the poem was written by Ruthie S. Premack.

¹⁵⁵⁶ https://en.wikipedia.org/wiki/De_Rivaz_engine

- The first effort was by JĘDRZEJ ŚNIADECKI¹⁵⁵⁷ (**11768 HE – 11838 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.¹⁵⁵⁸
- The second effort was by Swedish physician and chemist BARON JÖNS JACOB BERZELIUS (**11779 HE – 11848 HE**), who tried to isolate Ruthenium but didn't.
- The third effort was by German Scientist GOTTFRIED WILHELM OSANN¹⁵⁵⁹ (**11796 HE– 11866 HE**), chemist and physicist. OSANN was known for his work on the

¹⁵⁵⁷ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁵⁵⁸ https://en.wikipedia.org/wiki/Jędrzej_Śniadecki

¹⁵⁵⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

chemistry of platinum metals.¹⁵⁶⁰ In **11825 HE** OSANN worked on isolating Ruthenium and failed, but he did name it.

- Finally, KARL ERNST CLAUS (also Karl Klaus or Carl Claus) (**11796 HE** – **11864 HE**), a Baltic German chemist and naturalist, isolated the Star Stuff chemical element Ruthenium in **11840 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.¹⁵⁶¹
- Author / Compiler note: I celebrate the name of this Element! It relates my name to science, and I am beginning to

¹⁵⁶⁰ https://en.wikipedia.org/wiki/Gottfried_Osann

¹⁵⁶¹ https://en.wikipedia.org/wiki/Gottfried_Osann

understand that science is one of the greatest achievements of our human species!



11843 HE painting of JĘDRZEJ ŚNIADECKI by Aleksander Sleńdziński, location unknown.¹⁵⁶²

¹⁵⁶² https://en.wikipedia.org/wiki/Jędrzej_Śniadecki



- Portrait is of GOTTFRIED WILHELM OSANN, date, location, artist unknown.¹⁵⁶³

¹⁵⁶³ https://en.wikipedia.org/wiki/Gottfried_Osann



Photo is of KARL ERNST CLAUS, date, location, and photographer unknown..¹⁵⁶⁴

¹⁵⁶⁴ 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.¹⁵⁶⁵ It is an effective hardener for Platinum and Palladium. It has been added to Titanium deep-water pipes to improve their resistance to corrosion.¹⁵⁶⁶

¹⁵⁶⁵ <http://images-of-elements.com/ruthenium.php#a>

¹⁵⁶⁶ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

11807 HE – 11873 HE: JEAN LOUIS RODOLPHE AGASSIZ, United States scientist¹⁵⁶⁷ 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.¹⁵⁶⁸

⇒ In **11837 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 simultaneously encroached southward on the plains and

¹⁵⁶⁷ BBC Men of Rock 3 of 3 12010HE BBC TV show “The Big Freeze”

¹⁵⁶⁸ https://en.wikipedia.org/wiki/Louis_Agassiz

mountains of Europe, Asia and North America, smothering the entire northern hemisphere in a prolonged Ice Age.¹⁵⁶⁹ In **11840 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.¹⁵⁷⁰

⇒ 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.¹⁵⁷¹

¹⁵⁶⁹ https://en.wikipedia.org/wiki/Louis_Agassiz

¹⁵⁷⁰ BBC Men of Rock 3 of 3 12010HE BBC TV show "The Big Freeze"

¹⁵⁷¹ https://en.wikipedia.org/wiki/Louis_Agassiz



JEAN LOUIS RODOLPHE AGASSIZ, date, location, and artist unknown.¹⁵⁷²

- ⇒ 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

¹⁵⁷² 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 **12002 HE**, due to concerns about Agassiz's racism, and to honor Maria Louise Baldwin the African-American principal

of the school who served from **11889 HE** until **11922 HE**. The neighborhood, however, continues to be known as Agassiz.¹⁵⁷³

¹⁵⁷³ https://en.wikipedia.org/wiki/Louis_Agassiz

Chapter Six

THE MODERN SCIENTIFIC ERA: Circa 11859 HE (Lasting, so far, less than 175 years)

Evolution, Atomic and Quantum Physics, Astrophysics, Technology, and the Information Age.

11809 HE – 11882 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.¹⁵⁷⁴

¹⁵⁷⁴ https://en.wikipedia.org/wiki/Charles_Darwin

Charles Darwin



Photo of CHARLES DARWIN, date and location unknown¹⁵⁷⁵

¹⁵⁷⁵ https://en.wikipedia.org/wiki/Charles_Darwin



The title page of the 1859 edition

11859 HE: DARWIN's title page for *The Origin of Species* draft.¹⁵⁷⁶ In the Sixth Edition of *The Origin of Species*, DARWIN references lists and published works of others who

¹⁵⁷⁶ <http://darwin-online.org.uk/content/search-results?freetext=origin%20of%20species>

before him, or contemporaneously with him, referenced or speculated about natural selection.¹⁵⁷⁷

11811 HE – 11861 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.¹⁵⁷⁸

¹⁵⁷⁷ CHARLES DARWIN The Origin of Species

¹⁵⁷⁸ SciShow 5-2-12016HE youtube.com Video: ***The Truth About 10 Famous Inventions***



ELISHA OTIS, photographer, date, location unknown.¹⁵⁷⁹

¹⁵⁷⁹ https://en.wikipedia.org/wiki/Elisha_Otis



11854 HE *Otis Free-fall safety demonstration elevator*, artist and location unknown. OTIS received no patent for his safety break elevators which made skyscrapers possible. ¹⁵⁸⁰

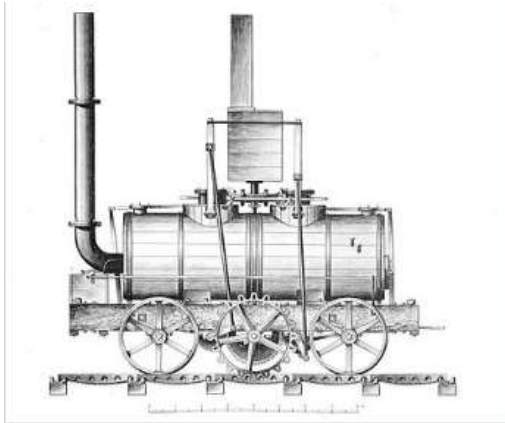
¹⁵⁸⁰ SciShow 5-2-12016HE youtube.com Video: *The Truth About 10 Famous Inventions*

Circa 11812 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.¹⁵⁸¹

⇒ As of **12018 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.¹⁵⁸²

¹⁵⁸¹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁵⁸² https://en.wikipedia.org/wiki/Rack_railway



11812 HE: Drawing (unknown artist and location) of MATTHEW MURRAY's rack locomotive *Salamanca*.¹⁵⁸³

¹⁵⁸³ 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.¹⁵⁸⁴

¹⁵⁸⁴ https://en.wikipedia.org/wiki/Rack_railway

11813 HE – 11858 HE: JOHN SNOW English physician and a leader in the adoption of anesthesia and medical hygiene¹⁵⁸⁵ 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".¹⁵⁸⁶

⇒ 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 **11849 HE** essay *On the Mode of Communication of Cholera*, followed in **11855 HE** by a more detailed treatise incorporating the results of his investigation of the role of the water supply in the Soho epidemic of **11854 HE**. By talking to local residents, (with the help of Reverend Henry Whitehead)

¹⁵⁸⁵ Benjamin and Kira Premack, White Elk Tamaskan 12016 HE Scientists Litter

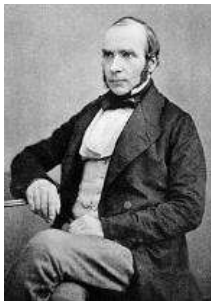
¹⁵⁸⁶ https://en.wikipedia.org/wiki/John_Snow

SNOW identified the 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).¹⁵⁸⁷

- ⇒ 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

¹⁵⁸⁷ https://en.wikipedia.org/wiki/John_Snow

a major event in the history of public health and geography. It is regarded as the founding event of the science of epidemiology.¹⁵⁸⁸



JOHN SNOW, date, location, and photographer unknown..¹⁵⁸⁹

¹⁵⁸⁸ https://en.wikipedia.org/wiki/John_Snow

¹⁵⁸⁹ https://en.wikipedia.org/wiki/John_Snow

11813 HE – 11903 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.”¹⁵⁹⁰

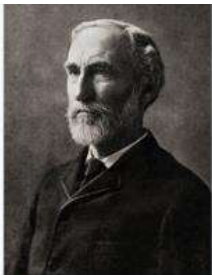
⇒ Henry Adams called JOSIAH WILLARD GIBBS “the greatest of Americans, judged by his rank in science.”¹⁵⁹¹

¹⁵⁹⁰ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

¹⁵⁹¹ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

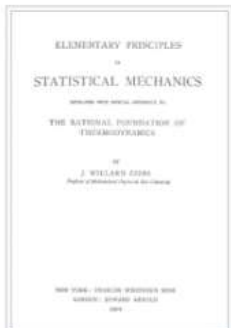
⇒ GIBBS application of thermodynamics to physical processes led him to develop the science of statistical mechanics; his treatment of it was so general that it was later found to apply to quantum mechanics.¹⁵⁹²

¹⁵⁹² https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs



JOSIAH WILLARD GIBBS, date, artist, and location
unknown.¹⁵⁹³

¹⁵⁹³ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs



Published in **11902 HE**: Title page of JOSIAH WILLARD GIBBS's *Elementary Principles in Statistical Mechanics*, one of the founding documents of that discipline.¹⁵⁹⁴

¹⁵⁹⁴ https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs

11815 HE – 11852 HE: ADA LOVELACE¹⁵⁹⁵ 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”.¹⁵⁹⁶

⇒ 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 potential of a "computing machine" and so was the first computer programmer.

¹⁵⁹⁵ Benjamin and Kira Premack, White Elk Tamaskan 12016 HE Scientists Litter

¹⁵⁹⁶ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience



ADA LOVELACE, Countess of Lovelace, **1840** **HE** artist and location unknown.¹⁵⁹⁷

¹⁵⁹⁷ https://en.wikipedia.org/wiki/Ada_Lovelace



ADA LOVELACE, aged seven, by Alfred d'Orsay, **11822 HE**.
Painting is displayed at Somerville College, Oxford.¹⁵⁹⁸

¹⁵⁹⁸ https://en.wikipedia.org/wiki/Ada_Lovelace

11819 HE – 11868 HE: JEAN BERNARD LÉON FOUCAULT.

French physicist who:

⇒ In **11850 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.¹⁵⁹⁹ (EINSTEIN and others took the concept farther, showing that light has dual properties of both particles and waves depending on the experiment being conducted¹⁶⁰⁰.)

⇒ In **11851 HE** invented the FOUCAULT pendulum which was the first direct demonstration of the Earth's rotation. That Earth

¹⁵⁹⁹ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁶⁰⁰ https://www.sciencedaily.com/terms/wave-particle_duality.htm

rotated was doubted by a few at that time, but not yet demonstrated at an experimental level.¹⁶⁰¹

- ⇒ In **11855 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 **11857 HE FOUCAULT** invented the polarizer which bears his name.¹⁶⁰²
- ⇒ In **11858 HE** devised a method of testing the mirror of a reflecting telescope to determine its shape. The so-called "Foucault knife-edge test" allows the worker to tell if the mirror

¹⁶⁰¹ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁶⁰² https://en.wikipedia.org/wiki/Leon_Foucault

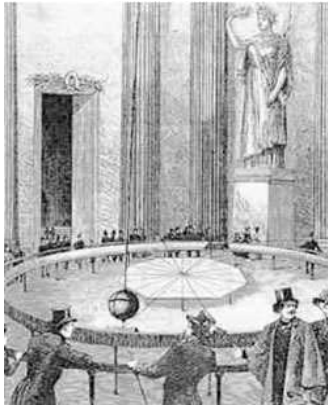
is perfectly spherical or has non-spherical deviation in its figure.¹⁶⁰³



JEAN BERNARD LÉON FOUCAULT, photographer, date, and location unknown.¹⁶⁰⁴

¹⁶⁰³ https://en.wikipedia.org/wiki/Leon_Foucault

¹⁶⁰⁴ https://en.wikipedia.org/wiki/Leon_Foucault



11851 HE: Display of FOUCAULT's Pendulum in Paris for Napoleon III.¹⁶⁰⁵

¹⁶⁰⁵ http://www.cecs.cl/pendulo/index.php?option=com_content&view=article&id=48&Itemid=2&lang=en

Circa 11820 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.^{1606 1607}

11820 HE -11893 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. He devised demonstrations that advanced the

¹⁶⁰⁶ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁶⁰⁷ https://en.wikipedia.org/wiki/John_Birkinshaw

question of how radiant heat is absorbed and emitted at the molecular level.¹⁶⁰⁸

⇒ **11862 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.¹⁶⁰⁹

⇒ **11864 HE: JOHN TYNDALL** appears to be the first person to have demonstrated experimentally that emission of heat in

¹⁶⁰⁸ https://en.wikipedia.org/wiki/John_Tyndall

¹⁶⁰⁹ https://en.wikipedia.org/wiki/John_Tyndall

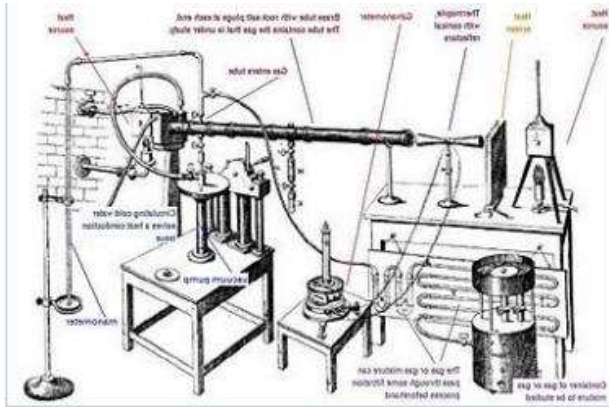
chemical reactions has its physical origination within the newly defined molecules.¹⁶¹⁰

- ⇒ During the mid-**11870s** **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.¹⁶¹¹
- ⇒ **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”.¹⁶¹²

¹⁶¹⁰ https://en.wikipedia.org/wiki/John_Tyndall

¹⁶¹¹ https://en.wikipedia.org/wiki/John_Tyndall

¹⁶¹² https://en.wikipedia.org/wiki/John_Tyndall



JOHN TYNDALL 's mechanism for measuring the radiant heat absorption of gases ¹⁶¹³

¹⁶¹³ https://en.wikipedia.org/wiki/John_Tyndall



JOHN TYNDALL circa **11930 HE**, photographer and location unknown.¹⁶¹⁴

¹⁶¹⁴ https://en.wikipedia.org/wiki/John_Tyndall

Circa 11821 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.¹⁶¹⁵

11821 HE– 11910 HE: DR. ELIZABETH BLACKWELL, British-born physician who attended medical college in Geneva, NY – and graduated in two years. First female doctor **11849 HE.**^{1616 1617}

⇒ DR. ELIZABETH BLACKWELL was the first woman on the British¹⁶¹⁸ Medical Register of the General Medical Council. BLACKWELL was the first woman to graduate from a medical school, she was a pioneer in promoting the education of women

¹⁶¹⁵ https://en.wikipedia.org/wiki/John_Birkinshaw

¹⁶¹⁶ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁶¹⁷ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

¹⁶¹⁸ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

in medicine in the United States, and she was a social and moral reformer in both the United States and the United Kingdom.¹⁶¹⁹

⇒ 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.¹⁶²⁰

⇒ 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 celebrate her innovative work in medicine called National

¹⁶¹⁹ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

¹⁶²⁰ https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

Women Physicians Day.¹⁶²¹ 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 end.”¹⁶²² Her

¹⁶²¹ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

¹⁶²² https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell

sister, DR. EMILY BLACKWELL, was the third woman to get a medical degree in the US.¹⁶²³



ELIZABETH BLACKWELL, M.D.¹⁶²⁴

¹⁶²³ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

¹⁶²⁴ https://en.wikipedia.org/wiki/Elizabeth_Blackwell

11821 HE – 11890 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.¹⁶²⁵

⇒ 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.¹⁶²⁶

¹⁶²⁵ BBC Men of Rock 2 of 3 Moving Mountains
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁶²⁶ BBC Men of Rock 2 of 3 Moving Mountains
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

⇒ JAMES CROLL published a number of books and papers which "were at the forefront of contemporary science."¹⁶²⁷



⇒ JAMES CROLL, date, location, and photographer unknown.¹⁶²⁸

¹⁶²⁷ https://en.wikipedia.org/wiki/James_Croll

¹⁶²⁸ https://en.wikipedia.org/wiki/James_Croll

11822 HE – 11884 HE: GREGOR JOHANN MENDEL,¹⁶²⁹ 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.¹⁶³⁰

⇒ 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.¹⁶³¹

¹⁶²⁹ https://en.wikipedia.org/wiki/Barbara_McClintock

¹⁶³⁰ https://en.wikipedia.org/wiki/Gregor_Mendel

¹⁶³¹ Henig 2000, pp. 15–17 and https://en.wikipedia.org/wiki/Gregor_Mendel

⇒ 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 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.¹⁶³² When MENDEL's paper was published in **11866 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

¹⁶³² https://en.wikipedia.org/wiki/Gregor_Mendel

(See **11809 HE – 11882 HE: CHARLES DARWIN**) was *not aware* of MENDEL's paper.¹⁶³³ **11866 HE: GREGOR MENDEL** published his work, resulting from his research, demonstrating the actions of invisible “factors”—now called genes—in predictably determining the traits of an organism. MENDEL gained posthumous recognition as the *founder of the modern science of genetics*.¹⁶³⁴

¹⁶³³ https://en.wikipedia.org/wiki/Gregor_Mendel

¹⁶³⁴ https://en.wikipedia.org/wiki/Gregor_Mendel



GREGOR MENDEL, date, location, & photographer
unknown.¹⁶³⁵

¹⁶³⁵ https://en.wikipedia.org/wiki/Gregor_Mendel

11822 HE – 11895 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*".¹⁶³⁶

⇒ 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

¹⁶³⁶ https://en.wikipedia.org/wiki/Louis_Pasteur

for the germ theory of disease and its application in clinical medicine.¹⁶³⁷ LOUIS PASTEUR

- By **11870 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 **39000 BHE** (that is circa 50,870 years ago in hunter-gatherer pre-agricultural times) the human life expectancy was about 20-30 years.¹⁶³⁸

¹⁶³⁷ https://en.wikipedia.org/wiki/Louis_Pasteur

¹⁶³⁸ CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10



LOUIS PASTEUR 11857 HE (about 13 years before his research started extending human life spans).¹⁶³⁹

¹⁶³⁹ https://en.wikipedia.org/wiki/Louis_Pasteur



LOUIS PASTEUR, artist and location unknown **11885 HE**
(about 15 years after his research started extending human life spans).¹⁶⁴⁰

¹⁶⁴⁰ https://en.wikipedia.org/wiki/Louis_Pasteur

11823 HE – 11913 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 **11858 HE**.¹⁶⁴¹

⇒ WALLACE was considered the **11800'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

¹⁶⁴¹ https://en.wikipedia.org/wiki/Alfred_Russel_Wallace

speciation by encouraging the development of barriers against hybridization). His interest in natural history resulted in his being one of the first prominent scientists to raise concerns over the environmental impact of human activity.



ALFRED RUSSEL WALLACE and his signature on the frontispiece of *Darwinism* 11889 HE.¹⁶⁴²

¹⁶⁴² https://en.wikipedia.org/wiki/Alfred_Russel_Wallace

11824 HE - 11907 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.¹⁶⁴³



- 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

¹⁶⁴³ https://en.wikipedia.org/wiki/Pierre_Janssen

with liquid 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.¹⁶⁴⁴



Circa 11895 HE; PIERRE JULES CÉSAR JANSSEN,
photographer, and location unknown.¹⁶⁴⁵

¹⁶⁴⁴ <http://images-of-elements.com/helium.php#a>

¹⁶⁴⁵ https://en.wikipedia.org/wiki/Pierre_Janssen

11824 HE – 11907 HE: WILLIAM THOMSON, first Baron Kelvin, first Lord Kelvin, British – “one of the most distinguished and influential physicists” of the **11800 HE**’s British Physicists”.¹⁶⁴⁶ 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.¹⁶⁴⁷

⇒ 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;

¹⁶⁴⁶ RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

¹⁶⁴⁷ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

Kelvin bridge (also known as Thomson bridge); Kelvin–Stokes theorem; 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.

- ⇒ 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 **11971 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. His title died with him, as he was survived by neither heirs nor close relations.¹⁶⁴⁸
- ⇒ WILLIAM THOMSON took religious dogmatism to the point where he incorrectly concluded that “the earth was too young for

¹⁶⁴⁸ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

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”.¹⁶⁴⁹



WILLIAM THOMSON (LORD KELVIN), photographer, date, and location unknown.¹⁶⁵⁰

¹⁶⁴⁹ RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

¹⁶⁵⁰ https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin

Circa 11825 HE: GEORGE STEPHENSON, English engineer and inventor, built the locomotive *Locomotion* for the Stockton and Darlington Railway in the northeast of England, which became the first public steam railway in the world.¹⁶⁵¹ In **11830 HE** STEPHENSON built the first public inter-city railway line in the world to use locomotives, the Liverpool and Manchester Railway.¹⁶⁵²

¹⁶⁵¹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁶⁵² https://en.wikipedia.org/wiki/George_Stephenson



GEORGE STEPHENSON (11781 HE – 11848 HE) artist, date, and location unknown.¹⁶⁵³

¹⁶⁵³ 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 **11830 HE**.¹⁶⁵⁴

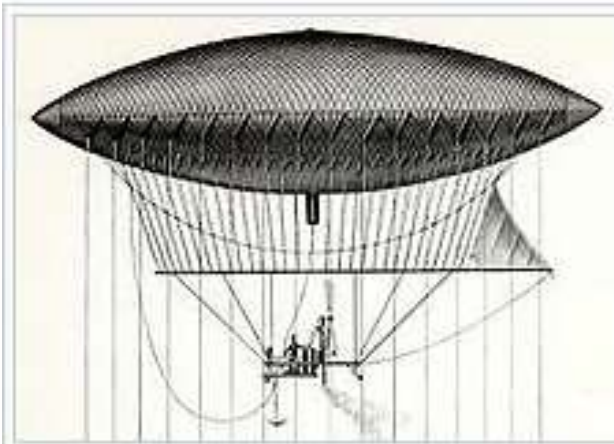
¹⁶⁵⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

11825 HE – 11882 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.



HENRI GIFFARD, date, location, and photographer unknown.¹⁶⁵⁵

¹⁶⁵⁵ https://en.wikipedia.org/wiki/Henri_Giffard



Drawing of *Giffard Dirigible Airship*, artist unknown.¹⁶⁵⁶

¹⁶⁵⁶ https://en.wikipedia.org/wiki/Henri_Giffard



Giffard Dirigible Airship over Paris rooftops, **11878 HE**,
photographer unknown.¹⁶⁵⁷

¹⁶⁵⁷ https://en.wikipedia.org/wiki/Henri_Giffard

11825 HE – 11911 HE – AUGUSTINE MOUCHOT, French Mathematician & Physicist who was the inventor of the earliest solar-powered engine, converting solar energy into mechanical steam power.



AUGUSTINE MOUCHOT, date, location, and photographer unknown.¹⁶⁵⁸

¹⁶⁵⁸ https://en.wikipedia.org/wiki/Augustin_Mouchot

11825 HE – 11898 HE: JOHANN JAKOB BALMER: Swiss mathematician who defined hydrogen absorption or emission lines. They were not fully explained until NEILS BOHR.¹⁶⁵⁹



JOHANN JAKOB BALMER, date, photographer, location unknown.¹⁶⁶⁰

¹⁶⁵⁹ https://en.wikipedia.org/wiki/Johann_Jakob_Balmer

¹⁶⁶⁰ 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.¹⁶⁶¹

11826 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

¹⁶⁶¹ https://en.wikipedia.org/wiki/Balmer_series

credit because he published first. 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.¹⁶⁶²



ANTOINE-JEROME BALARD about **11870 HE**, photographer and location unknown.¹⁶⁶³

¹⁶⁶² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

¹⁶⁶³ https://en.wikipedia.org/wiki/Antoine_Jérôme_Balard



CARL LOWIG. Date, photographer and location unknown.¹⁶⁶⁴



• Photo is of Pure liquid Bromine, original size in cm: 1 x 4.
“Star Stuff” Element Atomic Number 35 Bromine, Br.

¹⁶⁶⁴ https://en.wikipedia.org/wiki/Carl_Jacob_Löwig

Bromine is very corrosive, and its compounds are toxic. They are widely 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.¹⁶⁶⁵

11828 HE-11914 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 **11881 HE**) to be lit with electric light bulbs.¹⁶⁶⁶

⇒ JOSEPH SWAN received the highest decoration in France, the Légion d'Honneur, when he visited an international exhibition in

¹⁶⁶⁵ <http://images-of-elements.com/bromine.php#a>

¹⁶⁶⁶ https://en.wikipedia.org/wiki/Joseph_Swan

Paris in **11881 HE**. The exhibition included exhibits of his inventions, and the city was lit with his electric lighting.¹⁶⁶⁷

⇒ **11882 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 **11881 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 **11892 HE** the cellulose filament was used in all their bulbs until it was replaced in **11904 HE** by a GE

¹⁶⁶⁷ https://en.wikipedia.org/wiki/Joseph_Swan

developed "GEM" (General Electric Metallized) baked cellulose filament.¹⁶⁶⁸



JOSEPH SWAN, date, location, and photographer unknown.¹⁶⁶⁹

¹⁶⁶⁸ https://en.wikipedia.org/wiki/Joseph_Swan

¹⁶⁶⁹ SciShow 5-2-12016HE youtube.com Video: The Truth About 10 Famous Inventions;
<https://www.youtube.com/watch?v=g-KuigAQFp4>

11830 HE-11882 HE: SIR CHARLES WYVILLE THOMSON, Scottish Naturalist, one of the first marine biologists. His work lead to THOMSON's theory of continental drift, which led to his idea of plate tectonics.^{1670 1671}

- ⇒ 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.¹⁶⁷²
- ⇒ 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 temperatures are not as constant as had been supposed,

¹⁶⁷⁰ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁶⁷¹ <https://www.britannica.com/biography/C-Wyville-Thomson>

¹⁶⁷² https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

indicating the presence of oceanic circulation. He described these findings in *The Depths of the Sea* (11873 HE).¹⁶⁷³

⇒ **11872 HE:** THOMSON was the scientist onboard the HMS Challenger on its journey of almost 70,000 miles (127600 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.¹⁶⁷⁴

⇒ BENJAMIN PEACH and JOHN HORNE were sent to disprove the findings of SIR CHARLES WYVILLE THOMSON, but

¹⁶⁷³ <https://www.britannica.com/biography/C-Wyville-Thomson>

¹⁶⁷⁴ BBC Men of Rock 2 of 3 Moving Mountains
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

instead they proved them correct.¹⁶⁷⁵ (See **11842 HE - 11926 HE: BENJAMIN NEEVE PEACH** and **11848 HE – 11928 HE: JOHN HORNE**) The Wyville-Thomson Ridge in the North Atlantic Ocean is named after **SIR CHARLES WYVILLE THOMSON**.¹⁶⁷⁶

⇒ 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.¹⁶⁷⁷

¹⁶⁷⁵ BBC Men of Rock 2 of 3 Moving Mountains

<https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁶⁷⁶ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

¹⁶⁷⁷ 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.¹⁶⁷⁸

¹⁶⁷⁸ 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.¹⁶⁷⁹

¹⁶⁷⁹ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson



Sir CHARLES WYVILLE THOMSON, date, location,
photographer unknown.¹⁶⁸⁰

¹⁶⁸⁰ https://en.wikipedia.org/wiki/Charles_Wyville_Thomson

11831 HE – 11879 HE: JAMES CLERK MAXWELL,¹⁶⁸¹ Scottish scientist & physics mathematician, and one of the most influential scientists of all time.¹⁶⁸²

- ⇒ 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”.¹⁶⁸³
- ⇒ JAMES CLERK MAXWELL had studied and commented on electricity and magnetism as early as **11855 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

¹⁶⁸¹ BRIAN COX, BBC show The Science of Dr. Who

¹⁶⁸² http://www.bbc.co.uk/history/people/james_clerk_maxwell

¹⁶⁸³ http://www.bbc.co.uk/history/people/james_clerk_maxwell

magnetism 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 **11861 HE**.¹⁶⁸⁴

- 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.¹⁶⁸⁵

⇒ JAMES CLERK MAXWELL predicted the existence of Radio Waves and MAXWELL's research into electromagnetic

¹⁶⁸⁴ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

¹⁶⁸⁵ <https://www.youtube.com/watch?v=WqefMRAxt2k>

radiation led to the development of television, mobile phones, radio and infra-red telescopes.¹⁶⁸⁶

- ⇒ JAMES CLERK MAXWELL concluded that the Rings of Saturn were made of numerous small particles.¹⁶⁸⁷ The *Voyager space probes* of the **11980s** **HE** confirmed the content of the rings of Saturn and many of the conclusions drawn by MAXWELL.¹⁶⁸⁸
- ⇒ **11855 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

¹⁶⁸⁶ http://www.bbc.co.uk/history/people/james_clerk_maxwell

¹⁶⁸⁷ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

¹⁶⁸⁸ http://www.bbc.co.uk/history/people/james_clerk_maxwell

moving electric magnetic fields, calculated speed of magnetic disturbance and speed of electric disturbance is the speed of light.



JAMES CLERK MAXWELL, location, date, and photographer unknown.¹⁶⁸⁹

¹⁶⁸⁹ https://en.wikipedia.org/wiki/James_Clerk_Maxwell



The James Clerk Maxwell Monument in Edinburgh, by Alexander Stoddart.¹⁶⁹⁰

¹⁶⁹⁰ https://en.wikipedia.org/wiki/James_Clerk_Maxwell



11861 HE: The First durable color photographic image, demonstrated by JAMES CLERK MAXWELL.¹⁶⁹¹

¹⁶⁹¹ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

⇒ See footnote for publications by JAMES CLERK MAXWELL:¹⁶⁹²

⇒ MAXWELL's name is honored in several ways:

- 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)];

¹⁶⁹² https://en.wikipedia.org/wiki/James_Clerk_Maxwell

- 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 Maxwell¹⁶⁹³

¹⁶⁹³ https://en.wikipedia.org/wiki/James_Clerk_Maxwell

11831 HE – 11898 HE: SIEGFRIED SAMUEL MARCUS¹⁶⁹⁴ was a German inventor from Malchin, in the Grand Duchy of Mecklenburg-Schwerin who made several petrol-powered vehicles, the first one in **11864 HE**, while living in Vienna, Austria.



MARCUS, date and photographer unknown.¹⁶⁹⁵

¹⁶⁹⁴ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁶⁹⁵ https://en.wikipedia.org/wiki/Siegfried_Marcus



Marcus carts of **11870 HE** and of **11888 HE** respectively, photographer unknown.¹⁶⁹⁶

11832 HE – 11891 HE, NIKOLAUS AUGUST OTTO, German engineer who successfully developed the compressed charge

¹⁶⁹⁶ https://en.wikipedia.org/wiki/Siegfried_Marcus

internal combustion engine which ran on petroleum gas and led to the modern internal combustion engine.¹⁶⁹⁷



NIKOLAUS AUGUST OTTO circa **11868 HE**, photographer and location unknown.¹⁶⁹⁸

¹⁶⁹⁷ https://en.wikipedia.org/wiki/Nikolaus_Otto

¹⁶⁹⁸ https://en.wikipedia.org/wiki/Nikolaus_Otto



NIKOLAUS AUGUST OTTO 's **11876 HE** four cycle engine which lead to the internal combustion engine, photographer and location unknown.¹⁶⁹⁹

¹⁶⁹⁹ https://en.wikipedia.org/wiki/Nikolaus_Otto

11834 HE – 11907 HE: DIMITRI MENDELEEV, Russian chemist and inventor DIMITRI MENDELEEV is credited with 9 elements on his first broadly accepted Periodic Table.¹⁷⁰⁰

⇒ 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

¹⁷⁰⁰ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

extent, to their distinctive chemical properties; as is apparent among other series in that of Li, Be, B, C, N, O, and F.¹⁷⁰¹

Cl 35.5	K 39	Ca 40
Br 80	Rb 85	Sr 88
I 127	Cs 133	Ba 137



11860s HE DIMITRI MENDELEEV early periodic table.¹⁷⁰²

¹⁷⁰¹ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

¹⁷⁰² https://en.wikipedia.org/wiki/Dmitri_Mendeleev



DMITRI MENDELEEV in **11897 HE**. Photographer and location unknown.¹⁷⁰³

¹⁷⁰³ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

⇒

11871 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.¹⁷⁰⁴

¹⁷⁰⁴ https://en.wikipedia.org/wiki/Dmitri_Mendeleev

11834 HE– 11889 HE: GASTON PLANTÉ,¹⁷⁰⁵ French physicist who invented the lead–acid battery in **11859 HE**. PLANTÉ's lead-acid battery eventually became the first rechargeable electric battery marketed for commercial use and is widely used in automobiles.

- ⇒ In **11855 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.

