

***Illustrated Holocene Era Timeline:***

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

# Table of Contents

CHAPTER ONE	THE HOLOCENE ERA .....	4
CHAPTER TWO	THE BRONZE AGE: CIRCA 6,401 HE - CIRCA 9,001 HE (LASTING CIRCA 2,600 YEARS).....	47
CHAPTER THREE	THE IRON AGE: CIRCA 9,001 HE- CIRCA 11,543 HE (LASTING CIRCA 2,760 YEARS) .....	173
CHAPTER FOUR	THE SCIENTIFIC REVOLUTION: CIRCA 11,543 HE - NOW (LASTING, SO FAR, LESS THAN 600 YEARS) .....	452
CHAPTER FIVE	THE INDUSTRIAL REVOLUTION: CIRCA 11,760 HE - NOW (LASTING, SO FAR, LESS	

	THAN 300 YEARS, PART OF THE SCIENTIFIC REVOLUTION).....	667
CHAPTER SIX	THE MODERN SCIENTIFIC ERA: CIRCA 11,859 HE (LASTING, SO FAR, LESS THAN 175 YEARS).....	937
	ABOUT THE HE CALENDAR AND FORMATTING .....	1707
	AUTHOR / COMPILER'S NOTE.....	1710
	ABOUT THE AUTHOR / COMPILER.....	1713

## Chapter One      THE HOLOCENE ERA

“Holocene” means “entirely recent”. The Holocene Era begins about 12,000 years before now, at the end of the Stone Age.<sup>1</sup>

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

**Circa 1 HE:** This is also a rough approximation of the start of the current geologic epoch, the Holocene Epoch, and approximates when human civilization (the first settlements and agriculture) arose when the last ice age ended.<sup>2</sup>

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<sup>1</sup> ISAAC ASIMOV: ASIMOV'S Chronology of the World

<sup>2</sup> [https://en.wikipedia.org/wiki/Holocene\\_calendar](https://en.wikipedia.org/wiki/Holocene_calendar)



**Circa 1 HE:** The world-wide population of humans was approximately 5 million.<sup>3</sup>

**Circa 1 HE:** France: The Magdalenian Culture (after having been around from **Circa 5,300 BHE** / **Circa 4,981 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.<sup>4</sup>

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

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<sup>3</sup> <https://www.worldometers.info/world-population/>

<sup>4</sup> <https://www.britannica.com/topic/Magdalenian-culture>



“The Main Hall, Lascaux cave, photographer unknown.”<sup>5</sup>

- ⇒ 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,

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<sup>5</sup> <http://www.ancient-wisdom.com/francelascaux.htm>

the existence of humans in association with the reindeer, and the extinction of the mammoth.

- ⇒ The use of bone and ivory for various implements, already begun in the preceding Solutrean epoch, was much increased, and the period is essentially a bone period.
- ⇒ The bone instruments are quite varied: spear-points, harpoon-heads, borers, hooks, and needles.<sup>6</sup>
- ⇒ 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

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<sup>6</sup> <https://en.wikipedia.org/wiki/Magdalenian>

extinction, or which were dying because of the end of the last ice age, to once more become abundant.<sup>7</sup>

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<sup>7</sup> <https://www.britannica.com/topic/Magdalenian-culture>



“The Hall of Bulls”, Lascaux cave, photographer unknown.”<sup>8</sup>

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<sup>8</sup> <http://www.ancient-wisdom.com/francelascaux.htm>



Photo of **11,940 HE** entrance to Lascaux Cave, France.<sup>9</sup>

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<sup>9</sup> <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 **12,007 HE**.

⇒ There are more than 5,000 recorded art sites illustrating Ubirr Aboriginal culture over thousands of years. The archaeological sites demonstrate Aboriginal occupation for at least 20,000 and possibly up to 40,000 years<sup>10</sup> beginning **Circa 29,999 BHE**.

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<sup>10</sup> [https://en.wikipedia.org/wiki/Kakadu\\_National\\_Park](https://en.wikipedia.org/wiki/Kakadu_National_Park)



The Ubirr Aboriginal rock art site, photographer unknown.<sup>11</sup>

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<sup>11</sup> [https://en.wikipedia.org/wiki/Kakadu\\_National\\_Park](https://en.wikipedia.org/wiki/Kakadu_National_Park)





Rock art painting at Ubirr, photographer unknown.<sup>12</sup>

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<sup>12</sup> [https://en.wikipedia.org/wiki/Kakadu\\_National\\_Park](https://en.wikipedia.org/wiki/Kakadu_National_Park)

**1 HE: Africa, San People inhabit the Kalahari Desert<sup>13</sup> from Circa 29,999 BHE – Current times HE:**



Rock paintings in the Cederberg, Western Cape, photographer unknown.<sup>14</sup>

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<sup>13</sup> [https://en.wikipedia.org/wiki/San\\_people](https://en.wikipedia.org/wiki/San_people)

<sup>14</sup> [https://en.wikipedia.org/wiki/San\\_people](https://en.wikipedia.org/wiki/San_people)



San paintings near Murewa, Zimbabwe, photographer unknown.<sup>15</sup>

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<sup>15</sup> [https://en.wikipedia.org/wiki/San\\_people](https://en.wikipedia.org/wiki/San_people)



San paintings near Murewa, photographer unknown.<sup>16</sup>

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<sup>16</sup> [https://en.wikipedia.org/wiki/San\\_people](https://en.wikipedia.org/wiki/San_people)

**Circa 1 HE: Japan: 4,500 BHE – 9,700 HE: Japan Jōmon period** Japan was inhabited by a hunter-gatherer culture, which reached a considerable degree of cultural complexity.<sup>17</sup>



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

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<sup>17</sup> [https://en.wikipedia.org/wiki/Jomon\\_period](https://en.wikipedia.org/wiki/Jomon_period)

<sup>18</sup> [https://en.wikipedia.org/wiki/Jomon\\_period](https://en.wikipedia.org/wiki/Jomon_period)

## **Circa 1 HE: Native American Tribes Circa 500 BHE – to current.**<sup>19</sup>

⇒ This is a list of all known Native American Tribes and languages:

- Abenaki (Abnaki, Abanaki, Abeniqui), Acatec, Achi, Achumawi (Achomawi), Acoma, Adai, Ahtna (Atna), Ais, Akimel O'odham, Alabama-Coushatta, Aleut, Alsea, Alutiiq, Algonquians (Algonkians), Algonquin (Algonkin), Alsea, Andoke, Anishinaabe (Anishinabemowin, Anishnabay), Antoniaño, Apache, Apalachee, Apalachicola, Applegate, Arabela, Arapaho (Arapahoe), Arara, Arawak, Arikara, Arua, Ashaninka, Assiniboine, Atakapa, Atikamekw, Atsina, Atsugewi (Atsuke), Araucano (Araucanian), Avoyel (Avoyelles), Aymara, Aztec,

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<sup>19</sup> <http://www.native-languages.org>

- Babine, Bannock, Bare, Bari, Baure, Beaver, Bella Bella, Bella Coola, Beothuks, Bidai, Biloxi, Black Carib, Blackfoot (Blackfeet), Blood Indians, Bora,
- Caddo (Caddoe), Cahita, Cahto, Cahuilla, Calusa (Caloosa), Carib, Carquin, Carrier, Caska, Catawba, Cathlamet, Cayuga, Cayuse, Celilo, Central Pomo, Chahta, Chalaque, Chappaquiddick (Chappaquiddic, Chappiquidic), Chatot, Chawchilla, Chehalis, Chelan, Chemehuevi, Cheraw, Cheroenhaka, Cherokee, Chetco, Cheyenne (Cheyanne), Chiaha, Chickasaw, Chilcotin, Chimariko, Chinook, Chinook Jargon, Chipewyan, Chippewa, Chitimacha (Chitamacha), Choctaw, Cholon, Chontal de Tabasco, Chukchansi, Chumash, Clackamas (Clackama), Clallam, Clatskanie, Clatsop, Cmique, Cochimi, Cochiti, Cocopa (Cocopah), Coeur d'Alene, Cofan, Columbia (Columbian), Colville, Comanche, Comcaac, Comox, Conestoga, Coos (Coosan), Copalis, Coquille, Cora, Coree, Coso, Costanoan, Coushatta,

Cowichan, Cowlitz, Cree, Creek, Croatan (Croatoan), Crow, Cuna, Cucupa (Cucapa), Cupa, Cupik (Cuit),

- Dakelh, Dakota, Dawson, Deg Xinag (Deg Hit'an), Delaware, Deline, Dena'ina, Dene, Dene Tha, Diegueno, Dine (Dineh), Dogrib, Dumna, Dunne-za,
- Eastern Inland Cree, Eastern Pomo, Eel River Athabaskan, Eeyou, Endeve, Eno, Entiat, Erie, Eskimo, Esselen, Etchemin, Euchee, Excelen, Eyak,
- Flathead Salish, Fox,
- Gabrielino, Gae, Galibi, Galice, Garifuna, Gitxsan (Gitksan), Gosiute (Goshute), Grand Ronde, Grigra, Gros Ventre, Guarani, Guarijio, Gulf, Gwich'in (Gwichin, Gwitchin),
- Haida, Haisla, Halkomelem, Hän, Hanis, Hare, Hatteras, Haudenosaunee, Havasupai, Hawaiian, Heiltsuk, Heve, Hiaki, Hichiti (Hitchiti), Hidatsa, Hocak (Ho-Chunk, Hochunk), Hoh, Holikachuk, Hoopa, Hopi, Hualapai, Huichol, Huichun, Humptulips, Hupa, Huron,



- Illini (Illiniwek, Illinois), Inca, Ingalik, Innoko, Innu, Inuktitut (Inupiat, Inupiaq, Inupiatun), Iowa-Oto (Ioway), Iroquois Confederacy, Ishak, Isleño, Isleta, Itza Maya, Iynu,
- Jaqaru, James Bay Cree, Jemez, Juaneno (Juaneño), Jumano,
- Kainai (Kainaiwa), Kalapuya (Kalapuyan), Kalina, Kallawaya, Kanien'kehaka (Kanienkehaka), Kalispel, Kansa (Kanza, Kanze), Karankawa, Karkin, Karok (Karuk), Kashaya, Kaska, Kaskaskia, Kathlamet, Kato, Kaw, Kawki, Keres (Keresan), Kickapoo (Kikapu), Kiliwa (Kiliwi), Kiowa, Kiowa Apache, Kitanemuk, Kitsai, Klallam, Klamath-Modoc, Klickitat, Koasati, Konkow, Kootenai (Ktunaxa, Kutenai), Koso, Koyukon, Kulanapan, Kumeyaay (Kumiai), Kuna, Kupa, KUnited Statesn, Kuskokwim, Kutchin, Kwakiutl (Kwakwala), Kwantlen,
- Laguna, Lake Indians, Lakhota (Lakota), Lassik, Laurentian (Lawrencian), Lenape (Lenni Lenape), Lillooet, Lipan Apache, Listiguj (Listuguj), Lnuk (Lnu), Lokono, Loup,

Lower Umpqua, Luckiamute, Luiseño, Lumbee, Lummi, Lushootseed,

- Mahican, Maidu, Maina (Mayna), Makah, Makushi, Maliseet (Maliceet), Mandan, Mapuche (Mapudungun), Maricopa, Mattole, Matlatzinca, Mayan, Mayo, Meherrin, Mengwe, Menominee (Menomini), Meskwaki (Mesquakie), Methow, Miami-Illinois, Mical, Miccosukee, Michif, Micmac (Mi'gmaq), Mikasuki, Mi'kmaq, Mingo, Minqua, Minsi, Minto, Miskito (Mosquito), Missouriia, Miwok (Miwuk), Mixe, Mixtec (Mixteco, Mixteca), Mobile, Mobilian Jargon, Mococo, Modoc, Mohave, Mohawk, Mohegan, Mohican, Mojave, Molale (Molalla, Molala), Monacan, Monache (Mono), Montagnais, Montauk, Multnomah, Munsee (Munsie, Muncey, Muncie), Muskogee (Muscogee, Mvskoke), Musqueam, Mutsun,
- Nabesna, Nahane (Nahani), Nahuat, Nahuatl, Nakoda (Nakota), Nambe, Nanaimo, Nanticoke, Nantucket,

Narragansett, Naskapi, Natchez, Natchitoches, Natick, Naugutuck, Nauset, Navajo (Navaho), Nawat, Nespelem, Neutral, Nez Perce, Niantic, Nipmuc, Nisenan, Nisga'a (Nisgaa), Nlaka'pamux (Nlakapamux), Nooksack (Nooksak), Nootka (Nutka), Nottoway, Nuuchahnulth, Nuxalk,

- Ocuilteco, Oconee, Odawa, Ofo, Ohlone, Ojibwa (Ojibway, Ojibwe, Ojibwemowin), Okanagan (Okanogan), Okmulgee, Omaha-Ponca, Oneida, Onondaga, O'odham (Oodham), Opata, Osage, Otchipwe, Otoe, Ottawa, Ozette,
- Pai, Paipai, Paiute, Palouse, Pamlico, Panamint, Papago-Pima, Pascua Yaqui, Passamaquoddy, Patuxet, Patwin, Paugussett (Paugusset), Pawnee, Pecos, Pee Dee, Peigan, Pend D'Oreille, Pennacook, Penobscot (Pentagoet), Pensacola, Peoria, Pequot, Petun, Picuris, Piegan (Piikani), Pima, Pima Bajo, Pipil, Piscataway, Pit River, Plains Indian Sign Language, Pojoaque, Pomo (Pomoan), Ponca,

Poospatuck (Poosepatuck), Popoluca (Popoloca), Potawatomi (Pottawatomie, Potawatomie), Powhatan, Pueblo, Puquina,

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

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

(Witchita), Willapa, Winnebago, Wintu (Wintun), Wishram, Wiyot, Wyandot (Wyandotte), Wynoochee,

- Yakama (Yakima), Yamasee, Yamel, Yanesha, Yaquina, Yavapai, Yaqui, Yellowknife, Yokuts (Yokut), Yoncalla, Yucatec Maya (Yucateco, Yucatan), Yuchi, Yuki, Yuma, Yupik (Yuit), Yurok,
- Zapotec, Zia, Zoque, Zuni.<sup>20</sup>

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<sup>20</sup> <http://www.native-languages.org/languages.htm>

**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.<sup>21</sup>



Pre-Mediterranean Neolithic Ruins of Göbekli Tepe, photographer unknown.<sup>22</sup>

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<sup>21</sup> [https://en.wikipedia.org/wiki/Gobekli\\_Tepe](https://en.wikipedia.org/wiki/Gobekli_Tepe)

<sup>22</sup> [https://en.wikipedia.org/wiki/Gobekli\\_Tepe](https://en.wikipedia.org/wiki/Gobekli_Tepe)

**Circa 1,301 HE:** A copper pendant has been found in modern day Iraq that dates to **1,301 HE**.<sup>23</sup> (Photo not found.)