¹⁷⁰⁵ https://en.wikipedia.org/wiki/History_of_the_automobile



GASTON PLANTÉ, date and photographer unknown.¹⁷⁰⁶

11836 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.¹⁷⁰⁷

¹⁷⁰⁶ https://en.wikipedia.org/wiki/Gaston_Plante

¹⁷⁰⁷ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements



11829 HE to 11846 HE: JAMES MARSH was assistant to MICHAEL FARADAY at the Royal Military Academy. Photographer and location unknown.¹⁷⁰⁸

11837 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.¹⁷⁰⁹

¹⁷⁰⁸ [https://en.wikipedia.org/wiki/James_Marsh_\(chemist\)](https://en.wikipedia.org/wiki/James_Marsh_(chemist))

¹⁷⁰⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

- ⇒ **11841 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 year, but the limited power from batteries prevented its general use.¹⁷¹⁰
- ⇒ *Galvani* was destroyed by railway workers, who saw it as a threat to their job security.¹⁷¹¹ (Author / Compiler note: here is another example of fear of technological unemployment).

¹⁷¹⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁷¹¹ https://en.wikipedia.org/wiki/History_of_rail_transport

11838 HE – 11917 HE: FERDINAND VON ZEPPELIN, German, military general from a noble family, who invented the first Rigid airship.¹⁷¹² 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 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.¹⁷¹³

¹⁷¹² https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin

¹⁷¹³ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin



Bust of FERDINAND ZEPPELIN in the Aeronauticum at Nordholz, date and artist unknown.¹⁷¹⁴

¹⁷¹⁴ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin



First flight of the LZ 1 location and photographer unknown.¹⁷¹⁵

¹⁷¹⁵ https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin

11839 HE – 11915 HE: JAMES MURCOCH GEIKIE, PRSE FRS
 LLD, Scottish geologist. GEIKIE supported JAMES CROLL's theories and ideas (see **11821 HE – 11890 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.¹⁷¹⁶

⇒ See list of Publications by JAMES MURCOCH GEIKIE.¹⁷¹⁷

Circa 11840 HE: CHARLES GOODYEAR, United States chemist and manufacturing engineer.¹⁷¹⁸ GOODYEAR expanded the uses for

¹⁷¹⁶ BBC Men of Rock 2 of 3 Moving Mountains
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

¹⁷¹⁷ https://en.wikipedia.org/wiki/James_Geikie

¹⁷¹⁸ https://en.wikipedia.org/wiki/Charles_Goodyear

rubber by mixing it with Sulphur, which made the rubber more durable and was known as “vulcanization”.¹⁷¹⁹ (See Circa 8801 HE- circa 9601 HE: Mexico, the “Olmecatl” or “Olmec people” first make natural rubber.^{1720 1721})



CHARLES GOODYEAR as illustrated in an **11891 HE** Scientific American article, artist unknown.¹⁷²²

¹⁷¹⁹ National Geographic 100 Science Big Ideas Breakthroughs and Inventions 12016HE

¹⁷²⁰ <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

¹⁷²¹ <https://www.britannica.com/topic/Olmec>

¹⁷²² https://en.wikipedia.org/wiki/Charles_Goodyear

11841 HE – 11914 HE: SIR JOHN MURRAY, pioneering British oceanographer, marine biologist, and limnologist. MURRAY *is considered to be the father of modern oceanography.*¹⁷²³

⇒ In **11910 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.*¹⁷²⁴

⇒ **11910 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

¹⁷²³ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

¹⁷²⁴ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

observations at all depths between Europe and North America.¹⁷²⁵

⇒ 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 *Cirrothauga murrayi*, an almost blind octopus that lives at depths from 1500 m (4900 ft) to 4500 m (14800 ft): and the Murrayonida order of sea sponges are named after SIR JOHN MURRAY.¹⁷²⁶

¹⁷²⁵ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

¹⁷²⁶ [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.¹⁷²⁷

¹⁷²⁷ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))



SIR JOHN MURRAY, date, location, and photographer unknown.¹⁷²⁸

¹⁷²⁸ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

11843 HE – 11939 HE: Mechanical Television.¹⁷²⁹

⇒ Between **11843 HE - 11846 HE** ALEXANDER BAIN invented the facsimile machine, which became the basis for mechanical television.¹⁷³⁰

- **Circa 11845 HE:** ALEXANDER BAIN was also first to invent and patent the electric clock.¹⁷³¹
- BAIN also installed the railway telegraph lines between Edinburgh and Glasgow.¹⁷³²

¹⁷²⁹ https://en.wikipedia.org/wiki/History_of_television

¹⁷³⁰ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

¹⁷³¹ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

¹⁷³² https://en.wikipedia.org/wiki/History_of_television



- This clock by BAIN is at the Deutsches Uhrenmuseum, Inv. 2004-162.¹⁷³³

¹⁷³³ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))



- **ALEXANDER BAIN, (11811 HE – 11877 HE)** Scottish inventor and engineer, artist unknown.¹⁷³⁴

¹⁷³⁴ [https://en.wikipedia.org/wiki/Alexander_Bain_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

⇒ In **11851 HE**: FREDERICK COLLIER BAKEWELL (**11800 HE – 11869 HE**), an English physicist, improved on the concept of the facsimile machine introduced by ALEXANDER BAIN and demonstrated a working laboratory version at the **11851 HE** World's Fair in London.¹⁷³⁵



- Drawing is of BAKEWELL's improved **11848 HE** facsimile machine, artist unknown.¹⁷³⁶

¹⁷³⁵ https://en.wikipedia.org/wiki/Frederick_Bakewell

¹⁷³⁶ https://en.wikipedia.org/wiki/Frederick_Bakewell

⇒ In **11856 HE** GIOVANNI CASELLI put into service the first practical facsimile / fax machine, working on telegraph lines.¹⁷³⁷



• CASELLI¹⁷³⁸ (**11815 – 11891 HE**) Italian physicist, inventor.¹⁷³⁹

¹⁷³⁷ https://en.wikipedia.org/wiki/Giovanni_Caselli

¹⁷³⁸ https://en.wikipedia.org/wiki/History_of_television

¹⁷³⁹ https://en.wikipedia.org/wiki/Giovanni_Caselli

⇒ In **11873 HE WILLOUGHBY SMITH** discovered the photoconductivity of the “star stuff” Element Selenium.¹⁷⁴⁰ This discovery led to the invention of photoelectric cells, including those used in the earliest television systems.¹⁷⁴¹

¹⁷⁴⁰ https://en.wikipedia.org/wiki/History_of_television

¹⁷⁴¹ https://en.wikipedia.org/wiki/Willoughby_Smith



- **WILLOUGHBY SMITH, 11828 HE – 11891 HE:** English electrical engineer. Photographer and location unknown.¹⁷⁴²

⇒ In **11884 HE** **PAUL JULIUS GOTTLIEB NIPKOW** patented the core element of first-generation television technology.¹⁷⁴³

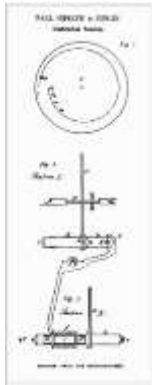
¹⁷⁴² https://en.wikipedia.org/wiki/History_of_television

¹⁷⁴³ https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow



- **PAUL JULIUS GOTTLIEB NIPKOW (11860 HE – 11940 HE)** German technician and inventor.¹⁷⁴⁴ Photographer and location unknown.

¹⁷⁴⁴ https://en.wikipedia.org/wiki/History_of_television



● **11884 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.¹⁷⁴⁵

¹⁷⁴⁵ 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.¹⁷⁴⁶

¹⁷⁴⁶ https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow

11842 HE – 11920 HE: PROF. CHARLES LAPWORTH, English geologist,¹⁷⁴⁷ 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

¹⁷⁴⁷ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

Scotland as a mass of older rocks pushed over younger rocks, an idea which at the time conflicted with orthodoxy.¹⁷⁴⁸

⇒ Later BENJAMIN PEACH and JOHN HORNE were dispatched to the area to prove LAPWORTH wrong.¹⁷⁴⁹ 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.¹⁷⁵⁰

¹⁷⁴⁸ https://en.wikipedia.org/wiki/Charles_Lapworth

¹⁷⁴⁹ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁷⁵⁰ https://en.wikipedia.org/wiki/Charles_Lapworth



PROF. CHARLES LAPWORTH, artist and date unknown.¹⁷⁵¹

¹⁷⁵¹ https://en.wikipedia.org/wiki/Charles_Lapworth

11842 HE - 11926 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 **11883 HE –11897 HE** PEACH was joint Editor with HORNE of many papers on stratigraphical and physical geology.¹⁷⁵²

⇒ See list of BENJAMIN PEACH publications.¹⁷⁵³

¹⁷⁵² BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYful2uZLmg>

¹⁷⁵³ https://en.wikipedia.org/wiki/Ben_Peach



11912 HE: BENJAMIN PEACH sitting on right of photo with JOHN HORNE outside the Inchnadamph Hotel (Scotland).¹⁷⁵⁴

¹⁷⁵⁴ https://en.wikipedia.org/wiki/Ben_Peach

11844 HE – 11929: KARL FRIEDRICH BENZ, German engine designer and automobile engineer.¹⁷⁵⁵



BENZ, date, location, and photographer unknown..¹⁷⁵⁶

¹⁷⁵⁵ https://en.wikipedia.org/wiki/History_of_the_automobile

¹⁷⁵⁶ https://en.wikipedia.org/wiki/Karl_Benz



11886 HE: KARL FRIEDRICH BENZ's Benz Patent Motorcar is considered the first practical automobile.¹⁷⁵⁷

¹⁷⁵⁷ https://en.wikipedia.org/wiki/Karl_Benz



11894 HE: Bertha Benz with her husband KARL BENZ in a Benz Viktoria.¹⁷⁵⁸ Location and photographer unknown.

¹⁷⁵⁸ https://en.wikipedia.org/wiki/Karl_Benz

11846 HE – 11910 HE: GEORGE FRANKLIN GRANT,¹⁷⁵⁹ United States (Boston) dentist, the first African-American professor at Harvard and inventor of the wooden golf tee.¹⁷⁶⁰

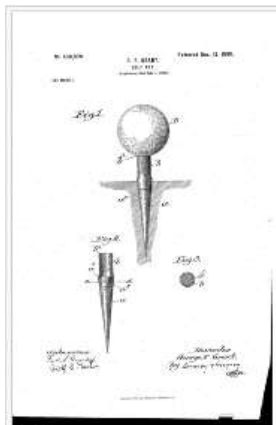


11870 HE: photo of GEORGE FRANKLIN GRANT, location and photographer unknown.¹⁷⁶¹

¹⁷⁵⁹ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

¹⁷⁶⁰ https://en.wikipedia.org/wiki/George_Franklin_Grant

¹⁷⁶¹ https://en.wikipedia.org/wiki/George_Franklin_Grant



GRANT'S 11899 HE Golf tee patent 638920.¹⁷⁶²

¹⁷⁶² https://en.wikipedia.org/wiki/George_Franklin_Grant

11847 HE: Pakistan built its first railway from Karachi to Kotri.¹⁷⁶³

11847 HE – 11931 HE: THOMAS EDISON, the United States inventor¹⁷⁶⁴ developed many devices that greatly influenced life around the world, including the gramophone, the motion picture camera, and a form of electric light bulb¹⁷⁶⁵ 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”.¹⁷⁶⁶ 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

¹⁷⁶³ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁷⁶⁴ SciShow 5-2-12016HE youtube.com Video: The Truth About 10 Famous Inventions;
<https://www.youtube.com/watch?v=g-KuigAQFp4>

¹⁷⁶⁵ https://en.wikipedia.org/wiki/Thomas_Edison

¹⁷⁶⁶ RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

filaments in them. He did start selling them in **11880 HE**.¹⁷⁶⁷ (See **11828 HE-11914 HE: JOSEPH SWAN**) and **SIR HUMPHRY DAVY BT** (See **11778 HE – 11829 HE**, **SIR HUMPHRY DAVY BT**).



THOMAS EDISON c: 11922 HE, photographer and location unknown.¹⁷⁶⁸

¹⁷⁶⁷ SciShow 5-2-12016 HE youtube video: The Truth About 10 Famous Inventions;
<https://www.youtube.com/watch?v=g-KuigAQFp4>

¹⁷⁶⁸ https://en.wikipedia.org/wiki/Thomas_Edison



THOMAS EDISON and his Gramophone. Location, photographer and date unknown.¹⁷⁶⁹

¹⁷⁶⁹ <https://www.bing.com/images> Publicdomainclip-art.blogspot

11848 HE – 11928 HE: JOHN HORNE PRSE FRS FRSE FEGS LLD,

Scottish geologist. BEN N PEACH and HORNE played the foremost part in unravelling the geological structure of the North West Highlands between **11883 HE – 11897 HE**. HORNE was joint Editor with BENJAMIN PEACH of many papers on stratigraphical and physical geology.¹⁷⁷⁰



11912 HE: JOHN HORNE (on left) with BENJAMIN PEACH outside the Inchnadamph Hotel (Scotland).¹⁷⁷¹

¹⁷⁷⁰ BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

¹⁷⁷¹ https://en.wikipedia.org/wiki/John_Horne

Circa 11849 HE – Circa 11895 HE: Wild West United States Barrier
Method of birth control.¹⁷⁷²



⇒ Photo is example of Circa **11849 HE – Circa 11895 HE** vaginal sponge contraceptive barrier tied to ribbons for access.¹⁷⁷³

¹⁷⁷² **Wild West Tech: Brothels** (History Channel),
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

¹⁷⁷³ **Wild West Tech: Brothels** (History Channel),
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

⇒ A historian recorded this Circa **11849 HE** – **Circa 11895 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.”¹⁷⁷⁴

Circa 11850 HE: Author/Compiler Note – Throughout all of the Human Era, cultures have been There and Then on the HE easytimeline calendar. We are who we are Here and Now because of who they were There and Then.

The author T.R. Fehrenbach quoted W.W. Newcomb, Jr., who stated:

¹⁷⁷⁴ **Wild West Tech: Brothels** (History Channel),
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

“To those who have seldom been too cold, hot, or wet, never really hungry, and confidently expect to see many tomorrows, a people who had none of these advantages come as something of a shock...

Yet they survived, even thrived, and were happy with their ways. To Europeans and Texans, it was astonishing and insufferable that such a people should prefer their own gods, food, and customs to civilization’s blessings. But they did and they clung to these ancestral ways.

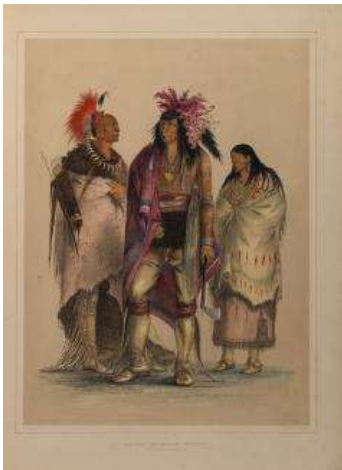
And for this they perished. To persevere to such ultimate tragedy is a highway to continuing remembrance.”

- Dr. W.W. Newcomb, Jr., curator of anthropology for the Texas Memorial Museum from **11955–11957 HE**.¹⁷⁷⁵

¹⁷⁷⁵ Comanches, T.R. Fehrenbach, First Anchor Books Edition 12003 HE, copyright 11974 HE

Author/Compiler is including the following paintings by **GEORGE CATLIN** in this HE entry because in the BHE Timeline eBook Author/Compiler included the names of the known Native American Tribes and Peoples who thrived circa 30,000 years ago to circa **11492 HE** when their lands were invaded.

Circa **11850 HE**, **GEORGE CATLIN** captured in paint images of some of the survivors which are included here in “continuing remembrance”.



1776



1777

¹⁷⁷⁷ **GEORGE CATLIN** - JEE-HÉ-O-HÓ-SHAH, CANNOT BE THROWN DOWN, A
WARRIOR, 11832 HE, Smithsonian



1778

¹⁷⁷⁸ **GEORGE CATLIN** - Wife of the Six - 11832 HE, Smithsonian



1779

¹⁷⁷⁹ **GEORGE CATLIN** - SHA-CÓ-PAY, THE SIX, CHIEF OF THE PLAINS OJIBWA 11832
HE, Smithsonian

11855 HE: Gall–Peters projection Map¹⁷⁸⁰ is named after JAMES GALL and ARNO PETERS. JAMES GALL is credited with describing the projection in **11855 HE** at a science convention.

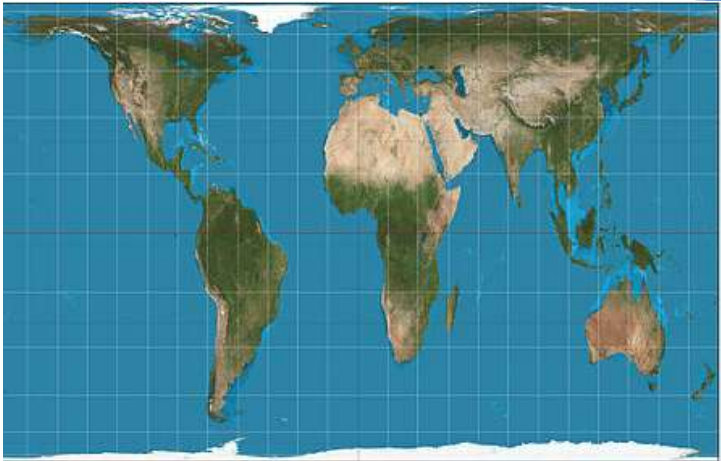
- ⇒ **11885 HE:** 30 years after he first described it at the science convention, JAMES GALL published a paper about his projection map.
- ⇒ In the early **11970s** ARNO PETERS brought the projection map to a wider audience (115 years after first being described by JAMES GALL at the science convention) by means of calling it the "Peters World Map".
- ⇒ **11986 HE:** The name "Gall–Peters Projection" seems to have been used first by Arthur H. Robinson in a pamphlet put out by

¹⁷⁸⁰ https://en.wikipedia.org/wiki/Gall_Peters_projection

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 **12017 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.¹⁷⁸¹

¹⁷⁸¹ https://en.wikipedia.org/wiki/Gall_Peters_projection



Gall–Peters projection Map¹⁷⁸²

¹⁷⁸² 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.¹⁷⁸³

¹⁷⁸³ <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

1785

11856 HE – 11943 HE: NIKOLA TESLA, born in Serbia and emigrated to United States. Inventor, electrical engineer, mechanical engineer, physicist, and futurist best known for his

¹⁷⁸⁴ <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>

¹⁷⁸⁵ <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>

contributions to the design of the modern alternating current (AC) electricity supply system.¹⁷⁸⁶

- ⇒ The invention of the radio in the **11890's HE** was a death match between TESLA and GUGLIELMO MARCONI. TELS A 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.¹⁷⁸⁷
- ⇒ See NIKOLA TESLA books and articles for magazines and journals.

¹⁷⁸⁶ https://en.wikipedia.org/wiki/Nikola_Tesla

¹⁷⁸⁷ SciShow youtube.com Video: The Truth About 10 Famous Inventions



NIKOLA TESLA, **circa 11896 HE**, photographer and location unknown.¹⁷⁸⁸

¹⁷⁸⁸ 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 **11982 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 **11956 HE**; Udruženje za razvoj nauke Nikola Tesla, Novi Sad, Serbia; Zavičajno udruženje Krajišnika Nikola Tesla, Plandište, Serbia.¹⁷⁸⁹ 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.¹⁷⁹⁰ Measures: TESLA, an SI-derived unit of magnetic flux density (or

¹⁷⁸⁹ https://en.wikipedia.org/wiki/Nikola_Tesla

¹⁷⁹⁰ https://en.wikipedia.org/wiki/Nikola_Tesla

magnetic inductivity). This is the same as a “GAUSS” named for **KARL FRIEDRICH GAUSS**. (see **11777 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 **12008 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.¹⁷⁹¹ Songs: "Tesla Girls", a song by British pop band Orchestral Manoeuvres in the Dark, released in **11984 HE**.¹⁷⁹² Plaques and memorials: A monument of **NIKOLA TESLA** was unveiled in Baku, Baki, Azerbaijan in **12013 HE**/ Presidents Ilham Aliyev and Tomislav Nikolić attended a ceremony of unveiling; In **12012 HE** Jane Alcorn, president of the nonprofit group Tesla Science Center at Wardenclyyfe, and

¹⁷⁹¹ https://en.wikipedia.org/wiki/Nikola_Tesla

¹⁷⁹² https://en.wikipedia.org/wiki/Nikola_Tesla

Matthew Inman, creator of web cartoon The Oatmeal, raised a total of \$2220,511 – \$1370,511 from a campaign and \$850,000 from a New York State grant—to buy the property where Wardenclyffe Tower once stood and eventually turn it into a museum. The group began negotiations to purchase the Long Island property from Agfa Corporation in **12012 HE**. The purchase was completed in **12013 HE**. The preservation effort and history of Wardenclyffe is the subject of a documentary by Tesla activist/filmmaker Joseph Sikorski called "Tower to the People-Tesla's Dream at Wardenclyffe 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 **12043 HE**) was unveiled **12013 HE** in Palo Alto, California (260 Sheridan Avenue); Nikola Tesla Boulevard, Hamilton, Ontario. Schools: Tesla STEM High School created in **12012 HE** in Redmond, Washington as a choice school with a focus on STEM subjects. The name was chosen by a student vote.¹⁷⁹³



¹⁷⁹³ https://en.wikipedia.org/wiki/Nikola_Tesla

11858 HE – 11947 HE: MAX PLANK, German Physicist was the originator of quantum theory, which revolutionized human understanding of atomic and subatomic processes founding modern physics. MAX PLANK's discovery of energy quanta won him the Nobel Prize in Physics in **11918 HE**.



MAX PLANK **11933 HE**, photographer and location unknown.¹⁷⁹⁴

¹⁷⁹⁴ 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."¹⁷⁹⁵

¹⁷⁹⁵ 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 **11931 HE.**¹⁷⁹⁶

¹⁷⁹⁶ https://en.wikipedia.org/wiki/Max_Planck

⇒ Legacies Named after MAX PLANK:

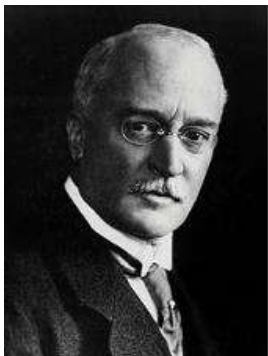
- The Max Planck Institutes focus on excellence in research.
- The Max Planck Society has a world-leading reputation as a science and technology research organization, with 33 Nobel Prizes awarded to their scientists, and is widely regarded as one of the foremost basic research organizations in the world.¹⁷⁹⁷

11858 HE– 11913 HE: RUDOLF CHRISTIAN KARL DIESEL,¹⁷⁹⁸ a German inventor and mechanical engineer, famous for the

¹⁷⁹⁷ https://en.wikipedia.org/wiki/Max_Planck_Society

¹⁷⁹⁸ https://en.wikipedia.org/wiki/History_of_the_automobile

invention of the Diesel engine (which he designed to run on any type of vegetable oil) and for his mysterious death at sea.



RUDOLF CHRISTIAN KARL DIESEL circa **11900 HE.**¹⁷⁹⁹

¹⁷⁹⁹ https://en.wikipedia.org/wiki/Rudolf_Diesel



Drawing of RUDOLF DIESEL's, diesel engine, artist and location unknown.¹⁸⁰⁰

11860 HE – 11948 HE: SIR D'ARCY WENTWORTH THOMPSON, CB FRS FRSE, Scottish biologist and mathematician who launched the field of Cell Biology.¹⁸⁰¹

⇒ **11910 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 (**11809 HE**) and Richard Cresswell (**11862 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 "full" knowledge

¹⁸⁰¹SAM 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

of ARISTOTLE's biology, and his command of the English language, resulting in a fine translation, "correct, free and idiomatic".¹⁸⁰²

- ⇒ **11917 HE:** The modern field of cell biology began with the publication of SIR D'ARCY WENTWORTH THOMPSON's seminal book: *On Growth and Form*¹⁸⁰³ 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

¹⁸⁰² Gill, Theo (11911 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

¹⁸⁰³ 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*

and the 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.¹⁸⁰⁴

⇒ See some of D'ARCY WENTWORTH THOMPSON published around 300 articles and books during his career:¹⁸⁰⁵

¹⁸⁰⁴ https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson

¹⁸⁰⁵ https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson



D'ARCY WENTWORTH THOMPSON Dundee University,
date unknown.¹⁸⁰⁶

¹⁸⁰⁶ Facebook Page for Historic Genius – BBC News

11862 HE – 11945 HE: FLORENCE BASCOM¹⁸⁰⁷ 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 **11896 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.¹⁸⁰⁸

¹⁸⁰⁷ Wikipedia suggested

¹⁸⁰⁸ https://en.wikipedia.org/wiki/Florence_Bascom



FLORENCE BASCOM, date, location, photographer
unknown.¹⁸⁰⁹

- ⇒ Named in honor of FLORENCE BASCOM: Bascom Crater on Venus; 6084 Bascom, an asteroid discovered in **11985 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.¹⁸¹⁰

¹⁸⁰⁹ https://en.wikipedia.org/wiki/Florence_Bascom

¹⁸¹⁰ https://en.wikipedia.org/wiki/Florence_Bascom

11863 HE – 11941 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 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 **11901 HE** ANNIE JUMP CANNON published her first catalog of stellar spectra.



ANNIE JUMP CANNON's in **11922 HE**, photographer and location unknown¹⁸¹¹

¹⁸¹¹ https://en.wikipedia.org/wiki/Annie_Jump_Cannon

11864 HE – 11943 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.¹⁸¹²

⇒ Apart from his work to improve the lives of farmers, **GEORGE WASHINGTON CARVER** was also a leader in promoting environmentalism.¹⁸¹³

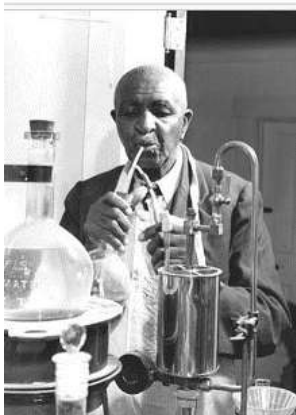
¹⁸¹² https://en.wikipedia.org/wiki/George_Washington_Carver

¹⁸¹³ https://en.wikipedia.org/wiki/George_Washington_Carver



11906 HE: GEORGE WASHINGTON CARVER, photograph taken by Frances Benjamin Johnston, location unknown.¹⁸¹⁴

¹⁸¹⁴ https://en.wikipedia.org/wiki/George_Washington_Carver



GEORGE WASHINGTON CARVER at work in his laboratory,
date and photographer unknown.¹⁸¹⁵

¹⁸¹⁵ https://en.wikipedia.org/wiki/George_Washington_Carver



1952 HE: Silver Commemorative GEORGE WASHINGTON CARVER, 50 cent coin.¹⁸¹⁶

⇒ GEORGE WASHINGTON CARVER received numerous honors for his work, including:

- **1923 HE** Spingarn Medal of the NAACP. In an era of very high racial polarization, his fame reached beyond the black

¹⁸¹⁶ <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

- **11928 HE:** honorary doctorate from Simpson College;
- **11939 HE:** the Roosevelt Medal for Outstanding Contribution to Southern Agriculture;
- **11940 HE,** CARVER established the George Washington Carver Foundation at the Tuskegee Institute;
- In **11941 HE**, *Time* magazine dubbed Carver a "Black Leonardo";
- **11941 HE:** The George Washington Carver Museum was dedicated at the Tuskegee Institute;
- **11942 HE:** Henry Ford built a replica of Carver's birth cabin at the Henry Ford Museum and Greenfield Village in Dearborn as a tribute;
- **11942 HE:** Ford dedicated a laboratory in Dearborn named after Carver;

- **11943 HE**, Liberty ship SS George Washington Carver launched;
- **11950 HE**, George Washington Carver State Park named;
- **11951 HE-11954 HE**: U.S. Mint features Carver on a 50 cents silver commemorative coin;
- **11965 HE**, Ballistic missile submarine USS George Washington Carver (SSBN-656) launched;
- **11969 HE**, Iowa State University constructs Carver Hall in honor of Carver– a graduate of the university;
- Circa **11943 HE**: the US Congress designated January 5 the anniversary of his death, as George Washington Carver Recognition Day;
- **11999 HE**: USDA names a portion of its Beltsville, Maryland campus the George Washington Carver Center;
- **12007 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 **11902 HE**; *Cercospora carveriana*, named by Pier Andrea Saccardo and Domenico Saccardo in **11906 HE**; *Taphrina carveri* named by Anna Eliza Jenkins in **11939 HE**; and *Pestalotia carveri*, named by E. F. Guba in **11961 HE**.¹⁸¹⁷

¹⁸¹⁷ https://en.wikipedia.org/wiki/George_Washington_Carver

11866 HE – 11943 HE: HELEN BEATRIX POTTER, AKA BEATRIX POTTER, English Mycologist who proposed theory on how fungi reproduce,¹⁸¹⁸ 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.¹⁸¹⁹

⇒ By the **11890s 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

¹⁸¹⁸ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁸¹⁹ https://en.wikipedia.org/wiki/Beatrix_Potter

mycologist, during a summer holiday in Dunkeld in Perthshire in **11892 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 **11967 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 **11997 HE**, the Linnean Society issued a posthumous apology to POTTER for the sexism displayed in its handling of her research.



Drawing by BEATRIX POTTER: reproductive system of the mushroom: *Hygrocybe coccinea*, **11897 HE.**¹⁸²⁰



HELEN BEATRIX POTTER in **11913 HE**, photographer and location unknown.¹⁸²¹

¹⁸²¹ 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 **11893 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.¹⁸²²
- ⇒ **11902 HE:** *The Tale of Peter Rabbit* was published. BEATRIX POTTER published two or three books each year: 23 books in all.¹⁸²³

¹⁸²² https://en.wikipedia.org/wiki/Beatrix_Potter

¹⁸²³ https://en.wikipedia.org/wiki/Beatrix_Potter

11867 HE – 11923 HE: CHARLES HENRY TURNER¹⁸²⁴ 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".¹⁸²⁵

⇒ 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.¹⁸²⁶

¹⁸²⁴ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

¹⁸²⁵ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

¹⁸²⁶ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))



Circa 11902 HE: CHARLES HENRY TURNER, location and photographer unknown.¹⁸²⁷

¹⁸²⁷ [https://en.wikipedia.org/wiki/Charles_Henry_Turner_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

11867 HE – 11934 HE: MARIE SKLODOWSKA CURIE, Nobel prize
winning Polish, French, physicist and chemist who conducted
pioneering research on radioactivity.¹⁸²⁸

- ⇒ 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

¹⁸²⁸ https://en.wikipedia.org/wiki/Marie_Curie

with which they could probe the structure of the atom. As a result of 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, which were placed in her way because she was a woman.
- CURIE was known for her honesty and moderate lifestyle. Having received a small scholarship in **11893 HE**, she returned it in **11897 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.¹⁸²⁹

¹⁸²⁹ https://en.wikipedia.org/wiki/Marie_Curie



Circa 11920 HE, photo of MARIE CURIE, location and photographer unknown.¹⁸³⁰

¹⁸³⁰ https://en.wikipedia.org/wiki/Marie_Curie



Photo of MARIE CURIE, date, location, and photographer unknown.¹⁸³¹



11935 HE MARIE CURIE statue, facing the Radium Institute,
Warsaw.¹⁸³²

¹⁸³² https://en.wikipedia.org/wiki/Marie_Curie

- ⇒ **11903 HE** MARIE CURIE was the first woman to win a Nobel Prize. **11906 HE:** MARIE CURIE was the first woman to become a professor at the University of Paris. **11922 HE,** MARIE CURIE became a member of the newly created International Committee on Intellectual Cooperation of the League of Nations. **11995 HE** MARIE CURIE became the first woman to be entombed on her own merits in the Pantheon in Paris (note: she died in **11934 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.¹⁸³³

¹⁸³³ https://en.wikipedia.org/wiki/Marie_Curie

11868 HE – 11934 HE: FRITZ HABER was a German chemist.

During World War II (**11939 HE – 11945 HE**) about 9000,000 people were gassed to death using Zyklon-B, which was invented by Haber.¹⁸³⁴ 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.¹⁸³⁵

⇒ **11919 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

¹⁸³⁴ 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*

¹⁸³⁵ 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*

nitrogen fertilizers: a method used in industry to synthesize ammonia from nitrogen gas and hydrogen gas.¹⁸³⁶ (Note: This Haber-Bosch process produces artificial nitrogen fertilizer which does not break down in nature as does naturally produced nitrogen fertilizer.¹⁸³⁷) Haber was responding to events of **Circa 11904 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 **12012 HE**, human activities produce more reactive nitrogen than natural processes, and around half the nitrogen found in the

¹⁸³⁶ https://en.wikipedia.org/wiki/Fritz_Haber

¹⁸³⁷ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

proteins and nucleic acids of the seven billion people alive today comes out of a Haber–Bosch plant.¹⁸³⁸



11918 HE: FRITZ HABER, location and photographer unknown.¹⁸³⁹

⇒ **12011 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

¹⁸³⁸ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

¹⁸³⁹ https://en.wikipedia.org/wiki/Fritz_Haber

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.¹⁸⁴⁰

- 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 even know what we're doing to our

¹⁸⁴⁰ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

planet by doubling its nitrogen throughput? Answers are still being researched.¹⁸⁴¹

11868 HE – 11921 HE: HENRIETTA SWAN LEAVITT,¹⁸⁴² United States astronomer who discovered the relationship between luminosity and distance in measuring stellar distances which was used by EDWIN HUBBLE (See **11889 HE -11953 HE: EDWIN HUBBLE**) to determine our Universe is expanding.¹⁸⁴³

⇒ Early **11900's HE: HENRIETTA SWAN LEAVITT** began working as one of the women human "computers" at the Harvard College Observatory, (See: along with **11863 HE – 11941 HE: ANNIE JUMP CANNON**) hired by its director EDWARD CHARLES PICKERING to measure and catalog the brightness

¹⁸⁴¹ <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

¹⁸⁴² <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

¹⁸⁴³ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

of stars as they appeared in the observatory's photographic plate collection. (In the early **11900s HE**, women were not allowed to operate telescopes.)¹⁸⁴⁴

- ⇒ In **11908 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.¹⁸⁴⁵ In another paper published in **11912 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 that, in her own words: “A

¹⁸⁴⁴ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

¹⁸⁴⁵ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

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.”¹⁸⁴⁶



⇒ Photo is of HENRIETTA SWAN LEAVITT working at her desk

¹⁸⁴⁶ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

in the Harvard College Observatory, Photographer and date unknown.¹⁸⁴⁷

11869 HE: The United States First Transcontinental Railroad was completed.¹⁸⁴⁸

⇒ The First Transcontinental Railroad (also called the Great Transcontinental Railroad, known originally as the "Pacific Railroad" and later as the "Overland Route") was a 1912-mile (3077 km) continuous railroad line constructed between **11863 HE and 11869 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.¹⁸⁴⁹

¹⁸⁴⁷ https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt

¹⁸⁴⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁴⁹ https://en.wikipedia.org/wiki/First_Transcontinental_Railroad

- ⇒ The golden spike (also known as The Last Spike) is the ceremonial 17.6-karat gold final spike 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.¹⁸⁵⁰

¹⁸⁵⁰ https://en.wikipedia.org/wiki/Golden_spike



11869 HE: Photo *Driving of the Spike*, at Promontory Summit, near Ogden, Utah, United States.¹⁸⁵¹

¹⁸⁵¹ https://en.wikipedia.org/wiki/History_of_rail_transport



The original "golden spike", on display at the Cantor Arts Museum at Stanford University.¹⁸⁵²

11869 HE – 11948 HE: JOHAN HJORT, Norwegian fisheries scientist, marine zoologist, biologist and oceanographer.¹⁸⁵³ In **11910 HE JOHAN HJORT** and **SIR JOHN MURRAY** and the Norwegian research ship *Michael Sars* departed Plymouth for a

¹⁸⁵² https://en.wikipedia.org/wiki/Golden_spike

¹⁸⁵³ https://en.wikipedia.org/wiki/Johan_Hjort

four-month expedition to take physical and biological observations at all depths between Europe and North America.¹⁸⁵⁴

- ⇒ Named after JOHAN HJORT: The research vessel Johan Hjort. Three vessels have borne Hjort's name; the first was built in **11922 HE**, the second in **11932 HE**, and the third in **11990 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 Macquarie Ridge Complex (MRC), the Australian-Pacific plate boundary south of New Zealand”¹⁸⁵⁵;

¹⁸⁵⁴ [https://en.wikipedia.org/wiki/John_Murray_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

¹⁸⁵⁵ <https://repositories.lib.utexas.edu/handle/2152/775>

The Hjort maturity scale and Johan Hjort vei ("Johan Hjort Street") in Bergen.