**Circa 2,000 HE:** Scotland, Warren Field, Aerial survey reveals Lunar Calendar.<sup>24</sup>

⇒ The Warren Field "calendar" is thousands of years older than previous known formal time-measuring monuments created in Mesopotamia. "The evidence suggests that hunter-gatherer societies in Scotland had both the need and sophistication to track time across the years, to correct for seasonal drift of the lunar year and that this occurred nearly 5,000 years before the first formal calendars known in the Near East. In doing so, this illustrates one important step towards the formal construction of

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<sup>23</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

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



time and therefore history itself" says DAVE COWLEY, RCAHMS.<sup>25</sup>

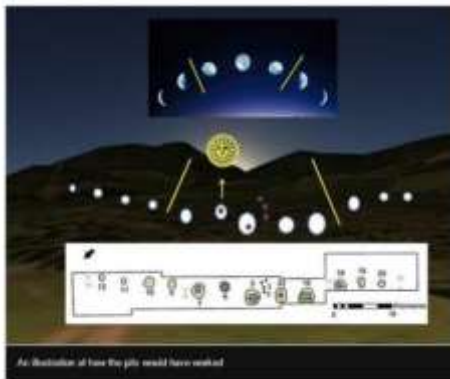


Prof. VINCE GAFFNEY led the project to analyze the calendar pits at Warren Field.<sup>26</sup>

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

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



An illustration of how the pits would have worked<sup>27</sup>

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

**Circa 2,000 HE: Rivers are used for irrigation.<sup>28</sup>**

**Circa 2,000 HE: Xianren Cave, China.<sup>29</sup>**



Xianren Cave, China, photographer and date unknown.<sup>30</sup>

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<sup>28</sup> ISAAC ASIMOV: ASIMOV'S Chronology of the World

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

<sup>30</sup> [https://en.wikipedia.org/wiki/Xianren\\_Cave](https://en.wikipedia.org/wiki/Xianren_Cave)



Photo of Chinese pottery storage/cooking vessel found in the Xianren cave, around 10,000 years old, photographer unknown.<sup>31</sup>

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<sup>31</sup> [https://en.wikipedia.org/wiki/Xianren\\_Cave](https://en.wikipedia.org/wiki/Xianren_Cave)

**Circa 3,001 HE:** China: The process of fermentation. The earliest archaeological evidence of the consumption of alcoholic beverages was discovered in Neolithic China dating from **3,001 HE**. Examination and analysis of ancient pottery jars from the Neolithic village of Jiahu in Henan province in northern China revealed residue left behind by the alcoholic beverages they once contained.<sup>32</sup>

**Circa 3,001 HE – 8,501 HE:** The Chinchorro preceramic culture<sup>33</sup> inhabited what is now the Pacific coastal region of current northern Chile and southern Peru.<sup>34</sup>

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<sup>32</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

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

<sup>34</sup> [https://en.wikipedia.org/wiki/Chinchorro\\_culture](https://en.wikipedia.org/wiki/Chinchorro_culture)



The funeral rite is shown as a human skull with funeral helmet and various items, collection of the Anker Nielsen museum in Iquique, Chile. The mummification practice is displayed in the Archaeology Museum of San Miguel de Azapa.<sup>35</sup>

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<sup>35</sup> [https://en.wikipedia.org/wiki/Chinchorro\\_culture](https://en.wikipedia.org/wiki/Chinchorro_culture)



**Circa 4,951 HE** Chinchorro Mummies at the museum in San Miguel de Azapa in Chile, photographer unknown.<sup>36</sup>

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<sup>36</sup> [https://en.wikipedia.org/wiki/Chinchorro\\_mummies](https://en.wikipedia.org/wiki/Chinchorro_mummies)

**Circa 3,001 HE:** China: The first evidence of pottery urn comes from the early Jiahu site, where a total of 32 burial urns are found.<sup>37</sup>

**Circa 3,001 HE:** Baskets, pottery and textiles.<sup>38</sup>

**Circa 4,001 HE:** Linen cords used for nets, rafts invented, sickles invented.<sup>39</sup>

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

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<sup>37</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>38</sup> ISAAC ASIMOV: ASIMOV'S Chronology of the World

<sup>39</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



dating from the **4,001 HE** has been discovered in a Hemudu culture site at Yuyao, Zhejiang.<sup>40</sup>

**Circa 4,001 HE:** The rise of Sumer or Sumeria, beginning of priest-kings and religion.<sup>41</sup>

**Circa 4,301 HE – 5,501 HE:** Vinca culture period Neolithic archaeological culture in present-day Serbia and smaller parts of Bulgaria and Romania (particularly Transylvania).<sup>42</sup>

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<sup>40</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>41</sup> ISAAC ASIMOV: ASIMOV'S Chronology of the World

<sup>42</sup> [https://en.wikipedia.org/wiki/Vinca\\_culture](https://en.wikipedia.org/wiki/Vinca_culture)



Smelting evidence in Pločnik, Serbia. An anthropomorphic figurine with incised lines depicting clothing, photographer and location unknown.<sup>43</sup>

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<sup>43</sup> [https://en.wikipedia.org/wiki/Vinca\\_culture](https://en.wikipedia.org/wiki/Vinca_culture)



The "*Lady of Vinča*", an iconic terracotta anthropomorphic figurine excavated in **11,929 HE**, at the archaeological site of Vinča-Belo Brdo, in the municipality of Grocka, Belgrade. The figurine is housed in Belgrade's National Museum of Serbia, photographer unknown.<sup>44</sup>

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<sup>44</sup> [https://en.wikipedia.org/wiki/Vinca\\_culture](https://en.wikipedia.org/wiki/Vinca_culture)

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



# Circa 5,001 HE – c 6,501 HE: The Danube Valley; The Lost World of Old Europe: the Cucuteni-Trypillian culture.<sup>45</sup>



DID WOMEN RULE?



WHAT WAS HE THINKING?



WHY DID THEY BURN  
DOWN THEIR HOUSES?



WHY DID THEY VANISH?



Art from the Cucuteni-Trypillian culture.<sup>46</sup>

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

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



Balta Popii, Romania, Pre-Cucuteni Clay Figures **circa 5,101 HE - 5,251 HE**, photographer unknown.<sup>47</sup>

**Circa 5,001 HE:** Scales for measurement developed, Irrigation used.<sup>48</sup>

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<sup>47</sup> [https://en.wikipedia.org/wiki/Cucuteni-Trypillian\\_culture](https://en.wikipedia.org/wiki/Cucuteni-Trypillian_culture)

<sup>48</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

**Circa 6,001 HE:** Sundial invented <sup>49</sup>; Greek name: gnomon: original sundial was a stick stuck into ground, so its shadow could be followed to give a rough estimate of time.<sup>50</sup>

**Circa 6,001 HE:** Copper obtained from ore.<sup>51</sup>

⇒ Author / Compiler Note: Although a copper pendant was found in modern day Iraq that dates back to **1,301 HE**<sup>52</sup> it was not until **6,001 HE** that (according to ISAAC ASIMOV) copper was obtained from ore. For that reason, we are including the description of the “Star Stuff” element copper at this point in the timeline.

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<sup>49</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>50</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery p. 17

<sup>51</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

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



Photo is of Natural Copper nugget, 44 grams. Original size in cm: 1 x 2.5 x 3.5 “Star Stuff” Element Atomic Number 29, Copper, Cu, Copper is an abundant and quite inert metal with a golden-red color, which is useful for a lot of different things. It is known since ancient times and was the first metal used by humans. Together with tin, it is main ingredient of bronze. In an alloy together with zinc, it forms brass. Copper has a very high electrical conductivity, so it is used for most electrical lines (copper wire). Sometimes copper nuggets like this can be found, but most copper is won from ore. Copper also is a necessary trace element for most multicellular organisms.<sup>53</sup> In the human body, Copper combines with proteins to produce enzymes which

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



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.<sup>54</sup>

**Circa 6,001 HE:** Japan, a rowing oar measuring 63.4 cm (2 ft) in length, dating from **6,001 HE**, has also been unearthed at Ishikawa Prefecture.<sup>55</sup>

**Circa 6,001 HE:** Polynesian colonization of South Pacific Islands.<sup>56</sup>

**Circa 6,241 HE:** The Ancient Hebrew culture epoch (reference date), 1 Tishrei AM 1.<sup>57</sup>

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<sup>54</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>55</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>56</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery p.17

<sup>57</sup> [https://en.wikipedia.org/wiki/Hebrew\\_calendar](https://en.wikipedia.org/wiki/Hebrew_calendar)



Map of Ancient Hebrew culture cosmology; Earth Quite Prominent – (but flat and under a dome). illustrated by George L. Robinson.<sup>58</sup>

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

## Chapter Two

### THE BRONZE AGE:

Circa 6,401 HE - Circa 9,001 HE  
(lasting circa 2,600 years)

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

**Circa 6,401 HE:** Bronze discovered, the wheel invented for use in making pottery, oars, plows<sup>59</sup>

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<sup>59</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

**Circa 6,401 HE: Malta - Ġgantija** (Maltese pronunciation: [dʒɡan'tiːja], "Giants' Tower") is a megalithic temple complex from the Neolithic on the Mediterranean island of Gozo.<sup>60</sup>



Entrance of the main temple of Ġgantija, photographer and date unknown<sup>61</sup>

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

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

**Circa 6,501 HE:** Wheeled carts invented – but not yet wheel barrows; river boats used, writing developed.<sup>62</sup>

**Circa 6,501 HE:** China; Triangular-shaped stone ploughshares are found at the sites of Majiabang culture around Lake Taihu.<sup>63</sup>



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

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<sup>62</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>63</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

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

**Circa 6,501 HE:** The Fertile Crescent witnessed the spread of small settlements supported by agricultural surplus. Geometric tokens emerged to be used to manage stewardship of this surplus.<sup>65</sup>



Clay tokens, from Susa, Uruk period, circa **6,501 HE**.  
Department of Oriental Antiquities, Louvre.<sup>66</sup>

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<sup>65</sup> <https://en.wikipedia.org/wiki/Proto-Elamite>

<sup>66</sup> <https://en.wikipedia.org/wiki/Proto-Elamite>

**Circa 6,601 HE – 7,501 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.<sup>67</sup>
- ⇒ The civilization of Sumeria: first medical writing. *“The Sumarian Clay Slab”* that lists 250 plants for preparing medicines.<sup>68</sup>
- ⇒ Record of one of the oldest stories ever written: *The Epic of Gilgamesh* or Bilgamesh was made in this area.<sup>69</sup>

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<sup>67</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 11

<sup>68</sup> [Pharmacoplantae.org/MedHistory.aspx](http://Pharmacoplantae.org/MedHistory.aspx)

<sup>69</sup> <https://en.wikipedia.org/wiki/Gilgamesh>



Tablet V of the *Epic of Gilgamesh*. The Sulaymaniyah Museum, Iraq<sup>70</sup>

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<sup>70</sup> <https://en.wikipedia.org/wiki/Gilgamesh>



⇒ **Circa 6,601 HE- 7,501 HE:** The people of this Sumer, Uruk area AKA Proto-Elamite civilization were also known for development of technological innovations such as the plough (also see **Circa 6,501 HE:** China), sailing boats and copper metal working. Clay tablets with pictographic characters appeared in this period to record commercial transactions.<sup>71</sup>

**Circa 6,701 HE – circa 8,901 HE:** The ancient Cycladic culture flourished in the islands of the Aegean Sea from. Along with the Minoan civilization and Mycenaean Greece, the Cycladic people are counted among the three major Aegean cultures. Cycladic art therefore comprises one of the three main branches of Aegean art.<sup>72</sup>

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

<sup>72</sup> [https://en.wikipedia.org/wiki/Cycladic\\_art](https://en.wikipedia.org/wiki/Cycladic_art)



Cycladic figurine Female Figure, c. **7,001 HE** Brooklyn Museum.<sup>73</sup>

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<sup>73</sup> [https://en.wikipedia.org/wiki/Cycladic\\_art](https://en.wikipedia.org/wiki/Cycladic_art)



Male harp player from Keros, National Archaeological Museum, Athens).<sup>74</sup>

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<sup>74</sup> [https://en.wikipedia.org/wiki/Cycladic\\_art](https://en.wikipedia.org/wiki/Cycladic_art)



Idol, Cycladic figurine, darker stone. Torso with a hole in the throat and dírkama thighs.<sup>75</sup>

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<sup>75</sup> [https://en.wikipedia.org/wiki/Cycladic\\_art](https://en.wikipedia.org/wiki/Cycladic_art)

**Circa 6,800 HE:** Scotland. Carved Stone Balls. Geometric balls carved of stone. Nearly all have been found in north-east Scotland, the majority in Aberdeenshire, the fertile land lying to the east of the Grampian Mountains.<sup>76</sup>



Three examples of Scottish Carved Stone Balls, in Kelvingrove Art Gallery and Museum, Glasgow, Scotland, photographer unknown.<sup>77</sup>

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<sup>76</sup> [https://en.wikipedia.org/wiki/Carved\\_Stone\\_Balls](https://en.wikipedia.org/wiki/Carved_Stone_Balls)

<sup>77</sup> [https://en.wikipedia.org/wiki/Carved\\_Stone\\_Balls](https://en.wikipedia.org/wiki/Carved_Stone_Balls)

**Circa 6,801 HE – Circa 7,301 HE:** Stretching from Susa, Uruk in the west, to Tepe Yahya in the east, the Proto-Elamite writing system, (many still largely undeciphered), was used over a very large geographical area, and perhaps beyond. The known corpus of inscriptions consists of some 1600 tablets, the vast majority unearthed at Susa, Uruk.<sup>78</sup>



**Circa 6,801 HE to 7,301 HE:** Tablet with numeric signs and

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<sup>78</sup> <https://en.wikipedia.org/wiki/Proto-Elamite>

script. From Tepe Sialk, Susa, Uruk period Department of Oriental Antiquities, Louvre.<sup>79</sup>



**Circa 6,801 HE to 7,301 HE:** Economic tablet with numeric signs. Proto-Elamite script in clay, Susa, Uruk period. Department of Oriental Antiquities, Louvre.<sup>80</sup>

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<sup>79</sup> <https://en.wikipedia.org/wiki/Proto-Elamite>

<sup>80</sup> <https://en.wikipedia.org/wiki/Proto-Elamite>

**Circa 6,801 HE – Circa 8,001 HE:** Peru, The Norte Chico civilization (also Caral or Caral-Supe civilization).<sup>81</sup>

⇒ The Norte Chico civilization (also Caral or Caral-Supe civilization) was a complex pre-Columbian era society that included as many as 30 major population centers in what is now the Norte Chico region of north-central coastal Peru. The civilization flourished between circa **6,001 HE and 8,001 HE** with the formation of the first city generally dated to circa **6,501 HE**, at Huaricanga, in the Fortaleza area. It is from **6,501 HE** onward that large-scale human settlement and communal construction become clearly apparent, which lasted until a period of decline.<sup>82</sup>

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<sup>81</sup> [https://en.wikipedia.org/wiki/Norte\\_Chico\\_civilization](https://en.wikipedia.org/wiki/Norte_Chico_civilization)

<sup>82</sup> [https://en.wikipedia.org/wiki/Norte\\_Chico\\_civilization](https://en.wikipedia.org/wiki/Norte_Chico_civilization)





Remains of the two main Caral pyramids in the arid Supe Valley, date and photographer unknown.<sup>83</sup>

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<sup>83</sup> [https://en.wikipedia.org/wiki/Norte\\_Chico\\_civilization](https://en.wikipedia.org/wiki/Norte_Chico_civilization)



Caral panorama, date and photographer unknown.<sup>84</sup>

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<sup>84</sup> [https://en.wikipedia.org/wiki/Norte\\_Chico\\_civilization](https://en.wikipedia.org/wiki/Norte_Chico_civilization)



Remains of platform mound structures at Caral.<sup>85</sup>

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<sup>85</sup> [https://en.wikipedia.org/wiki/Norte\\_Chico\\_civilization](https://en.wikipedia.org/wiki/Norte_Chico_civilization)

**Circa 6,801 HE:** Newgrange, Ireland, *World Heritage Site*; The accuracy of Newgrange as a time-telling device is remarkable when one considers that it was built 500 years before the Great Pyramids, more than 1,000 years before Stonehenge and more than 2000 years before Karnak.<sup>86</sup>

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<sup>86</sup> <http://newgrange.com/>



The entrance to Newgrange in the late **11,800 HEs**, when the mound had become largely overgrown <sup>87</sup>

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



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

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<sup>88</sup> <http://newgrange.com/>

**Circa 6,821 HE – Circa 7,501 HE:** Scotland; Europe's most complete Neolithic village: Skara Brae UNESCO World Heritage Site.<sup>89</sup>

- ⇒ 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.<sup>90</sup>

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<sup>89</sup> [https://en.wikipedia.org/wiki/Skara\\_Brae](https://en.wikipedia.org/wiki/Skara_Brae)

<sup>90</sup> [https://en.wikipedia.org/wiki/History\\_of\\_water\\_supply\\_and\\_sanitation](https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation)



Evidence of home furnishings at Skara Brae<sup>91</sup> including indoor water toilets, photographer unknown.<sup>92</sup>

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<sup>91</sup> [https://en.wikipedia.org/wiki/Skara\\_Brae](https://en.wikipedia.org/wiki/Skara_Brae)

<sup>92</sup> [https://en.wikipedia.org/wiki/History\\_of\\_water\\_supply\\_and\\_sanitation](https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation)





Skara Brae, looking north, photographer unknown.<sup>93</sup>

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<sup>93</sup> [https://en.wikipedia.org/wiki/Skara\\_Brae](https://en.wikipedia.org/wiki/Skara_Brae)



Excavated dwellings at Skara Brae, photographer unknown.<sup>94</sup>

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<sup>94</sup> [https://en.wikipedia.org/wiki/Skara\\_Brae](https://en.wikipedia.org/wiki/Skara_Brae)

**Circa 6,851 HE:** Malta, in the Mediterranean Sea, Tarxien Phase in Maltese prehistory; Traces of a lost Civilization.<sup>95</sup>



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.<sup>96</sup>

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<sup>95</sup> [http://www.maltacultureguide.com/index.php?page=article&article\\_id=25](http://www.maltacultureguide.com/index.php?page=article&article_id=25)

<sup>96</sup> [https://en.wikipedia.org/wiki/Megalithic\\_Temples\\_of\\_Malta](https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta)



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.<sup>97</sup>

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<sup>97</sup> [https://en.wikipedia.org/wiki/Megalithic\\_Temples\\_of\\_Malta](https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta)



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.<sup>98</sup>

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<sup>98</sup> [https://en.wikipedia.org/wiki/Megalithic\\_Temples\\_of\\_Malta](https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta)



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.<sup>99</sup>

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<sup>99</sup> [https://en.wikipedia.org/wiki/Megalithic\\_Temples\\_of\\_Malta](https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta)



UNESCO World Heritage Site, Tarxien Megalithic Temple of Malta, photographer unknown.<sup>100</sup>

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<sup>100</sup> [https://en.wikipedia.org/wiki/Megalithic\\_Temples\\_of\\_Malta](https://en.wikipedia.org/wiki/Megalithic_Temples_of_Malta)

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



**11,892 HE** photograph of El Castillo at Chichen Itza, by Teoberto Maler.<sup>101</sup>

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<sup>101</sup> [https://en.wikipedia.org/wiki/Maya\\_civilization](https://en.wikipedia.org/wiki/Maya_civilization)





El Castillo, at Chichen Itza.<sup>102</sup> Photographer and more current date unknown.

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


















<sup>102</sup> [https://en.wikipedia.org/wiki/Maya\\_civilization](https://en.wikipedia.org/wiki/Maya_civilization)

- ⇒ Mayans had multiple calendars: Mayan “creation date:” **6,877 HE**; Mayan Round Calendar: 52 years; Mayan Tzolk’in calendar: 260 days; Mayan Haab calendar: 365 days; **12,012 HE**: end date of a 5,126 -year-long cycle in the Mesoamerican Mayan long count calendar.<sup>103</sup>
- ⇒ Mayan Civilization included: People, Society, Languages, Writing, Religion Mythology, Human Sacrifice, Cities, Architecture, Astronomy, Calendar, Stelae, Art, Textiles, Trade, Music, Dance, Medicine, Cuisine.<sup>104</sup>

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<sup>103</sup> [https://en.wikipedia.org/wiki/Maya\\_calendar](https://en.wikipedia.org/wiki/Maya_calendar)

<sup>104</sup> [https://en.wikipedia.org/wiki/Maya\\_civilization](https://en.wikipedia.org/wiki/Maya_civilization)

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



400s			
20s			
1s			
	33	429	5125

Images of Mayan Numerals<sup>105</sup>

<sup>105</sup> [https://en.wikipedia.org/wiki/Maya\\_numerals](https://en.wikipedia.org/wiki/Maya_numerals)

**Circa 6,901 HE:** The first “nation” united in Egypt<sup>106</sup>, called the First Dynasty of Egypt.<sup>107</sup>



Pottery jar with integral strainer, First Dynasty, Early Dynastic Period, Egypt. The Petrie Museum of Egyptian Archaeology, London.<sup>108</sup>

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<sup>106</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>107</sup> [https://en.wikipedia.org/wiki/First\\_Dynasty\\_of\\_Egypt](https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt)

<sup>108</sup> [https://en.wikipedia.org/wiki/First\\_Dynasty\\_of\\_Egypt](https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt)

⇒ Egyptian hieroglyphs were fully developed by then, and their shapes would be used with little change for more than three thousand years.<sup>109</sup> This early writing of hieroglyphs was called cuneiform and consisted of making specific marks in wet clay with a reed implement.<sup>110</sup>

**Circa 7,001 HE:** First evidence of candles being used for artificial lighting.<sup>111</sup>

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

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<sup>109</sup> [https://en.wikipedia.org/wiki/First\\_Dynasty\\_of\\_Egypt](https://en.wikipedia.org/wiki/First_Dynasty_of_Egypt)

<sup>110</sup> <https://www.ancient.eu/writing/>

<sup>111</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Farm carts near Stonehenge **circa 11,885 HE**, photographer unknown.<sup>112</sup>

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



**Post WWI** Stonehenge aerial photograph, photographer unknown.<sup>113</sup>

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



A then contemporary newspaper depiction of the **11,920 HE** restoration of Stonehenge.<sup>114</sup>

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





Stonehenge in **12,014 HE**, photographer unknown.<sup>115</sup>

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

**Circa 7,051 HE: IMHOTEP**, Egyptian scholar, 2000 years after his death made into a god, architect of the first pyramid.<sup>116</sup>



Late Period statue of IMHOTEP, Musée du Louvre.<sup>117</sup>

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

<sup>117</sup> [https://en.wikipedia.org/wiki/Old\\_Kingdom\\_of\\_Egypt](https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt)

**Circa 7,401 HE:** Sumer continues, (see **Circa 4,001 HE:** The rise of Sumeria) “Sumer had now developed into 28 cities over these hundreds of years. Uruk was one city in Sumer.”<sup>118</sup> “They call this place Uruk. We call it Iraq. It's a part of Mesopotamia, the land between the Tigris and the Euphrates rivers.”<sup>119</sup>



Dated to **Circa 7,401 HE — Circa 7,501 HE:** An image

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

<sup>119</sup> COSMOS, A Space Time Odyssey, by Ann Druyan, Episode 11

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.<sup>120</sup>

**Circa 7,401 HE – Circa 8,101 HE:** What is now Pakistan: the Harappan Civilization Phase of the Indus Valley Civilization in the Indian Sub-continent.<sup>121</sup>

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<sup>120</sup> [Pharmacoplantae.org/MedHistory.aspx](http://Pharmacoplantae.org/MedHistory.aspx)

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



Excavated ruins of Mohenjo-Daro, Sindh province, Pakistan, showing the Great Bath in the foreground. Mohenjo-Daro, on the right bank of the Indus River, is a UNESCO World Heritage Site, the first site in South Asia to be so declared.<sup>122</sup>

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<sup>122</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)

⇒ From a room that appears to have been set aside for bathing, waste water was directed to covered drains, which lined the major streets.<sup>123</sup>



⇒ A large well and bathing platforms at Harappa, remains of the city's phase of occupation from **7,801 HE to 8,101 HE**.<sup>124</sup>

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<sup>123</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)