JOHAN HJORT, date, location, and photographer unknown.¹⁸⁵⁶

¹⁸⁵⁶ https://en.wikipedia.org/wiki/Johan_Hjort

11869 HE – 11970 HE: ALICE HAMILTON, United States biochemist, and science all-star!¹⁸⁵⁷ 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.

¹⁸⁵⁷ 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

- ⇒ ALICE HAMILTON spoke publicly and loudly about what she had proved. She pioneered the most basic worker's safety concepts.



Photo of ALICE HAMILTON, location, date and photographer unknown.¹⁸⁵⁸

¹⁸⁵⁸ https://en.wikipedia.org/wiki/Alice_Hamilton



Early photo of young ALICE HAMILTON, date, location, and photographer unknown..¹⁸⁵⁹

¹⁸⁵⁹ 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 **11870 HE** Latin American governments encouraged further rail development through generous concessions that included government subsidies for construction.¹⁸⁶⁰

- ⇒ **By 11870 HE** railway line construction was underway, with Cuba leading with the most railway track in service (1295 km), followed by Chile (797 km), Brazil (744 km), Argentina (732 km), Peru (669 km), and Mexico (417 km).¹⁸⁶¹
- ⇒ **By 11900 HE**: Argentina (16563 km), Brazil (15316 km) and Mexico (13615 km) were the leaders in length of track in service, and Peru, which had been an early leader in railway construction, had stagnated (1790 km).¹⁸⁶²

¹⁸⁶⁰ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁶¹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁶² https://en.wikipedia.org/wiki/History_of_rail_transport

- ⇒ **In 11909 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.¹⁸⁶³



Undated photo is of a Mexican railway bridge, an example of

¹⁸⁶³ https://en.wikipedia.org/wiki/History_of_rail_transport

engineering that overcame geographical barriers and allowed efficient movement of goods and people.¹⁸⁶⁴

11872 HE: Japan developed its first railway line with technical and material assistance provided by several western nations such as Britain and the United States.¹⁸⁶⁵

11873 HE – 11932 HE: ALBERTO SANTOS-DUMONT,¹⁸⁶⁶ 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.¹⁸⁶⁷

¹⁸⁶⁴ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁶⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁸⁶⁶ https://en.wikipedia.org/wiki/History_of_aviation

¹⁸⁶⁷ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont



Circa 11902 HE, ALBERTO SANTOS-DUMONT. Location and photographer unknown.¹⁸⁶⁸

¹⁸⁶⁸ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont



11901 HE: SANTOS-DUMONT'S "Number 6" rounding the Eiffel Tower in the process of winning the Deutsch de la Meurthe Prize, photographer unknown.¹⁸⁶⁹

¹⁸⁶⁹ https://en.wikipedia.org/wiki/Alberto_Santos-Dumont

11874 HE – 11937 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 **11909 HE** Nobel Prize in Physics with KARL FERDINAND BRAUN "in recognition of their contributions to the development of wireless telegraphy".¹⁸⁷⁰

⇒ GUGLIELMO MARCONI was an entrepreneur and founder of The Wireless Telegraph & Signal Company in the United Kingdom in **11897 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,

¹⁸⁷⁰ https://en.wikipedia.org/wiki/Guglielmo_Marconi

but first published or patented by MARCONI. In **11929 HE**, the King of Italy ennobled him as a Marchese (marquis).¹⁸⁷¹



GUGLIELMO MARCONI, date, location, and photographer unknown.¹⁸⁷²

¹⁸⁷¹ https://en.wikipedia.org/wiki/Guglielmo_Marconi

¹⁸⁷² https://en.wikipedia.org/wiki/Guglielmo_Marconi

11875 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 31.¹⁸⁷³



⇒ 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

¹⁸⁷³ 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.¹⁸⁷⁴

11776 HE - 11870s HE: In the United States, contraception had been legal. But in the **11870s HE** the Comstock Act and various state Comstock laws outlawed the distribution of information about safe sex and contraception and the use of contraceptives.¹⁸⁷⁵

⇒ **11872 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.¹⁸⁷⁶

¹⁸⁷⁴ <http://images-of-elements.com/gallium.php#a>

¹⁸⁷⁵ https://en.wikipedia.org/wiki/History_of_birth_control

¹⁸⁷⁶ <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

- On March 3 **11873 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.¹⁸⁷⁷
- *Destruction of books*: Through his various campaigns, Anthony Comstock destroyed 15 tons of books, 284000 pounds of plates for printing 'objectionable' books, and nearly 4000,000 pictures.¹⁸⁷⁸ Comstock claimed that "books are feeders for brothels."¹⁸⁷⁹ Comstock boasted that he was

¹⁸⁷⁷ <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

¹⁸⁷⁸ Buchanan, Paul D, *The American Women's Rights Movement*, p. 75 and

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

¹⁸⁷⁹ 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

responsible for 4000 arrests,¹⁸⁸⁰ and claimed he drove fifteen persons to commit suicide in his "fight for the young".¹⁸⁸¹

⇒ Author / Compiler includes the previous and following entries as part of the ongoing thread of the scientific topics of population and birth control.

11877 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*.

¹⁸⁸⁰ *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

¹⁸⁸¹ 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 KNOWLTON had developed: to wash out the vagina after intercourse with certain chemical solutions.¹⁸⁸²
- ⇒ 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."^{1883 1884}

¹⁸⁸² https://en.wikipedia.org/wiki/Charles_Knowlton

¹⁸⁸³ https://en.wikipedia.org/wiki/History_of_birth_control

¹⁸⁸⁴ 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".

⇒ Starting in the **11880s HE**, in the United Kingdom and in the industrialized countries, birth rates began to drop steadily as 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.^{1885 1886}

¹⁸⁸⁵ ^ Draznin, Yaffa Claire (12001 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
¹⁸⁸⁶ <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

11878 HE – 11968 HE: LISE MEITNER^{1887 1888} Austrian-Swedish physicist who worked on radioactivity and nuclear physics,¹⁸⁸⁹ was the first female member of the scientific class of the Austrian Academy of Sciences. In **11939 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."¹⁸⁹⁰

¹⁸⁸⁷ 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 book by science reporter Sam Kean.

¹⁸⁸⁸ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

¹⁸⁸⁹ https://en.wikipedia.org/wiki/Lise_Meitner

¹⁸⁹⁰ https://en.wikipedia.org/wiki/Lise_Meitner



LISE MEITNER in **11946 HE**, location and photographer unknown¹⁸⁹¹

¹⁸⁹¹ https://en.wikipedia.org/wiki/Lise_Meitner



OTTO HAHN, DR. HARTMANN, LISE MEITNER, WERNER HEISENBERG, THEODOR HEUSS in **11958 HE**. Credit: Ullstein Bild, Getty Images.¹⁸⁹²

¹⁸⁹² <https://blogs.scientificamerican.com/voices/honoring-a-pioneering-woman-in-physics/>



Nuclear fission experimental setup, reconstructed at the Deutsches Museum, Munich, photographer unknown.¹⁸⁹³

¹⁸⁹³ https://en.wikipedia.org/wiki/Lise_Meitner



Statue of LISE MEITNER (sculptor: Anna Franziska Schwarzbach, **12014 HE**), at Humboldt University in Berlin.¹⁸⁹⁴

⇒ Since her **11968 HE** death, she has received many naming honors: In **11997 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

¹⁸⁹⁴ https://en.wikipedia.org/wiki/Lise_Meitner

both Marie and Pierre 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 **12000 HE**, the European Physical Society established the biannual "Lise Meitner Prize" for excellent research in nuclear science. In **12006 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 **12008 HE**, the chemical, biological, radiological, and nuclear defense school of the Austrian Armed Forces (NBC) established the Lise Meitner Award. In **12010 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 **12014 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, Hampshire, UK, her resting place, is named Meitner Close. Schools and streets were named after her in many cities in Austria and Germany. Since **12015 HE** AlbaNova university centre in Stockholm has an annual LISE MEITNER Distinguished Lecture. In **12017 HE**, the Advanced Research Projects Agency-Energy in the United States named a major nuclear energy research program in her honor.¹⁸⁹⁵

11879 HE – 11955 HE: ALBERT EINSTEIN, Subject of the Kingdom of Württemberg during the German Empire: (**11879 HE–11896 HE**); Stateless: (**11896 HE–11901 HE**); Citizen of Switzerland (**11901 HE–11955 HE**); Austrian subject of the Austro-Hungarian Empire (**11911 HE–11912 HE**); Subject of the Kingdom of Prussia during the German Empire (**11914 HE–11918 HE**); German citizen of the Free State of Prussia; Weimar Republic,

¹⁸⁹⁵ https://en.wikipedia.org/wiki/Lise_Meitner

11918 HE–11933 HE; Citizen of the United States (**11940 HE–11955 HE**): Physicist and Philosopher.¹⁸⁹⁶

⇒ After graduating in **11900 HE**, ALBERT EINSTEIN spent almost two frustrating years searching for a teaching post. EINSTEIN acquired Swiss citizenship in February **11901 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 **11903 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*

¹⁸⁹⁶ https://en.wikipedia.org/wiki/Albert_Einstein

*the patent office related to questions about transmission of electric signals and electrical-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.*¹⁸⁹⁷

⇒ 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".

¹⁸⁹⁷ https://en.wikipedia.org/wiki/Albert_Einstein

- ⇒ ALBERT EINSTEIN received the **11921 HE** Nobel Prize in Physics “for his services to theoretical physics, and especially for his discovery of the law of the photoelectric effect,” a pivotal step in the development of quantum theory.¹⁸⁹⁸
- ⇒ From **11926 HE until 11934 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.¹⁸⁹⁹

¹⁸⁹⁸ https://en.wikipedia.org/wiki/Albert_Einstein

¹⁸⁹⁹ https://en.wikipedia.org/wiki/Einstein_refrigerator

Scientists from Oxford are struggling to revive his invention today.¹⁹⁰⁰

- ⇒ EINSTEIN was a passionate, committed antiracist and joined the National Association for the Advancement of Colored People (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".¹⁹⁰¹
- ⇒ ALBERT EINSTEIN resolved the two differing opinions of ARISTOTLE and of ISAAC NEWTON to define time as we now know it.¹⁹⁰²

¹⁹⁰⁰ <https://www.greenoptimistic.com/einstein-refrigerator/>

¹⁹⁰¹ https://en.wikipedia.org/wiki/Albert_Einstein

¹⁹⁰² Carlo Rovelli's The Order of Time

- ARISTOTLE had concluded that time is measured by the changing of things. ARISTOTLE had concluded that if nothing changes, there is no time.¹⁹⁰³
- NEWTON had concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.¹⁹⁰⁴
- 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.¹⁹⁰⁵ Time varies depending on the observer's frame of reference. Someone moving faster

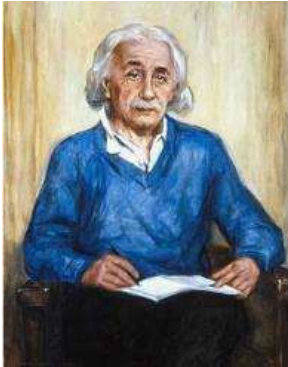
¹⁹⁰³ Carlo Rovelli's *The Order of Time*

¹⁹⁰⁴ Carlo Rovelli's *The Order of Time*

¹⁹⁰⁵ https://en.wikipedia.org/wiki/Absolute_space_and_time

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.¹⁹⁰⁶

¹⁹⁰⁶ Carlo Rovelli's *The Order of Time*



ALBERT EINSTEIN / artist: Max Westfield / Oil on canvas,
11944 HE; National Portrait Gallery, Smithsonian Institution;
gift of the artist.¹⁹⁰⁷

¹⁹⁰⁷ <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.¹⁹⁰⁸

⇒ Awards and Honors Received by ALBERT EINSTEIN:

- **11925 HE** the Royal Society awarded ALBERT EINSTEIN the Copley Medal. In **11929 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 **11931 HE** EINSTEIN received the Prix Jules Janssen award. In **11934 HE** ALBERT EINSTEIN gave the Josiah Willard Gibbs lecture. In **11936 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 **12005 HE** the "World Year of Physics" in commemoration of the 100th

anniversary of the publication of EINSTEIN's paper on Special Relativity.¹⁹⁰⁹

⇒ 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

¹⁹⁰⁹ https://en.wikipedia.org/wiki/Einsteins_awards_and_honors

Einstein seated with manuscript papers in hand. The statue, commissioned in **11979 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 **11955 HE**, four months after Einstein's death. "2001 Einstein" is an inner main belt asteroid discovered on 5 March **11973 HE**. In **11999 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 **11999 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 **11990 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 (**11965 HE–11978 HE**) 8¢ postage stamp. In **12008 HE**, ALBERT EINSTEIN was inducted into the New Jersey Hall of Fame.¹⁹¹⁰

⇒ 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–

¹⁹¹⁰ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_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 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).¹⁹¹¹

¹⁹¹¹ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

- ⇒ 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 detector; Albert Einstein ATV, a European unmanned cargo resupply spacecraft.¹⁹¹²
- ⇒ 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;

¹⁹¹² https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

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 School, a German gymnasium in Groß-Bieberau; Grammar School of Albert Einstein, Bratislava, Slovakia.¹⁹¹³

- ⇒ 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

¹⁹¹³ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

Street, Tel Aviv, Israel; Einstein Street, Haifa, Israel; Einstein St. in Norman, Oklahoma.¹⁹¹⁴

- ⇒ 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 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.¹⁹¹⁵
- ⇒ 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 **1955** **HE** by BERTRAND RUSSELL in

¹⁹¹⁴ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

¹⁹¹⁵ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

the midst of the Cold War; Einstein–Szilárd letter, a letter sent to President Franklin Delano Roosevelt in August **11939 HE**; Einstein Symposium, on the centennial of **11905 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 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.¹⁹¹⁶

¹⁹¹⁶ https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein

11879 HE – 11966 HE: MARGARET HIGGINS SANGER SLEE
AKA MARGARET SANGER: United States nurse, writer, social
reformer.¹⁹¹⁷



11922 HE: MARGARET HIGGINS SANGER SLEE, location
and photographer unknown.¹⁹¹⁸

¹⁹¹⁷ https://en.wikipedia.org/wiki/History_of_birth_control

¹⁹¹⁸ https://en.wikipedia.org/wiki/Margaret_Sanger

- ⇒ **11916 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.¹⁹¹⁹
- ⇒ Books and pamphlets by MARGARET HIGGINS SANGER SLEE:
- In **11911 HE** or **11912 HE:** *What Every Mother Should Know* - Originally based on a series of articles SANGER SLEE published in **11911 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 **11910 HE –11911**

¹⁹¹⁹ https://en.wikipedia.org/wiki/Margaret_Sanger

HE.¹⁹²⁰ Multiple editions were published through the **11920s** **HE** by Max N. Maisel, Sincere Publishing, with the title *What Every Mother Should Know, or how six little children were taught the truth.* (Online **11921 HE** edition, Michigan State University);

- **11914 HE: Family Limitation** – Originally published as a 16-page pamphlet; also published in several later editions. (Online **11917 HE** 6th edition, Michigan State University);
- **11916 HE: What Every Girl Should Know** – Originally published by Max N. Maisel; 91 pages; also published in

¹⁹²⁰ 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

several later editions. (Online **11922 HE** edition, Michigan State University);

- **11916 HE:** *Fight for Birth Control*, New York (The Library of Congress);
- **11917 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);
- **11919 HE:** *Birth Control A Parent's Problem or Women's?"* The Birth Control Review;
- **11920 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;

- **11921 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 (**11921 HE**, Michigan State University);
- **11922 HE: The Pivot of Civilization**, Brentanos. Online (**11922 HE**, Project Gutenberg); Online (**11922 HE**, Google Books);
- **11928 HE: Motherhood in Bondage**, Brentanos. Online (Google Books);

- **11931 HE:** *My Fight for Birth Control*, New York: Farrar & Rinehart;
- **11938 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 **11914 HE** to August **11914 HE**. SANGER SLEE was publisher and editor; *Birth Control Review* – Published monthly from February **11917 HE** – **11940 HE**. SANGER SLEE was Editor until **11929 HE**; Not to be confused with *Birth Control News*, published by the London-based Society for Constructive Birth Control and Racial Progress.¹⁹²¹

¹⁹²¹ https://en.wikipedia.org/wiki/Margaret_Sanger

long hours of sleepless nights and increasing tension by referring to latent hysteria).

The law does well often help in this difficulty. There are many girls who have had no education so that when put on duty at the privilege of the men who were not content of the women have a degraded and repulsive, from which it takes some time to recover. Most disappointed about the education of the girl, but never depends upon the attitude of the man toward the relation.

THE PRESERVE AND THE SPONGE

Another form of protection is the preservative cloth. This is one of the most common preservative 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 caught up in more distant, as they were imported into this country from France. Today they are no longer used in this country, and may be had from the following.

They come in three varieties, medium and small. It is said to give the neck some rest, but most men are only for very small bones, women and only get out of place.



(French)

In my experience a well fitted preservative cloth of the most suitable of preserving conception. I have known hundreds of women who have used it for years with the most satisfactory results. The middle is

12.



This page from SANGER'S *Family Limitation*, 11917 HE edition, describes a cervical cap.¹⁹²²

¹⁹²² https://en.wikipedia.org/wiki/Margaret_Sanger

11879 HE: “Star Stuff” Element Scandium discovered by LARS FREDRIK NILSON a Swedish chemist.¹⁹²³



LARS FREDRIK NILSON, 11840 HE – 11899 HE,
photographer and date unknown.¹⁹²⁴

¹⁹²³ https://en.wikipedia.org/wiki/Lars_Fredrik_Nilson

¹⁹²⁴ https://en.wikipedia.org/wiki/Lars_Fredrik_Nilson



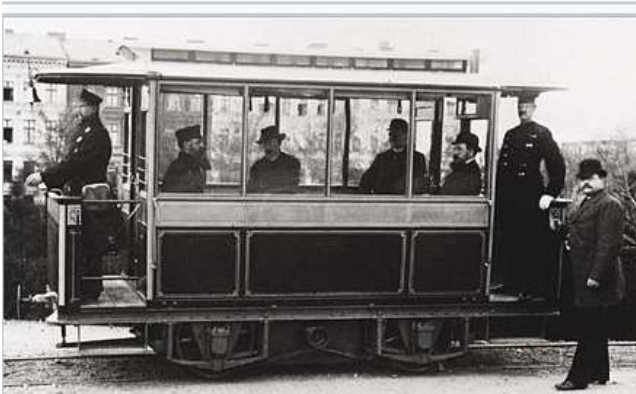
- The photo is of ultrapure crystalline scandium, 5 grams. Original size in cm: 2. “Star Stuff” Element Atomic Number 21 Scandium, Sc, Scandium is the first transition metal and the first rare earth element; the latter also includes Yttrium and the Lanthanoids. The chemistry of the ignoble light metal 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.¹⁹²⁵

¹⁹²⁵ <http://images-of-elements.com/scandium.php#a>

11881 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 **11891 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.¹⁹²⁶

¹⁹²⁶ https://en.wikipedia.org/wiki/History_of_rail_transport



11882 HE: Photo of a Lichterfelde tram, photographer unknown.¹⁹²⁷

¹⁹²⁷ https://en.wikipedia.org/wiki/History_of_rail_transport



12012 HE: photo of the current Lichterfelde tram.¹⁹²⁸

¹⁹²⁸ <https://www.bing.com/images/search?q=lichterfelde+tram>

11881 HE – 11965 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.¹⁹²⁹



Sir EDWARD BATTERSBY BAILEY, photo by and at The
Royal Society.¹⁹³⁰

¹⁹²⁹ BBC Men of Rock 2 of 3 12010 HE BBC TV show “Moving Mountains”

¹⁹³⁰ Pictures.royalsociety.org bing search

11882 HE – 11935 HE: EMMY NOETHER, German and United States mathematician known for her landmark contributions to abstract algebra and theoretical physics.¹⁹³¹

⇒ 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.¹⁹³²

¹⁹³¹ Podcast: Stuff You Missed in History Class

¹⁹³² 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.¹⁹³³ Tim James says EMMY NOETHER ranked up there with EINSTEIN and FEYNMAN.¹⁹³⁴

¹⁹³³ https://en.wikipedia.org/wiki/Emmy_Noether

¹⁹³⁴ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience



NOETHER in **11930 HE**, location and photographer unknown.¹⁹³⁵

¹⁹³⁵ https://en.wikipedia.org/wiki/Emmy_Noether



Young EMMY NOETHER, date, location, and photographer unknown..¹⁹³⁶

¹⁹³⁶ 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 **12015 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.¹⁹³⁷

¹⁹³⁷ https://en.wikipedia.org/wiki/Emmy_Noether

11883 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.¹⁹³⁸

11886 HE: CLEMENS WINKLER, German chemist, discovered / isolated “Star Stuff” Element Germanium (15 years after DIMITRI MENDELEEV had predicted, in **11871 HE**, the existence of the element and its properties).¹⁹³⁹



⇒ 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

¹⁹³⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁹³⁹ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

in 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.¹⁹⁴⁰



Photo of CLEMENS ALEXANDER WINKLER: **11838 HE** – **11904 HE**; date, location, and photographer unknown..¹⁹⁴¹

¹⁹⁴⁰ <http://images-of-elements.com/germanium.php#a>

¹⁹⁴¹ https://en.wikipedia.org/wiki/Clemens_Winkler

11886 HE: HENRI MOISSAN, France, chemist, discovered / isolated “Star Stuff” element Fluorine.¹⁹⁴² MOISSAN was awarded the **11906 HE** Nobel Prize in Chemistry and he was one of the original members of the International Atomic Weights Committee.¹⁹⁴³



- 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 nearly everything, in most cases very violently. At

¹⁹⁴² www.chemistryexplained.com/elements/C-K/Fluorine.html

¹⁹⁴³ https://en.wikipedia.org/wiki/Henri_Moissan

contact with water, it forms the very caustic hydrofluoric acid, HF.¹⁹⁴⁴**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 **11950s HE**. Fluorides are effective in preventing tooth decay and are added to urban water supplies as well.¹⁹⁴⁵
- 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 fluoride for the first time in history

¹⁹⁴⁴ <http://images-of-elements.com/fluorine.php#a>

¹⁹⁴⁵ www.chemistryexplained.com/elements/C-K/Fluorine.html

allowed humans to die with their own teeth in their mouths,
but quickly becomes poisonous if the dose is too high.¹⁹⁴⁶



11852 HE – 11907 HE: HENRI MOISSAN, France, chemist,
photographer and location unknown.¹⁹⁴⁷

¹⁹⁴⁶ <http://images-of-elements.com/fluorine.php#a>

¹⁹⁴⁷ www.chemistryexplained.com/elements/C-K/Fluorine.html

11886 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.¹⁹⁴⁸



11886 HE advertisement for Pears soap¹⁹⁴⁹

¹⁹⁴⁸ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

¹⁹⁴⁹ [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):



- **11884 HE:** The original Pears soap advertisement based on the fable “Washing the Blackamoor White,” published in the *Graphic for Christmas*.¹⁹⁵⁰

¹⁹⁵⁰ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))



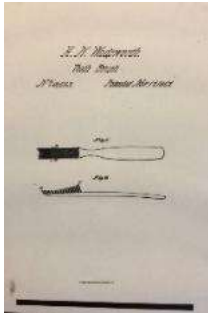
● **11890s HE:** Advertisement for Pears soap promoting cleanliness as a justification for racist imperialism.¹⁹⁵¹

11887 HE: The nation of Iran installed an approximately 20-km long railway between Tehran and Ray.¹⁹⁵²

¹⁹⁵¹ [https://en.wikipedia.org/wiki/Pears_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

¹⁹⁵² https://en.wikipedia.org/wiki/History_of_rail_transport

11887 HE: H.N. WADSWORTH patented the first toothbrush in America. It was made of animal bone and swine hair.¹⁹⁵³



H.N. WADSWORTH's toothbrush patent.¹⁹⁵⁴

¹⁹⁵³ <https://www.padental.org/Online/Public/Children/Invention%20of%20Toothbrush.aspx>

¹⁹⁵⁴ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>



11800's HE: bone toothbrushes dug out of a garbage dump in Scotland, photographer and location unknown.¹⁹⁵⁵

⇒ 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

¹⁹⁵⁵ <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

wagons stayed overnight at the property. Evidently personal toothbrushes were rare in the 118th Century HE.

11888 HE: ANDREAS FLOCKEN (**11845 HE – 11913 HE**) was a German entrepreneur and inventor who created possibly the first real *passenger electric car* in the world called the Flocken Elektrowagen.¹⁹⁵⁶

¹⁹⁵⁶ https://en.wikipedia.org/wiki/Andreas_Flocken



ANDREAS FLOCKEN, 11910 HE, photographer and location unknown.¹⁹⁵⁷

¹⁹⁵⁷ https://en.wikipedia.org/wiki/Andreas_Flocken



Reconstruction of Flocken Elektrowagen, (reconstruction, **12011**
HE) photographer and location unknown.¹⁹⁵⁸

¹⁹⁵⁸ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11888 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*".¹⁹⁵⁹



FRANK J. SPRAGUE, (11857 HE – 11934 HE) unknown photographer, date, location.¹⁹⁶⁰

¹⁹⁵⁹ https://en.wikipedia.org/wiki/History_of_rail_transport

¹⁹⁶⁰ https://en.wikipedia.org/wiki/Frank_J._Sprague



11923 HE: Drawing of the Richmond Theatrical District, with Perley Thomas streetcars.¹⁹⁶¹

Circa 11888 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,

¹⁹⁶¹ https://en.wikipedia.org/wiki/Richmond_Union_Passenger_Railway

used by travelers, and referred to in poetry, song, stories and art,
*scientists and humanity still did not know what stars were!*¹⁹⁶²



11888 HE: Vincent van Gogh's painting “Starry Night over the Rhone”. Location: Musée d'Orsay.¹⁹⁶³

¹⁹⁶² Neil de grass Tyson Youtube.com video

¹⁹⁶³ https://en.wikipedia.org/wiki/The_Starry_Night



11889 HE: Vincent van Gogh's painting 'Starry Night' Location: New York Museum of Modern Art.¹⁹⁶⁴

¹⁹⁶⁴ https://en.wikipedia.org/wiki/The_Starry_Night

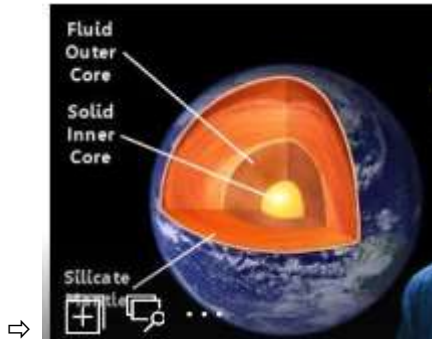
11888 HE – 11993 HE: INGE LEHMANN,¹⁹⁶⁵ Danish seismologist and geophysicist and the longest-lived woman scientist - having lived for over 104 years.¹⁹⁶⁶

⇒ **11936 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

¹⁹⁶⁵ Benjamin and Kira Premack, White Elk Tamaskan 12016 HE Scientists Litter

¹⁹⁶⁶ https://en.wikipedia.org/wiki/Inge_Lehmann

measurements. Other seismologists tested and then accepted LEHMANN'S explanation.¹⁹⁶⁷



11936 HE: drawing of INGE LEHMANN's discovery that the Earth has a solid inner core inside a molten outer core.¹⁹⁶⁸

¹⁹⁶⁷ https://en.wikipedia.org/wiki/Inge_Lehmann

¹⁹⁶⁸ [Famousscientists.org](https://famousscientists.org)



11932 HE: Photo of INGE LEHMANN, location unknown, photographer signed the photo.¹⁹⁶⁹



12017 HE: A new memorial dedicated to LEHMANN was installed on Frue Plads in Copenhagen. The monument is designed by Elisabeth Toubro.¹⁹⁷⁰

- ⇒ INGE LEHMANN received many honors for her outstanding scientific achievements, among them: The asteroid 5632 *Ingelehmman* and **11997 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 **12015 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-11900's HE**, a new beetle species named after her: *Globicornis (Hadrotoma) ingelehmannae*; In **12015 HE**, on the 127th anniversary of her birth, Google dedicated its worldwide Google Doodle to her.¹⁹⁷¹

11889 HE -11953 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 **11900's HE**. EDWIN HUBBLE used the work of, among others, HENRIETTA SWAN LEAVITT (see **11868 HE – 11921**

¹⁹⁷¹ https://en.wikipedia.org/wiki/Inge_Lehmann

HE) United States astronomer, who discovered the relationship between luminosity and distance in measuring stellar distances.¹⁹⁷²

- ⇒ 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.¹⁹⁷³

¹⁹⁷² <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

¹⁹⁷³ https://en.wikipedia.org/wiki/Edwin_Hubble

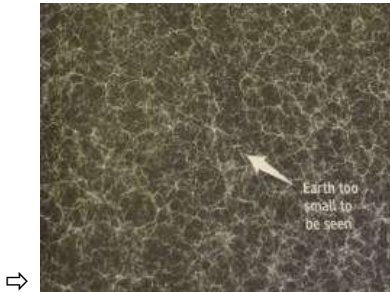
- **11919 HE...** “when HUBBLE first put his head to the eyepiece, the number of galaxies that were known to us was exactly one: the Milky Way. Everything else was thought to be either part of the Milky Way itself or one of the many distant peripheral puffs of gas. HUBBLE quickly demonstrated how wrong that belief was.”¹⁹⁷⁴

¹⁹⁷⁴ Bill Bryson: A Short History of Nearly Everything



EDWIN HUBBLE, date, location, and photographer
unknown.¹⁹⁷⁵

¹⁹⁷⁵ 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.^{1976 1977}

¹⁹⁷⁶ <http://wwwmpa.mpa-garching.mpg.de/galform/virgo/millennium/>

¹⁹⁷⁷ SEAN CARROLL *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*

11889 HE – 11964 HE: Ms. ROGER ARLINER YOUNG,¹⁹⁷⁸ United States female scientist of zoology, biology, and marine biology. YOUNG was the first African-American woman to receive a doctorate degree in zoology.¹⁹⁷⁹

⇒ **12005 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 **11933 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 **11943 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 **11973 HE**

¹⁹⁷⁸ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

¹⁹⁷⁹ https://en.wikipedia.org/wiki/Roger_Arliner_Young

became the first 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.¹⁹⁸⁰

¹⁹⁸⁰ https://en.wikipedia.org/wiki/Roger_Arliner_Young



ROGER ARLINER YOUNG, photographer, date and location unknown.¹⁹⁸¹

¹⁹⁸¹ https://en.wikipedia.org/wiki/Roger_Arliner_Young

11890 HE – 11965 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.¹⁹⁸²

- ⇒ 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.^{1983 1984}
- ⇒ 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