<sup>124</sup> [https://en.wikipedia.org/wiki/History\\_of\\_water\\_supply\\_and\\_sanitation](https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation)

⇒ Although some houses were larger than others, Indus Civilization cities were remarkable for their apparent, if relative, egalitarianism. All the houses had access to water and drainage facilities. This gives the impression of a society with relatively low wealth concentration, though clear social levelling is seen in personal adornments. The prehistory of Indo-Iranian borderlands shows a steady increase over time in the number and density of settlements. The population increased in Indus plains because of hunting and gathering.<sup>125</sup>

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<sup>125</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)



Dholavira Sophisticated Water Reservoir, evidence for hydraulic sewage systems in the ancient Indus Valley Civilization.<sup>126</sup>

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<sup>126</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)



⇒ Toilets that used water were used in the Indus Valley Civilization. The cities of Harappa and Mohenjo-Daro had an early indoor toilet in almost every house, attached to a sophisticated sewage system.<sup>127</sup>

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<sup>127</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)



Indus Valley Pottery, photographer and location unknown.<sup>128</sup>

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<sup>128</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)



Indus valley seals with Bull, Elephant, and Rhinoceros, photographer and location unknown.<sup>129</sup>

<sup>129</sup> [https://en.wikipedia.org/wiki/Indus\\_Valley\\_Civilisation](https://en.wikipedia.org/wiki/Indus_Valley_Civilisation)

- ⇒ The Indus people, through over- irrigation had increased the salt content of their fields to such an extent that they could not grow crops enough to support themselves any longer.<sup>130</sup>

**Circa 7,401 HE – 8,901 HE:** The Minoan Civilization, in Ancient Greece, was an Aegean Bronze Age civilization which flourished on the island of Crete and other Aegean islands. It preceded the Mycenaean civilization of Ancient Greece. The civilization was rediscovered at the beginning of the **19,000's HE** through the work of British archaeologist ARTHUR EVANS.<sup>131 132</sup>

- ⇒ Minoan cities were connected by roads paved with blocks cut with bronze saws. Streets were drained, and water and sewage

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<sup>130</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>131</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)

<sup>132</sup> <https://www.youtube.com/watch?v=czgOWmtGVGs> [en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)

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.<sup>133</sup>

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<sup>133</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)



Restored model of a Minoan house found in Archanes, artist, photographer and location unknown.<sup>134</sup>

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<sup>134</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)



Map of Minoan Crete, artist and location unknown.<sup>135</sup>

<sup>135</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization#/media/File:Map\\_Minoan\\_Crete-en.svg](https://en.wikipedia.org/wiki/Minoan_civilization#/media/File:Map_Minoan_Crete-en.svg)



Ruins of the palace at Knossos, photographer and date unknown.<sup>136</sup>

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<sup>136</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)





Sewers of the palace of Knossos<sup>137</sup>

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<sup>137</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)



The partially-restored "campstool fresco" from Knossos, photographer unknown.<sup>138</sup>

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<sup>138</sup> [https://en.wikipedia.org/wiki/Minoan\\_civilization](https://en.wikipedia.org/wiki/Minoan_civilization)



The Dolphin Mural from Knossos, photographer unknown.<sup>139</sup>

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<sup>139</sup> [www.touropia.com](http://www.touropia.com)



Palace complex at Phaistos, Minoan Civilization at Phaistos, Crete, photographer unknown.<sup>140</sup>

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<sup>140</sup> [https://en.wikipedia.org/wiki/Phaistos\\_Disc](https://en.wikipedia.org/wiki/Phaistos_Disc)



**Circa 8,151 HE:** The 15 cm or circa 5” Phaistos Disc (side A) is on display at the Heraklion Archaeological Museum, Crete. Its purpose and meaning, and even its original geographical place of manufacture, even authenticity, remain disputed.<sup>141</sup>

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<sup>141</sup> [https://en.wikipedia.org/wiki/Phaistos\\_Disc](https://en.wikipedia.org/wiki/Phaistos_Disc)

Circa **7,412 HE**: Fourth Dynasty of Egypt; "the Age of the Pyramids."<sup>142</sup>

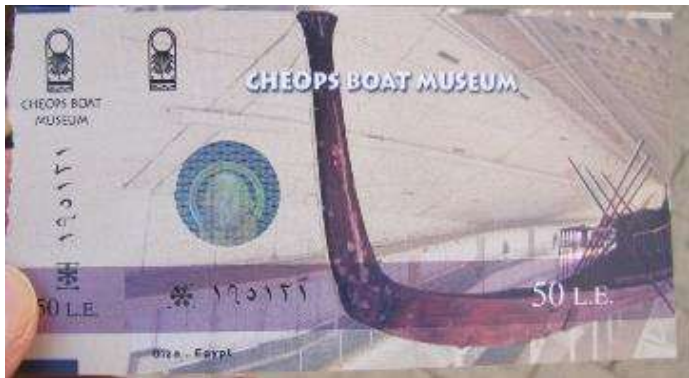


Statue of “Khufu” (AKA Cheops, Suphis, Chnoubos and Sofe) in the Cairo Museum.<sup>143</sup>

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<sup>142</sup> [https://en.wikipedia.org/wiki/Old\\_Kingdom\\_of\\_Egypt](https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt)

<sup>143</sup> [https://en.wikipedia.org/wiki/Old\\_Kingdom\\_of\\_Egypt](https://en.wikipedia.org/wiki/Old_Kingdom_of_Egypt)



⇒ Cairo, Egypt **12,009 HE** ticket to Cheops Boat Museum.<sup>144</sup>

<sup>144</sup> From author family **12,010 HE** visit to Egypt



Cairo, Egypt; Boat excavation hole just to the side of the Cheops Pyramid.<sup>145</sup>

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<sup>145</sup> From author family **12,010 HE** visit to Egypt





Cairo, Egypt, Cheops Boat Museum; excavated **circa 4,605-year-old rope** used for Egyptian Cheops Boats (and ok, Author / Compiler, son and daughter).<sup>146</sup>

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<sup>146</sup> From author family **12,010 HE** visit to Egypt, photographer Paul Premack



Cairo, Egypt, Cheops Boat Museum; circa **4,605-year-old** boat excavated from above photo/hole just to the side of the Cheops Pyramid.<sup>147</sup>

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<sup>147</sup> From author family visit to Egypt



Cairo, Egypt, Cheops Boat Museum; view of circa 4,605-year-old paddles design from excavated boat.<sup>148</sup>

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<sup>148</sup> From author family **12,010 HE** visit to Egypt

**Circa 7.421 HE:** Construction of the Great Pyramid of Giza, Egypt.<sup>149</sup>



The Great Pyramid of Giza, current times, photographer unknown.<sup>150</sup>

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<sup>149</sup> [https://en.wikipedia.org/wiki/Great\\_Pyramid\\_of\\_Giza](https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza)

<sup>150</sup> [https://en.wikipedia.org/wiki/Great\\_Pyramid\\_of\\_Giza](https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza)



Great Pyramid of Giza from a **11,800s HE** stereopticon card photo<sup>151</sup>

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<sup>151</sup> [https://en.wikipedia.org/wiki/Great\\_Pyramid\\_of\\_Giza](https://en.wikipedia.org/wiki/Great_Pyramid_of_Giza)

**Circa 7,441 HE: Egypt:** The earliest archaeological evidence of papyrus was excavated in **12,012 HE and 12,013 HE** at Wadi al-Jarf, an ancient Egyptian harbor located on the Red Sea coast. These documents date from end of the reign of Khufu. The papyrus rolls describe the last years of building the Great Pyramid of Giza.<sup>152</sup>

- 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”<sup>153</sup> Using the included HE conversion calculator to get to **11,950 HE** then subtracting 4,200 from it, was the calculation used to achieve the “**Circa 7,450 HE**” for dating

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<sup>152</sup> <https://en.wikipedia.org/wiki/Papyrus>

<sup>153</sup> <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 **7,450 HE** and other HE dates to the flow of our history, rather than bleep over the reference: “4200 years before 1950” without having a big picture comparison. Yay CESARE EMILIANI’s HE timeline idea!

**Circa 7,450 HE:** The Meghalayan Age of the Holocene Epoch.<sup>154</sup>

⇒ 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

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<sup>154</sup> <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.<sup>155</sup>

**Circa 7,501 HE:** Glass used.<sup>156</sup>

**Circa 7,501 HE:** The civilization of Crete ends under the ashes of a volcanic explosion.<sup>157</sup>

**Circa 7,501 HE – Circa 8,001 HE:** Horses tamed.<sup>158</sup> Some researchers do not consider an animal to be "domesticated" until it exhibits physical changes consistent with selective breeding, or at least

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<sup>155</sup> <http://www.iflscience.com/environment/welcome-to-the-meghalayan-we-are-now-living-in-a-new-geological-age/>

<sup>156</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery PAGE 24

<sup>157</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>158</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



having been born and raised entirely in captivity. Until that point, they classify captive animals as merely "tamed".<sup>159</sup> Those who hold to this theory of domestication point to a change in skeletal measurements was detected among horse bones recovered from middens dated about **7,501 HE** in eastern Hungary in Bell-Beaker sites, and in later Bronze Age sites in the Russian steppes, Spain, and eastern Europe.<sup>160</sup>

**Circa 7,661 HE:** In the region that eventually became known as Assyria and over the territory to the east of the Tigris which was known as Elam: Sargon established the First Empire we know of

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<sup>159</sup> [https://en.wikipedia.org/wiki/Domestication\\_of\\_the\\_horse](https://en.wikipedia.org/wiki/Domestication_of_the_horse)

<sup>160</sup> [https://en.wikipedia.org/wiki/Domestication\\_of\\_the\\_horse](https://en.wikipedia.org/wiki/Domestication_of_the_horse)

by uniting Akkad and Sumeria: peoples with different languages and different cultures.<sup>161</sup>

**Circa 7,701 HE – Circa 8,401 HE:** Central Europe; in what are now the Germany, Poland and Czech areas at the start of the Central European Bronze Age, lived the archaeological Únětice culture<sup>[87]</sup> who created the Nebra Sky Disc. The Nebra Sky Disc was made of bronze and features the oldest tangible depiction of cosmic phenomena worldwide. It was buried along with two precious swords, two axes, two spiral arm-rings and one bronze chisel circa 3,600 years ago.

⇒ The Únětice culture bronze disc is considered to be one of the most important archaeological finds of the **11,900's HE**. It

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<sup>161</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, pages 24-25

<sup>[87]</sup> [https://en.wikipedia.org/wiki/Unetice\\_culture](https://en.wikipedia.org/wiki/Unetice_culture)

contains an extraordinary comprehension of astronomical phenomena that enable unique glimpses into the early knowledge of the skies.<sup>162</sup>

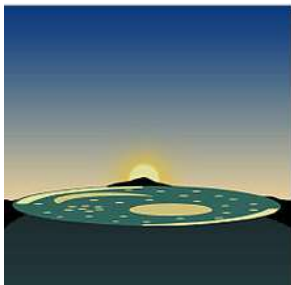


Únětice culture Nebra Sky Disk discovered in Saxony Anhalt, Germany, LDA Sachsen-Anhalt. Photo by J. Lipták.<sup>163</sup>

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<sup>162</sup> <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/>

<sup>163</sup> [https://en.wikipedia.org/wiki/Unetice\\_culture](https://en.wikipedia.org/wiki/Unetice_culture)



Unknown artist rendering of Nebra sky disk, position of the arcs at evening of summer solstice.<sup>164</sup>

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<sup>164</sup> [https://en.wikipedia.org/wiki/Unetice\\_culture](https://en.wikipedia.org/wiki/Unetice_culture)



Swords buried with the Únětice culture Nebra sky disk, location and photographer unknown.<sup>165</sup>

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<sup>165</sup> [https://en.wikipedia.org/wiki/Unetice\\_culture](https://en.wikipedia.org/wiki/Unetice_culture)

Circa 8,151 HE – Circa 8,201 HE: Egypt, the “Moscow or Golenishchev” Mathematical Papyrus<sup>166</sup> 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.<sup>166</sup>



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

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<sup>166</sup> [https://en.wikipedia.org/wiki/Moscow\\_Mathematical\\_Papyrus](https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus)

Width: 3.8 to 7.6 cm (1.5 to 3 in) *Moscow Mathematical Papyrus* at Pushkin State Museum of Fine Arts in Moscow<sup>168</sup>

⇒ Solutions by the Soviet Orientalist Vasily Vasilievich Struve in **11,930 HE**, exist.<sup>169</sup>

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

•

The solution to the 10th problem means the scribe of the *Moscow Papyrus* could approximate pi  $256/81 = 3.16049$ .<sup>170</sup>

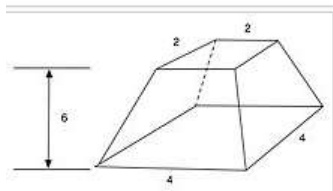
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<sup>167</sup> [thematematicaltourist.wordpress.com](http://thematematicaltourist.wordpress.com)

<sup>168</sup> [https://en.wikipedia.org/wiki/Moscow\\_Mathematical\\_Papyrus](https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus)

<sup>169</sup> [https://en.wikipedia.org/wiki/Moscow\\_Mathematical\\_Papyrus](https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus)