¹⁹⁸² BBC Men of Rock 2 of 3 12010 HE BBC TV show "Moving Mountains"

¹⁹⁸³ https://en.wikipedia.org/wiki/Arthur_Holmes

¹⁹⁸⁴ BBC Men of Rock 2 of 3 12010 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.¹⁹⁸⁵

¹⁹⁸⁵ https://en.wikipedia.org/wiki/Arthur_Holmes



ARTHUR HOLMES around age 22; photographer and location unknown¹⁹⁸⁶

¹⁹⁸⁶ https://en.wikipedia.org/wiki/Arthur_Holmes



The tectonic plates of the world were mapped in the second half of the **11900's HE**.¹⁹⁸⁷

¹⁹⁸⁷ https://en.wikipedia.org/wiki/Plate_tectonics

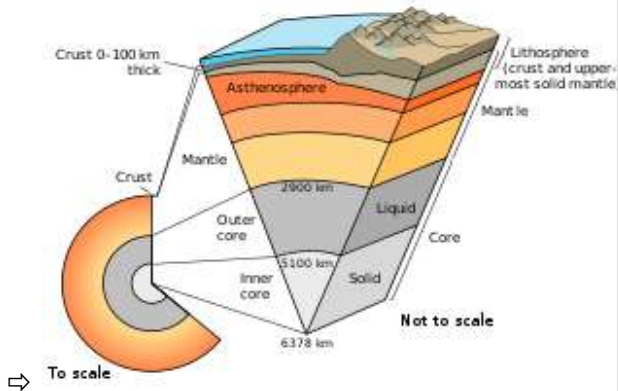
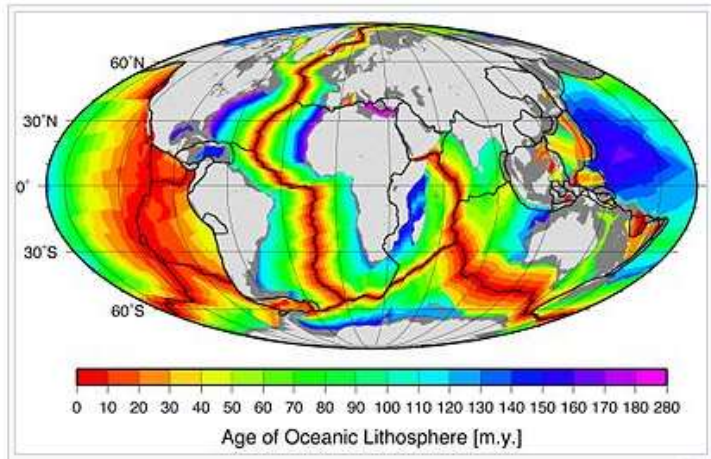


Diagram of the internal layering of the Earth showing the lithosphere above the asthenosphere (not to scale).¹⁹⁸⁸



● Sea Floor spreading by continental drift.¹⁹⁸⁹

¹⁹⁸⁹ 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.¹⁹⁹⁰

Circa 11890 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 **12000's HE**.¹⁹⁹¹

¹⁹⁹⁰ https://en.wikipedia.org/wiki/Arthur_Holmes

¹⁹⁹¹ https://en.wikipedia.org/wiki/Baker_Motor_Vehicle



1909 Baker Suburban Runabout 



1992



Photo captures of ads for electric vehicles.¹⁹⁹³

¹⁹⁹³ https://en.wikipedia.org/wiki/Baker_Motor_Vehicle

11893 HE – 11916 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.¹⁹⁹⁴

⇒ ERNST MACH also became well known for his philosophy developed in close interplay with his science. MACH defended a type of phenomenism 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 **11897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!"^{1995 1996 1997}

¹⁹⁹⁴ https://en.wikipedia.org/wiki/Ernst_Mach

¹⁹⁹⁵ Yourgrau, P. (2005). A World Without Time: The Forgotten Legacy of Gödel and Einstein. Allen Lane

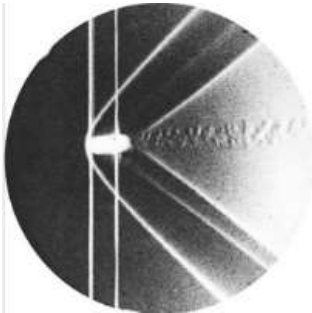
¹⁹⁹⁶ https://en.wikipedia.org/wiki/Ernst_Mach

¹⁹⁹⁷ Max Tegmark, Our Mathematical Universe



ERNST MACH, date, photographer and location unknown.¹⁹⁹⁸

¹⁹⁹⁸ https://en.wikipedia.org/wiki/Ernst_Mach



ERNST MACH'S work also focused on the Doppler effect in optics and acoustics.¹⁹⁹⁹ This historic **11887 HE** shadowgraph is of a bow shockwave around a supersonic bullet.²⁰⁰⁰

¹⁹⁹⁹ https://en.wikipedia.org/wiki/Ernst_Mach

²⁰⁰⁰ John D. Anderson, Jr. "Research in Supersonic Flight and the Breaking of the Sound Barrier -- Chapter 3". history.nasa.gov. p. 65.

11894 HE - 11996 HE: GEORGES LEMAÎTRE, Belgian priest – scholar; astronomer and professor of physics²⁰⁰¹ 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 **11927 HE**, two years before HUBBLE's article. LEMAÎTRE also proposed what became known as the *Big Bang* theory of the origin of the universe,²⁰⁰² (See another who gets credit for the term Big Bang: **11915 HE – 12001 HE** FRED HOYLE).

²⁰⁰¹ Bill Bryson Short History of Nearly Everything ebook

²⁰⁰² Bill Bryson Short History of Nearly Everything ebook

LEMAÎTRE called the Big Bang his "hypothesis of the primeval atom" or the "Cosmic Egg".²⁰⁰³



LEMAÎTRE circa **11933 HE**, photographer and location unknown.²⁰⁰⁴

²⁰⁰³ https://en.wikipedia.org/wiki/Georges_Lemaitre

²⁰⁰⁴ https://en.wikipedia.org/wiki/Georges_Lemaitre

11894 HE: “Star Stuff” element Argon is discovered by JOHN WILLIAM STRUTT (**11842 HE – 11919 HE**) and WILLIAM RAMSEY (**11852 HE – 11916 HE**).²⁰⁰⁵



The photo is of a vial of glowing ultrapure argon. Our air consists to 1% of “Star Stuff” Element Atomic Number 18 Argon, Ar.

²⁰⁰⁵<https://www.bing.com/search?q=what%20year%20was%20argon%20element%20discovered%3F&q=n&form=QBRE&sp=-1&pq=undefined&sc=0-39&sk=&cvid=5CC3DFB9A91445B192A739969CD88D16>

- Because of its abundance, Argon is the cheapest and most frequently used noble gas, which comes into operation when an inert atmosphere is needed.²⁰⁰⁶ It is more than twice as abundant 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.²⁰⁰⁷

²⁰⁰⁶ <http://images-of-elements.com/argon.php#a>

²⁰⁰⁷ <https://en.wikipedia.org/wiki/Argon>



JOHN WILLIAM STRUTT and
WILLIAM RAMSAY, photographers, locations, and dates
unknown.²⁰⁰⁸

11895 HE: The formal isolation / discovery of the “Star Stuff” element Helium was made in **11895 HE** by two Swedish chemists, PER TEODOR CLEVE and NILS ABRAHAM LANGLET, who found helium emanating from the uranium ore cleveite.²⁰⁰⁹

2008

<https://www.bing.com/search?q=who+discovered+argon+element&PC=U316&FORM=CHROMN>
²⁰⁰⁹ <https://en.wikipedia.org/wiki/Helium>

- ⇒ The “Star Stuff” element Helium was first detected as an unknown yellow spectral line signature in sunlight during a solar eclipse in **1868** **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 **1868** **HE** while NORMAN LOCKYER observed it 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.²⁰¹⁰



• 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. So now it is quite rare here.

²⁰¹⁰ Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

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.²⁰¹¹

11895 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.²⁰¹²

²⁰¹¹ <http://images-of-elements.com/helium.php#a>

²⁰¹² https://en.wikipedia.org/wiki/History_of_rail_transport

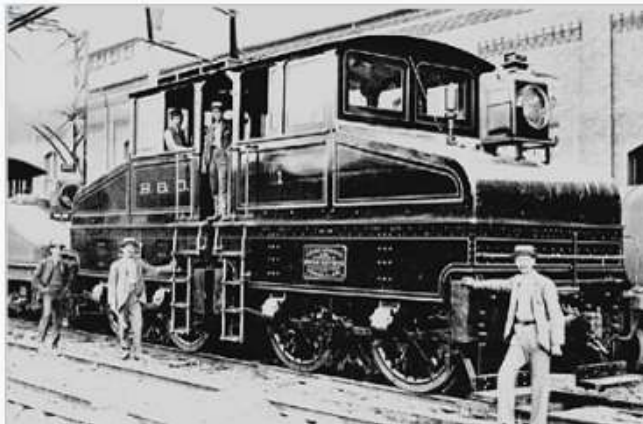


Photo is of 3 men with a Baltimore & Ohio electric engine, photographer and date unknown.²⁰¹³

²⁰¹³ https://en.wikipedia.org/wiki/History_of_rail_transport

11895 HE: Electric car built by THOMAS PARKER.



PARKER's electric car. Photographer and location unknown²⁰¹⁴

²⁰¹⁴ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

11897 HE: This tool was used in the construction of the Panama Canal.



C.L. Berger Transit, Boston, Mass. Patented in **11897 HE**.²⁰¹⁵

²⁰¹⁵ This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.



More various circa **11800 HE – 11900 HE** engineer's tools.²⁰¹⁶

²⁰¹⁶ This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.

11897 HE– 11956 HE: IRÈNE JOLIOT-CURIE, French scientist, the daughter of MARIE CURIE and PIERRE CURIE and the wife of FRÉDÉRIC JOLIOT-CURIE.²⁰¹⁷

⇒ Jointly with her husband, IRÈNE JOLIOT-CURIE was awarded the Nobel Prize in Chemistry in **11935 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.²⁰¹⁸

²⁰¹⁷ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

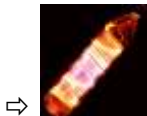
²⁰¹⁸ https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie



IRÈNE JOLIOT-CURIE, date, location, and photographer
unknown²⁰¹⁹

²⁰¹⁹ https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie

11898 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.²⁰²⁰
Discovered by WILLIAM RAMSAY and MORRIS TRAVERS.²⁰²¹



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 compound has been produced so far. It is mainly used for

²⁰²⁰ <https://en.wikipedia.org/wiki/Neon>

²⁰²¹ <https://en.wikipedia.org/wiki/Neon>

light sources, as it glows in a characteristic reddish-orange light.²⁰²²



WILLIAM RAMSAY, date, location, photographer unknown.²⁰²³



²⁰²² <http://images-of-elements.com/neon.php#a>

²⁰²³ <https://en.wikipedia.org/wiki/Neon>

119th Century HE

Circa 11900 HE: The population of the world was approximately 1,600,000,000 people.²⁰²⁴

11900 HE – 11979 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

²⁰²⁴ <http://www.worldometers.info/world-population/world-population-by-year/>

the Earth. She was able to determine the paths of stellar evolution.²⁰²⁵

²⁰²⁵ https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin



CECILIA PAYNE-GAPOSCHKIN, date, location, and photographer unknown.²⁰²⁶

²⁰²⁶ https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin

11901 HE – 11954 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-1.²⁰²⁷

⇒ Nobel Prize in Physics, **11938 HE**. In **11926 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 **11927 HE**, Fermi was elected Professor of Theoretical Physics at the University of Rome (a post which he retained until **11938 HE**, when he – immediately after the receipt of the Nobel Prize – emigrated to the United States, primarily to escape Mussolini's fascist dictatorship).²⁰²⁸

²⁰²⁷ https://en.wikipedia.org/wiki/Enrico_Fermi

²⁰²⁸ <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>



Photo of ENRICO FERMI, location, date, photographer unknown.²⁰²⁹

²⁰²⁹ <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>

11901 HE – 11994 HE: LINUS PAULING, United States chemist and biochemist,²⁰³⁰ peace activist, editor, educator, and husband of United States human rights activist Ava Helen Pauling.²⁰³¹ LINUS PAULING published more than 1200 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 **12000 HE** he was rated the 16th most important scientist in history.²⁰³²

⇒ LINUS PAULING was one of the founders of the fields of quantum chemistry and molecular biology.

²⁰³⁰ 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*.

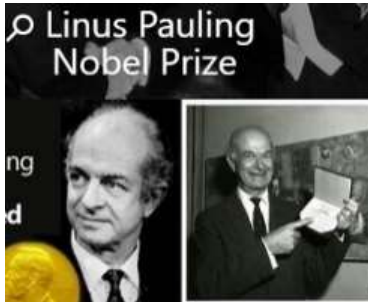
²⁰³¹ https://en.wikipedia.org/wiki/Linus_Pauling

²⁰³² https://en.wikipedia.org/wiki/Linus_Pauling

- ⇒ PAULING's contributions to the theory of the chemical bond include the concept of orbital hybridization and the first accurate 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 **1954 HE**. For his peace activism, he was awarded the Nobel Peace Prize in **1962 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.²⁰³³

²⁰³³ https://en.wikipedia.org/wiki/Linus_Pauling



LINUS PAULING receiving the Nobel Prize, **11954 HE**, Stockholm; photographer unknown.²⁰³⁴

11902 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 **11902**

²⁰³⁴ <https://www.bing.com/images/search?q=linus+pauling&qpv=linus+pauling&FORM=IGRE>

HE. The electrical system was three-phase at 3 kV 15 Hz designed by KALMAN KANDO and a team from the Ganz works.



11901 HE: Prototype of the Ganz AC electric locomotive in Valtellina, Italy.²⁰³⁵

²⁰³⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

11902 HE – 11992 HE: BARBARA MCCLINTOCK²⁰³⁶ United States Nobel Prize winning scientist and cytogeneticist.²⁰³⁷ 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.²⁰³⁸ During the **11940s HE and 11950s 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 **11953 HE**.²⁰³⁹

²⁰³⁶ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²⁰³⁷ https://en.wikipedia.org/wiki/Barbara_McClintock

²⁰³⁸ <https://en.wikipedia.org/wiki/Cytogenetics>

²⁰³⁹ https://en.wikipedia.org/wiki/Barbara_McClintock

- ⇒ MCCLINTOCK proposed the idea of genetic recombination in reproduction.²⁰⁴⁰
- ⇒ In **11973 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 **11950s 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*

²⁰⁴⁰ <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

manners of their operation. One must await the right time for conceptual change."²⁰⁴¹

⇒ **11983 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.

²⁰⁴¹ https://en.wikipedia.org/wiki/Barbara_McClintock



BARBARA MCCLINTOCK shown in her laboratory, date and photographer unknown.²⁰⁴²

²⁰⁴² 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.²⁰⁴³

²⁰⁴³ https://en.wikipedia.org/wiki/Barbara_McClintock



⇒

11983 HE Photo of BARBARA MCCLINTOCK giving her Nobel Lecture.²⁰⁴⁴

⇒ Honors and Awards: In **11947 HE**, BARBARA MCCLINTOCK received the Achievement Award from the American

²⁰⁴⁴ https://en.wikipedia.org/wiki/Barbara_McClintock

Association of University Women. She was elected a Fellow of the American Academy of Arts and Sciences in **11959 HE**. In **11967 HE**, MCCLINTOCK was awarded the Kimber Genetics Award; three years later, she was given the National Medal of Science by Richard Nixon in **11970 HE**. She was the first woman to be awarded the National Medal of Science. Cold Spring Harbor named a building in her honor in **11973 HE**. She received the Louis and Bert Freedman Foundation Award and the Lewis S. Rosensteil Award in **11978 HE**. In **11981 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 **11982 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 **11822 HE – 11884 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 **11989 HE**. MCCLINTOCK received the Benjamin Franklin Medal for Distinguished Achievement in the Sciences of the American Philosophical Society in **11993 HE**. She was awarded 14 Honorary Doctor of Science degrees and an Honorary Doctor of Humane Letters. In **11986 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 **11983 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.²⁰⁴⁵

11903 HE: WILBER WRIGHT & ORVILLE WRIGHT, United States,²⁰⁴⁶ at Kill Devil Hills on the Outer Banks of North Carolina,²⁰⁴⁷ 4 miles south of Kitty Hawk, North Carolina, the

²⁰⁴⁵ https://en.wikipedia.org/wiki/Barbara_McClintock

²⁰⁴⁶ https://en.wikipedia.org/wiki/Wright_brothers

²⁰⁴⁷ <https://www.nps.gov/wrbr/learn/historyculture/thefirstflight.htm>

WRIGHTS made the first controlled, sustained flight of a powered, heavier-than-air passenger carrying aircraft.²⁰⁴⁸

- Author / Compiler note: We celebrate them and recognize they stood on the shoulders of giants. Research says: While WILBER 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.

²⁰⁴⁸ https://en.wikipedia.org/wiki/Wright_brothers

- **GEORGE CAYLEY**, Englishman, **11773 HE – 11857 HE** focused his science on fixed wing shape.
- Later, **OTTO LILIENTHAL**, **11848 HE – 11896 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**, **11873 HE – 11932 HE**, Brazilian inventor and aviation pioneer.²⁰⁴⁹

²⁰⁴⁹ https://en.wikipedia.org/wiki/History_of_aviation

- 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.²⁰⁵⁰

⇒ **11867 HE – 11912 HE: WILBER WRIGHT**, Editor, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.²⁰⁵¹

²⁰⁵⁰ SciShow 5-2-12016HE youtube.com Video: *The Truth About 10 Famous Inventions*

²⁰⁵¹ https://en.wikipedia.org/wiki/Wright_brothers



- WILBER WRIGHT, date, location, and photographer unknown..²⁰⁵²

⇒ **11871HE – 11948HE: ORVILLE WRIGHT**, Printer/publisher, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.²⁰⁵³

²⁰⁵² https://en.wikipedia.org/wiki/Wright_brothers

²⁰⁵³ https://en.wikipedia.org/wiki/Wright_brothers



• ORVILLE WRIGHT, date, location, and photographer unknown.²⁰⁵⁴

²⁰⁵⁴ https://en.wikipedia.org/wiki/Wright_brothers



11929 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.²⁰⁵⁵

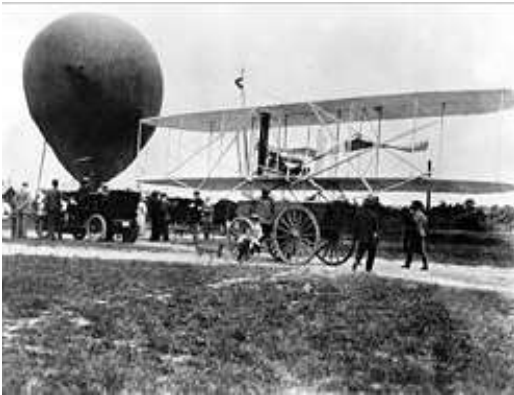
²⁰⁵⁵ https://en.wikipedia.org/wiki/Wright_brothers



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 **1958**

HE.²⁰⁵⁶

²⁰⁵⁶ <https://wright.nasa.gov/orville.htm>



The Wright Military Flyer aboard a wagon in **11908 HE**,
photographer unknown.²⁰⁵⁷

²⁰⁵⁷ https://en.wikipedia.org/wiki/Wright_brothers

- ⇒ It is notable that distinguished, accomplished, and recognized United States scientists of the time **WILLIAM HENRY PICKERING (11858 HE – 11938 HE)** and **SIMON NEWCOMB (11835 HE – 11909 HE)** both said flight by humans could not be a serious or practical proposition.²⁰⁵⁸
- ⇒ Also, Bishop Milton Wright, (**11828 HE -11917 HE**) United States Episcopalian Bishop and Father of **WILBUR WRIGHT** and **ORVILLE WRIGHT** said, “Men will never fly, because flying is reserved for angels.”²⁰⁵⁹

²⁰⁵⁸ RICHARD DAWKINS *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder*

²⁰⁵⁹ *Asimov's Book of Science and Nature Quotations* (Blue Cliff Edition), edited by ISAAC ASIMOV and Jason A. Shulman, section 1.14

11903 HE – 11972 HE: LOUIS LEAKEY, British and Kenyan paleoanthropologist and archeologist.²⁰⁶⁰ 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.²⁰⁶¹

²⁰⁶⁰ https://en.wikipedia.org/wiki/Wright_brothers

²⁰⁶¹ https://en.wikipedia.org/wiki/Louis_Leakey



LOUIS LEAKEY examining skulls from Olduvai Gorge, Tanzania, date, location, and photographer unknown²⁰⁶²

²⁰⁶² https://en.wikipedia.org/wiki/Human_evolution#First_fossils

11904 HE – 11983 HE: JOSEPH EDWARD MAYER,²⁰⁶³ United States chemist who formulated the Mayer expansion in statistical field theory.²⁰⁶⁴ It was through finding him that we learned of his **11963 HE** Nobel Laureate Wife (See **11906 HE – 11972 HE:** MARIA GOEPPERT MAYER).



²⁰⁶³ 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*

²⁰⁶⁴ https://en.wikipedia.org/wiki/Joseph_Edward_Mayer

11904 HE: German electric car, with the chauffeur on top²⁰⁶⁵

11905 HE:



Columbia Electric's (**11896 HE – 11899 HE**) "Victoria" electric

²⁰⁶⁵ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

cab on Pennsylvania Ave., Washington D.C., seen from Lafayette Park in **11905 HE**; photographer unknown.²⁰⁶⁶

11905 HE – 11962 HE: Dr. WILLIAM W. CARDOZO, United States Pediatrician published in **11937 HE:** "*Immunologic Studies in Sickle Cell Anemia*" in the Archives of Internal Medicine; many of the findings are still valid today.²⁰⁶⁷

²⁰⁶⁶ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

²⁰⁶⁷ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists



Dr. CARDOZO, artist, date and location unknown.²⁰⁶⁸

11905 HE – 11989 HE: EMILIO SEGRÈ²⁰⁶⁹, Italian born United States physicist and a **11959 HE** shared Nobel Prize winner. SEGRÈ and others discovered the antiproton.

²⁰⁶⁸ <https://aaregistry.org/story/sickle-cell-pioneer-william-w-cardozo/>

²⁰⁶⁹ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

- ⇒ **11937 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 **11943 HE to 11946 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 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.²⁰⁷⁰



EMILIO SEGRÈ, date, location, and photographer unknown..²⁰⁷¹

²⁰⁷⁰ https://en.wikipedia.org/wiki/Emilio_Segrè

²⁰⁷¹ https://en.wikipedia.org/wiki/Emilio_Segrè

11906 HE – 11972 HE: MARIA GOEPPERT MAYER²⁰⁷² 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.²⁰⁷³ 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 **11904 HE – 11983 HE**) and moved to the United States, where he was an associate professor at Johns Hopkins

²⁰⁷² 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*

²⁰⁷³ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

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.²⁰⁷⁴

- ⇒ **11935 HE:** MARIA GOEPPERT MAYER published a landmark paper on double beta decay.²⁰⁷⁵
- ⇒ **11937 HE:** MARIA GOEPPERT MAYER moved to Columbia University, where she was only offered an unpaid position.²⁰⁷⁶
- ⇒ **Circa 11939 HE – 11945 HE:** During World War II, MARIA GOEPPERT MAYER worked for the Manhattan Project at Columbia on isotope separation, and with EDWARD TELLER

²⁰⁷⁴ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁰⁷⁵ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁰⁷⁶ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

at the Los Alamos Laboratory on the development of Teller's "Super" bomb.²⁰⁷⁷

⇒ **Circa 11950 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 **11963 HE**, which she shared with J. HANS D. JENSEN and EUGENE WIGNER.²⁰⁷⁸ GOEPPERT MAYER's model explained why certain numbers of nucleons in an atomic nucleus result in particularly stable configurations. These numbers are what

²⁰⁷⁷ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

²⁰⁷⁸ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

EUGENE WIGNER called magic numbers: 2 8 20, 28 50, 82 and 126.²⁰⁷⁹

⇒ ENRICO FERMI (SEE **11901 HE – 11954 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*

²⁰⁷⁹ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

they circle the room, each pair both twirling and circling. But only some of 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 **11960 HE**, MARIA GOEPPERT MAYER was appointed full professor of physics at the University of California, San Diego.²⁰⁸⁰

²⁰⁸⁰ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer



MARIA GOEPPERT MAYER, date, location, and photographer unknown..²⁰⁸¹

²⁰⁸¹ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer



11963 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.²⁰⁸²

²⁰⁸² https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

⇒ Other Honors: Crater Goeppert Mayer on Venus with a diameter of about 35 km is named after Goeppert-Mayer. The unit for the two-photon absorption cross section is named the Goeppert Mayer (GM) unit. In **12011 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.²⁰⁸³

²⁰⁸³ https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer

11906 HE – 11992 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), an early high-level computer programming business language. She was also a Navy Rear Admiral.²⁰⁸⁴

²⁰⁸⁴ https://en.wikipedia.org/wiki/Grace_Hopper



11984 HE: Rear Admiral GRACE M. HOPPER.²⁰⁸⁵

²⁰⁸⁵ https://en.wikipedia.org/wiki/Grace_Hopper



11978 HE: GRACE HOPPER in a computer room in Washington DC. Photographed by Lynn Gilbert.²⁰⁸⁶

²⁰⁸⁶ https://en.wikipedia.org/wiki/Grace_Hopper



Circa 11960 HE: GRACE HOPPER (and three other unnamed people) at the UNIVAC I console. Photographer unknown.²⁰⁸⁷

²⁰⁸⁷ https://en.wikipedia.org/wiki/Grace_Hopper

11907 HE– 11964 HE: RACHEL CARSON, United States marine biologist, author of *Silent Spring*, and conservationist.²⁰⁸⁸



11940 HE: RACHEL CARSON (Fish & Wildlife Service employee photo).²⁰⁸⁹

²⁰⁸⁸ https://en.wikipedia.org/wiki/Rachel_Carson

²⁰⁸⁹ https://en.wikipedia.org/wiki/Rachel_Carson



Statue of RACHEL CARSON at the Museo Rocsen, Nono, Argentina.²⁰⁹⁰

²⁰⁹⁰ https://en.wikipedia.org/wiki/Rachel_Carson

11909 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.²⁰⁹¹ However:

⇒ **Circa 11350 HE** in “The Prologue” of Chaucer’s *Canterbury Tales* “Borax” is mentioned.²⁰⁹² The people of the time had an idea of how to use it... but did not know it was an element.

⇒ **In the early 11800’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.²⁰⁹³

²⁰⁹¹ <https://en.wikipedia.org/wiki/Boron>

²⁰⁹² Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

²⁰⁹³ <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.²⁰⁹⁴

²⁰⁹⁴ <http://images-of-elements.com/boron.php#a>

11909 HE – 12012 HE: RITA LEVI-MONTALCINI, OMRI, OMCA, Italian. In **11986 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.²⁰⁹⁵

⇒ RITA LEVI-MONTALCINI, Some Honors and Awards: In **11966 HE**, she was elected a Fellow of the American Academy of Arts and Sciences. In **11968 HE**, she became the tenth woman elected to the United States National Academy of Sciences. In **11987 HE**, she received the National Medal of Science, the

²⁰⁹⁵ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

highest American scientific honor. In **11991 HE**, she expressed her desire to formulate a Carta of Human Duties as necessary counterpart of the 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 **11993 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 **11995 HE**. In **12009 HE**, she received the Leonardo da Vinci Award from European Academy of Sciences. In **12011 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 **12009 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.²⁰⁹⁶



12009 HE Photo of RITA LEVI-MONTALCINI. Location and photographer unknown.²⁰⁹⁷

²⁰⁹⁶ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²⁰⁹⁷ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

11909 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 **11920s HE**.^{2098 2099}

11910 HE – 12008 HE: DOROTHY JOHNSON VAUGHAN²¹⁰⁰
United States mathematician and human computer who worked for the National Advisory Committee for Aeronautics (NACA), and NASA,²¹⁰¹ and became acting supervisor of the West Area Computers, the first African-American woman to supervise a

²⁰⁹⁸ https://en.wikipedia.org/wiki/History_of_birth_control

²⁰⁹⁹ Fritz, Marc A.; Speroff, Leon (12011 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.

²¹⁰⁰ *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race.* by Margot Lee Shetterly

²¹⁰¹ https://en.wikipedia.org/wiki/Dorothy_Vaughan

group of staff composed entirely of African-American women mathematicians at NACA.²¹⁰²



DOROTHY JOHNSON VAUGHAN date, location, and photographer unknown..²¹⁰³

²¹⁰² https://en.wikipedia.org/wiki/Dorothy_Vaughan

²¹⁰³ https://en.wikipedia.org/wiki/Dorothy_Vaughan

11910 HE – 11997 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 **11940s HE**, COUSTEAU is credited with improving the aqualung design which gave birth to the open-circuit scuba technology used today. In **11950 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 (**11952 HE**).²¹⁰⁴

²¹⁰⁴ https://en.wikipedia.org/wiki/Jacques_Cousteau



COUSTEAU'S submarine near Oceanographic Museum in Monaco. Photographer and date unknown.²¹⁰⁵

²¹⁰⁵ https://en.wikipedia.org/wiki/Jacques_Cousteau



JACQUES-YVES COUSTEAU in **11972 HE**. Photographer and location unknown.²¹⁰⁶

²¹⁰⁶ https://en.wikipedia.org/wiki/Jacques_Cousteau

11910 HE– 11994 HE: DOROTHY MARY CROWFOOT HODGKIN OM FRS HonFRSC, British **11964 HE** Nobel Prize winning chemist who invented / developed *Protein Crystallography*: the technique which shines light at proteins to expose their 3-dimensional structure.²¹⁰⁷ (See **11638 HE – 11686 HE:** NICHOLAS STENO, Danish Geologist²¹⁰⁸ who developed crystallography.²¹⁰⁹)

⇒ As of **12016 HE** she remained the only British woman scientist to have been awarded a Nobel Prize in any of the three sciences it recognizes.²¹¹⁰

²¹⁰⁷ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²¹⁰⁸ ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

²¹⁰⁹ https://en.wikipedia.org/wiki/Nicolas_Steno

²¹¹⁰ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

⇒ Some of the Honors, awards and legacies of DOROTHY MARY CROWFOOT HODGKIN: Elected a Fellow of the Royal Society (FRS) in **11947 HE** and EMBO Membership in **11970 HE**; The National Portrait Gallery, London lists 17 portraits of CROWFOOT HODGKIN. In **11965 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 **12016 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 **11983 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.²¹¹¹



⇒ Photo of DOROTHY MARY CROWFOOT HODGKIN, date, location, and photographer unknown..²¹¹²

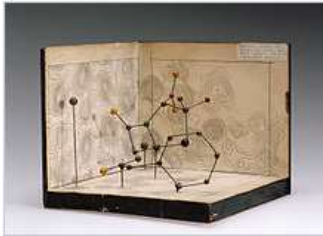
²¹¹¹ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

²¹¹² https://en.wikipedia.org/wiki/Dorothy_Hodgkin



Circa 11945 HE: Model of the structure of penicillin by

DOROTHY MARY CROWFOOT HODGKIN, photographer
and location unknown.²¹¹³



Circa 11945 HE: Molecular model of penicillin by DOROTHY
MARY CROWFOOT HODGKIN, photographer and location
unknown.²¹¹⁴

²¹¹³ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

²¹¹⁴ https://en.wikipedia.org/wiki/Dorothy_Hodgkin

11912 HE – 11997 HE: CHIEN-SHIUNG WU²¹¹⁵ 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 **11957 HE** Nobel Prize in physics and earned WU the inaugural Wolf Prize in Physics in **11978 HE**.²¹¹⁶

²¹¹⁵ 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*

²¹¹⁶ https://en.wikipedia.org/wiki/Chien-Shiung_Wu



11958 HE Photo is of CHIEN-SHIUNG WU at Columbia University. Photographer unknown.²¹¹⁷

²¹¹⁷ 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.²¹¹⁸

²¹¹⁸ 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).²¹¹⁹

²¹¹⁹ https://en.wikipedia.org/wiki/Chien-Shiung_Wu

11912 HE – 11991 HE: SALVADOR LURIA²¹²⁰ Italian microbiologist, later a naturalized United States citizen and a **11969 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.²¹²¹

⇒ **11963 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.

²¹²⁰ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²¹²¹ https://en.wikipedia.org/wiki/Salvador_Luria

- SALVADOR LURIA awards and recognitions: He was named a member of the National Academy of Sciences in **11960 HE**. From **11968 HE** to **11969 HE**, he served as president of the American Society for Microbiology. In **11969 HE**, he was awarded the Louisa Gross Horwitz Prize from Columbia University together with MAX DELBRÜCK. In the U.S. he won the **11974 HE** National Book Award in Science for his popular science book *Life: The Unfinished Experiment* and received the National Medal of Science in **11991 HE**.²¹²²

²¹²² https://en.wikipedia.org/wiki/Salvador_Luria



The photo is of SALVADOR LURIA, date, location, and photographer unknown..²¹²³

²¹²³ https://en.wikipedia.org/wiki/Salvador_Luria

11912 HE – 11977 HE: WERNHER MAGNUS MAXIMILIAN FREIHERR VON BRAUN²¹²⁴ German, and, later, United States aerospace engineer and space architect.