<sup>170</sup> [https://en.wikipedia.org/wiki/Moscow\\_Mathematical\\_Papyrus](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.<sup>171</sup>

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<sup>171</sup> [https://en.wikipedia.org/wiki/Moscow\\_Mathematical\\_Papyrus](https://en.wikipedia.org/wiki/Moscow_Mathematical_Papyrus)



**Circa 8,201 HE:** Egypt, uses of fermentation for drink or bread is further discovered (see **3,001 HE** in China); number system based on 60 developed; 7-day week devised; 5 planets and 12 constellations of zodiac named.<sup>172</sup>

**Circa 8,201 HE:** *The Kahun Gynecological Papyrus*<sup>173</sup> (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.<sup>174</sup>

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<sup>172</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>173</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>174</sup> [https://en.wikipedia.org/wiki/Kahun\\_Gynaecological\\_Papyrus](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.<sup>175</sup>

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<sup>175</sup> [https://en.wikipedia.org/wiki/Kahun\\_Gynaecological\\_Papyrus](https://en.wikipedia.org/wiki/Kahun_Gynaecological_Papyrus)

⇒ *The Kahun Gynecological Papyrus* describes various contraceptive pessaries, including:

- acacia gum, which recent research has confirmed to have spermicidal qualities and is still used in contraceptive jellies.
- the application of gummy substances to cover the "mouth of the womb" (i.e. the cervix),
- a mixture of honey and sodium carbonate applied to the inside of the vagina, and
- a pessary made from crocodile dung.
- Lactation (breast-feeding) of up to three years was also used for birth control purposes in ancient Egypt.<sup>176</sup>

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<sup>176</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

## Circa 8,247 HE: Babylonia; Mesopotamia.

- ⇒ The Babylonians knew math. They knew about the right-angled triangle, that the shorter sides were one unit long, and the hypotenuse is the square root of two – not a whole number but an irrational number.<sup>177</sup>
- ⇒ *Code of Hammurabi*, The Babylonians established the first surviving law code.<sup>178</sup>

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<sup>177</sup> Liz Strachan *A Slice of Pi*

<sup>178</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



Code on clay tablets



Code on basalt stele



Two versions of the *Code of Hammurabi* at the Louvre Museum.<sup>179</sup>

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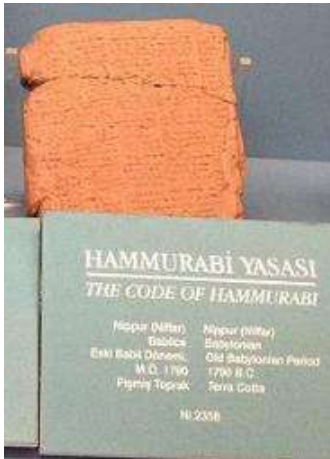
<sup>179</sup> [https://en.wikipedia.org/wiki/Code\\_of\\_Hammurabi](https://en.wikipedia.org/wiki/Code_of_Hammurabi)



**Hammurabi** stele at American Museum of Natural History, New York.<sup>180</sup>

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<sup>180</sup> [https://en.wikipedia.org/wiki/Code\\_of\\_Hammurabi](https://en.wikipedia.org/wiki/Code_of_Hammurabi)



A version of the code at the Istanbul Archaeological Museums.<sup>181</sup>

⇒ Numbers as we know them still did not exist. Below are examples of early use of Babylonian numbers:

1	11	21	31	41	51
2	12	22	32	42	52
3	13	23	33	43	53
4	14	24	34	44	54
5	15	25	35	45	55
6	16	26	36	46	56
7	17	27	37	47	57
8	18	28	38	48	58
9	19	29	39	49	59
10	20	30	40	50	

⇒

Babylonian Cuneiform Numerals.<sup>182</sup>

<sup>181</sup> [https://en.wikipedia.org/wiki/Code\\_of\\_Hammurabi](https://en.wikipedia.org/wiki/Code_of_Hammurabi)

<sup>182</sup> [http://www-history.mcs.st-and.ac.uk/HistTopics/Babylonian\\_numerals.html](http://www-history.mcs.st-and.ac.uk/HistTopics/Babylonian_numerals.html)



- ⇒ **Soap is invented!**- but not necessarily used to wash the body. The next recorded evidence of soap making are Babylonian clay cylinders. Inscriptions on the cylinders are the earliest known written soap recipe and they describe a process by which fats could be combined with wood ash and water to create a substance capable of cleaning. The product thus produced was not necessarily used to wash the body; it might have been used to clean textile fibers such as wool and cotton in preparation for weaving into cloth.<sup>183</sup>
- ⇒ **Circa 8,247 HE:** Babylonians first recorded oral hygiene by use of tooth cleaning sticks.<sup>184</sup>

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<sup>183</sup> <http://www.soaphistory.net/soap-history/first-soap/>

<sup>184</sup> <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).<sup>185</sup> (Author / Compiler sees two sticks in the picture. Maybe it is two halves of the same stick?)

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<sup>185</sup> <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

**Circa 8,301 HE – 8,801 HE:** Ancient Egyptian Empire.<sup>186</sup>

⇒ **Circa 8,351 HE:** AHMES, Egyptian scribe who on papyrus scribed what others authored in the ***Rhind Mathematical Papyrus*** (mathematical treatise “Directions for Attaining Knowledge of all Dark Things”). It is now in the British Museum.<sup>187</sup>

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<sup>186</sup> ISAAC ASIMOV’S Chronology of the World

<sup>187</sup> <https://www.britannica.com/biography/Ahmes>



Photo is of a portion of the *Rhind Mathematical Papyrus*, British Museum, London.<sup>188</sup>

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<sup>188</sup> [https://en.wikipedia.org/wiki/Rhind\\_Mathematical\\_Papyrus](https://en.wikipedia.org/wiki/Rhind_Mathematical_Papyrus)

**Circa 8,401 HE:** First Egyptian medical text was on papyrus (named after the dealer, Edwin Smith, who bought it in **11,862 HE**).<sup>189</sup>



Plates vi & vii of the *Edwin Smith Papyrus* at the Rare Book Room, New York Academy of Medicine.<sup>190</sup>

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<sup>189</sup> [https://en.wikipedia.org/wiki/Edwin\\_Smith\\_Papyrus](https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus)

<sup>190</sup> [https://en.wikipedia.org/wiki/Edwin\\_Smith\\_Papyrus](https://en.wikipedia.org/wiki/Edwin_Smith_Papyrus)

**Circa 8,401 HE – 8,955 HE:** China, Shang Dynasty, first Chinese early written records were on bone<sup>191</sup>



A Shang dynasty oracle bone from the Shanghai Museum<sup>192</sup>

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<sup>191</sup> [https://en.wikipedia.org/wiki/Oracle\\_bone](https://en.wikipedia.org/wiki/Oracle_bone)

<sup>192</sup> [https://en.wikipedia.org/wiki/Oracle\\_bone](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.”<sup>193</sup>

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<sup>193</sup> PBS Skunk Bear How Eclipses changed History youtube video:  
[https://www.youtube.com/watch?v=tTxz\\_d2q7Js](https://www.youtube.com/watch?v=tTxz_d2q7Js)

**Circa 8,401 HE – 8,801 HE:** Tumulus Culture of Central Europe. In **11,902 HE**, PAUL REINECKE distinguished the Tumulus culture by distinguishing cultural horizons that showed the practice of burying the dead beneath burial mounds (tumuli or kurgans). Tumuli have been used elsewhere in Europe from the Stone Age to the Iron Age; the term "Tumulus culture" specifically refers to the South German variant of the Bronze Age.<sup>194</sup>

**Circa 8,501 HE:** The “Star Stuff” element Iron was first smelted by the Hittites of Asia Minor.<sup>195</sup>

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<sup>194</sup> [https://en.wikipedia.org/wiki/Tumulus\\_culture](https://en.wikipedia.org/wiki/Tumulus_culture)

<sup>195</sup> 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.<sup>196</sup> 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.<sup>197</sup>

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<sup>196</sup> <http://images-of-elements.com/iron.php#a>

<sup>197</sup> PAUL PARSONS & GAIL DIXON *The Periodic Table*

**Circa 8,501 HE:** The Alphabet from which all alphabets grew, was developed by some nameless Canaanite or Phoenician as they were called by the Greeks.<sup>198</sup>

⇒ There is no record of what the Phoenicians called themselves. It is only through their reference by others do we know of the Phoenicians.<sup>199</sup>

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<sup>198</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>199</sup> Stuff you missed in history class podcast <https://www.missedinhistory.com/podcasts/the-phoenician-alphabet.htm>



Phoenician Alphabet, The Alphabet from which all alphabets grew<sup>200</sup>

<sup>200</sup> [https://en.wikipedia.org/wiki/Phoenician\\_alphabet](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 **11,923 HE**, which revealed a number of Phoenician royal tombs. The tomb of Ahiiram was ten meters deep.<sup>201</sup>

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<sup>201</sup> [https://en.wikipedia.org/wiki/Ahiiram\\_sarcophagus](https://en.wikipedia.org/wiki/Ahiiram_sarcophagus)



The Sarcophagus of Ahiem in its current location at the National Museum of Beirut.<sup>202</sup>

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<sup>202</sup> [https://en.wikipedia.org/wiki/Ahiem\\_sarcophagus](https://en.wikipedia.org/wiki/Ahiem_sarcophagus)

**Circa 8,501 HE: The Ebers Papyrus,**<sup>203</sup> also known as **Papyrus Ebers,** is an Egyptian medical papyrus of herbal knowledge. Among the oldest and most important medical papyri of ancient Egypt, it was purchased at Luxor (Thebes) in the winter of **11,873 HE–11,874 HE** by Georg Ebers.<sup>204</sup> 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;

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<sup>203</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control) AND HISTORY OF SOAP

<sup>204</sup> [https://en.wikipedia.org/wiki/Ebers\\_Papyrus](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. (3,500 years later, this remains the standard treatment.);
- For Medicinal use of ochre clays; one of the more common remedies described in the *Ebers Papyrus* is ochre, or medicinal clay. Ochre, or medicinal clay, is prescribed for intestinal and eye complaints. Yellow ochre is also described as a remedy for urological complaints.<sup>205</sup>

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<sup>205</sup> [https://en.wikipedia.org/wiki/Ebers\\_Papyrus](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.<sup>206</sup> The first recorded evidence of induced abortion is from the Egyptian *Ebers Papyrus*<sup>207</sup>

⇒ 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.<sup>208</sup> SOAP and HYGENE! More detailed accounts of soap use came from Ancient Egypt, where soaps and aromatic oils were not only

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<sup>206</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>207</sup> [https://en.wikipedia.org/wiki/History\\_of\\_abortion](https://en.wikipedia.org/wiki/History_of_abortion)

<sup>208</sup> <http://www.soaphistory.net/soap-history/first-soap/>

used for washing but also as an important medical cure for many skin and muscle diseases.<sup>209</sup>



A photo of a piece of The **Ebers Papyrus**, c. **8,501 HE** from Ancient Egypt. It is currently kept at the library of the University of Leipzig, in Germany.<sup>210</sup>

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<sup>209</sup> <http://www.soaphistory.net/soap-history/first-soap/>

<sup>210</sup> [https://en.wikipedia.org/wiki/Ebers\\_Papyrus](https://en.wikipedia.org/wiki/Ebers_Papyrus)

## Circa 8,601 HE to circa 8,650 HE: Egypt, Karnak, UNESCO World Heritage Site<sup>211</sup>

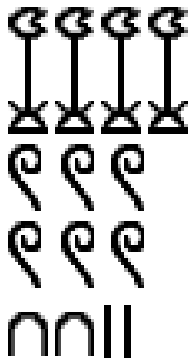
Value	1	10	100	1,000	10,000	100,000	1 million, or many
Hieroglyph		∩	9	⌚	⌚	⌚	⌚



Numbers as we know them still did not exist. The image above shows the Ancient Hieroglyphs and matching current Hindu-Arabic number.<sup>212</sup>

<sup>211</sup> <http://www.karnak.org/>

<sup>212</sup> [https://en.wikipedia.org/wiki/Egyptian\\_numerals](https://en.wikipedia.org/wiki/Egyptian_numerals)



A drawing of a stone carving from Karnak (artist and date unknown) shows the number 4622.<sup>213</sup>

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<sup>213</sup> [https://en.wikipedia.org/wiki/Egyptian\\_numerals](https://en.wikipedia.org/wiki/Egyptian_numerals)



Karnak Gate built for Winter Solstice alignment.<sup>214 215</sup>

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<sup>214</sup> Tiffany Premack 12,010 HE family trip to Egypt

- ⇒ **Circa 10,323 HE:** When Constantine the Great recognized the Christian religion, the Karnak complex was closed and abandoned.<sup>216</sup>
- ⇒ 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.<sup>217</sup>
- ⇒ In Asia hygiene remained respected and enforced by tradition.<sup>218</sup>

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<sup>215</sup> Photo from author **12,010 HE** family trip to Egypt

<sup>216</sup> [https://en.wikipedia.org/wiki/Karnak#Precinct\\_of\\_Amun-Re](https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re)

<sup>217</sup> <http://www.soaphistory.net/soap-facts/soap-benefits/>

<sup>218</sup> <http://www.soaphistory.net/soap-facts/soap-benefits/>

**Circa 8,651 HE – Circa 8,801 HE:** *The Brugsch Papyrus (Pap. Berl. 3038)*, also known as *the Greater Berlin Papyrus*, or simply *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 **11,827 HE** for the Berlin Museum, where it is still housed. The style of writing is that of Egypt's 19th dynasty.<sup>219</sup>

⇒ It deals with:

- women's health,
- contraception,
- gynecological diseases,
- fertility tests, pregnancy, etc.<sup>220</sup>

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<sup>219</sup> [https://en.wikipedia.org/wiki/Brugsch\\_Papyrus](https://en.wikipedia.org/wiki/Brugsch_Papyrus)

<sup>220</sup> [https://en.wikipedia.org/wiki/Brugsch\\_Papyrus](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 **11,909 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 8,501 HE**). Some historians believe that this papyrus was used by GALEN (see: **Circa 10,200 HE: AELIUS OR CLAUDIUS GALENUS**, Greek, GALEN of PERGAMON) in his writings.<sup>221</sup>

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<sup>221</sup> [https://en.wikipedia.org/wiki/Brugsch\\_Papyrus](https://en.wikipedia.org/wiki/Brugsch_Papyrus)



**Circa 8,659 HE – circa 8,677 HE: Egypt: King Tutankhamen**



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Wooden bust of the boy king, found in his tomb<sup>222</sup>

⇒ Tutankhamun's mummy was discovered by English Egyptologist Howard Carter and his team in **11,925** HE in tomb KV62 of

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<sup>222</sup> <https://en.wikipedia.org/wiki/Tutankhamun>

Egypt's Valley of the Kings. Tutankhamun was the 11th pharaoh of the 18th Dynasty of the New Kingdom of Egypt, making his mummy over 3,300 years old.