⇒ **11942 HE:** VON BRAUN helped develop the Nazi V2 rocket (German, military, sub-orbital). **11944 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

²¹²⁴ PAUL PREMACK suggested his name

frequent stays at Dora. Even the aspect of corpses did not touch him: On a small area near the ambulance shed, 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.”²¹²⁵

- ⇒ **11945 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.²¹²⁶ Either the US got him or the Soviets, so this was the way the US got him.²¹²⁷ **11952 HE - 11956 HE**, VON BRAUN led the US

²¹²⁵ https://en.wikipedia.org/wiki/Wernher_von_Braun

²¹²⁶ https://en.wikipedia.org/wiki/Wernher_von_Braun

²¹²⁷ PAUL PREMACK clarified

Army's rocket development team resulting in the Redstone rocket. with the first high-precision inertial guidance system.

11958 HE: As 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.²¹²⁸

²¹²⁸ https://en.wikipedia.org/wiki/Wernher_von_Braun



11960 HE WERNHER VON BRAUN (photographer unknown) was the leading figure in the development of rocket technology in Germany and the father of rocket technology and space science in the United States.²¹²⁹

²¹²⁹ https://en.wikipedia.org/wiki/Wernher_von_Braun

11912 HE:



Detroit Electric vehicle advertisement, artist unknown.²¹³⁰

²¹³⁰ https://en.wikipedia.org/wiki/History_of_the_automobile

11913 HE:



²¹³¹

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 **11927 HE**, Ford had produced over 15000,000 Model T automobiles.²¹³²

²¹³¹ https://en.wikipedia.org/wiki/Ford_Model_T

²¹³² https://en.wikipedia.org/wiki/History_of_the_automobile

11913 HE:



THOMAS EDISON and an electric car, photographer and location unknown.²¹³³

²¹³³ https://en.wikipedia.org/wiki/History_of_the_automobile

11913 HE – 11996 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.²¹³⁴

²¹³⁴ https://en.wikipedia.org/wiki/Mary_Leakey

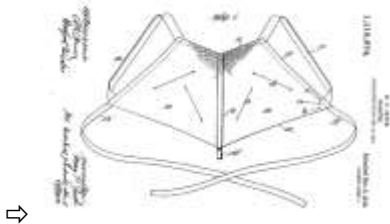
Mary Leakey



11977 HE MARY LEAKEY, photographer unknown and location unknown.²¹³⁵

²¹³⁵ https://en.wikipedia.org/wiki/Mary_Leakey

11914 HE: MARY P. JACOB patents the first modern bra.²¹³⁶



United States Patent for the first modern bra.²¹³⁷

²¹³⁶ <https://www.youtube.com/watch?v=aqKm-tYHlwM>

²¹³⁷ <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=%25252Fnetahml%25252FPTO%25252Fsrchnum.htm%2526r=1%2526f=G%2526l=50%2526s1=1115674.PN.%2526OS=PN/1115674%2526RS=PN/1115674>



11914 HE:

Swiss & German co-production of world's first functional diesel–electric railcar. Location and photographer unknown.²¹³⁸

²¹³⁸ https://en.wikipedia.org/wiki/History_of_rail_transport

11914 HE - 12000 HE: HEDY LAMARR²¹³⁹ born Hedwig Eva Maria Kiesler, Austrian-born United States inventor and film star.²¹⁴⁰ 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 **11960s 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.^{2141 2142}

²¹³⁹ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²¹⁴⁰ https://en.wikipedia.org/wiki/Hedy_Lamarr

²¹⁴¹ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²¹⁴² https://en.wikipedia.org/wiki/Hedy_Lamarr



HEDY LAMARR, date, location, artist unknown.²¹⁴³

²¹⁴³ https://en.wikipedia.org/wiki/Hedy_Lamarr

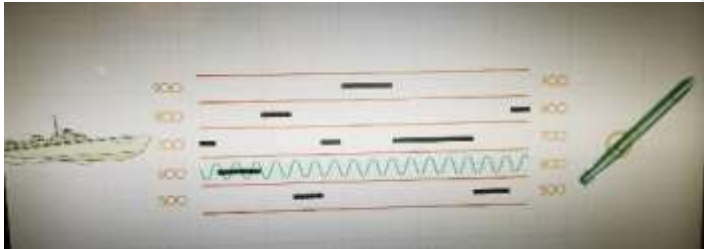


Illustration of Frequency Hopping technology invented by LAMARR.²¹⁴⁴

²¹⁴⁴ Netflix: Bombshell: The Hedy Lamarr Story

Circa 11915 HE: According to CARL SAGAN, due to scientific advancements, human life expectancy rose to about 50 years. To put that into context: A) Around **39000 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 **11870 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.).²¹⁴⁵

²¹⁴⁵ CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

11915 HE - 11958 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.²¹⁴⁶

Born 11918 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.²¹⁴⁷ JOHNSON was cited as a pioneering example of African-American women in STEM.²¹⁴⁸

²¹⁴⁶ https://en.wikipedia.org/wiki/National_Advisory_Committee_for_Aeronautics

²¹⁴⁷ ***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.

²¹⁴⁸ https://en.wikipedia.org/wiki/Katherine_Johnson

- ⇒ At the **12016 HE** NASA building dedication event in honor of KATHERINE JOHNSON, deputy director Lewin said this about 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 **12016 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."



KATHERINE COLEMAN GOBLE JOHNSON at NASA in **11966 HE**, photographer unknown.²¹⁴⁹



12015 HE: KATHERINE COLEMAN GOBLE JOHNSON being awarded the Presidential Medal of Freedom by President Obama.²¹⁵⁰ (Author / Compiler did not remove other face from the photo).

²¹⁴⁹ https://en.wikipedia.org/wiki/Katherine_Johnson

²¹⁵⁰ https://en.wikipedia.org/wiki/Katherine_Johnson

11918 HE – 12003 HE: FRANCO MODIGLIANI²¹⁵¹ was an Italian born United States economist and the recipient of the **11985 HE** Nobel Prize in Economics "for his pioneering analyses of saving and of financial markets."²¹⁵² MODIGLIANI, from the **11950s 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).²¹⁵³

⇒ Author / Compiler note: As of **12019 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 MODIGLIANI was awarded the Nobel Prize

²¹⁵¹ https://en.wikipedia.org/wiki/Rita_Levi-Montalcini

²¹⁵² https://en.wikipedia.org/wiki/Franco_Modigliani

²¹⁵³ https://en.wikipedia.org/wiki/Franco_Modigliani

in Economics for his pioneering analyses of saving and of financial markets.



12000 HE photo is of FRANCO MODIGLIANI, location and photographer unknown.²¹⁵⁴

²¹⁵⁴ https://en.wikipedia.org/wiki/Franco_Modigliani

11918 HE: KALMAN KANDO (Hungarian engineer, **11869 HE - 11931 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.²¹⁵⁵



KALMAN KANDO, date, location, photographer unknown.²¹⁵⁶

²¹⁵⁵ https://en.wikipedia.org/wiki/History_of_rail_transport

²¹⁵⁶ https://en.wikipedia.org/wiki/Kálmán_Kandó

11918 HE - 11999 HE: GERTRUDE BELLE ELION; United States, biochemist and pharmacologist who shared the **11988 HE** Nobel Prize in Physiology or Medicine with GEORGE H. HITCHINGS AND SIR JAMES BLACK.²¹⁵⁷

⇒ 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 **11937 HE** with a degree in chemistry and New York University (M.Sc.) in **11941 HE**, while working as a high school teacher during the day. 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 worked as a food quality supervisor at

²¹⁵⁷ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion

A&P supermarkets and other odd jobs while she did her science research.²¹⁵⁸

- ⇒ 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.²¹⁵⁹ 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

²¹⁵⁸ https://en.wikipedia.org/wiki/Gertrude_B._Elion

²¹⁵⁹ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion

selective and effective drug of its kind).²¹⁶⁰ She invented treatments for gout, meningitis, septicemia, and bacterial infections of the urinary and respiratory tracts, and cancer treatment.²¹⁶¹

²¹⁶⁰ https://en.wikipedia.org/wiki/Gertrude_B._Elion

²¹⁶¹ Stuff You Missed In History Class podcast: and https://en.wikipedia.org/wiki/Gertrude_B._Elion



GERTRUDE BELLE ELION, photographer, date and location unknown.²¹⁶²

²¹⁶² https://en.wikipedia.org/wiki/Gertrude_B._Elion

11918 HE - 11988 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.²¹⁶³

⇒ In **11965 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.²¹⁶⁴

⇒ FEYNMAN developed a widely used pictorial representation scheme for the mathematical expressions governing the behavior

²¹⁶³ https://en.wikipedia.org/wiki/Richard_Feynman

²¹⁶⁴ https://en.wikipedia.org/wiki/Richard_Feynman

of subatomic particles, which later became known as Feynman diagrams.²¹⁶⁵

⇒ During his lifetime, RICHARD FEYNMAN became one of the best-known scientists in the world. In an **11999 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.²¹⁶⁶ FEYNMAN was a keen popularizer of physics through both books and lectures.²¹⁶⁷

²¹⁶⁵ https://en.wikipedia.org/wiki/Richard_Feynman

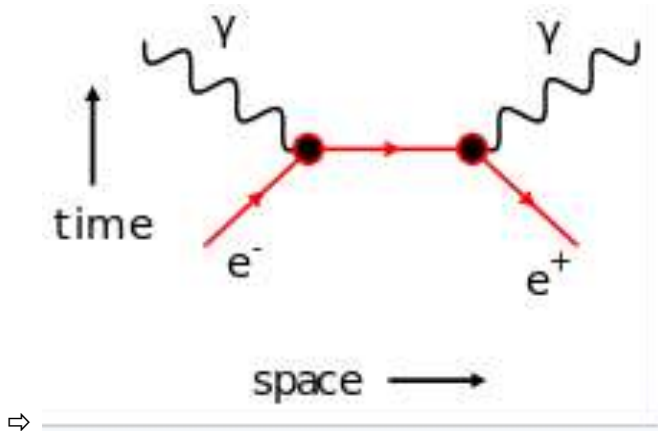
²¹⁶⁶ https://en.wikipedia.org/wiki/Richard_Feynman

²¹⁶⁷ https://en.wikipedia.org/wiki/Richard_Feynman



RICHARD FEYNMAN at the Robert Treat Paine Estate in Waltham, Massachusetts in **11984 HE**.²¹⁶⁸

²¹⁶⁸ https://en.wikipedia.org/wiki/Richard_Feynman



⇒ One example of a Feynman diagram. This example is of electron/positron annihilation²¹⁶⁹

²¹⁶⁹ https://en.wikipedia.org/wiki/Richard_Feynman



⇒ The Feynman section at the Caltech bookstore, date and photographer unknown.²¹⁷⁰

²¹⁷⁰ https://en.wikipedia.org/wiki/Richard_Feynman

11919 HE – 12013 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.²¹⁷¹

⇒ 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).²¹⁷²

²¹⁷¹ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²¹⁷² https://en.wikipedia.org/wiki/Jane_C._Wright



Dr. JANE COOKE WRIGHT, date, location, and photographer unknown.²¹⁷³

²¹⁷³ https://en.wikipedia.org/wiki/Jane_C._Wright

11920 HE – 11958 HE: ROSALIND FRANKLIN²¹⁷⁴ 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.²¹⁷⁵ 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.²¹⁷⁶

²¹⁷⁴ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience and Benjamin and Kira Premack, White Elk Tamaskan 12016 HE Scientists Litter

²¹⁷⁵ https://en.wikipedia.org/wiki/Rosalind_Franklin

²¹⁷⁶ <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience



ROSALIND FRANKLIN, photographer, location, and date unknown.²¹⁷⁷

²¹⁷⁷ https://en.wikipedia.org/wiki/Rosalind_Franklin

11920 HE – 12006 HE: MARIE THARP, United States oceanographer and geologist.²¹⁷⁸

- ⇒ Before the **11950s HE**, little was known about the layout of the ocean floor. (SEE **11869 HE – 11948 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 **11863 HE – 11941**

²¹⁷⁸ <https://exploration.marinersmuseum.org/subject/marie-tharp/>

HE: ANNIE JUMP CANNON.) **BRUCE HEEZEN** went on research vessels and 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.

- ⇒ **11953 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 **11880 HE – 11930 HE: ALFRED WEGENER**) (Also See **11890 HE – 11965 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.

- ⇒ **11957 HE:** Based THARP's calculations, the first map of the North Atlantic Ocean was published.
- ⇒ **11961 HE:** Based THARP's calculations, a map showing the South Atlantic Ocean floor was published.
- ⇒ **11964 HE:** Based THARP's calculations, a map of the Indian ocean floor was published.
- ⇒ **11977 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.²¹⁷⁹

²¹⁷⁹ <https://exploration.marinersmuseum.org/subject/marie-tharp/>



MARIE THARP. Photographer, location, and date unknown.²¹⁸⁰

²¹⁸⁰ <https://exploration.marinersmuseum.org/subject/marie-tharp/>

MARIE THARP with *The World Ocean Floor* map in globe format. Photographer, location, and date unknown.²¹⁸¹

²¹⁸¹ Bing search browsebiography.com

11922 HE – 11995 HE: CESARE EMILIANI, Italian-United States geologist, micropaleontologist, founder of paleoceanography and *Inventor of the Human Era calendar*. EMILIANI developed the timescale of marine isotope stages, which despite modifications remains in very wide use today.

- ⇒ 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.²¹⁸²
- ⇒ 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 the hypotheses of seafloor spreading and plate

²¹⁸² https://en.wikipedia.org/wiki/Cesare_Emiliani

tectonics.²¹⁸³ (Also see **11452 HE– 11519 HE: LEONARDO DA VINCI** and **11830 HE-11882 HE: SIR CHARLES WYVILLE THOMSON**, and **11890 HE – 11965 HE: PROF. ARTHUR HOLMES**, and **11920 HE – 12006 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 **11983 HE**, and the Alexander Agassiz Medal of the U.S. National Academy of

²¹⁸³ https://en.wikipedia.org/wiki/Cesare_Emiliani

Sciences in **11989 HE** for his isotopic studies on Pleistocene and Holocene planktic foraminifera.²¹⁸⁴

- ⇒ **Circa 11993 HE:** In his later years, EMILIANI dedicated a great deal of time to promoting a calendar reform based on the Human Era (**HE**) calendar concept to eliminate the BC–AD chronology gap caused by the lack of a year 0.
- The Human 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.

²¹⁸⁴ https://en.wikipedia.org/wiki/Cesare_Emiliani

- EMILIANI's proposal for a calendar reform sought to solve a number of alleged problems with the current *Anno Domini* / AD 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 Human Era.
- The *Anno Domini* / AD era has no year zero, with 1 BC followed immediately by AD 1 complicating the calculation of timespans further.²¹⁸⁵
- The years BC are counted down when moving from past to future, making calculation of timespans difficult.²¹⁸⁶

²¹⁸⁵ https://en.wikipedia.org/wiki/Cesare_Emiliani

²¹⁸⁶ 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 **10400 HE or 9601 BHE**.²¹⁸⁷ (See the included HE Year Converter Calculator.²¹⁸⁸)
- HE places its beginning at **1 HE**, a rough approximation of the start of the current geologic epoch: the Holocene/Human Era.²¹⁸⁹

²¹⁸⁷ https://en.wikipedia.org/wiki/Cesare_Emiliani

²¹⁸⁸ By PAUL PREMACK, JD, CELA

²¹⁸⁹ https://en.wikipedia.org/wiki/Cesare_Emiliani



CESARE EMILIANI in the early **1950s** **HE** while conducting pioneering research at the University of Chicago. (Photo: Archives of the Rosenstiel School of Marine and Atmospheric Science, University of Miami.)²¹⁹⁰

²¹⁹⁰ https://en.wikipedia.org/wiki/Cesare_Emiliani

11922 HE - 11999 HE: MARIE VAN BRITTAN BROWN, United States Inventor of the home security system in 11966 HE.²¹⁹¹

⇒ Thirteen inventors who came along after BROWN have cited her patent, with the latest being in **12013 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.²¹⁹²

²¹⁹¹ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²¹⁹² https://en.wikipedia.org/wiki/Marie_Van_Brittan_Brown

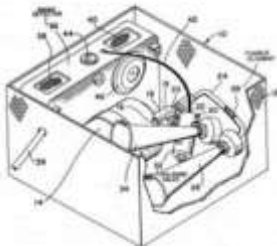


Photo is of MARIE VAN BRITTAN BROWN and part of the drawing for her Home Security System. Date, location and photographer and artist unknown.²¹⁹³

²¹⁹³ <https://www.bing.com/images/search> Greatest-Gadgets-Created-By-Black-Inventors-Home-Security-System



11966 HE: one drawing from BROWN's U.S. Patent 3482037 for the first home security system.²¹⁹⁴

²¹⁹⁴ <https://patents.google.com/patent/US3482037>

11922 HE – 11995 HE: CLAIR CAMERON (PAT) PATTERSON, United States Geochemist²¹⁹⁵ 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.²¹⁹⁶

⇒ Both he and his wife LORNA (LAURIE) PATTERSON as scientists were sent to work on the Manhattan Project.²¹⁹⁷ At Oak Ridge, they worked together at the uranium-235 electromagnetic

²¹⁹⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²¹⁹⁶ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

²¹⁹⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

separation plant. This is where CLAIRE PATTERSON gained experience with the mass spectrometer.²¹⁹⁸

- 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."²¹⁹⁹

⇒ **11956 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, PATTERSON calculated an age for the Earth of 4.55 billion

²¹⁹⁸ <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

²¹⁹⁹ <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

years; a figure far more accurate than those that existed at the time and one that has remained largely unchanged.²²⁰⁰

⇒ CLAIR CAMERON PATTERSON had first encountered lead contamination in the late **11940s HE** as a graduate student at the University of Chicago.²²⁰¹

⇒ 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 communication network between the cells. It interferes with

²²⁰⁰ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

²²⁰¹ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson

the molecular receptors that are vital to memory and learning. This is especially damaging to children - but lead poisoning spares no one.²²⁰²

- ⇒ Starting about **11900 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 **11920'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.²²⁰³

²²⁰² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²⁰³ 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 **9855 HE** – circa **10529 HE**: Antiquity Roman Empire.)²²⁰⁴
- 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 Kehoe said there was no

²²⁰⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

evidence to suggest that lead posed any threat to the consumer.²²⁰⁵

- 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.²²⁰⁶

⇒ PATTERSON and everyone else at the time assumed the prevalence of lead in the environment occurred naturally.²²⁰⁷ 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

²²⁰⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²⁰⁶ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²⁰⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

concentrations of lead in deep and shallow seawater. PATTERSON found that his initial data made no sense.²²⁰⁸

- 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.²²⁰⁹
- Knowing the quantity of lead in the shallow seas and the time needed to mix it into the deeper layers, PATTERSON was

²²⁰⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²⁰⁹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

able to estimate the rate of lead contamination at the surface.²²¹⁰

- 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.²²¹¹
- The U.S. government - the Army, the Navy, the atomic energy commission, the public health service, and the

²²¹⁰ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²¹¹ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

National Science Foundation supported PATTERSON's research on lead pollution.²²¹²

- 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.²²¹³ It was a form of time travel, to recover snow that had fallen three centuries ago, before the start of the Industrial Revolution.²²¹⁴

²²¹² COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²¹³ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²¹⁴ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- 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.²²¹⁵
- PATTERSON published his findings in a major environmental health journal and sent copies to various government leaders, including Senator Edmund Muskie of Maine, the chair of the Senate Subcommittee on Air and Water Pollution. In **11966 HE**, Muskie held hearings on the lead question. The first witness was Dr. Robert Kehoe, longtime scientific advocate for leaded 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.

²²¹⁵ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

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%.²²¹⁶

²²¹⁶ 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.*²²¹⁷
- ⇒ PATTERSON, the man who figured out the age of the earth, was also responsible for one of the greatest public health victories of the 1900s HE.²²¹⁸

²²¹⁷ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

²²¹⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7



CLAIR CAMERON PATTERSON, date, location, photographer unknown.²²¹⁹

²²¹⁹ https://en.wikipedia.org/wiki/Clair_Cameron_Patterson



LORNA (LAURIE) MCCLEARY PATTERSON; United States, chemist. Photo **11943 HE**, Graduation from Grinnell College.²²²⁰

²²²⁰ <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

11922 HE: NIELS HENRIK DAVID BOHR (11885 HE – 11962 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 **11930s 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 **11943 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 chair of the Nordic Institute for Theoretical Physics in **11957 HE.**²²²¹

- ⇒ 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

²²²¹ https://en.wikipedia.org/wiki/Niels_Bohr

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 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.²²²²

²²²² https://en.wikipedia.org/wiki/List_of_things_named_after_Niels_Bohr



BOHR founded the Institute of Theoretical Physics at the University of Copenhagen, now known as the Niels Bohr Institute, which opened in **11920 HE.** (Date of photo and photographer unknown.)²²²³

²²²³ https://en.wikipedia.org/wiki/Niels_Bohr



NIELS HENRIK DAVID BOHR, date, location, and photographer unknown..²²²⁴

11923 HE: Star stuff element 72 Hafnium was discovered by DIRK COSTER, Dutch physicist and GEORG VON HEVESY

²²²⁴ https://en.wikipedia.org/wiki/Niels_Bohr

Hungarian Chemist²²²⁵ 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.²²²⁶



● 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, they are hard to separate. The silvery, heavy Hafnium so far is used only for a few special technical

²²²⁵ 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*

²²²⁶ https://en.wikipedia.org/wiki/Dirk_Coster

applications. Hafnium carbide (HfC) and tantalum hafnium carbide (Ta_4HfC_5) are very hard and mechanically enduring, the latter the highest melting point of all materials at over 4000°C .²²²⁷

⇒ **11885 HE – 11966 HE:** GEORG VON HEVESY, who in **11943 HE** received the Nobel Prize for Chemistry. He was a Fellow of the Royal Society²²²⁸ and discovered that water takes 9 days to pass through the human body by consuming heavy water and measuring the output.²²²⁹ 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

²²²⁷ <http://images-of-elements.com/hafnium.php#a>

²²²⁸ https://en.wikipedia.org/wiki/George_de_Hevesy

²²²⁹ 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

found to be 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.²²³⁰

- Awards: **11949 HE** HEVESY received the Copley Medal; **11950 HE** HEVESY received the Faraday Lectureship Prize; **11958 HE:** HEVESY received the Atoms for Peace Award.²²³¹

²²³⁰ 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

²²³¹ https://en.wikipedia.org/wiki/George_de_Hevesy



- **11943 HE:** GEORG VON HEVESY, photographer and location unknown.²²³²

²²³² https://en.wikipedia.org/wiki/George_de_Hevesy

⇒ **11889 HE – 11950 HE:** DIRK COSTER, chemist, political activist, and anti-Nazi. In **11938 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.²²³³

- The asteroid 10445 Coster is named after DIRK COSTER.²²³⁴

²²³³ https://en.wikipedia.org/wiki/Dirk_Coster

²²³⁴ https://en.wikipedia.org/wiki/Dirk_Coster



- DIRK COSTER, date, location, and photographer unknown..²²³⁵

²²³⁵ https://en.wikipedia.org/wiki/Dirk_Coster

11926 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 this will be amazingly simple compared with our

present telephone. A man will be able to carry one in his vest pocket.”²²³⁶

11925 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 **11929 HE**.²²³⁷

Born 11927 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).²²³⁸

⇒ JOAN FEYNMAN studied the science behind climate change. Along with her colleague, and husband, ALEXANDER

²²³⁶ <https://www.thoughtco.com/history-of-smartphones-4096585>

²²³⁷ https://en.wikipedia.org/wiki/Dot_matrix_printing

²²³⁸ 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.²²³⁹
- ⇒ 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

²²³⁹ https://en.wikipedia.org/wiki/Joan_Feynman

discovered that the periodic spouting of solar material known as a solar coronal 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.²²⁴⁰

²²⁴⁰ https://en.wikipedia.org/wiki/Joan_Feynman



JOAN FEYNMAN, date, location, and photographer
unknown.²²⁴¹

11928 HE – 12016 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.²²⁴²

⇒ VERA COOPER RUBIN's attempts to explain the galaxy rotation problem led to the theory of dark matter.²²⁴³

²²⁴¹ https://en.wikipedia.org/wiki/Joan_Feynman

²²⁴² https://en.wikipedia.org/wiki/Vera_Rubin

²²⁴³ https://en.wikipedia.org/wiki/Vera_Rubin



VERA COOPER RUBIN, date, location, and photographer unknown.²²⁴⁴

²²⁴⁴ http://summer-astronomy-pc.wikispaces.com/file/view/vera_rubin.jpg/153326721/239x359/vera_rubin.jpg

11928 HE – 11997 HE: EUGENE SHOEMAKER, United States geologist and astronomer. SHOEMAKER became famous in **11994** when, working with his wife CAROLYN S. SHOEMAKER and DAVID LEVY they discovered a comet destined to crash into Jupiter (**SEE 11994**).²²⁴⁵

11928 HE: Penicillin discovered.²²⁴⁶

⇒ The world's first antibiotic substance benzylpenicillin (Penicillin G) was discovered by Sir ALEXANDER FLEMING, Scottish Physician and Researcher.²²⁴⁷

²²⁴⁵ <https://www2.jpl.nasa.gov/sl9/sl9.html>

²²⁴⁶ <https://www.biography.com/people/alexander-fleming-9296894>

²²⁴⁷ https://en.wikipedia.org/wiki/Alexander_Fleming

⇒ In **11945 HE FLEMMING** shared the Nobel Prize in Physiology or Medicine for the discovery and development of Penicillin with **HOWARD FLOREY** and **ERNST BORIS CHAIN**.²²⁴⁸

- Some of the legacies of **SIR ALEXANDER FLEMING**:
11881 HE – 11955 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

²²⁴⁸ https://en.wikipedia.org/wiki/Alexander_Fleming

is named after him in Sofia, Bulgaria; In Athens, a square in the downtown district of 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-**12009** **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.



- SIR ALEXANDER FLEMING: date, location, and photographer unknown.²²⁴⁹

²²⁴⁹ https://en.wikipedia.org/wiki/Alexander_Fleming



- Barcelona, Spain: to SIR ALEXANDER FLEMING (**11956 HE**), by Catalan sculptor Josep Manuel Benedicto. Barcelona: Jardins del Doctor Fleming.²²⁵⁰

²²⁵⁰ https://en.wikipedia.org/wiki/Alexander_Fleming



• Faroe Islands postage stamp commemorating FLEMING.²²⁵¹

²²⁵¹ https://en.wikipedia.org/wiki/Alexander_Fleming

⇒ **11898 HE – 11968 HE: HOWARD WALTER FLOREY,**²²⁵²
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.”²²⁵³

- Some of FLOREY's honors and legacies: His portrait appeared on the Australian \$50 note for 22 years (**11973 HE – 11995 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

²²⁵² https://en.wikipedia.org/wiki/Alexander_Fleming

²²⁵³ 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.



- Florey Building, location, date and photographer unknown.²²⁵⁴

²²⁵⁴ 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).²²⁵⁵

²²⁵⁵ https://en.wikipedia.org/wiki/Howard_Florey



• Australian out of circulation \$50 note²²⁵⁶

²²⁵⁶ https://en.wikipedia.org/wiki/Howard_Florey



- Lord HOWARD WALTER FLOREY, date, location, and photographer unknown..²²⁵⁷

²²⁵⁷ https://en.wikipedia.org/wiki/Howard_Florey

⇒ **ERNST BORIS CHAIN (11906 HE – 11979 HE)** German-born British biochemist and fellow by the Royal Society²²⁵⁸ 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.

²²⁵⁸ 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.²²⁵⁹
- 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.²²⁶⁰

²²⁵⁹ <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>

²²⁶⁰ <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>



- ERNST BORIS CHAIN in **11945 HE**, photographer and location unknown.²²⁶¹

²²⁶¹ https://en.wikipedia.org/wiki/Ernst_Chain

Born 11929 HE: PETER WARE HIGGS,²²⁶² CH FRS FRSE, is a British theoretical physicist, emeritus professor in the University of Edinburgh, and **12013 Nobel Prize laureate** in physics, for his work on the mass of subatomic particles.²²⁶³

- ⇒ **Circa 11964 HE:** PETER HIGGS proposed that broken symmetry in electroweak theory could explain the origin of mass of elementary particles in general.²²⁶⁴
- ⇒ According to modern physics, matter consists of a set of particles that act as building blocks. Between these particles lie forces that are mediated by another set of particles. A

²²⁶² LAWRENCE M. KRAUSE The Greatest Story Ever Told: So Far

²²⁶³ https://en.wikipedia.org/wiki/Peter_Higgs

²²⁶⁴ https://en.wikipedia.org/wiki/Peter_Higgs

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.²²⁶⁵
- ⇒ See **11212 HE** entry on discovery of the Higgs Boson at CERN.
- ⇒ HIGGS Honors and Awards: Hughes Medal (**11981 HE**); FRS (**11983 HE**); Rutherford Medal (**11984 HE**); Dirac Medal (**11997 HE**); Wolf Prize in Physics (**12004 HE**); Sakurai Prize (**12010 HE**); Nobel Prize in Physics (**12013 HE**); Copley Medal (**12015 HE**).²²⁶⁶

²²⁶⁵ <https://www.nobelprize.org/prizes/physics/2013/higgs/facts/>

²²⁶⁶ https://en.wikipedia.org/wiki/Peter_Higgs



PETER HIGGS, date, place, photographer unknown.²²⁶⁷

²²⁶⁷ https://en.wikipedia.org/wiki/Peter_Higgs



PETER HIGGS; portrait by Lucinda Mackay hanging at James Clerk Maxwell Foundation.²²⁶⁸

²²⁶⁸ https://en.wikipedia.org/wiki/Peter_Higgs

Circa 11930 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.²²⁶⁹

Born 11930 HE: TU YOUYOU²²⁷⁰, 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.²²⁷¹

²²⁶⁹ ***Margaret Sanger – 20th Century Hero*** (PDF). Planned Parenthood. p. 8. and https://en.wikipedia.org/wiki/Margaret_Sanger

²²⁷⁰ Benjamin and Kira Premack, White Elk Tamaskan **12016 HE** Scientists Litter

²²⁷¹ 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 **1900s HE** century tropical medicine, saving millions of lives in developing countries in South Asia, Africa, and South America.²²⁷²
- ⇒ Awards received by TU YOUYOU: **1978 HE**, National Science Congress Prize, P.R. China; **1979 HE**, National Inventor's Prize, P.R. China; **1992 HE**, (One of the) Ten Science and Technology Achievements in China, State Science Commission, P.R. China; **1997 HE**, (One of the) Ten Great Public Health Achievements in New China, P.R. China; **2011 HE**, GlaxoSmithKline Outstanding Achievement Award in Life Science; **2011 HE**, Lasker-DeBakey Clinical Medical Research Award; **2011 HE**, Outstanding Contribution Award, China

²²⁷² https://en.wikipedia.org/wiki/Tu_Youyou

Academy of Chinese Medical Sciences; **12012 HE**, (One of the Ten) National Outstanding Females, P.R. China; **12015 HE**, Warren Alpert Foundation Prize (co-recipient); **12015 HE**, Nobel Prize in Physiology or Medicine **12015 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; **12016 HE**, Highest Science and Technology Award, China.²²⁷³

²²⁷³ https://en.wikipedia.org/wiki/Tu_Youyou



Photo of TU YOUYOU. Photographer, location and date unknown.²²⁷⁴

²²⁷⁴ https://en.wikipedia.org/wiki/Tu_Youyou

11931 HE – 11942 HE: Wind generator: The WIME D-30 in service in Balaklava, Yalta, USSR was a forerunner of modern horizontal-axis utility-scale wind generators.²²⁷⁵

11934 HE – 11996 HE: CARL SAGAN: United States astronomer, cosmologist, astrophysicist, astrobiologist, science educator.²²⁷⁶ 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 **11980 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

²²⁷⁵ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

²²⁷⁶ https://en.wikipedia.org/wiki/Carl_Sagan

Contact. His papers, containing 595000 items, are archived at The Library of Congress.²²⁷⁷

- ⇒ In **1960 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.²²⁷⁸
- ⇒ In the original Cosmos series, in **1980 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."²²⁷⁹

²²⁷⁷ https://en.wikipedia.org/wiki/Carl_Sagan

²²⁷⁸ COSMOS, A Space Time Odyssey, by Ann Druyan Episode 12

²²⁷⁹ 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 **12014 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.²²⁸⁰
- 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.²²⁸¹

²²⁸⁰ https://en.wikipedia.org/wiki/Carl_Sagan

²²⁸¹ ISAAC ASIMOV *In Joy Still Felt* The autobiography of ISAAC ASIMOV



11980 HE: CARL SAGAN, photographer and location unknown.²²⁸²

²²⁸² https://en.wikipedia.org/wiki/Carl_Sagan

11939 HE – 11942 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.²²⁸³

²²⁸³ <https://www.thoughtco.com/john-atanasoff-and-clifford-berry-inventors-4078350>



11903 HE – 11995 HE: DR. JOHN V. ATANASOFF was an American physicist and inventor, best known for being credited with inventing the first electronic digital computer.²²⁸⁴

²²⁸⁴ https://en.wikipedia.org/wiki/John_Vincent_Atanasoff

⇒ **11918 HE – 11963 HE:** CLIFFORD EDWARD BERRY helped JOHN VINCENT ATANASOFF create the first digital electronic computer.²²⁸⁵ (No photo found.)

Born 11939 HE: GEORGE ROBERT CARRUTHERS,²²⁸⁶ United States inventor, physicist, and space scientist.²²⁸⁷ 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 Halley's Comet, and he invented a camera that was used in the Space Shuttle Mission.

²²⁸⁵ https://en.wikipedia.org/wiki/Clifford_Berry

²²⁸⁶ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²²⁸⁷ https://en.wikipedia.org/wiki/George_Robert_Carruthers



Telescope developed by Dr. GEORGE CARRUTHERS on display at the National Air and Space Museum.²²⁸⁸

²²⁸⁸ 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.²²⁸⁹

²²⁸⁹ https://en.wikipedia.org/wiki/George_Robert_Carruthers

Born 11940 HE: GEORGE EDWARD ALCORN, JR.,²²⁹⁰ United States physicist and inventor who worked primarily for IBM and NASA who in **12015 HE** was inducted into the National Inventors Hall of Fame.²²⁹¹

⇒ List of U.S. Patents issued to ALCORN: #3986912 Process for controlling the wall inclination of a plasma etched via hole; #4062720, Process for forming ledge-free aluminum copper silicon conductor structure; #4172004 Method for forming dense dry etched multi-level metallurgy with non-overlapped vias; #4201800, Hardened photoresist master image mask process; #4289834 Dense dry etched multi-level metallurgy with non-overlapped vias; #4472728 Imaging X-ray spectrometer; #4543442 GaAs Schottky barrier photo-responsive device and

²²⁹⁰ https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists

²²⁹¹ https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

method of fabrication; and #4618380, Method of fabricating an imaging X-ray spectrometer.²²⁹²



Photo of GEORGE EDWARD ALCORN JR. Date, location and photographer, unknown.²²⁹³

²²⁹² https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

²²⁹³ https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.

In **11941 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.



Photo is of the world's first megawatt-sized wind turbine near Grandpa's Knob Summit, Castleton, Vermont.²²⁹⁴

²²⁹⁴ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

Born 11941 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.²²⁹⁵

11995 HE until 12008 HE: DAWKINS was emeritus fellow of New College, Oxford, and was the University of Oxford's Professor for Public Understanding of Science.²²⁹⁶ 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

²²⁹⁵ <https://www.richarddawkins.net/2014/02/whats-in-a-meme>

²²⁹⁶ https://en.wikipedia.org/wiki/Richard_Dawkins

highest and most aesthetically rewarding achievements of the human spirit.”²²⁹⁷



12010 HE: RICHARD DAWKINS at Cooper Union, New York City, photographer unknown.²²⁹⁸

²²⁹⁷ <https://www.richarddawkins.net/>

²²⁹⁸ https://en.wikipedia.org/wiki/Richard_Dawkins

Born 11942 HE: ROBERT DUANE BALLARD,²²⁹⁹ United States Explorer and Professor of Oceanography.²³⁰⁰

⇒ ROBERT DUANE BALLARD is most noted for his work in underwater archaeology, maritime archaeology, and the archeology of shipwrecks.²³⁰¹ **11973 – 11975 HE BALLARD** dived 9000 feet (2750 meters) in *Alvin* and in a French submersible to explore the Mid-Atlantic Ridge, an underwater mountain chain in the Atlantic Ocean.²³⁰² **11977 HE and 11979 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 synthesis of food

²²⁹⁹ Tiffany Premack, and Alien Deep documentary, Netflix.

²³⁰⁰ https://en.wikipedia.org/wiki/Robert_Ballard

²³⁰¹ https://en.wikipecia.org/wiki/Robert_Ballard

²³⁰² <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

energy.²³⁰³ **11985 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.²³⁰⁴ **ROBERT DUANE BALLARD Awards and Honors: 11988 HE,** BALLARD was awarded an Honorary Degree (Doctor of Science) by the University of Bath; **11990 HE,** he received the Academy of Achievement's Golden Plate Award; **11994 HE** Kilby International Awards recipient; **11996 HE** the U.S. Navy Memorial Foundation awarded Ballard its Lone Sailor Award for his naval service and his work on underwater archaeology; **12002 HE** he received The Caird Medal of the National Maritime Museum; **12003 HE** he was awarded The National Humanities Medal.

²³⁰³ <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

²³⁰⁴ Alien Deep documentary, Netflix.



ROBERT DUANE BALLARD, date, location, photographer
unknown.²³⁰⁵

²³⁰⁵ https://en.wikipedia.org/wiki/Robert_Ballard

11945 HE – 11956 HE: The first general– purpose digital computer, the Electronic Numerical Integrator and Computer (ENIAC).²³⁰⁶ 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.²³⁰⁷

⇒ The team of design engineers assisting the development included ROBERT F. SHAW (function tables), JEFFREY CHUAN CHU

²³⁰⁶ <http://www.computerhistory.org/timeline/computers/>

²³⁰⁷ <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 **11946 HE**, the researchers resigned from the University of Pennsylvania and formed the Eckert-Mauchly Computer Corporation.²³⁰⁸

⇒ **11956 HE:** By the end of its operation, ENIAC contained 20,000 vacuum tubes, 7200 crystal diodes, 1500 relays, 70,000 resistors, 10000 capacitors and approximately 5000,000 hand-soldered joints. It weighed more than 30 short tons (27 t), was roughly $2.4 \text{ m} \times 0.9 \text{ m} \times 30 \text{ m}$ ($8 \text{ ft} \times 3 \text{ ft} \times 98 \text{ ft}$) in size,

²³⁰⁸ <https://en.wikipedia.org/wiki/ENIAC>

occupied 167m^2 (1800 sq. ft) and consumed 150 kW of electricity.²³⁰⁹



ENIAC in BRL building 328. (U.S. Army photo).²³¹⁰

²³⁰⁹ <https://en.wikipedia.org/wiki/ENIAC>

²³¹⁰ <https://en.wikipedia.org/wiki/ENIAC>



11946 HE Photo is of ENIAC's 2 designers American physicist JOHN MAUCHLY (**11907 HE – 11980 HE**) and American engineer J. PRESPEER ECKERT (**11919 HE – 11995 HE**) of the University of Pennsylvania, with Walter Cronkite.²³¹¹

²³¹¹ https://en.wikipedia.org/wiki/John_Mauchly

11945 HE – 12001 HE: JOSEPH MONROE JACKSON III, United States computer scientist.²³¹²

- ⇒ **11984 HE: JOSEPH M. JACKSON III** is the co-inventor of United States Patent 4447676: “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 **11983 HE** and granted May 8 **11984 HE**.²³¹³

²³¹² Our daughter-in-law's Father

²³¹³ <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 unknown²³¹⁴.

²³¹⁴ Image from

<https://www.facebook.com/photo.php?fbid=10203579947792994&set=a.1186946627533&type=3&theater>

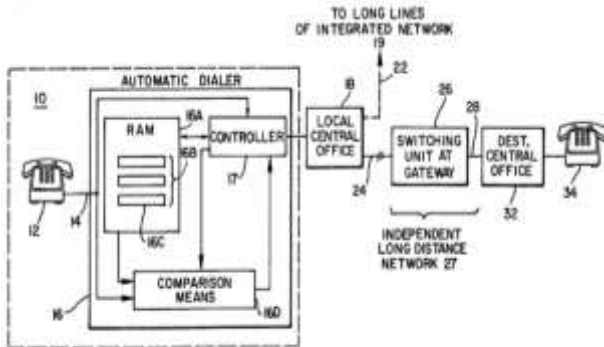


Fig. 1



Page 2 of JACKSON's Patent.²³¹⁵

²³¹⁵pdfpiw.uspto.gov/.piw?PageNum=0&docid=04447676&IDKey=8EED3D54C92C%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnpnph-

11950's HE: The first birth control pills were developed by **GREGORY PINCUS** and **JOHN ROCK** with help from the Planned Parenthood Federation of America.²³¹⁶



Photo is of **GREGORY PINCUS, (11903 HE – 11967 HE).**

Parser%3FSect1%3DPTO1%2526Sect2%3DHITOFF%2526d%3DPALL%2526p%3D1%2526u%3D%25252Fmetahtml%25252FPTO%25252Fsrchnum.htm%2526r%3D1%2526f%3DG%2526l%3D50%2526s1%3D4447676.PN.%2526OS%3DPN%2F4447676%2526RS%3DPN%2F4447676
²³¹⁶ https://en.wikipedia.org/wiki/History_of_birth_control

American biologist and researcher. Location and photographer unknown.²³¹⁷

⇒ Author / Compiler could find no photo of **JOHN ROCK (11890 HE – 11984 HE)**, American obstetrician and gynecologist.²³¹⁸

11951 HE: The first computer for commercial use was introduced to the public; the Universal Automatic Computer (UNIVAC).^{2319 2320} JOHN PRESER 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 exploding U.S. population (the beginning of the

²³¹⁷ https://en.wikipedia.org/wiki/Gregory_Goodwin_Pincus

²³¹⁸ [https://en.wikipedia.org/wiki/John_Rock_\(American_scientist\)](https://en.wikipedia.org/wiki/John_Rock_(American_scientist))

²³¹⁹ <http://www.computerhistory.org/timeline/computers/>

²³²⁰ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

famous baby boom). In April **11946 HE**, a \$300,000 deposit was given to ECKERT and MAUCHLY for the research into a new computer called UNIVAC.²³²¹

- ⇒ The fifth UNIVAC machine (built for the U.S. Atomic Energy Commission) was used by CBS to predict the result of the **11952 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 of computing technology, and from then on

²³²¹ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

computerized predictions became part of election night broadcasts.²³²²



UNIVAC displayed at unknown location, photographer unknown.²³²³

²³²² https://en.wikipedia.org/wiki/UNIVAC_I

²³²³ <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

11953 HE: East German Postal service uses electric vehicles to deliver mail.



East German electric vans of the Deutsche Post, photographer unknown.²³²⁴

²³²⁴ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

Born 11953 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.²³²⁵

⇒ CAROLYN PORCO was founder of The Day the Earth Smiled and “Astronomers Without Borders” coordinated events internationally. NASA spearheaded a related event called 'Wave

²³²⁵ https://en.wikipedia.org/wiki/Carolyn_Porco

at Saturn' "to help acknowledge the historic interplanetary portrait as it was being taken."²³²⁶ ²³²⁷

⇒ 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.

²³²⁶ https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled

²³²⁷ 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.”²³²⁸

²³²⁸ https://en.wikipedia.org/wiki/Carolyn_Porco



CAROLYN PORCO, date, location, and photographer
unknown..²³²⁹



July 19 **12013 HE**: This image taken by *Cassini* is called “The Day the Earth Smiled.” Earth is a blue dot underneath the rings of Saturn.²³³⁰

²³²⁹ https://en.wikipedia.org/wiki/Carolyn_Porco

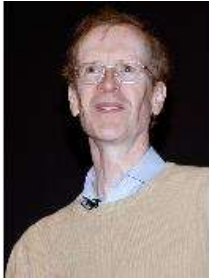
²³³⁰ https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled

Born 11953 HE: SIR ANDREW WILES, British Mathematician, professor at Princeton University.²³³¹ In **19995 HE** WILES published the correct proof to Fermat's Last Theorem.²³³² 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 **11900's HE** not available to previous mathematicians²³³³ such as GERMAIN or FERMAT. (See **11776 HE – 11831 HE** MARIE-SOPHIE GERMAIN and **11607 HE – 11665 HE:** PIERRE DE FERMAT.)

²³³¹ Liz Strachan *A Slice of Pi*

²³³² Liz Strachan *A Slice of Pi*

²³³³ https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem



12005 HE SIR ANDREW WILES, photographer and location unknown²³³⁴

Born 11954 HE: LAWRENCE M. KRAUSS is a United States-Canadian theoretical physicist, cosmologist, and founder of

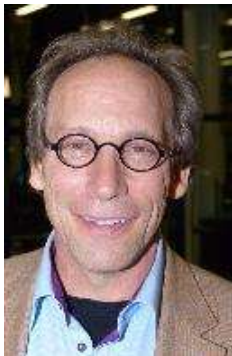
²³³⁴ https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem

Arizona State University's Origins Project to investigate fundamental questions about the universe.²³³⁵

⇒ 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.²³³⁶

²³³⁵ https://en.wikipedia.org/wiki/Lawrence_M._Krauss

²³³⁶ https://en.wikipedia.org/wiki/Lawrence_M._Krauss



LAWRENCE M. KRAUSS at Ghent University, **12013 HE**,
photographer unknown.²³³⁷

Born **11955 HE**: Dr. LUCILLE M. JONES, United States seismologist
and public voice for earthquake science and earthquake safety in

²³³⁷ https://en.wikipedia.org/wiki/Lawrence_M._Krauss

California. Dr. JONES said: “Earthquakes are inevitable, but disasters are not.”²³³⁸



Dr. LUCILLE M. JONES (photographer, location and date unknown.)²³³⁹

²³³⁸ https://en.wikipedia.org/wiki/Lucy_Jones

²³³⁹ Wikipedia suggested

11955 HE – 11966 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.



11955 HE: Photo is of the Experimental wind turbine at Nogent-le-Roi, France.²³⁴⁰

²³⁴⁰ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

11955 HE - current: PAUL EDWARD STAMETS is an American mycologist. STAMETS received the Bioneers Award from the Collective Heritage Institute in **11998 HE** and the Award for Contributions to Amateur Mycology from the North American Mycological Association in **12013 HE**. He also received an Invention Ambassador **12014 HE –12015 HE** award from the American Association for the Advancement of Science (AAAS).

STAMETS was involved with the documentary film *Fantastic Fungi*. He was also the namesake of a main character in Star Trek: Discovery, an engineer who worked with a fictionalized mycelial network.²³⁴¹

²³⁴¹ https://en.wikipedia.org/wiki/Paul_Stamets



PAUL STAMUTS photo from **2/6/12024**
HE titled 100 Strains of Agarikon.²³⁴²

²³⁴² <https://paulstamets.com/>

Born 11955 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 (11993 HE–11998 HE)**, the Netflix show *Bill Nye Saves the World* (**12017 HE–present**), and for his many subsequent appearances in popular media as a science educator.²³⁴³

²³⁴³ 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.²³⁴⁴
- ⇒ 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.²³⁴⁵

²³⁴⁴ https://en.wikipedia.org/wiki/Bill_Nye

²³⁴⁵ https://en.wikipedia.org/wiki/Bill_Nye



12016 HE BILL NYE speaking to a group about Mars, photographer and location unknown.²³⁴⁶

²³⁴⁶ https://en.wikipedia.org/wiki/Bill_Nye

Born 11956 HE: Dr. MAE CAROL JEMISON,²³⁴⁷ United States, physician, engineer, astronaut, and the first African-American woman in space.²³⁴⁸

- ⇒ **11993 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.²³⁴⁹
- ⇒ 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

²³⁴⁷ https://en.wikipedia.org/wiki/Roger_Arliner_Young

²³⁴⁸ https://en.wikipedia.org/wiki/Mae_Jemison

²³⁴⁹ https://en.wikipedia.org/wiki/Mae_Jemison

Black Achievement 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.²³⁵⁰

⇒ 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,

²³⁵⁰ https://en.wikipedia.org/wiki/Mae_Jemison

Michigan; Mae Jemison School, an elementary public school in Hazel Crest, Illinois; Jemison High School, Huntsville, Alabama.



11992 HE: Dr. MAE JEMISON, photographer unknown.²³⁵¹

²³⁵¹ https://en.wikipedia.org/wiki/Mae_Jemison



Dr. MAE JEMISON aboard the Spacelab Japan (SLJ) science module on the Earth-orbiting *Endeavour*, date unknown.²³⁵²

²³⁵² https://en.wikipedia.org/wiki/Mae_Jemison



Dr. MAE JEMISON with Nichelle Nichols on the set of Star Trek: The Next Generation. Photographer unknown.²³⁵³

²³⁵³ https://memory-alpha.fandom.com/wiki/Mae_Jemison

11957 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.²³⁵⁴ *The B2FH group first advanced the idea of "nucleosynthesis" or fusion of lighter elements into heavier ones, which occurs during stars explosive*

²³⁵⁴ https://en.wikipedia.org/wiki/B2FH_paper

oxygen burning and silicon burning events. For this they received the Warner Prize in **11959 HE**.^{2355 2356}

- ⇒ **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

²³⁵⁵ https://en.wikipedia.org/wiki/Margaret_Burbidge

²³⁵⁶ https://en.wikipedia.org/wiki/B2FH_paper

layers of the star collapsing onto the core, creating a 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.²³⁵⁷

- ⇒ **MARGARET BURBIDGE 11919 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

²³⁵⁷ https://en.wikipedia.org/wiki/Stellar_nucleosynthesis

the Center for Astronomy and Space Sciences at the University of California at San Diego (UCSD).²³⁵⁸



• ELEANOR MARGARET PEACHEY BURBIDGE, date, location, and photographer unknown.²³⁵⁹

²³⁵⁸ https://en.wikipedia.org/wiki/Margaret_Burbidge

²³⁵⁹ https://en.wikipedia.org/wiki/Margaret_Burbidge

⇒ **GEOFFREY RONALD BURBIDGE: 11925 HE – 12010 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 **11978 HE** to **11984 HE**.²³⁶⁰



- **GEOFFREY RONALD BURBIDGE**, date, location, and photographer unknown²³⁶¹

²³⁶⁰ https://en.wikipedia.org/wiki/Geoffrey_Burbidge

²³⁶¹ Image search from datuopinion.com

⇒ **11911 HE – 11995 HE**: WILLIAM ALFRED FOWLER, United States Scientist. In **11983 HE** FOWLER was awarded the Nobel Prize in Physics.²³⁶²

- 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

²³⁶² https://en.wikipedia.org/wiki/William_Alfred_Fowler

Mark Twain Society, and elected to the Society of American Baseball Research.²³⁶³



- WILLIAM ALFRED FOWLER, date and location unknown.²³⁶⁴

⇒ **11915 HE – 12001 HE:** FRED HOYLE, British Astronomer who sarcastically coined the term the “Big Bang.” (See the other

²³⁶³ <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>

²³⁶⁴ https://en.wikipedia.org/wiki/William_Alfred_Fowler

scientist who got credit for the term “Big Bang” **11894 HE - 11996 HE: GEORGES LEMAÎTRE**). HOYLE promoted the idea of panspermia as the origin of life on Earth.²³⁶⁵

- 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.....”²³⁶⁶

²³⁶⁵ https://en.wikipedia.org/wiki/Fred_Hoyle

²³⁶⁶ <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>



SIR FRED HOYLE. Location, date and photographer unknown.²³⁶⁷

²³⁶⁷ https://en.wikipedia.org/wiki/Fred_Hoyle

11935 HE - current: SYLVIA ALICE EARLE was the first female chief scientist of the U.S. National Oceanic and Atmospheric Administration. Among many other accomplishments, EARLE was named by Time Magazine as its first Hero for the Planet in **11998 HE**. EARLE is an American marine biologist, oceanographer, explorer, author, and lecturer. She has been a National Geographic Explorer at Large (formerly Explorer in Residence) since **11998 HE**.²³⁶⁸

⇒ Hope Spots are overseen by Mission Blue, a non-profit organization founded by SYLVIA EARLE with her **12009 HE** TED prize. Hope Spots are ecologically unique areas of the ocean designated for protection under a global conservation campaign.²³⁶⁹

²³⁶⁸ https://en.wikipedia.org/wiki/Sylvia_Earle

²³⁶⁹ https://en.wikipedia.org/wiki/Hope_Spots



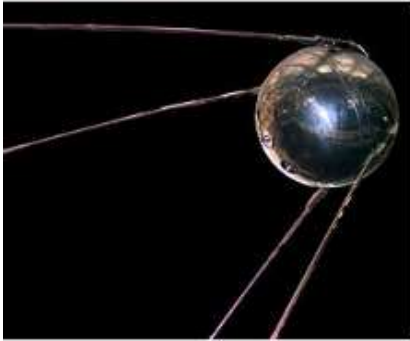
DR.SYLVIA EARLE²³⁷⁰



²³⁷⁰ President Barack Obama talks with Dr. SYLVIA EARLE, during a visit to Midway Atoll on **9/1/2016 HE**. DR. EARLE shows the President a photo of a newly discovered species of blue fish native to Midway waters.

²³⁷⁰ https://en.wikipedia.org/wiki/Sylvia_Earle

11957 HE: The Soviets launched two orbital spacecraft, *Sputnik 1* and *Sputnik 2*.²³⁷¹



A replica of Soviet *Sputnik 1* at the Smithsonian.²³⁷²

²³⁷¹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²³⁷² 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.²³⁷³

²³⁷³ https://en.wikipedia.org/wiki/Sputnik_1



Model of *Sputnik 2* at the Polytechnic Museum in Moscow.²³⁷⁴
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.²³⁷⁵

²³⁷⁴ https://en.wikipedia.org/wiki/Sputnik_2

²³⁷⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>

Born 11958 HE: your humble Author / Compiler and her Techno-Manager, too.

11958 HE: *Explorer 1* United States first successful launch of a US Satellite.²³⁷⁶



Photo is of WILLIAM HAYWARD PICKERING, JAMES VAN ALLEN, and WERNHER VON BRAUN displaying a full-

²³⁷⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

scale model of *Explorer 1* at a crowded news conference in Washington, DC after confirmation that the satellite was in orbit.²³⁷⁷

Born 11958 HE: NEIL DEGRASSE TYSON, United States, astrophysicist, cosmologist, author, and science communicator.

- ⇒ **11996 HE – present HE**, 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.²³⁷⁸
- ⇒ TYSON served on a **12001 HE** government commission on the future of the U.S. aerospace industry, and on the **12004 HE** Moon, Mars and Beyond commission.

²³⁷⁷ https://en.wikipedia.org/wiki/Explorer_1

²³⁷⁸ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

- ⇒ **12004 HE:** TYSON was awarded the NASA Distinguished Public Service Medal. The U.S. National Academy of Sciences awarded Tyson the Public Welfare Medal in **12015 HE** for his "extraordinary role in exciting the public about the wonders of science".²³⁷⁹
- ⇒ **12014 HE:** NEIL deGRASSE TYSON hosted the television series Cosmos: A Spacetime Odyssey, a successor to CARL SAGAN'S **11980 HE** series Cosmos: A Personal Voyage.²³⁸⁰

²³⁷⁹ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

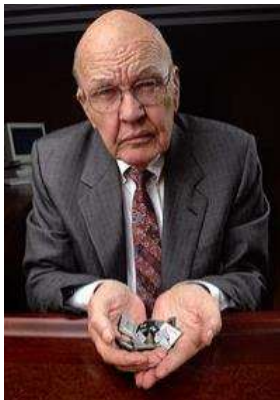
²³⁸⁰ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson



12009 HE NEIL deGRASSE TYSON, photographer and
location unknown²³⁸¹

²³⁸¹ https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson

11958 HE: Patent of integrated circuit at Texas Instruments.²³⁸²



12000 HE: JACK KILBY (11923 HE – 12005 HE) was a United States electrical engineer who was awarded the Nobel

²³⁸² https://en.wikipedia.org/wiki/Jack_Kilby

Prize in 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."²³⁸³

²³⁸³ https://en.wikipedia.org/wiki/Jack_Kilby



11958 HE: JACK KILBY'S original integrated circuit, photographer and location unknown.²³⁸⁴

- ⇒ 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

²³⁸⁴ https://en.wikipedia.org/wiki/Jack_Kilby

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.²³⁸⁵

²³⁸⁵ https://en.wikipedia.org/wiki/Jack_Kilby

11959 HE – 11960 HE:



The Henney Kilowatt was an electric car introduced in the US for two years.²³⁸⁶

²³⁸⁶ https://en.wikipedia.org/wiki/Henney_Kilowatt

11960 HE – current: SUZANNE SIMARD is a Canadian scientist and Professor in the Department of Forest and Conservation Sciences at the University of British Columbia. SIMARD is best known for the research she conducted on the underground networks of forests characterized by fungi and roots. SIMARD studies how these fungi and roots facilitate communication and interaction between trees and plants of an ecosystem. Within the communication between trees and plants is the exchange of carbon, water, nutrients, and defense signals between trees.²³⁸⁷

On YouTube you can see among other videos: The Secret Language of Trees by Camille Defrenne and SUZANNE SIMARD and watch TED and other talks with SUZANNE SIMARD and learn how

²³⁸⁷ https://en.wikipedia.org/wiki/Suzanne_Simard

trees are able to communicate with each other through a vast root system and symbiotic fungi, called mycorrhizae.²³⁸⁸



DR. SUZANNE SIMARD²³⁸⁹

²³⁸⁸ <https://www.youtube.com/watch?v=V4m9SefyRjg&t=1s>

²³⁸⁹ https://en.wikipedia.org/wiki/Suzanne_Simard

Born circa 11960 HE: SUE O'CONNOR,²³⁹⁰ 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.
- ⇒ In **12017 HE** O'CONNOR's research team recovered the world's oldest fishhooks from an ancient burial site in Indonesia. Five circular, rotating hooks, probably used for deep-sea fishing, were found under the chin and around the jaws of an adult female

²³⁹⁰ http://archive.archaeology.org/1203/trenches/jerimalai_cave_east_timor_fish_hooks.html

skeleton buried 12000 years ago. (See also **circa 11000 BHE – 4000 BHE**: Jerimalai cave site in East Timor.)



SUE O'CONNOR, photographer, date and location unknown.²³⁹¹

²³⁹¹ <https://www.australianarchaeologicalassociation.com.au/awards/rhys-jones-medal/sue-oconnor/>

11961 HE: YURI GARGARIN, Soviet Union, is the first human to orbit earth.²³⁹²



YURI GAGARIN (11934 HE – 11968 HE) in Helsinki, photographer unknown.²³⁹³

²³⁹² <https://www.archives.gov/research/alic/reference/space-timeline.html>

²³⁹³ https://en.wikipedia.org/wiki/Yuri_Gagarin

11961 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.²³⁹⁴ 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 **11971 HE:** This Photo is of ALAN

²³⁹⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

SHEPPARD on the moon. SHEPPARD was the only Mercury astronaut to become a moon walker.²³⁹⁵



Photo is of American Astronaut ALAN SHEPPARD (**11923 HE** – **11998 HE**), and his wife Louise meeting First Lady Jacqueline Kennedy, President John F. Kennedy and Vice President Lyndon B. Johnson at the South Portico of the White House.²³⁹⁶

²³⁹⁵ https://en.wikipedia.org/wiki/Alan_Shepard

²³⁹⁶ https://en.wikipedia.org/wiki/Alan_Shepard

Circa 11961 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.²³⁹⁷

⇒ 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 Leverton, Jerri Sloan, Hamilton Sloan Truhill, Bernice Trimble Steadman.²³⁹⁸

²³⁹⁷

<https://www.npr.org/templates/story/story.php?storyId=4770249&storyid=4770249?storyId=4770249&storyid=4770249>

²³⁹⁸ https://en.wikipedia.org/wiki/Mercury_13

11962 HE: United States, Bell Laboratories *Telstar 1* – first commercial communications satellite launched.²³⁹⁹



Photo is of a Model of a *Telstar* satellite, on display at Conservatoire national des arts et métiers.²⁴⁰⁰

²³⁹⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴⁰⁰ <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 **1964** **HE** to discover the Cosmic Microwave Background).²⁴⁰¹

²⁴⁰¹ <https://en.wikipedia.org/wiki/Telstar>

11963 HE: VALENTINA TERESHKOVA, Soviet engineer, first woman in space.



11963 HE photo of VALENTINA TERESHKOVA.²⁴⁰²

²⁴⁰² <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>

11964 HE; ARNO ALLAN PENZIAS, German Physicist who with ROBERT WOODROW WILSON, United States Physicist, discover the Cosmic Microwave Background.^{2403 2404}



ARNO ALLAN PENZIAS (right), German Physicist with

²⁴⁰³ https://en.wikipedia.org/wiki/Robert_Woodrow_Wilson

²⁴⁰⁴ 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.²⁴⁰⁵

11964 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.²⁴⁰⁶

²⁴⁰⁵ https://en.wikipedia.org/wiki/Arno_Allan_Penzias

²⁴⁰⁶ https://en.wikipedia.org/wiki/History_of_rail_transport



11964 HE: Photo is of a *0-Series Shinkansen*, which triggered the intercity train travel boom.²⁴⁰⁷

²⁴⁰⁷ https://en.wikipedia.org/wiki/History_of_rail_transport



12016 HE: Shinkansen in Osaka.²⁴⁰⁸

²⁴⁰⁸ Image: Premack family photo

11965 HE: ALEXI LEONOV, Soviet Cosmonaut – first spacewalker.
Three months later, United States Astronaut ED WHITE did a
spacewalk.²⁴⁰⁹



Photo of ALEXI LEONOV is from **11974 HE.**²⁴¹⁰

²⁴⁰⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴¹⁰ https://en.wikipedia.org/wiki/Alexey_Leonov



Photo of ED WHITE is from **11966 HE**.²⁴¹¹

11966 HE: Television premier of Star Trek.²⁴¹²

Born 11966 HE: SEAN MICHAEL CARROLL is a USA cosmologist and physics professor specializing in dark energy and general

²⁴¹¹ [https://en.wikipedia.org/wiki/Ed_White_\(astronaut\)](https://en.wikipedia.org/wiki/Ed_White_(astronaut))

²⁴¹² PAUL PREMACK, personal witness to event.

relativity. 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..²⁴¹³

Born 11967 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. TEGMARK has also

²⁴¹³ https://en.wikipedia.org/wiki/Sean_M._Carroll

<https://www.bing.com/images/search?q=image%20sean%20m%20carroll&id=56979022668C2A97142571DBFE5DF6BD2DD74357&FORM=IQFRBA>

formulated the "Ultimate Ensemble theory of everything", whose only postulate is that "all structures that exist mathematically exist also physically".²⁴¹⁴



Photo of MAX TEGMARK, photographer, date, location unknown.²⁴¹⁵

²⁴¹⁴ https://en.wikipedia.org/wiki/Max_Tegmark

²⁴¹⁵ https://en.wikipedia.org/wiki/Max_Tegmark

11968 HE: Seiko Epson, Japan, EP-101 the world's first miniprinter, is launched.²⁴¹⁶



Photo of the world's first miniprinter. Dimensions and photographer unknown.²⁴¹⁷

²⁴¹⁶ <https://epson.com/company-history>

²⁴¹⁷ <https://epson.com/company-history>

11968 HE: ROBERT NORTON NOYCE, United States, founded Intel.²⁴¹⁸



Photo is of ROBERT NORTON NOYCE (**11927 HE – 11990 HE**) in front of the Intel SC1 building in Santa Clara in **11970 HE**. Nicknamed “the Mayor of Silicon Valley,” ROBERT NORTON NOYCE, along with JACK KILBY, are credited with the realization of the first integrated circuit or microchip that

²⁴¹⁸ https://en.wikipedia.org/wiki/Robert_Noyce

fueled the personal computer revolution and gave Silicon Valley its name.²⁴¹⁹

⇒ ROBERT NORTON NOYCE was granted 15 patents.²⁴²⁰

Born 11968 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.²⁴²¹ 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

²⁴¹⁹ https://en.wikipedia.org/wiki/Robert_Noyce

²⁴²⁰ https://en.wikipedia.org/wiki/Robert_Noyce

²⁴²¹ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

detectors at a distance of 420 meters from the interaction points of the main experiments.²⁴²²

- ⇒ 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

²⁴²² [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

the Universe. COX won twice at the Broadcasting Press Guild Awards for “Best Performer” in a non-acting role, while Wonders of the Solar System was named best documentary series of **12010 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 **12016 HE**.²⁴²³

²⁴²³ [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, **12016 HE**.²⁴²⁴

11968 HE: The first computer mouse was sold (but not widely adopted until **11980s HE**).²⁴²⁵

²⁴²⁴ [https://en.wikipedia.org/wiki/Brian_Cox_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

²⁴²⁵ <http://www.computerhistory.org/timeline/computers/>

⇒ **11968 HE**: The GUI (graphical user interface) was actually the baby of DOUGLASS ENGELBART (**11925 HE – 12013 HE**) who demonstrated in **11968 HE** an operating system with a mouse pointer being inspired by an essay written in **11945 HE** (Author / Compiler wonders by whom?) about making a computer more interactive.²⁴²⁶

- 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. Microsoft understood the GUI was the thing that would allow a user to interface with their computer using

²⁴²⁶ SciShow 5-2-12016HE youtube.com Video: The Truth About 10 Famous Inventions
<https://www.youtube.com/watch?v=g-KuigAQFp4>

windows rather than typing lines of commands into prompts. Microsoft made the GUI suitable for business.²⁴²⁷

- 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 **11968 HE**. “Engelbart's Law”, the observation that the intrinsic rate of human performance is exponential, is named after him.

²⁴²⁷ SciShow 5-2-12016HE 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..²⁴²⁸

²⁴²⁸ https://en.wikipedia.org/wiki/Douglas_Engelbart



ENGELBART'S prototype of a computer mouse, as designed by Bill English from ENGELBART'S sketches.²⁴²⁹

²⁴²⁹ Edwards, Benj (2008-12-09). "*The computer mouse turns 40*". Macworld. and https://en.wikipedia.org/wiki/Douglas_Engelbart

11969 HE: First United States (NASA) moon landing, Apollo 11.²⁴³⁰



Eagle, the Lunar Module ascent stage of Apollo 11 in orbit above the Moon. Earth is visible in the distance.²⁴³¹

²⁴³⁰ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴³¹ https://en.wikipedia.org/wiki/Apollo_Lunar_Module

11969 HE: ARPANET, the forerunner to the modern internet.²⁴³² 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.²⁴³³

11970 HE: DRAM memory introduced by Intel.²⁴³⁴ 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.²⁴³⁵

²⁴³² <http://www.computerhistory.org/timeline/computers/>

²⁴³³ <https://en.wikipedia.org/wiki/ARPANET>

²⁴³⁴ <http://www.computerhistory.org/timeline/computers/>

²⁴³⁵ https://en.wikipedia.org/wiki/Dynamic_random-access_memory

Starting **11970s 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.²⁴³⁶

⇒ **11980 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.
- **11987 HE:** Mifepristone became available France.
- **12000 HE:** Mifepristone became available the United States.