223

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<sup>223</sup> [https://en.wikipedia.org/wiki/Tutankhamun's\\_mummy](https://en.wikipedia.org/wiki/Tutankhamun's_mummy)



HOWARD CARTER and associates opening the shrine doors in the burial chamber (**11,924 HE** reenactment of the **11,923 HE** event)<sup>224</sup>

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<sup>224</sup> [https://en.wikipedia.org/wiki/KV62#/media/File:The\\_Moment\\_Carter\\_Opens\\_the\\_Tomb.JPG](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 11,730s HE. (See 11,730 HE GEORG BRANDT).



⇒

Tutankhamun's death mask.<sup>225</sup>

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<sup>225</sup> <https://en.wikipedia.org/wiki/Tutankhamun>

**Circa 8,701 HE:** Map of Eastern Hemisphere Human Population groups. At this time there were approximately 45,000,000 people.<sup>226</sup>



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<sup>226</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>227</sup> [http://worldhistorymaps.info/images/East-Hem\\_1000bc.jpg](http://worldhistorymaps.info/images/East-Hem_1000bc.jpg) Thomas Lessman

**Circa 8,701 HE – 9,251 HE:** The Urnfield culture was a late Bronze Age culture of central Europe, often divided into several local cultures within a broader Urnfield tradition. The name comes from the custom of cremating the dead and placing their ashes in urns which were then buried in fields. Over much of Europe, the Urnfield culture followed the Tumulus culture and was succeeded by the Hallstatt culture.<sup>228</sup> 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.<sup>229 230</sup>

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<sup>228</sup> Chadwick and Corcoran, Nora and J.X.W.P. (11,970 HE). *The Celts. Penguin Books. 28–29*

<sup>229</sup> Kruta, Venceslas (11,991 HE). *The Celts* pp. 93–100.

<sup>230</sup> Gimbutas, Marija (11,965 HE). Bronze age cultures in Central and Eastern Europe. 274–298.



Drawing of urns in a burial site, artist and location unknown.<sup>231</sup>

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<sup>231</sup> [gettyimages.com](https://www.gettyimages.com)

**Circa 8,801 HE:** In both Egypt and China dyes resistant to sun & to water developed.<sup>232</sup>

**Circa 8,801 HE:** In India: The decimal Hindu-Arabic numeral system was invented.<sup>233</sup> (Roman numerals still mostly in use.) (See **Circa 10,830 HE:** SIND IBN ALI, Baghdad and **Circa 10,825 HE:** AL-KHWARIZMI).

**Circa 8,801 HE – circa 9,201 HE:** Luristan (Western Iran).

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<sup>232</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>233</sup> [https://en.wikipedia.org/wiki/Hindu%E2%80%93Arabic\\_numeral\\_system](https://en.wikipedia.org/wiki/Hindu%E2%80%93Arabic_numeral_system)





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).<sup>234</sup>

**Circa 8,801 HE- circa 9,601 HE:** Mexico - the Aztec name for these people was “Olmecatl” or modern name is “Olmec people.”<sup>235</sup>

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<sup>234</sup> <http://www.antiquesword101.com/pre-columbian.php#!/Ancient-Luristan-Bronze-Pin-12th-8th-century-BC/p/17351967>; a similar bronze pin is published in the book *“Iran in the Ancient East”* by Ernest E. Herzfeld. New York, 11,988 HE, page 153. Fig. 272

<sup>235</sup> <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

- ⇒ Olmec People used science to extract latex from Panama rubber trees (*Castilla elastica*) growing in the region and mixed it with the juice of a local vine (*Ipomoea alba*, moonflower) to create rubber.<sup>236</sup>
- ⇒ Olmec People carved large items from stone.<sup>237</sup>



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

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<sup>236</sup> <https://www.britannica.com/topic/Olmec>

<sup>237</sup> <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).<sup>238</sup>



The Olmec people built Earth mounds such as this one, which was part of the **11,967 HE** excavations of the now famous Olmec site of San Lorenzo. As a then 26-year-old archaeology student, Dr. **RICHARD DIEHL** participated in the efforts.<sup>239</sup>

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<sup>238</sup> <https://en.wikipedia.org/wiki/Olmec>

<sup>239</sup> <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>



**Circa 8,801 HE – circa 9,601 HE:** Olmec mask; Jadeite mask, Olmec culture, Mexico, now in the Metropolitan Museum of Art, New York City, bequest of Alice K. Bache, **11,977 HE**.<sup>240</sup>

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<sup>240</sup> <https://www.britannica.com/topic/Olmec>



**Circa 8,801 HE – circa 9,601 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 **11,979 HE**.<sup>241</sup>

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<sup>241</sup> <https://www.britannica.com/topic/Olmec>



**Circa 9,401 HE:** The major Formative Period (Pre-Classic Era) sites in present-day Mexico which show Olmec influences in the archaeological record.<sup>242</sup>

<sup>242</sup> <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.<sup>243</sup>

**Circa 8,801 HE – circa 9,201 HE:** The Greek Dark Ages<sup>244</sup> began because the Dorians used iron ore from meteorites to make their weapons and crushed the bronze weapon using Mycenaeans.<sup>245</sup>

⇒ 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?”<sup>246</sup>

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<sup>243</sup> [https://en.wikipedia.org/wiki/Sweat\\_lodge](https://en.wikipedia.org/wiki/Sweat_lodge)

<sup>244</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>245</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>246</sup> 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.<sup>247</sup>

**Circa 8,901 HE:** The Phoenicians first developed sea routes around the entire Mediterranean. They used oars.<sup>248</sup>

<sup>247</sup> [https://en.wikipedia.org/wiki/Greek\\_numerals](https://en.wikipedia.org/wiki/Greek_numerals)

<sup>248</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



## **Chapter Three    THE IRON AGE: CIRCA 9,001 HE- CIRCA 11,543 HE (lasting circa 2,760 years)**

When tools were made from iron and steel. THE IRON AGE ended with the emergence of the Scientific Revolution. Some historians end the Iron Age in Roman times, but have trouble agreeing on labels for the following periods. This timeline could have spoken of the Dark Ages, the Renaissance, etc., but we decided to have the Iron Age chapter run until the beginning of the chapter of the Scientific Revolution.

**Circa 9,001 HE:** Iron age began, Steel was developed.<sup>249</sup>

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<sup>249</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

**Circa 9,001 HE** – Map of Eastern Hemisphere Human Population groups. At this time approximately there were about 50,000,000 people.<sup>250</sup>



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<sup>250</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>251</sup> [http://worldhistorymaps.info/images/East-Hem\\_1000bc.jpg](http://worldhistorymaps.info/images/East-Hem_1000bc.jpg) Thomas Lessman

**Circa 9,001 HE:** Bronze was still in use in China.



China, A bronze ritual bell, Zhou Dynasty, photographer and location unknown.<sup>252</sup>

**Circa 9,051 HE - current:** Africa, Berber Agricultural Calendar started, Tuareg people. (Starting from the **11,960s HE**, however,

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<sup>252</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

on the initiative of the Academie Berbere in Paris, some Berbers have begun computing the years starting from **9,051 HE**, the approximate date of the rising into power of the first Libyan Pharaoh in Egypt, Shosheng I, whom they identified as the first prominent Berber in history.)<sup>253</sup>

**Circa 9,101 HE:** Camels domesticated in the southern Levant (Israel / Jordan area) in conjunction with expanding copper mining.<sup>254</sup>

**Circa 9,181 HE:** AL-MAHAINI, Persia, conceived the idea of reducing geometrical problems such as doubling the cube to problems in the not yet named area of math now called Algebra.<sup>255</sup>

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<sup>253</sup> [https://en.wikipedia.org/wiki/Berber\\_calendar](https://en.wikipedia.org/wiki/Berber_calendar)

<sup>254</sup> <https://www.sciencedaily.com/releases/2014/02/140203131518.htm>

<sup>255</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_geometry](https://en.wikipedia.org/wiki/Timeline_of_geometry)

## **Circa 9,201 HE – Circa 10,600 HE: Ancient Greek birth control methods:**

⇒ Plants commonly used for birth control in ancient Greece included:

- Queen Anne's lace (*Daucus carota*),
  - willow,
  - date palm,
  - pomegranate,
  - pennyroyal,
  - artemisia,
  - myrrh,
  - and rue.
- 
- Some of these plants are toxic and ancient Greek documents specify safe dosages. Recent studies have confirmed the birth control properties of many of these plants, confirming for

example that Queen Anne's lace has post coital anti-fertility properties. Queen Anne's lace is still used today for birth control in India.<sup>256</sup>

- ⇒ The single most effective method of birth control known in antiquity was probably coitus interruptus.<sup>257</sup>
- ⇒ The ancient Greek philosopher ARISTOTLE (see Circa **9,617 HE – 9,678 HE** ARISTOTLE) recommended applying cedar oil to the womb before intercourse. ARISTOTLE, and the humans of his time, had no knowledge of how conception worked, and he probably recommended this believing that the oil's smoothness would prevent conception. In reality, this method may have sometimes been effective because the oil may have

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<sup>256</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>257</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

gummed up the area which thereby reduced the mobility of the sperm, but effectiveness would have been only occasional and highly variable.<sup>258</sup>

**Circa 9,201 HE:** BAUDHAYANA, India, mathematician of the 4 books of Dharmasūtra of Baudhayana Sulba *Sutra is a Vedic Sanskrit geometric text*, contains quadratic equations, and calculates the irrational number that is the square root of 2 correct to five decimal places, did work with what became known as the Pythagorean theorem, and circling the square.<sup>259</sup> (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.)

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<sup>258</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>259</sup> [https://en.wikipedia.org/wiki/Baudhayana\\_sutras](https://en.wikipedia.org/wiki/Baudhayana_sutras)

**Circa 9,201 HE – 9,501 HE:** Hallstatt Culture, named for a lakeside village in the Austrian Salzkammergut southeast of Salzburg where there was a rich salt mine, and some 1,300 burials are known, many with fine artefacts, was the was the predominant Western and Central European culture of the time.<sup>260</sup>

- ⇒ 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

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<sup>260</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_culture](https://en.wikipedia.org/wiki/Hallstatt_culture)



south of Germany, were towns rather than villages by modern standards.<sup>261</sup>



Textile fragment recovered from the Hallstatt salt mine.<sup>262</sup>

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<sup>261</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_culture](https://en.wikipedia.org/wiki/Hallstatt_culture)

<sup>262</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_Museum](https://en.wikipedia.org/wiki/Hallstatt_Museum)



Bronze container with stand, Hallstatt Ha C, photographer unknown.<sup>263</sup>

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<sup>263</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_Museum](https://en.wikipedia.org/wiki/Hallstatt_Museum)



Watercolor commissioned by JOHANN G. RAMSAUER documenting one of his cemetery digs at Hallstatt; unknown local artist.<sup>264</sup>

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<sup>264</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_culture](https://en.wikipedia.org/wiki/Hallstatt_culture)



The Strettweg Cult Wagon, one of the most elaborate objects from the **Circa 9,201 HE – 9,501 HE** Hallstatt period. Location: Der Kultwagen von Strettweg im Archäologiemuseum in Graz, Österreich.<sup>265</sup>

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<sup>265</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_culture](https://en.wikipedia.org/wiki/Hallstatt_culture)



Hallstatt Geographical Range was Europe, North of Current day Italy.<sup>266</sup>

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<sup>266</sup> [https://en.wikipedia.org/wiki/Hallstatt\\_culture](https://en.wikipedia.org/wiki/Hallstatt_culture)

**Circa 9,206 HE: AL-BATANI, Turkey, Astronomer and mathematician<sup>267</sup>**



A modern artist's impression of AL-BATANI holding an astrolabe.<sup>268</sup>

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<sup>267</sup> <https://en.wikipedia.org/wiki/Al-Battani>

<sup>268</sup> <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.<sup>269</sup>

**Circa 9,225 HE - 10,394 HE:** The first Olympic Games held among representatives of Archaic Greece city-states. They were held in honor of Zeus, and the Greeks gave them a mythological origin. The games were held every four years, or an *Olympiad*, which became a unit of time in historical chronologies. They continued to be celebrated when Greece came under Roman rule, until the emperor Theodosius I suppressed them in **10,394 HE** as part of the campaign to impose Christianity as the state religion of Rome.<sup>270</sup>

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<sup>269</sup> <https://en.wikipedia.org/wiki/Al-Battani>

<sup>270</sup> [https://en.wikipedia.org/wiki/Ancient\\_Olympic\\_Games](https://en.wikipedia.org/wiki/Ancient_Olympic_Games)

**Circa 9,248 HE:** Roman Calendar: AUC: “ab urbe condita” AUC or “anno urbis” AU; initiated by Roman scholar Marcus Terentius Varro; AKA Founding of City of Rome Calendar.<sup>271</sup>

**Circa 9,251 HE – Circa 10,080 HE:** Etruscans built arches for the first time that could span a wider distance and hold more weight.<sup>272</sup>



This Etruscans arch is part of a massive set of walls which are 30

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<sup>271</sup> [https://en.wikipedia.org/wiki/Ab\\_urbe\\_condita](https://en.wikipedia.org/wiki/Ab_urbe_condita)

<sup>272</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



feet tall and 9,500 feet long made of travertine and set without mortar. It covers approximately a quarter of a square mile over three hills.<sup>273</sup>

**Circa 9,251 HE – circa 9,501 HE:** During this time span, Greece was lifting from its dark ages into the Archaic Greek era.<sup>274</sup>

**Circa 9,251 HE:** Greece, Homer is credited with creation of the epic tales<sup>275</sup> *Iliad* and *Odyssey*. These started as verbal accounts and were not written until many years later.<sup>276</sup>

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<sup>273</sup> [https://en.wikipedia.org/wiki/Etruscan\\_Arch](https://en.wikipedia.org/wiki/Etruscan_Arch)

<sup>274</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>275</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>276</sup> <https://en.wikipedia.org/wiki/Homer>

**Circa 9,301 HE:** Assyria and Jerusalem built aqueducts.<sup>277</sup> Egypt built Sundials.<sup>278</sup>

**Circa 9,301 HE – 9,401 HE:** MASTER TUNG-HSUAN, the Chinese physician, documented both coitus reservatus and coitus obstructus, which prevents the release of semen during intercourse. However, it is not known if these methods were used primarily as birth control methods or to preserve the man's yang. In the same century SUN SIMIAO documented the "*thousand of gold contraceptive prescription*" for women who no longer want to bear children. This prescription, which was supposed to induce sterility, was made of oil and quicksilver heated together for one day and taken orally.<sup>279</sup> (Author / Compiler's note: evidently they

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<sup>277</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>278</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>279</sup> Middleberg, Maurice I. (12,003 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 9,301 HE:** Mogador Island, Essaouira, Morocco.



Phoenician plate with red slip; at Sidi Mohammed ben Abdallah Museum.<sup>280</sup>

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<sup>280</sup> [http://www.digplanet.com/wiki/Sidi\\_Mohammed\\_ben\\_Abdallah\\_Museum](http://www.digplanet.com/wiki/Sidi_Mohammed_ben_Abdallah_Museum)

**Circa 9,341 HE:** Japan, as a nation came under its first emperor Jimmu Tenno.<sup>281</sup>

**Circa 9,361 HE:** First libraries consisting of a few volumes started. “Books”, whether clay bricks covered with cuneiform or papyrus covered with hieroglyphics and rolled (the word *volume* comes from the Latin word to roll up)<sup>282</sup>

**Circa 9,361 HE:** Nineveh, the monarch: “Ashurbanipal” arranged to have every cuneiform document in his kingdom to be copied for his personal library.<sup>283 284</sup>

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<sup>281</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>282</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>283</sup> <https://en.wikipedia.org/wiki/Ashurbanipal>

<sup>284</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

**Circa 9,361 HE:** Bartering started to be replaced with the use of coins.<sup>285</sup>

**Circa 9,401 HE:** Ancient Greek bathing: Greeks original form of bathing consisted of nothing more than a quick plunge into icy water until the people of Laconica came upon the idea of a hot-air bath. The hot-air bath later came to be known as a laconica bath. The people of Laconica were from the Sparta area.<sup>286</sup>

**Circa 9,401 HE:** Asia Minor, city of Magnesia, legend said a shepherd discovered that a certain type of ore which attracted iron.<sup>287</sup>  
Knowledge spread and...

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<sup>285</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>286</sup> [https://en.wikipedia.org/wiki/Greek\\_Baths](https://en.wikipedia.org/wiki/Greek_Baths) and Françoise de Bonneville's *The Book of the Bath*

<sup>287</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

- ⇒ ...THALES studied the fact in Circa **9,416 HE** (the dates are approximate) and knowledge spread and ... in China, unknown HE date, it was discovered that if a magnetic sliver was allowed to turn freely it would come to a resting point in a north – south position...<sup>288</sup>
- ⇒ ...eventually by Circa **11,800 HE**, English scholar ALEXANDER NECKAM was the first to refer to the directional ability of magnetism and Europeans put a magnetic needle on a card marked with directions and called it the magnetic compass (the French word for “to go around”).<sup>289</sup>

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<sup>288</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 80

<sup>289</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 80

**Circa 9,450 HE -9,522 HE: CONFUCIUS**, Latinized version of the CHINESE NAME KUNG FU-TZU.<sup>290</sup> CONFUCIUS wrote about ethical-sociopolitical teachings, core family, social harmony, and humanistic values”<sup>291</sup>



A portrait of CONFUCIUS by the Tang dynasty artist Wu Daozi, artist and location unknown.<sup>292</sup>

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<sup>290</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>291</sup> <https://en.wikipedia.org/wiki/Confucius>

<sup>292</sup> <https://en.wikipedia.org/wiki/Confucius>



⇒ Confucius Analects, artist and location unknown.<sup>293</sup>

<sup>293</sup> <https://en.wikipedia.org/wiki/Analects>



**Circa 9,451 HE:** ALCMAEON OF CROTON, Greek, Natural philosopher of science and medical theorist was the first recorded European to take the chance of deliberately and carefully dissecting humans.<sup>294</sup>

⇒ ALCMAEON OF CROTON was the first to discover part of the ear connecting the ear and the throat.<sup>295</sup> (see **11,552 HE** BARTOLOMMEO EUSTATCHIO)

**Circa 9,455 HE:** THALES, Greek Scientist, Mathematician, Astronomer, Philosopher was the first to ask, “What was the universe made of?” THALES thought in terms of “elements.”<sup>296</sup> It

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<sup>294</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>295</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 112

<sup>296</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

was THALES who realized the workings of nature could be explained without invoking the supernatural.<sup>297</sup>

⇒ 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.<sup>298</sup>

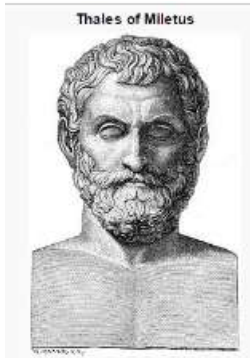
⇒ *Though none of the books THALES is said to have written survive*, THALES kindled a flame that still burns to this day: The very idea of cosmos out of chaos, a universe governed by the order of natural laws that we can figure out.<sup>299</sup>

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<sup>297</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

<sup>298</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>299</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6



THALES, artist, date and location unknown.<sup>300</sup>

- ⇒ There was a moment when Humanity awakened to a new way of thinking and seeing. It happened about 2,500 years ago, on the Greek islands that lie between the empires of the east and west.

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<sup>300</sup> <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.<sup>301</sup>

**Circa 9,455 HE – 10,400 HE:** This map spans a millennium of prominent Greco-Roman mathematicians, from THALES of Miletus to HYPATIA of Alexandria. Their names are on the map under their cities of birth.<sup>302</sup>

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<sup>301</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 6

<sup>302</sup> <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>



303

<sup>303</sup> <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

**Circa 9,481 HE:** Athens was moving towards a democracy. Sparta was becoming more militaristic.<sup>304</sup>

**Circa 9,481 HE:** PYTHAGORAS, Greek mathematician, scientist; Best known for the Pythagorean Theorem. Studied propositional geometry and vibrating lyre strings.<sup>305</sup>



Bust of PYTHAGORAS of Samos in the Capitoline Museums, Rome.<sup>306</sup>

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<sup>304</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>305</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>306</sup> <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.<sup>307</sup>

**Circa 9,481 HE:** China may have had a population of over 20,000,000 people.<sup>308</sup>

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<sup>307</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>308</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

**Circa 9,481 HE:** The Persian Empire may have had a population of over 15,000,000 people.<sup>309</sup>

**Circa 9,491 HE:** ANAXAGORAS, Pre-Socratic Greek Philosopher described the world as a mixture of primary imperishable ingredients, where material variation was never caused by an absolute presence of a particular ingredient, but rather by its relative preponderance over the other ingredients. In his words, "each one is... most manifestly those things of which there are the most in it".<sup>310</sup>

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

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<sup>309</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>310</sup> <https://en.wikipedia.org/wiki/Anaxagoras>



a fiery mass larger than the Peloponnese, as well as attempting to explain rainbows and meteors.<sup>311</sup>



ANAXAGORAS, part of a fresco in the portico of the National University of Athens.<sup>312</sup>

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<sup>311</sup> <https://en.wikipedia.org/wiki/Anaxagoras>

<sup>312</sup> <https://en.wikipedia.org/wiki/Anaxagoras>

**Circa 9,491 HE:** HECATAEUS OF MILETUS, Greek traveler<sup>313</sup> 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.<sup>314</sup>

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<sup>313</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>314</sup> [https://en.wikipedia.org/wiki/Hecataeus\\_of\\_Miletus](https://en.wikipedia.org/wiki/Hecataeus_of_Miletus)



Reconstruction of HECATAEUS's map, location unknown.<sup>315</sup>

**Circa 9,494 HE – 9,561 HE:** LU BAN, Chinese carpenter, engineer and inventor is credited with inventing: the saw, the square, the planer, the drill, the shovel, and an ink marking tool — to complete his many projects more quickly. His other inventions include a “Cloud ladder”, a mobile, counterweighted siege ladder, grappling hooks and ram—implements for naval warfare; and a Wooden bird—a non-powered, flying, wooden bird which could stay in the air for three days. It has been suggested to be a prototype of a kite.<sup>316</sup> The kite may have been the first form of Human-made aircraft.<sup>317</sup>

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<sup>315</sup> [https://en.wikipedia.org/wiki/Hecataeus\\_of\\_Miletus](https://en.wikipedia.org/wiki/Hecataeus_of_Miletus)

<sup>316</sup> [https://en.wikipedia.org/wiki/Lu\\_Ban](https://en.wikipedia.org/wiki/Lu_Ban)

<sup>317</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

⇒ LU BAN's wife was also credited with inventing the umbrella in order to permit him to work in inclement weather.<sup>318</sup>

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<sup>318</sup> [https://en.wikipedia.org/wiki/Lu\\_Ban](https://en.wikipedia.org/wiki/Lu_Ban)



## Circa 9,501 HE – 9,901 HE: Ancient Greece Olympia Bathhouse:

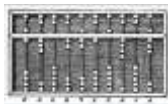
⇒ A Greek bathhouse of circa **9,501 HE** started off as nothing more than a single rectangular structure 20 meters long and four meters wide. A well was situated at one end of the room where the athletes could draw water. The bath was renovated upon several occasions. The first being around **9,601 HE** saw a smaller room added where small built tubs were put along the north and east side and an adjacent swimming pool. The third renovation took place around **9,901 HE** which saw an addition of a large apsidal room to the south along with a hypocaust system.<sup>321</sup>

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<sup>321</sup> [https://en.wikipedia.org/wiki/Greek\\_Baths](https://en.wikipedia.org/wiki/Greek_Baths); and Françoise de Bonneville's *The Book of the Bath*

**Circa 9,501 HE:** The Abacus, Egypt, the first really important computing device worked out by humans.<sup>322 323</sup>

⇒ The earliest known written documentation of the Chinese abacus dates to the **9,801 HE**.<sup>324</sup>



⇒ A Chinese abacus (suanpan) (the number represented in the picture is 6,302,715,408), artist unknown.<sup>325</sup>

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<sup>322</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>323</sup> <https://en.wikipedia.org/wiki/Abacus#Egyptian>

<sup>324</sup> <https://en.wikipedia.org/wiki/Abacus#Chinese>

<sup>325</sup> Encyclopædia Britannica - Article for "abacus", 9th edition Encyclopedia Britannica, volume 1 (11,875 HE); scanned and uploaded by Malcolm Farmer Transferred from en.wikipedia to Commons.