²⁴³⁶ https://en.wikipedia.org/wiki/Medical_abortion

- **12017 HE:** Mifepristone became available in Canada.²⁴³⁷

11970 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.²⁴³⁸

²⁴³⁷ <https://en.wikipedia.org/wiki/Mifepristone>

²⁴³⁸ <https://www.archives.gov/research/alic/reference/space-timeline.html>



The Soviet *Luna 16* location and date unknown.²⁴³⁹



²⁴³⁹ https://en.wikipedia.org/wiki/Luna_16



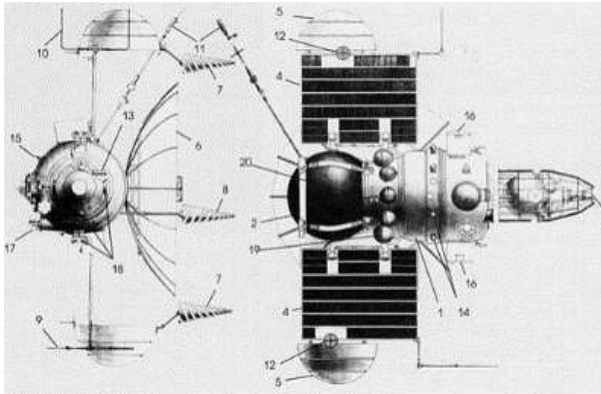
Launch of NASA Apollo 13 photographer unknown.²⁴⁴⁰

²⁴⁴⁰ Jpeg NASA.gov



The Soviet *Lunokhod 1* location and date unknown²⁴⁴¹

²⁴⁴¹ https://en.wikipedia.org/wiki/Lunokhod_1



The Soviet *Venera 7* was the first space probe to transmit data from another planet back to Earth²⁴⁴²

²⁴⁴² https://en.wikipedia.org/wiki/Venera_7

11971 HE: Email invented by RAY TOMLINSON. 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.²⁴⁴³

- ⇒ 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

²⁴⁴³ <http://www.computerhistory.org/timeline/computers/>

complete revolution, fundamentally changing the way people communicate".^{2444 2445}



12004 HE photo of RAY TOMLINSON (**11941 HE – 12016 HE**), photographer and location unknown.²⁴⁴⁶

²⁴⁴⁴ https://en.wikipedia.org/wiki/Ray_Tomlinson

²⁴⁴⁵ <http://www.computerhistory.org/timeline/computers/>

²⁴⁴⁶ https://en.wikipedia.org/wiki/Ray_Tomlinson

Circa 11971 HE – circa 11979 HE: GARY STARKWEATHER, United States engineer and inventor, who worked in Xerox's product development department, had the idea in **11969 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 invented and was 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.²⁴⁴⁷

²⁴⁴⁷ https://en.wikipedia.org/wiki/Laser_printing



12009 HE Photo of GARY STARKWEATHER (Born **11938 HE**).²⁴⁴⁸

11971 HE – 11972 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

²⁴⁴⁸ https://en.wikipedia.org/wiki/Gary_Starkweather

during the *Apollo 15* mission. The "moon buggy" was developed by Boeing and GM subsidiary Delco Electronics.²⁴⁴⁹



11971 HE: The U.S. Apollo *Lunar Rover* from *Apollo 15* on the Moon.²⁴⁵⁰

²⁴⁴⁹ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

²⁴⁵⁰ https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle



11972 HE: JOHN YOUNG works at the *Lunar Rover* on *Apollo 16*.²⁴⁵¹

²⁴⁵¹ https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle

11971 HE: Soviet space station *Salyut 1* was launched. United States *Mariner 9* probe became the first craft to orbit another world - Mars.²⁴⁵²



Photo of *Salyut 1* as seen from *Soyuz 1*.²⁴⁵³

²⁴⁵² <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴⁵³ https://en.wikipedia.org/wiki/Salyut_1

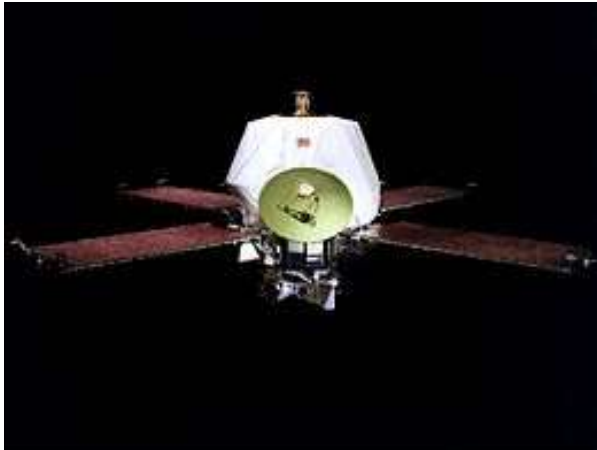
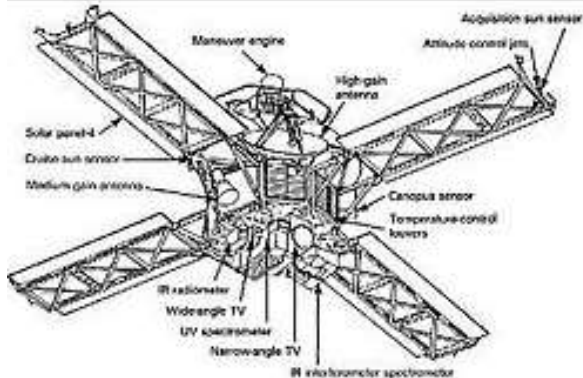


Photo of *Mariner 9*. Unknown location, photographer.²⁴⁵⁴

²⁴⁵⁴ <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.²⁴⁵⁵

²⁴⁵⁵ https://en.wikipedia.org/wiki/Mariner_9

11972 HE: United States Astronauts EUGENE CERNAN and HARRISON "JACK" SCHMITT became the last astronauts to walk on the moon, to date.²⁴⁵⁶



11971 HE Photo is of US Astronaut EUGENE CERNAN (11934 HE - 12017 HE.²⁴⁵⁷)

²⁴⁵⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴⁵⁷ https://en.wikipedia.org/wiki/Gene_Cernan



11971 HE Photo is of US Astronaut HARRISON SCHMITT (born **11935 HE**)²⁴⁵⁸.

11972 HE: NASA *Pioneer 10* is launched to Jupiter.²⁴⁵⁹

²⁴⁵⁸ https://en.wikipedia.org/wiki/Harrison_Schmitt

²⁴⁵⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>



Pioneer 10 in the final stages of construction.²⁴⁶⁰

²⁴⁶⁰ https://en.wikipedia.org/wiki/Pioneer_10

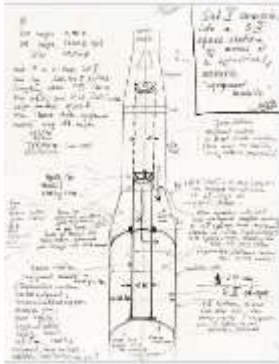
11973 HE: United States *Skylab* is launched on board the modified *Saturn V* rocket. The space station is made from the upper stage of the *Saturn V* rocket.²⁴⁶¹



Image of *Skylab* in Earth orbit. Unknown photographer or date.²⁴⁶²

²⁴⁶¹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴⁶² www.washingtonpost.com image of Skylab



11964 HE: WERNHER VON BRAUN (SEE 11912 HE – 11977 HE) sketch of a Space Station based on conversion of a Saturn V stage.²⁴⁶³

²⁴⁶³ <https://en.wikipedia.org/wiki/Skylab>

11975 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 **11922 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."²⁴⁶⁴

11975 HE: Microsoft founded by BILL GATES III and PAUL ALLEN.²⁴⁶⁵ Microsoft's first operating system was a version of Unix called Xenix, released in **11980 HE**. Microsoft's first wildly successful operating system was MS-DOS, which Microsoft wrote for IBM in **11981 HE** and was based on Tim Paterson's QDOS. In the deal of the century, BILL GATES only *licensed* MS-DOS to IBM. By retaining the rights to the software, BILL GATES made a

²⁴⁶⁴ <https://www.nobelprize.org/prizes/physics/1975/summary/>

²⁴⁶⁵ <https://www.thoughtco.com/microsoft-history-of-a-computing-giant-1991140>

fortune for Microsoft, and Microsoft became a major software vendor.²⁴⁶⁶

⇒ **11985 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.²⁴⁶⁷

²⁴⁶⁶ https://en.wikipedia.org/wiki/History_of_Microsoft

²⁴⁶⁷ https://en.wikipedia.org/wiki/History_of_Microsoft



12018 HE: BILL GATES III (born **11955 HE**) at the United States Department of Health and Human Services.²⁴⁶⁸ GATES has written two books: **11995 HE:** *The Road Ahead*, written with Microsoft executive Nathan Myhrvold and journalist Peter

²⁴⁶⁸ 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. **11999 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.²⁴⁶⁹

- **12000 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.²⁴⁷⁰

²⁴⁶⁹ https://en.wikipedia.org/wiki/Bill_Gates

²⁴⁷⁰ https://en.wikipedia.org/wiki/Bill_and_Melinda_Gates_Foundation



12013 HE: photo of PAUL ALLEN (**11953 HE – 12018 HE**) at Flying Heritage Collection.²⁴⁷¹ ALLEN is the founder of Vulcan Inc, Allen Institute for Brain Science, Institute for Artificial

²⁴⁷¹ https://en.wikipedia.org/wiki/Paul_Allen

Intelligence, Institute for Cell Science, and Stratolaunch Systems.²⁴⁷²

⇒ 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.

²⁴⁷² 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.²⁴⁷³

²⁴⁷³ https://en.wikipedia.org/wiki/Paul_Allen

11975 HE: US-Soviet space craft rendezvous and dock.²⁴⁷⁴



Photo is of US-Soviet space craft rendezvous and dock, photographer unknown.²⁴⁷⁵

11976 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.

²⁴⁷⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁴⁷⁵ Getty images

- ⇒ 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 **12012 HE**.²⁴⁷⁶

²⁴⁷⁶ https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html



Enterprise with NASA Administrator Fletcher, and Star Trek cast members.²⁴⁷⁷

²⁴⁷⁷ https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html

11976 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.²⁴⁷⁸



Photo is of an original **11976 HE** Apple 1 Computer in a briefcase, from the Sydney Powerhouse Museum collection.²⁴⁷⁹

²⁴⁷⁸ https://en.wikipedia.org/wiki/Steve_Wozniak

²⁴⁷⁹ <http://www.computerhistory.org/timeline/computers/>



12017 HE: Photo of STEVE WOZNIAK (Born **11950 HE**)
United States inventor, electronics engineer, programmer,
philanthropist, and technology entrepreneur.²⁴⁸⁰

²⁴⁸⁰ https://en.wikipedia.org/wiki/Steve_Wozniak

- 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.²⁴⁸¹
- 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 \$1300 and assembled the

²⁴⁸¹ https://en.wikipedia.org/wiki/Steve_Wozniak

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.^{2482 2483}

²⁴⁸² https://en.wikipedia.org/wiki/Steve_Wozniak

²⁴⁸³ Freiburger, 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.



12010 HE: photo at the Worldwide Developers Conference of STEVE JOBS (11955 HE – 12011 HE).²⁴⁸⁴

11977 HE: *Voyager 1 and 2* are launched. They reach the edge of the solar system in **12018 HE**.²⁴⁸⁵

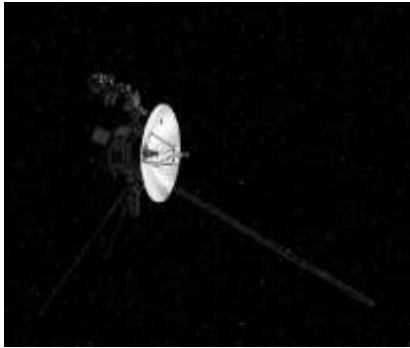
²⁴⁸⁴ https://en.wikipedia.org/wiki/Steve_Jobs

²⁴⁸⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>



Image of *Voyager 1*. Location and artist unknown.²⁴⁸⁶

²⁴⁸⁶ <https://voyager.jpl.nasa.gov/>



Artist's concept of the *Voyager 2* spacecraft in space. Credit: NASA.²⁴⁸⁷

⇒ After completing its primary mission with the flyby of Saturn on November 12 **11980 HE**, *Voyager 1* became the third of five

²⁴⁸⁷ <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 **12012 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 **12018 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 **12018 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.²⁴⁸⁸



Circa 11979 HE: Screen Snips of 8 of the many photos of Jupiter and area taken by *Voyager 2*.²⁴⁸⁹

²⁴⁸⁸ https://en.wikipedia.org/wiki/Voyager_1

²⁴⁸⁹ https://en.wikipedia.org/wiki/Voyager_2

⇒ **12270 HE:** *Voyager* famously and fictionally returns to our Solar System in the film *Star Trek: The Motion Picture* (released in **11979 HE**).²⁴⁹⁰

11979 HE: VisiCalc is the first commercial software widely adopted.²⁴⁹¹

11979 HE: WordStar is first commercial word processor.²⁴⁹²

11980 HE: Atari gaming console introduced.²⁴⁹³

²⁴⁹⁰ PAUL PREMACK

²⁴⁹¹ <http://www.computerhistory.org/timeline/computers/>

²⁴⁹² <http://www.computerhistory.org/timeline/computers/>

²⁴⁹³ <http://www.computerhistory.org/timeline/computers/>



The third version of the Atari Video Computer System sold from **11980 HE** to **11982 HE**.²⁴⁹⁴

²⁴⁹⁴ <https://en.wikipedia.org/wiki/Atari>

11980 HE: MS-DOS operating system first introduced.²⁴⁹⁵

Circa 11980 HE: Daisy wheel and Dot matrix printers introduced.



Photo is of The Royal LetterMaster, a daisy-wheel printer²⁴⁹⁶

²⁴⁹⁵ <http://www.computerhistory.org/timeline/computers/>

²⁴⁹⁶ https://en.wikipedia.org/wiki/Daisy_wheel_printing



Photo is of the **11980 HE** MX-80 Epson Dot matrix printer²⁴⁹⁷

²⁴⁹⁷ <https://epson.com/company-history>

11981 HE: IBM 5150 PC with IBM 5151 monitor introduced.²⁴⁹⁸



Photo is of the IBM PC, location, photographer unknown.²⁴⁹⁹

²⁴⁹⁸ <http://www.computerhistory.org/timeline/computers/>

²⁴⁹⁹ <http://www.computerhistory.org/timeline/computers/>

11981 HE: RICHARD FEYNMAN introduces the idea for quantum computing.²⁵⁰⁰

11981 HE: A new era in space flight began on April 12 **11981 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 **11972 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.²⁵⁰¹

²⁵⁰⁰ <http://www.computerhistory.org/timeline/computers/>

²⁵⁰¹ https://www.nasa.gov/multimedia/imagegallery/image_feature_2488.html



11981 HE: Launch of STS-1 Space Shuttle *Columbia*,
photographer unknown.²⁵⁰²

11981 HE: The NASA/DOE 7.5-megawatt Mod-2 three turbine cluster in Goodnoe Hills, Washington, United States.²⁵⁰³



Image of the NASA/DOE 7.5-megawatt Mod-2 three turbine cluster.

²⁵⁰² https://www.nasa.gov/mission_pages/shuttle/sts1/index.html

²⁵⁰³ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

11981 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.



11996 HE: Canadarm during Space Shuttle mission STS-72.²⁵⁰⁴

²⁵⁰⁴ <https://en.wikipedia.org/wiki/Canadarm>

11981 HE: *Voyager 2* reached Saturn and began transmitting images.²⁵⁰⁵ **11986 HE:** images arrive from Uranus, and in **11989 HE** images arrive from Neptune.



Circa 11981 HE: 8 of the many photos of Saturn and area taken by *Voyager 2*.²⁵⁰⁶

²⁵⁰⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁵⁰⁶ https://en.wikipedia.org/wiki/Voyager_2

Built between 1983 HE and 1998 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 10000 scientists and hundreds of universities and laboratories, as well as more than 100 countries.²⁵⁰⁷

⇒ On 4 July **2012 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

²⁵⁰⁷ https://en.wikipedia.org/wiki/Large_Hadron_Collider

by chance alone is less than 1 in 3 million. The two teams had been working 'blinded' from each other from around late **12011 HE** or early **12012 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.²⁵⁰⁸

- ⇒ **12015 HE**: The LHC's experimental work since restarting in **12015 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 **12015 HE** has provided strong evidence of the predicted direct decay into fermions such as pairs of bottom quarks (3.6

²⁵⁰⁸ https://en.wikipedia.org/wiki/Higgs_boson

sigma) - described as an "important milestone" in understanding its short lifetime and other rare decays - and also to confirm decay into pairs of tau 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".²⁵⁰⁹

⇒ **12017 HE**: The Large Hadron Collider has continued to produce findings that confirm the **12013 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".²⁵¹⁰

²⁵⁰⁹ https://en.wikipedia.org/wiki/Higgs_boson

²⁵¹⁰ https://en.wikipedia.org/wiki/Higgs_boson

⇒ **12018 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.²⁵¹¹

11983 HE: Nintendo introduced their first gaming console outside Japan.²⁵¹²



The Nintendo Entertainment System.²⁵¹³

²⁵¹¹ https://en.wikipedia.org/wiki/Higgs_boson

²⁵¹² <http://www.computerhistory.org/timeline/computers/>

²⁵¹³ https://en.wikipedia.org/wiki/Nintendo_video_game_consoles

11983 HE: GUION BLUFORD (Born **11942 HE**) is the first United States African-American astronaut in space.²⁵¹⁴



Photo of GUION BLUFORD, photographer unknown.²⁵¹⁵

²⁵¹⁴ https://en.wikipedia.org/wiki/Guion_Bluford

²⁵¹⁵ https://en.wikipedia.org/wiki/Guion_Bluford

11983 HE: SALLY RIDE (11951 HE – 12012 HE)²⁵¹⁶ is the first United States female astronaut in space.



Photo of SALLY RIDE on Challenger's mid-deck during STS-7; photographer unknown.²⁵¹⁷

²⁵¹⁶ https://en.wikipedia.org/wiki/Sally_Ride

²⁵¹⁷ <https://www.archives.gov/research/alice/reference/space-timeline.html>

11984 HE: KATHRYN SULLIVAN (born **11951 HE**²⁵¹⁸) is the first United States woman to do a spacewalk.



Photo of KATHRYN SULLIVAN; photographer unknown.²⁵¹⁹

²⁵¹⁸ https://en.wikipedia.org/wiki/Kathryn_D._Sullivan

²⁵¹⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

11984 HE: Apple's Macintosh introduced the GUI (graphical user interface).²⁵²⁰



The Mac GUI was the first commercially successful product to use a multi-panel window interface.²⁵²¹

²⁵²⁰ <http://www.computerhistory.org/timeline/computers/>

²⁵²¹ https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC

11985 HE: Microsoft Windows 1.01 including GUI introduced.²⁵²²

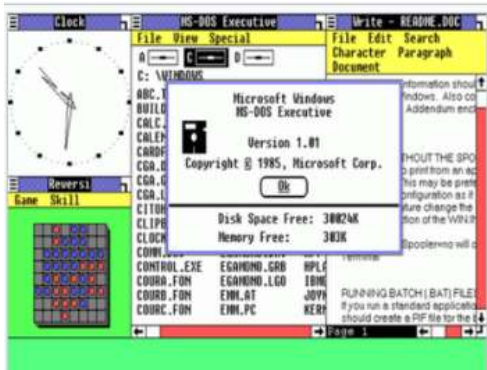


Photo is a screen snip of Windows 1.01.²⁵²³

²⁵²² <http://www.computerhistory.org/timeline/computers/>

²⁵²³ https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC

11986 HE – 12001 HE: Soviet space station *Mir*.



11998 HE: Soviet Union (and later Russia's) space station *Mir* seen from Space Shuttle *Endeavour* during STS-89.²⁵²⁴

²⁵²⁴ <https://en.wikipedia.org/wiki/Mir>

Circa 11987 HE - current: MERLIN SHELDRAKE is an expert in mycorrhizal fungi, holds a PhD in tropical ecology from the University of Cambridge for his work on underground fungal networks in tropical forests in Panama, where he was a predoctoral research fellow of the Smithsonian Tropical Research Institute, and he is on the advisory board of the Society for the Protection of Underground Networks.

C 12020 HE SHELDRAKE wrote Entangled Life: How Fungi Make Our Worlds, Change Our Minds, and Shape Our Futures. It is a non-fiction book on mycology. The Illustrated Edition of the above book has beautiful photography.²⁵²⁵

See YouTube videos of SHELDRAKE speaking to the UK Parliament Science, Technology & Innovation Committee; the BBC

²⁵²⁵ https://en.wikipedia.org/wiki/Entangled_Life

Breakfast, and see trailers for the IMAX movie narrated by Bjork
Fungi: Web of Life.²⁵²⁶

11988 HE: The International Dark Sky Association was formed. 100 years after Vincent Van Gogh painted “Starry Night over the Rhone” in **11888 HE**, almost 400 years to the date to the beginning of the Industrial Revolution which began around **11589 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.^{2527 2528}

²⁵²⁶ https://www.youtube.com/results?search_query=merlin+sheldrake+and+more....

²⁵²⁷ <http://darksky.org>

²⁵²⁸ Author / Compiler worked with DAVID CRAWFORD and many concerned Texans to enact the woefully inadequate Texas Dark Sky law, circa **11996 HE– 12000 HE**, sponsored by then

⇒ The mission of the IDA is "to preserve and protect the nighttime 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 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.²⁵²⁹

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.

²⁵²⁹ <http://darksky.org>

- ⇒ 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.²⁵³⁰



- ⇒ DAVID CRAWFORD, photographer and date unknown.²⁵³¹

²⁵³⁰

file:///C:/Users/pprem/AppData/Local/Microsoft/Windows/INetCache/Content.Outlook/51DO6AB
T/Robert_Dick_SkyTel_Jun16.pdf

²⁵³¹ bing.com/images/search?idaquebec.org

⇒ For more about dark skies, visit www.darksky.org or visit www.mcdonaldobservatory.com/darkskies.²⁵³²

11989 HE: World Wide Web, invented by TIM BERNERS-LEE,²⁵³³ also known as TimBL, an English engineer and computer scientist.²⁵³⁴

⇒ **11991 HE:** The first website was built and put online on for the first time at CERN. Despite this being an international

²⁵³² 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 eyes to see at night. 4) Yes a protection of nature 5) Yes a protection of Health 6) Yes a security measure.

²⁵³³ <http://www.computerhistory.org/timeline/computers/>

²⁵³⁴ https://en.wikipedia.org/wiki/Tim_Berners-Lee

organization hosted by Switzerland, the office that BERNERS-LEE used was just across the border in France.²⁵³⁵

- 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 were made daily to the information available on the page as the WWW project developed.²⁵³⁶
- **11992 HE:** BERNERS-LEE introduced the first web browser.²⁵³⁷

²⁵³⁵ <http://www.computerhistory.org/timeline/computers/>

²⁵³⁶ <http://www.computerhistory.org/timeline/computers/>

²⁵³⁷ <http://www.computerhistory.org/timeline/computers/>

- 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 express consent.²⁵³⁸

²⁵³⁸ https://en.wikipedia.org/wiki/Tim_Berners-Lee



12015 HE Photo is of SIR TIMOTHY JOHN BERNERS-LEE
OM KBE FRS FREng FRSA FBCS (born **11955 HE**).²⁵³⁹

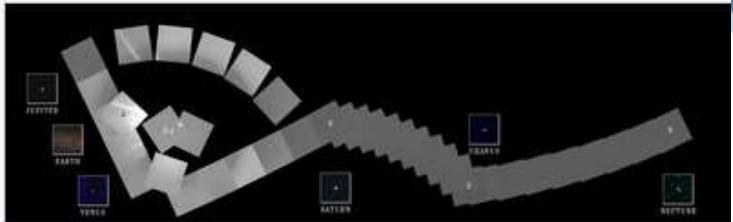
²⁵³⁹ https://en.wikipedia.org/wiki/Tim_Berners-Lee

11990 HE: Two of the many photos taken by *Voyager 1*:



11990 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.²⁵⁴⁰

²⁵⁴⁰ https://en.wikipedia.org/wiki/Pale_Blue_Dot



11990 HE: The Family Portrait of our Solar System from *Voyager 1*.²⁵⁴¹

1990 HE: TOYOHIRO AKIYAMA (born **11942 HE**) was the first Japanese astronaut and was on the Soviet Union spaceship *Soyuz TM-11*.

²⁵⁴¹ https://en.wikipedia.org/wiki/Voyager_1



Photo is of TOYOHIRO AKIYAMA.²⁵⁴²

²⁵⁴² https://en.wikipedia.org/wiki/List_of_Japanese_astronauts

11990 HE: The *Magellan* spacecraft began mapping the surface of Venus using radar equipment. The Space Shuttle *Discovery* deployed the *Hubble Space Telescope*.²⁵⁴³



Photo is of *Magellan* being fixed into position inside the payload bay of shuttle *Atlantis* prior to launch.²⁵⁴⁴

²⁵⁴³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁵⁴⁴ [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.²⁵⁴⁵

²⁵⁴⁵ https://en.wikipedia.org/wiki/Hubble_Space_Telescope

11992 HE: MAMORU MOHRI, Japan. Scientist who flew on the *Endeavour STS-47*.



Photo is of MAMORU MOHRI.²⁵⁴⁶

²⁵⁴⁶ https://en.wikipedia.org/wiki/List_of_Japanese_astronauts

11994 HE: Dr. CHIAKI MUKAI (born **11952 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 **11994 HE**, which was a Spacelab mission.
- Her second spaceflight was STS-95 aboard Space Shuttle *Discovery* in **11998 HE**. In total Dr. CHIAKI MUKAI has spent 23 days in space.²⁵⁴⁷

²⁵⁴⁷ https://en.wikipedia.org/wiki/Chiaki_Mukai



Photo of Dr. CHIAKI MUKAI.²⁵⁴⁸

²⁵⁴⁸ https://en.wikipedia.org/wiki/Chiaki_Mukai

11993 HE: Epson reaches its 5-year goal to be CFC free.



2549

11994 HE: Sony introduced the PlayStation.²⁵⁵⁰



⇒ Photo of the Original PlayStation, photographer unknown.²⁵⁵¹

²⁵⁵⁰ <http://www.computerhistory.org/timeline/computers/>

²⁵⁵¹ <https://en.wikipedia.org/wiki/PlayStation>

11994 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.²⁵⁵²

²⁵⁵² <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 **12001 HE**. The initial *LIGO* observatories were funded by the National Science

Foundation (NSF) and were conceived, built, and are operated by Caltech and MIT.²⁵⁵³

- ⇒ 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.

²⁵⁵³ <https://en.wikipedia.org/wiki/LIGO>



- EGO is the European Gravitational Observatory *VIRGO*, photographer unknown.²⁵⁵⁴
- ⇒ **12015 HE – 12017 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,

²⁵⁵⁴ <https://www.ego-gw.it/public/about/whatIs.aspx>

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.²⁵⁵⁵

⇒ **12017 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."²⁵⁵⁶

²⁵⁵⁵ https://en.wikipedia.org/wiki/Gravitational_wave

²⁵⁵⁶ <https://en.wikipedia.org/wiki/LIGO>



- RAINER WEISS, born **11932 HE**, is a United States physicist, contributor in gravitational physics and

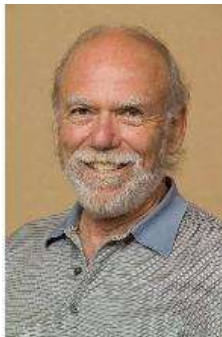
astrophysics. He invented the laser interferometric technique which is the basic operation of *LIGO*.²⁵⁵⁷



- **KIP THORNE:** born **11940** **HE** is a United States theoretical physicist and Nobel laureate, known for his contributions in

²⁵⁵⁷ https://en.wikipedia.org/wiki/Rainer_Weiss

gravitational physics and astrophysics. He continues to do scientific research and scientific consulting.²⁵⁵⁸



- **BARRY CLARK BARISH** born **11936 HE** is a United States experimental physicist and Nobel Laureate. He is a leading

²⁵⁵⁸ https://en.wikipedia.org/wiki/Kip_Thorne

expert on gravitational waves, and is Linde Professor of Physics, emeritus at California Institute of Technology.²⁵⁵⁹

⇒ Circa **12017 HE: SAMAYA NISSANKE**, Dutch Astrophysicist from Radboud University and²⁵⁶⁰ **SHEILA ROWAN**, Scottish Astrophysicist from University of Glasgow²⁵⁶¹ 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

²⁵⁵⁹ https://en.wikipedia.org/wiki/Barry_Barish

²⁵⁶⁰ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

²⁵⁶¹ [https://en.wikipedia.org/wiki/Sheila_Rowan_\(physicist\)](https://en.wikipedia.org/wiki/Sheila_Rowan_(physicist))

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 astrophysicists like us, the most exciting part is only just beginning"²⁵⁶² and "The night skies are incredibly dynamic and time-varying - and some of these transient sources shine brightly in both gravitational and electromagnetic radiation."²⁵⁶³

²⁵⁶² Podcast: BBC Science Hour October 21 12017 HE

²⁵⁶³ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>



SAMAYA NISSANKE, date, location, photographer
unknown.²⁵⁶⁴

²⁵⁶⁴ <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

11994 HE: First direct observation of a comet impacting Jupiter.



NASA/JPL composite image of fragments from comet SHOEMAKER-LEVY colliding with Jupiter. (See **11928 HE**, EUGENE SHOEMAKER).²⁵⁶⁵

²⁵⁶⁵ <https://www2.jpl.nasa.gov/sl9/sl9.html>

11995 HE: United States Astronaut Eileen Collins (born **11956 HE**) became the first female Space Shuttle *Pilot*.²⁵⁶⁶



Photo of American Astronaut Eileen Collins with President William Jefferson Clinton, location: The White House. (Hillary

²⁵⁶⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

Clinton was also present²⁵⁶⁷, but we could not find a photo including all their faces). [See **11999 HE** when Collins became first female Shuttle *Commander*.]

11995 HE: CHRIS AUSTIN HADFIELD²⁵⁶⁸ OC OOnt MSC CD (born **11959 HE**) - First Canadian in Space.

⇒ **12001 HE:** CHRIS HADFIELD became the first Canadian to walk in space and helped to install the Canadarm2.²⁵⁶⁹

²⁵⁶⁷ Netflix documentary “Mercury 13”

²⁵⁶⁸ Multiple Great Youtube.com videos

²⁵⁶⁹ 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.*²⁵⁷⁰



⇒ CHRIS AUSTIN HADFIELD, date unknown.²⁵⁷¹

²⁵⁷⁰ https://www.amazon.com/dp/0316253014/ref=cm_sw_r_cp_ep_dp_sCcFBb7FNTE7S

²⁵⁷¹ https://en.wikipedia.org/wiki/Chris_Hadfield

11996 HE – 11999 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.²⁵⁷² GM did not get back into electric car production until introduction of the Bolt, its first 100% electric vehicle, in **12016 HE**. The **12.006 HE** documentary “*Who Killed the Electric Car*” decried GM’s decision to take the EV1 away from its adoring drivers.²⁵⁷³

11996 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.²⁵⁷⁴

²⁵⁷² wikipedia.org/wiki/General_Motors_EV1

²⁵⁷³ <http://whokilledtheelectriccar.com>

²⁵⁷⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

11996 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.²⁵⁷⁵



²⁵⁷⁵ Author / Compiler family photos

11996 HE: *James Webb Space Telescope* is authorized.²⁵⁷⁶

- ⇒ **11996 HE - today:** NASA, ESA and CSA have collaborated on the telescope. ESA's participation in construction and launch was approved by its members in **12003 HE**, and an agreement was signed between ESA and NASA in **12007 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 workforce to support operations. The CSA will provide the Fine Guidance Sensor and the Near-Infrared Imager Slitless Spectrograph plus workforce to support operations.²⁵⁷⁷

²⁵⁷⁶ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁵⁷⁷ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

⇒ Countries Participating with the *James Webb Space Telescope* are *Austria, Belgium, Canada, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom, and United States.*²⁵⁷⁸

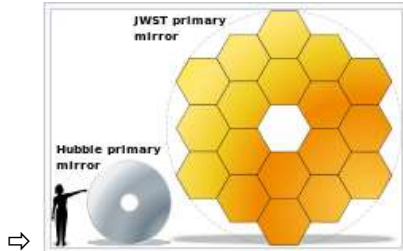
²⁵⁷⁸ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope



12016 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.²⁵⁷⁹

²⁵⁷⁹ https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

⇒ **12021 HE:** *James Webb Space Telescope* was launched on 12/25/12021.²⁵⁸⁰ It arrived at the L2 Lagrange point in January 12022. In July 12022 the first images were made public.²⁵⁸¹



⇒ *James Webb Space Telescope* primary mirror: Comparison with *Hubble Space Telescope* primary mirror.²⁵⁸²

²⁵⁸⁰ <https://www.archives.gov/research/alice/reference/space-timeline.html>

²⁵⁸¹ https://en.wikipedia.org/wiki/Timeline_of_the_James_Webb_Space_Telescope

²⁵⁸² https://en.wikipedia.org/wiki/James_Webb_Space_Telescope

11996 HE: Palm pilot introduced.²⁵⁸³ Palm's first PDAs ran the Palm OS, were smaller than competing handhelds, and proved to the industry 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.²⁵⁸⁴

²⁵⁸³ <http://www.computerhistory.org/timeline/computers/>

²⁵⁸⁴ [https://en.wikipedia.org/wiki/Palm_\(PDA\)#PalmPilot1000_and_5000_\(1996\)](https://en.wikipedia.org/wiki/Palm_(PDA)#PalmPilot1000_and_5000_(1996))

11996 HE: *Mars Pathfinder*, the United States robotic spacecraft base station with the wheeled robotic rover *Sojourner*, is launched. In **11997 HE** the *Mars Pathfinder* arrived on Mars and began transmitting images.²⁵⁸⁵



11995 HE: The *Pathfinder* air bags are tested.²⁵⁸⁶

²⁵⁸⁵ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁵⁸⁶ https://en.wikipedia.org/wiki/Mars_Pathfinder



11996 HE: *Pathfinder* and *Sojourner* at JPL being 'folded' into their launch positions.²⁵⁸⁷

²⁵⁸⁷ https://en.wikipedia.org/wiki/Mars_Pathfinder



Photo is of **11997 HE** close-up of the Mars sky at sunset, by Mars *Pathfinder*.²⁵⁸⁸ (Author / Compiler note: See how much

²⁵⁸⁸ https://en.wikipedia.org/wiki/Mars_Pathfinder

smaller our sun looks in this photo than in sunsets we view from Earth?²⁵⁸⁹)



Sojourner rover on Mars on sol 22.²⁵⁹⁰ (Author / Compiler note: “Sol 22” means the 22nd day on Mars).²⁵⁹¹

²⁵⁸⁹ <https://www.universetoday.com/14822/how-far-is-mars-from-the-sun/>

²⁵⁹⁰ https://en.wikipedia.org/wiki/Mars_Pathfinder

²⁵⁹¹ PAUL PREMACK

11997 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.²⁵⁹²



Prius Generation 1.²⁵⁹³

²⁵⁹² <http://www.cars-directory.net/history/toyota/prius/>

²⁵⁹³ www.bing.com/images/search?q=1997+Toyota+Prius&FORM=RESTAB

11997 HE: Human Lifespan, according to CARL SAGAN²⁵⁹⁴:

- **Circa 39000 BHE:** In hunter gather, pre-agricultural times, the human life expectancy was about 20-30 years.
- **Circa 11870 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 11915 HE:** (circa 45 years later) Due to further scientific advancement, human age expectancy rose to about 50 years.

²⁵⁹⁴ CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

- **Circa 11930 HE:** (Just 15 years later) Due to further scientific advancement human lifespan expectancy rose to about 60 years of age.
- **Circa 11955 HE:** (Just 25 years later) Due to further scientific advancement human lifespan expectancy rose to about 70 years of age.
- **Circa 11997 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.

11998 HE: FRED (11911 HE– 12002 HE) AND NORAH RODEN URQUART (11918 HE – 12009 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.²⁵⁹⁵



Poster for the 3D IMAX Film documentary film with Mike Slee as director took 5 years from funding to release in **12012 HE**.²⁵⁹⁶

²⁵⁹⁵ https://en.wikipedia.org/wiki/Fred_Urquhart

²⁵⁹⁶ https://en.wikipedia.org/wiki/Flight_of_the_Butterflies

11998 HE: Google is founded.²⁵⁹⁷ Google was officially launched by LARRY PAGE, United States computer scientist and Internet entrepreneur, and SERGEY BRIN, United States computer scientist and internet entrepreneur.²⁵⁹⁸

11998 HE: First Modules of *The International Space Station* are launched.²⁵⁹⁹

²⁵⁹⁷ <http://www.computerhistory.org/timeline/computers/>

²⁵⁹⁸ https://en.wikipedia.org/wiki/History_of_Google

²⁵⁹⁹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

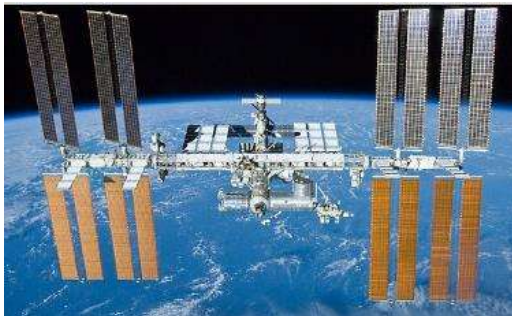


Photo is of *The International Space Station* on 23 May **12010**
HE as seen from the departing Space Shuttle *Atlantis* during
STS-132.²⁶⁰⁰

²⁶⁰⁰ https://en.wikipedia.org/wiki/International_Space_Station

⇒ The International Space Station program is a joint project among five participating space agencies²⁶⁰¹ (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.²⁶⁰²
- **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 **11975 HE** and headquartered in

²⁶⁰¹ https://en.wikipedia.org/wiki/International_Space_Station

²⁶⁰² https://en.wikipedia.org/wiki/Canadian_Space_Agency

Paris, France, ESA has a worldwide staff of about 2000 people.²⁶⁰³

- **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.²⁶⁰⁴
- **NASA,** United States.²⁶⁰⁵ As of **12018 HE**, the United States portion of ISS is funded through **12025 HE**.²⁶⁰⁶
- **Roscosmos:** The Russian Roscosmos State Corporation for Space Activities responsible for the space flight and

²⁶⁰³ https://en.wikipedia.org/wiki/European_Space_Agency

²⁶⁰⁴ <https://en.wikipedia.org/wiki/JAXA>

²⁶⁰⁵ https://www.nasa.gov/offices/ogc/about/space_act1.html

²⁶⁰⁶ https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station

cosmonautics program for the Russian Federation.²⁶⁰⁷

Roscosmos has endorsed the continued operation of ISS through **12024 HE** but has proposed using elements of the Russian Orbital Segment to construct a new Russian space station to be called OPSEK.²⁶⁰⁸

- In addition to the *Canadarm*,²⁶⁰⁹ 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

²⁶⁰⁷ <https://en.wikipedia.org/wiki/Roscosmos>

²⁶⁰⁸ https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station

²⁶⁰⁹ https://en.wikipedia.org/wiki/Mobile_Servicing_System#Canadarm2

module (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.²⁶¹⁰

²⁶¹⁰ 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.²⁶¹¹

²⁶¹¹ <https://www.youtube.com/watch?v=6YOz9Pxnzho>, Veritasium Interview

11999 HE: EILEEN COLLINS, United States, became the first female Shuttle *Commander*.^{2612 2613}



Mission Commander EILEEN COLLINS and STS-114 crew on their way to the launch pad.²⁶¹⁴

²⁶¹² Netflix documentary “Mercury 13”

²⁶¹³ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁶¹⁴ https://en.wikipedia.org/wiki/Eileen_Collins



Image is of Eileen Collins speaking at the 2016 Republican National Convention²⁶¹⁵

- Author / Compiler note: I have been trying to keep politics and religion out of this Human 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

²⁶¹⁵ https://en.wikipedia.org/wiki/Eileen_Collins

life and got to where she is, as an employee of the public taxpayer, 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,²⁶¹⁶ women denied right to their own children, women denied the right to own land, denied salary because of their sex,²⁶¹⁷ or women denied jobs in their field because of their sex,²⁶¹⁸ or women denied rights to her own body,²⁶¹⁹ or women who fought to get Collins the right to

²⁶¹⁶ <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

²⁶¹⁷ 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*

²⁶¹⁸ Stuff You Missed In History Class podcast: <https://www.missedinhistory.com/podcasts/three-astonishing-belles.htm>

²⁶¹⁹ https://en.wikipedia.org/wiki/Margaret_Sanger

vote and to even be educated, or to be in the military of the United States,²⁶²⁰ or to be a pilot in the USA military like United States “Mercury 13”²⁶²¹ 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.

²⁶²⁰ https://en.wikipedia.org/wiki/Grace_Hopper

²⁶²¹ 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 **12018 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.

11999 HE: Chandra X-ray Observatory telescope is launched.²⁶²²

²⁶²² <https://www.archives.gov/research/alic/reference/space-timeline.html>



Labeled diagram of CXO²⁶²³

²⁶²³ 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., **12000 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., **12000 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., **12001 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., **12004 HE**);
- On January 5 **12015 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 **12016 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 **12014 HE** and **12015 HE**, supporting the *New Horizons* spacecraft for its July **12015 HE** encounter.²⁶²⁴

²⁶²⁴ https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory

120th Century HE

12000 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 **12000 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 **11999 HE**, to January 1 **12000 HE**.²⁶²⁵

²⁶²⁵ <https://www.britannica.com/technology/Y2K-bug>

Circa 12000 HE: The population of the world was approximately 6,145,000,000 people.²⁶²⁶

12000 HE: Microsoft Windows mobile (pocket PC) introduced.²⁶²⁷



Photo is of The Windows Mobile Device Center in Windows Vista, photographer unknown.²⁶²⁸

²⁶²⁶ <http://www.worldometers.info/world-population/world-population-by-year/>

²⁶²⁷ <http://www.computerhistory.org/timeline/computers/>

²⁶²⁸ https://en.wikipedia.org/wiki/Windows_Mobile_Device_Center

12001 HE: Wikipedia is established²⁶²⁹ by JIMMY WALES and LARRY SANGER and quickly became a global project in multiple languages inspiring a wide range of online reference projects. In **12018 HE**, it was the world's fifth-most-visited website.²⁶³⁰

⇒ JIMMY WALES, United States, but who as of **12012 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 **12006 HE**, WALES was listed in the "Scientists & Thinkers" section of the TIME 100 and number 12 in Forbes "The Web Celebs 25". **12013 HE**, WALES was awarded the UNESCO Niels Bohr Medal in

²⁶²⁹ <http://www.computerhistory.org/timeline/computers/>

²⁶³⁰ https://en.wikipedia.org/wiki/History_of_Wikipedia

Copenhagen, Denmark at a conference on "An 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.²⁶³¹



12016 HE: JIMMY WALES at the Wikimania conference, photographer unknown.²⁶³²

²⁶³¹ https://en.wikipedia.org/wiki/Jimmy_Wales

²⁶³² https://en.wikipedia.org/wiki/Jimmy_Wales



12006 HE: photo of LARRY SANGER (Born **11968 HE**) (photographer and location unknown).²⁶³³ In **12002 HE** SANGER left Wikipedia and has since been critical of the project.²⁶³⁴

12001 HE: *NEAR (Near Earth Asteroid Rendezvous) Shoemaker* lands on asteroid Eros.²⁶³⁵ The mission is named after EUGENE

²⁶³³ https://en.wikipedia.org/wiki/Larry_Sanger

²⁶³⁴ https://en.wikipedia.org/wiki/Larry_Sanger

²⁶³⁵ <https://www.archives.gov/research/alice/reference/space-timeline.html>

SHOEMAKER who died in an automobile accident in **11997**
HE.²⁶³⁶

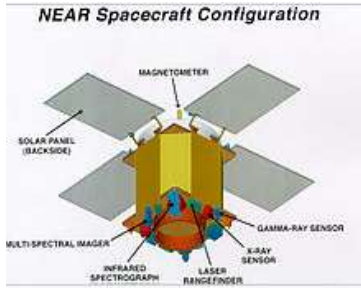


Diagram showing location of *NEAR* science instruments.²⁶³⁷

²⁶³⁶ <https://www2.jpl.nasa.gov/s19/news81.html>

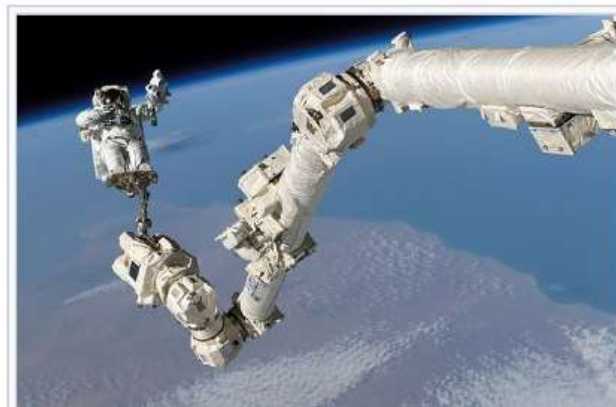
²⁶³⁷ https://en.wikipedia.org/wiki/NEAR_Shoemaker

⇒ 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, an asteroid, the second-largest near-Earth object. 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.²⁶³⁸

12001 HE: Canadarm 2 is launched to the ISS.²⁶³⁹ The Mobile Servicing System (MSS), also known as Canadarm2 is a robotic system on board the International Space Station (ISS).

²⁶³⁸ https://en.wikipedia.org/wiki/NEAR_Shoemaker

²⁶³⁹ 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 **12005 HE.**²⁶⁴⁰

²⁶⁴⁰ https://en.wikipedia.org/wiki/Mobile_Servicing_System

12002 HE:



2641



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 **12002 HE** and continues to support the several hundred Toyota RAV4-EVs in the hands of the general public and in fleet usage.²⁶⁴²

²⁶⁴¹ <https://www.bing.com/images/search?q=image+toyota+rav4->

²⁶⁴² https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12002 HE: 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.²⁶⁴³

12003 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*;

²⁶⁴³ <https://en.wikipedia.org/wiki/SpaceX>

- ⇒ 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 108000 mph.²⁶⁴⁴



● *Opportunity*, also known as MER-B (*Mars Exploration Rover*)

²⁶⁴⁴ <https://www.archives.gov/research/alic/reference/space-timeline.html>

– *B*) or *MER-1* is a robotic rover active on Mars since **12004 HE**. Photographer and location unknown, but clearly a lab on Earth not on Mars.²⁶⁴⁵

12004 HE -12017 HE: *Cassini-Huygens* missions to Saturn and Titan.²⁶⁴⁶

⇒ 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 **11953 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

²⁶⁴⁵ [https://en.wikipedia.org/wiki/Opportunity_\(rover\)](https://en.wikipedia.org/wiki/Opportunity_(rover))

²⁶⁴⁶ <https://www.archives.gov/research/alice/reference/space-timeline.html>

GIOVANNI CASSINI (See **11625 HE** – **11712 HE**;) and CHRISTIAAN HUYGENS. (See **11629 HE** – **11695 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 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.
- **12017 HE**, on which date *Cassini* was de-orbited to burn up in Saturn's upper atmosphere.²⁶⁴⁷

²⁶⁴⁷ <https://en.wikipedia.org/wiki/Cassini-Huygens>

12005 HE – current HE: 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 to seven astronauts into orbit and beyond. In **12012 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.²⁶⁴⁸

²⁶⁴⁸ <https://en.wikipedia.org/wiki/SpaceX>



Image is of the *Dragon* spacecraft approaching the ISS (photographer, and date unknown).²⁶⁴⁹

²⁶⁴⁹ <https://en.wikipedia.org/wiki/SpaceX>



Photo is of the *Dragon* is berthed to the ISS by Canadarm2 date and photographer unknown.²⁶⁵⁰

²⁶⁵⁰ <https://en.wikipedia.org/wiki/SpaceX>

12006 HE – current HE: The Cloud concept is established, evolving user's data storage and computing online.²⁶⁵¹

⇒ 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.²⁶⁵²

12007 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.

⇒ The following year, people and places around the world started voluntarily turning off their lights. EARTH HOUR is now the

²⁶⁵¹ <http://www.computerhistory.org/timeline/computers/>

²⁶⁵² https://en.wikipedia.org/wiki/Cloud_storage

world's largest grassroots movement for the environment, inspiring millions of people to take action for our planet and nature.²⁶⁵³

- ⇒ 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.²⁶⁵⁴

²⁶⁵³ <https://www.earthhour.org/what-is-earth-hour>

²⁶⁵⁴ <https://www.earthhour.org/celebrate-the-hour>

12007 HE: The first Kindle book reader is released²⁶⁵⁵



Image is of a first-generation Kindle Paperwhite.²⁶⁵⁶

²⁶⁵⁵ <http://www.computerhistory.org/timeline/computers/>

²⁶⁵⁶ https://en.wikipedia.org/wiki/Amazon_Kindle

12007 HE: The Apple iPhone first released.²⁶⁵⁷



iPhone OS 1 running on a first-generation iPhone.²⁶⁵⁸

²⁶⁵⁷ <http://www.computerhistory.org/timeline/computers/>

²⁶⁵⁸ https://en.wikipedia.org/wiki/IPhone_OS_1

12008 HE: Android operating system is first released.²⁶⁵⁹ 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 **12009 HE's** Android 1.5 Cupcake.²⁶⁶⁰

12008 HE – 12012 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. Tesla's vehicle is also the first production car to be launched into orbit and beyond, carried by a SpaceX Falcon Heavy rocket in a test flight launched

²⁶⁵⁹ <http://www.computerhistory.org/timeline/computers/>

²⁶⁶⁰ https://en.wikipedia.org/wiki/Android_version_history

on February 6 **12018 HE**.²⁶⁶¹ As of November **12.018 HE** the Roadster was nearing the orbit of Mars.



The **12008 HE** Tesla Electric Roadster...on Earth. Photographer unknown.²⁶⁶²

²⁶⁶¹ [https://en.wikipedia.org/wiki/Tesla_Roadster_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))

²⁶⁶² [https://en.wikipedia.org/wiki/Tesla_Roadster_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))



12018 HE photo of the Tesla **12008 HE** Roadster... in space.²⁶⁶³

Circa 12009 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.²⁶⁶⁴



12009 HE: The world's first full-scale floating wind turbine, *Hywind*, being assembled in the Åmøy Fjord near Stavanger, Norway, before deployment in the North Sea.²⁶⁶⁵

²⁶⁶³

<https://www.bing.com/images/search?q=images+of+tesla+roadster+in+space&qpv=images+of+tesla+roadster+in+space&FORM=IGRE>

²⁶⁶⁴ https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages

²⁶⁶⁵ https://en.wikipedia.org/wiki/Floating_wind_turbine

Circa 12009 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.²⁶⁶⁶

⇒ Goodbye “Homo Sapiens” / “The Knowing Ape”

⇒ Hello “TCATCGGTCATTGG”.²⁶⁶⁷

- Author / Compiler Note: “???!!!”

²⁶⁶⁶ 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*

²⁶⁶⁷ 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*

12010 HE – 12018 HE:



First generation Nissan electric LEAF sold in Japan, United States, Australia, Canada and 17 European countries.²⁶⁶⁸

²⁶⁶⁸ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12010 HE: Private Sector SpaceX first commercial launch.²⁶⁶⁹



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

²⁶⁶⁹ <https://www.archives.gov/research/aic/reference/space-timeline.html>

Falcon 9 v1.2 (Full Thrust), two versions of Falcon 9 Block 5 and Falcon Heavy.²⁶⁷⁰

12011 HE: The United States *Space Shuttle Program* is decommissioned.²⁶⁷¹ After this date through at least 12018 HE, NASA relied entirely on Russia's *Sputnik* to transport astronauts to the ISS. Private United States contractors, like the SpaceX *Dragon* spacecraft, became active in transferring crew members sometime after **12018 HE**.²⁶⁷²

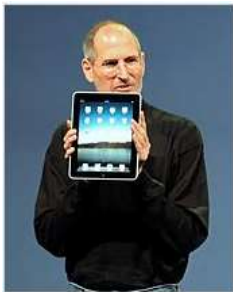
12011 HE: The Apple iPad is released²⁶⁷³

²⁶⁷⁰ <https://en.wikipedia.org/wiki/SpaceX>

²⁶⁷¹ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁶⁷² <https://en.wikipedia.org/wiki/SpaceX>

²⁶⁷³ <http://www.computerhistory.org/timeline/computers/>



STEVE JOBS, Apple's then CEO, introducing the iPad.²⁶⁷⁴ 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...”²⁶⁷⁵

²⁶⁷⁴ <https://en.wikipedia.org/wiki/iPad>

²⁶⁷⁵ <https://en.wikipedia.org/wiki/iPad>

12012 HE: This date is about 34 years since launch of *Voyager 1*²⁶⁷⁶ 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.²⁶⁷⁷

⇒ Travelling at about 17 kilometers per second (11 mi/s) *Voyager 1* has the fastest heliocentric recession speed of any spacecraft.²⁶⁷⁸

⇒ 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.

²⁶⁷⁶https://en.wikipedia.org/wiki/Voyager_1

²⁶⁷⁷<https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁶⁷⁸https://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.²⁶⁷⁹

²⁶⁷⁹ https://en.wikipedia.org/wiki/Voyager_1

12012 HE:



Global sales of the Renault electric Zoe, released in **12012 HE**, achieved the 50,000-unit milestone in **12016 HE**.²⁶⁸⁰

²⁶⁸⁰ https://en.wikipedia.org/wiki/History_of_the_automobile or https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12012 HE:



TESLA Model S fully electric, long range driving vehicle began deliveries, photographer unknown.²⁶⁸¹

²⁶⁸¹ https://en.wikipedia.org/wiki/Tesla,_Inc.

12013 HE:



Retail deliveries of the BMW electric i3 began in Europe in **12013 HE**. The electric i3 ranked as the third bestselling all-electric car in **12014 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.²⁶⁸² Photographer unknown.

²⁶⁸² https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12014 HE: Solar Roadways Incorporated (founded in **12006 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.²⁶⁸³

²⁶⁸³ https://en.wikipedia.org/wiki/Solar_Roadways



Solar Roadway founders Julie Brusaw and SCOTT BRUSAW²⁶⁸⁴ with solar road panel prototypes in Idaho, USA.²⁶⁸⁵ Photographer and date unknown.

²⁶⁸⁴ <http://solarroadways.com/About/Team>

²⁶⁸⁵ 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 Roadways²⁶⁸⁶

²⁶⁸⁶ <http://www.solarroadways.com/>

12015 HE: United States probe *New Horizons* passed Pluto.²⁶⁸⁷



New Horizons at Kennedy Space Center, **12005 HE.**²⁶⁸⁸

12015 HE: JEDIDAH C. ISLER, United States Observational Astrophysicist, first Black Woman to Graduate from Yale with a

²⁶⁸⁷ <https://www.archives.gov/research/alic/reference/space-timeline.html>

²⁶⁸⁸ https://en.wikipedia.org/wiki/New_Horizons

PhD in Astrophysics.²⁶⁸⁹ 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.²⁶⁹⁰

²⁶⁸⁹ *TED Fellows Talks*. <https://youtu.be/XzZJuEDQ1a0>

²⁶⁹⁰ <http://jedidahislerphd.com/research-interest/>

12015 HE:



2691

12015 HE: The Tesla Model X, a full-size electric crossover SUV, started deliveries.²⁶⁹²

12016 HE:

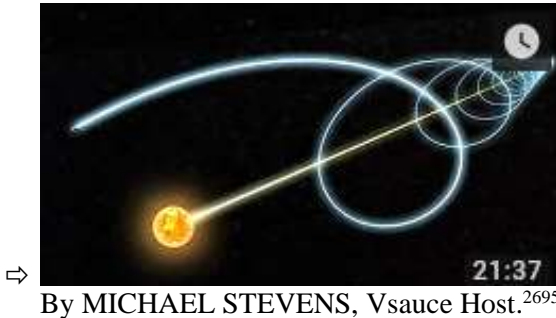


The first Chevrolet Bolt EVs were delivered to customers in the San Francisco Bay Area in **12016 HE**.²⁶⁹³

²⁶⁹² https://en.wikipedia.org/wiki/Tesla,_Inc.

²⁶⁹³ https://en.wikipedia.org/wiki/History_of_the_electric_vehicle

12016 HE: Youtube.com video “How Earth Moves” including further calendar explanations.²⁶⁹⁴



²⁶⁹⁴ <https://www.youtube.com/watch?v=IJhgZBn-LHg>

²⁶⁹⁵ <https://www.youtube.com/watch?v=IJhgZBn-LHg>

12016 HE: MIT scientists build the first 5-atom quantum computer²⁶⁹⁶ with the potential to crack the security of traditional encryption schemes.²⁶⁹⁷

12017 HE:



²⁶⁹⁸

Official launch and delivery started of the TESLA Model 3- mid-size (US) / compact executive (EU) luxury all-electric four-door sedan.²⁶⁹⁹

²⁶⁹⁶ <http://www.computerhistory.org/timeline/computers/>

²⁶⁹⁷ https://en.wikipedia.org/wiki/Timeline_of_computing_2010-19 and "**MIT's new 5-atom quantum computer could make today's encryption obsolete**".

²⁶⁹⁸ <https://www.bing.com/search?q=image+tesla+model+3&pc=MOZI&form=MOZLBR>

²⁶⁹⁹ https://en.wikipedia.org/wiki/Tesla_Model_3

12018 HE:



Second generation Nissan electric LEAF introduced.²⁷⁰⁰

²⁷⁰⁰ <https://www.nissanusa.com/leaf>

12018 HE: Methods of Birth Control.²⁷⁰¹

- 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

²⁷⁰¹ <https://www.birthcontrol.com/>

- Vasectomy
- 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

12018 HE: Updating CARL SAGAN's numbers on population - Most Populous Countries & Numbers, based on United Nations

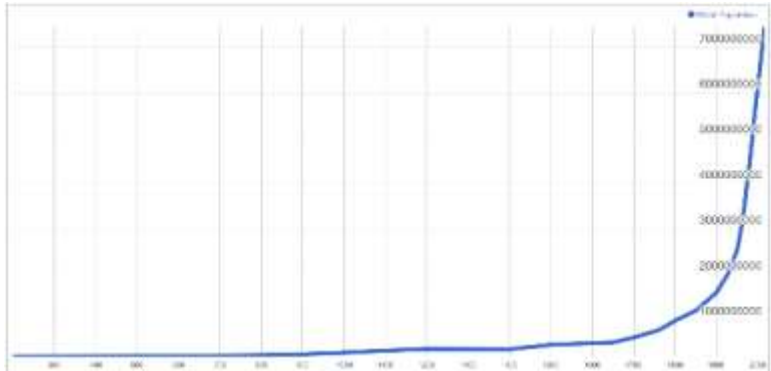
Estimates, comparing to the **11950 HE** populations. (Information retrieved October 22 - 24 **12018 HE.**)^{2702 2703}

Thailand:	69228466 people, not one of the most populous nations in 11950 HE
Iran:	82271115 people, not one of the most populous nations in 11950 HE
Turkey:	82271851 people, increase from 21408401 people in 11950 HE
Germany:	82349181 people, increase from 69966243 people in 11950 HE
Congo:	84781426 people, founded: 11960 HE
Viet Nam:	96779230 people, increase from 24809906 people in 11950 HE
Egypt:	99918032 people, not one of the most populous nations in 11950 HE
Philippines:	106989899 people not one of the most populous nations in 11950 HE
Ethiopia:	108292163 people, not one of the most populous nations in 11950 HE
Japan:	127092269 people, increase from 82802084 people in 11950 HE
Mexico:	131240,346 people, increase from 28012561 people in 11950 HE
Russia:	143964709 people, increase from 102798657 people in 11950 HE
Bangladesh:	166882594 people, increase from 37894681 people in 11950 HE
Nigeria:	197336063 people, increase from 37859744 people in 11950 HE
Pakistan:	201942393 people, increase from 37542376 people in 11950 HE
Brazil:	211349257 people, increase from 53974729 people in 11950 HE

²⁷⁰² <https://www.worldometers.info/world-population/>

²⁷⁰³ <http://www.worldometers.info/population/most-populous-countries/#past>

Indonesia: 267643638 people, increase from 69543316 people in **11950 HE**
 USA: 327470,395 people, increase from 158804395 people in **11950 HE**
 India: 1358548924 people, increase from 376325200 people in **11950 HE**
 China: 1416743377 people, increase from 554419275 people in **11950 HE**



- ⇒ World population of humans is increasing dramatically, expected to reach approximately 11 billion before it stabilizes (barring disaster).²⁷⁰⁴

As of **12018 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 27000 km (17000 mi) in total length.²⁷⁰⁵

²⁷⁰⁴ <https://www.worldometers.info/world-population/>

²⁷⁰⁵ https://en.wikipedia.org/wiki/High-speed_rail_in_China



China's Electric Railway network map.²⁷⁰⁶

²⁷⁰⁶ https://en.wikipedia.org/wiki/High-speed_rail_in_China



Shanghai Maglev Train connecting the Pudong Airport with the city. Photographer unknown.²⁷⁰⁷

²⁷⁰⁷ 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.²⁷⁰⁸

²⁷⁰⁸ https://en.wikipedia.org/wiki/High-speed_rail_in_China



Chinese designed CRH380AL train at Shanghai Hongqiao Railway Station. Photographer unknown.²⁷⁰⁹

²⁷⁰⁹ https://en.wikipedia.org/wiki/High-speed_rail_in_China

12018 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 **12018 HE.**²⁷¹⁰

⇒ Major cooperating contributing agencies and institutions:

- 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)

²⁷¹⁰ <https://mars.nasa.gov/insight/>

- 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)²⁷¹¹



Artist's Rendering of *InSight* on Mars, credit JPL.²⁷¹²

²⁷¹¹ <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

²⁷¹² <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

12019 HE: VICTOR LANCE VESCOVO (born 11966 HE) is a Modern Polymath. Whereas DA VINCI, circa only 700 years ago was considered a polymath of his times but did not have access to our Here and Now technology. VESCOVO an American private achieved the Explorers Grand Slam by reaching the North and South Poles and climbing the Seven Summits, and then visited the deepest points of all Earth's five oceans during the Five Deeps Expedition of **12018–12019 HE**.²⁷¹³



²⁷¹⁴ **VICTOR LANCE VESCOVO**

²⁷¹³ https://en.wikipedia.org/wiki/VICTOR_VESCOVO

²⁷¹⁴ https://en.wikipedia.org/wiki/VICTOR_VESCOVO

12020 HE: JENNIFER ANNE DOUDNA (born 11964 HE) and EMMANUELLE MARIE CHARPENTIER (born 11968 HE) win the Nobel Prize for the development of a method for genome editing. This was the first science Nobel Prize ever won by two women only.²⁷¹⁵

⇒ **In 12012 HE, DOUDNA and CHARPENTIER** were the first to propose that CRISPR-Cas9 (enzymes from bacteria that control microbial immunity) could be used for programmable editing of genomes, which has been called one of the most significant discoveries in the history of biology. Since then, **DOUDNA** has been a leading figure in what is referred to as the "CRISPR revolution" for her fundamental work and leadership in developing CRISPR-mediated genome editing.²⁷¹⁶

²⁷¹⁵ https://en.wikipedia.org/wiki/Emmanuelle_Charpentier

²⁷¹⁶ https://en.wikipedia.org/wiki/Jennifer_Doudna



²⁷¹⁷ **DOUDNA IN 12023 HE**

- ⇒ **DOUDNA**'s many other awards and fellowships include the **12000 HE** Alan T. Waterman Award for her research on the structure of a ribozyme, as determined by X-ray crystallography

²⁷¹⁷ https://en.wikipedia.org/wiki/Jennifer_Doudna

and the **12015 HE** Breakthrough Prize in Life Sciences for CRISPR-Cas9 genome editing technology, with **CHARPENTIER**.

- ⇒ **DOUDNA** is a co-recipient of the Gruber Prize in Genetics **12015 HE**, the Tang Prize **12016 HE**, the Canada Gairdner International Award **12016 HE**, and the Japan Prize **12017 HE**. She was named one of the Time 100 most influential people in **12015 HE**.
- ⇒ In **12021 HE** DOUDNA was the subject of Walter Isaacson's book *Code Breaker* and in **12023 HE** DOUDNA was inducted into the National Inventors Hall of Fame.²⁷¹⁸

²⁷¹⁸ https://en.wikipedia.org/wiki/Jennifer_Doudna



⇒ ²⁷¹⁹ **CHARPENTIER** in
12015 HE

⇒ **CARPENTIER's** many awards and fellowships include in
12009 HE the Theodor Körner Prize for Science and Culture,
12011 HE the Fernström Prize for young and promising

²⁷¹⁹ https://en.wikipedia.org/wiki/Emmanuelle_Charpentier

scientists, **12014 HE** – Alexander von Humboldt Professorship, **12015 HE** – Princess of Asturias and The Time 100 Pioneers (both shared with **DOUDNA**), **12016 HE** – Knight (Chevalier) French National Order of the Legion of Honour, **12017 HE** – Pour le Mérite, **12018 HE** – Austrian Decoration for Science and Art, **12018 HE** – Bijvoet Medal of the Bijvoet Center for Biomolecular Research of Utrecht University, the **12021 HE** Walter Isaacson biography *Code Breaker* of **DOUDNA** and her collaboration with **CHARPENTIER** leading to the discovery of CRISPR/CAS-9, **12024 HE** – Foreign Member of the Royal Society²⁷²⁰

12024 HE to the Future: So much has happened... Yet, we must end this eBook here. The Word file is sooooo big!

²⁷²⁰ https://en.wikipedia.org/wiki/Emmanuelle_Charpentier

Ok, last thoughts....Author / Compiler of this eBook sends smiles to you as you launch from my eBook/or print book from amazon.com Hopefully you will think of ways to put your HE interests into a fun-filled-fair-to-all-humans-dead-or-walking-our-earth HE timeline using our free calculator converter at www.easytimeline.org Make the idea of BHE/HE commonplace! Make EMALIANI's fair BHE/HE idea humanity's calendar standard! Cheers!

About the Author / Compiler



Wife, Mom, Law Office Business Manager, Science enthusiast, **11990 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 (the first edition of this book dates to **12014 HE**), 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!.....