**Circa 9,501 HE: HIPPOCRATES OF CHIOS**, Ancient Greek mathematician, geometer, and astronomer was the first Greek to write a systematically organized geometry textbook, called *Elements* (Στοιχεῖα, Stoicheia), It included basic theorems, or building blocks of mathematical theory. HIPPOCRATES OF CHIOS attempted to square a circle. From then on, mathematicians from all over the ancient world could, at least in principle, build on a common framework of basic concepts, methods, and theorems, which stimulated the scientific progress of mathematics.<sup>326</sup>

**Circa 9,501 HE: APASTAMBA**, Ancient India, Editor of *Apastamba Vedic Sanskrit geometric text*, tries at squaring the circle and also calculates the square root of 2 correct to five decimal places.<sup>327</sup>

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<sup>326</sup> [https://en.wikipedia.org/wiki/Hippocrates\\_of\\_Chios](https://en.wikipedia.org/wiki/Hippocrates_of_Chios)

<sup>327</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_geometry](https://en.wikipedia.org/wiki/Timeline_of_geometry)

**Circa 9,501 HE:** PANINI, India, mathematician

⇒ PANINI's notations were similar to, (so may have launched?) modern mathematical notation, and PANINI used metarules, transformations, and recursion.<sup>328 329</sup>

**Circa 9,501 HE – circa 9,678 HE:** 12 different Classical or Ancient Greek calendars based on regions were in use during this time.<sup>330</sup>

**Circa 9,521 HE:** The Greeks further felt that the universe ran according to laws of nature that could be understood by observation and

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<sup>328</sup> [https://en.wikipedia.org/wiki/History\\_of\\_mathematics](https://en.wikipedia.org/wiki/History_of_mathematics)

<sup>329</sup> Kadwany, John (2008-02-08). "Positional Value and Linguistic Recursion". Journal of Indian Philosophy

<sup>330</sup> [https://en.wikipedia.org/wiki/Hellenic\\_calendars](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.<sup>331</sup>

**Circa 9,531 HE – 9,610 HE: MOZI** (Chinese: 墨子; pinyin: *Mòzǐ*; Wade–Giles: *Mo Tzu*, Lat. as Micius, original name Mo Di (墨翟, was a Chinese philosopher during the Hundred Schools of Thought period (early Warring States period).<sup>332</sup>

⇒ In MOZI's writings could be found early stirrings of the scientific approach.<sup>333</sup> By MO TZE's time, the Chinese had already been recording their thoughts in books for at least a thousand years.<sup>334</sup>

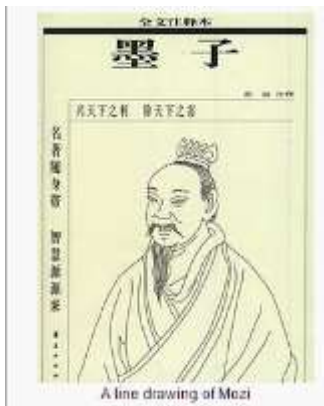
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<sup>331</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>332</sup> <https://en.wikipedia.org/wiki/Mozi>

<sup>333</sup> <http://web.newworldencyclopedia.org/entry/Mozu>

<sup>334</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



HE date unknown: line drawing of MO TZE, artist and location unknown.<sup>335</sup>

<sup>335</sup> <http://web.newworldencyclopedia.org/entry/Mozu>

靈巖山經原本

而勳有條也今邇夫好攻伐之君又飾其說以非子墨  
子曰以攻伐之子以攻伐之爲不美非利物與昔者禹  
征有苗湯伐桀武王伐紂此皆立爲聖王是何故也子  
墨子曰子未察吾言之類未明其故者也彼非所謂攻  
謂誅也昔者有三苗大亂天命殛之日妖宵出兩血三  
朝龍生廟大哭乎市夏涼地坼及泉太平御覽引此云  
三苗滅時地坼  
泉五效變化民乃大叛高陽乃命元  
宮禹親把鉞文選曰訖天之瑞令說文云以征有苗四

A page from the *Mozi*



A page from the Mozi, location unknown.<sup>336</sup>

<sup>336</sup> <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 **9,741 HE** – **9,791 HE** by first emperor of China: Qin Shi Huang.<sup>337</sup>

**Circa 9,541 HE:** DEMOCRITUS: Greek, (/dɪ'mɒkrɪtəs/; Greek: Δημόκριτος, *Dēmókritos*, meaning "chosen of the people"<sup>338</sup> was an influential Ancient Greek pre-Socratic philosopher primarily remembered today for his formulation of an atomic theory of the universe.<sup>339</sup>

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<sup>337</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

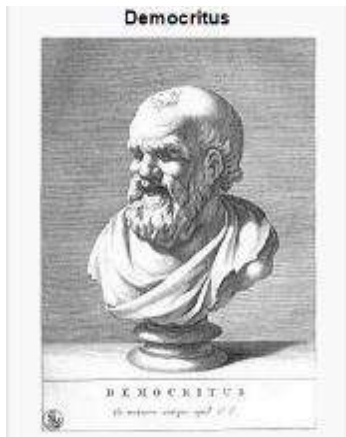
<sup>338</sup> <https://en.wikipedia.org/wiki/Democritus>

<sup>339</sup> <https://en.wikipedia.org/wiki/Democritus>

- ⇒ Neither DEMOCRITUS nor LEUCIPPUS had evidence for their atomistic views. They were only speculations, and the notions were rejected in their own time. It was to be circa 2,300 years before atomistic views began to gain ascendancy.<sup>340</sup>
- ⇒ (See among others: **11,627 HE – 11,691 HE**: ROBERT BOYLE and the work he did circa 2140 years after DEMOCRITUS predicted atoms; and see **11,893 HE – 11,916 HE**: the scientist ERNST MACH who, more than 200 years even after BOYLE, declared, after an **11,897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!" and then see **11,922 HE**: when NIELS HENRIK DAVID BOHR got the Nobel Prize for defining the structure of an atom circa 2,381 years after DEMOCRITUS' prediction.)

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<sup>340</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery



DEMOCRITUS, artist and location unknown.<sup>341</sup>

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<sup>341</sup> <https://en.wikipedia.org/wiki/Democritus>





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



Rembrandt as Democritus, The Laughing Philosopher **11,628**  
**HE.**<sup>342</sup>

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

**Circa 9,567 HE:** The Greek Historian HERODOTUS wrote of a Phoenician voyage, saying that he doubted people could live south of the Equator – actually feeling it was impossible- but that the Phoenicians reported during their voyage in the far south, the noonday sun was in the northern half of the sky.<sup>343</sup>

⇒ 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.<sup>344</sup>

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

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<sup>343</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>344</sup> <https://en.wikipedia.org/wiki/Herodotus>

that area – **circa 9,851 HE**: A common European misconception of those thousands of years was that anyone living below the equator would melt into deformity from the horrible heat. This misbelief was updated when the Phoenicians mapped below the equator.<sup>345</sup>

**Circa 9,569 HE**: EUCTEMON AND METON<sup>346</sup>: Athenian astronomers<sup>347</sup> who made records of the summer solstice of **9,569 HE** which they observed<sup>348</sup> 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

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<sup>345</sup> Dava Sobel's book: *Longitude*

<sup>346</sup> <https://en.wikipedia.org/wiki/Timocharis>

<sup>347</sup> <https://en.wikipedia.org/wiki/Euctemon>

<sup>348</sup> <https://en.wikipedia.org/wiki/Euctemon>

(sundials) and an armillary sphere.<sup>349</sup> Chris Parkin presents an animated explanation of the Armillary Sphere from the Museum of the History of Science collection.<sup>350</sup>

⇒ METON's further observations<sup>351</sup> 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.<sup>352</sup>

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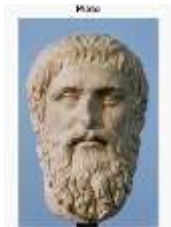
<sup>349</sup> <https://en.wikipedia.org/wiki/Timocharis>

<sup>350</sup> <https://www.youtube.com/watch?v=AaWuJHQL-bQ>

<sup>351</sup> [https://en.wikipedia.org/wiki/Meton\\_of\\_Athens](https://en.wikipedia.org/wiki/Meton_of_Athens)

<sup>352</sup> [https://en.wikipedia.org/wiki/Meton\\_of\\_Athens](https://en.wikipedia.org/wiki/Meton_of_Athens)

**Circa 9,574 HE– 9,654 HE:** PLATO, Greek philosopher who laid the very foundations of Western philosophy and science.<sup>353</sup> Some 250 known manuscripts of PLATO survive.<sup>354</sup>

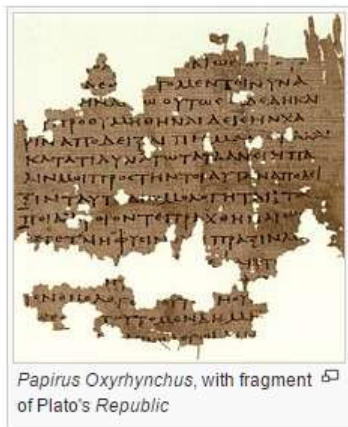


**Circa 9,631 HE** Roman Copy of a portrait bust of PLATO by Silanion. Photographer and location unknown.<sup>355</sup>

<sup>353</sup> "Plato". Encyclopedia Britannica. 2002

<sup>354</sup> <https://en.wikipedia.org/wiki/Plato>

<sup>355</sup> <https://en.wikipedia.org/wiki/Plato>



Papyrus Oxythynchus, with fragment of PLATO's *Republic*.<sup>356</sup>  
 Photographer and location unknown.

<sup>356</sup> <https://en.wikipedia.org/wiki/Plato>



PLATO'S CAVE<sup>357</sup>

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<sup>357</sup> 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.<sup>358</sup>

**Circa 9,601 HE:** Greeks developed trade routes in the Mediterranean using the length of the day, corrected for the time of the year, to estimate latitude.<sup>359</sup>

**Circa 9,601 HE – 10,200 HE:** Indian Sub-continent: Jain mathematicians in India wrote the “*Sthananga Sutra*”, which contains work on the theory of numbers, arithmetical operations,

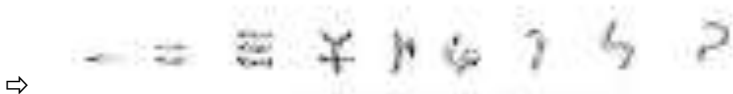
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<sup>358</sup> [https://en.wikipedia.org/wiki/Allegory\\_of\\_the\\_Cave](https://en.wikipedia.org/wiki/Allegory_of_the_Cave)

<sup>359</sup> [https://en.wikipedia.org/wiki/Ocean\\_exploration](https://en.wikipedia.org/wiki/Ocean_exploration)



geometry, operations with fractions, simple equations, cubic equations, quartic equations, and permutations and combinations.<sup>360 361</sup>



Jain first numerals; no zero yet<sup>362</sup>

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<sup>360</sup> [https://en.wikipedia.org/wiki/Sthananga\\_Sutra](https://en.wikipedia.org/wiki/Sthananga_Sutra)

<sup>361</sup> G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 11,991 HE)

<sup>362</sup> G G Joseph, The Crest of the Peacock: Non-European Roots of Mathematics (London, 11,991 HE)

- ⇒ The math book the “Sthananga Sutra” also gives classifications of five types of infinities.<sup>363</sup>
- ⇒ 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).<sup>364</sup>

**Circa 9,617 HE – 9,678 HE:** ARISTOTLE, Greek philosopher who began studying at PLATO’s Academy and who developed the method of identifying a question by gathering information from

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<sup>363</sup> [https://en.wikipedia.org/wiki/Sthananga\\_Sutra](https://en.wikipedia.org/wiki/Sthananga_Sutra)

<sup>364</sup> [https://en.wikipedia.org/wiki/Sthananga\\_Sutra](https://en.wikipedia.org/wiki/Sthananga_Sutra)

others and from self, and then developing ideas. ARISTOTLE developed the pre-cursor to the now used Scientific Method.<sup>365</sup>

⇒ 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."<sup>366</sup>

⇒ ARISTOTLE classified and arranged over 500 animal species into hierarchies.<sup>367</sup>

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<sup>365</sup> <https://en.wikipedia.org/wiki/Aristotle>

<sup>366</sup> <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

<sup>367</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

⇒ 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.<sup>368</sup>

- ARISTOTLE (**Circa 9,600 HE**) concluded that time is measured by the changing of things and that if nothing changes, there is no time.<sup>369</sup>
- ISAAC NEWTON (see **11,642 HE– 11,727 HE**) concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.<sup>370</sup>

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<sup>368</sup> Carlo Roveli's The Order of Time

<sup>369</sup> Carlo Roveli's *The Order of Time*

<sup>370</sup> Carlo Roveli's *The Order of Time*

- ALBERT EINSTEIN (see **11,879 HE – 11,955 HE**) concluded that both ARISTOTLE and ISAAC NEWTON were both correct when he combined mathematically space and time into “spacetime.” ALBERT EINSTEIN concluded that time varies depending on the observer’s frame of reference. Someone moving faster than someone else will experience time passing at 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.<sup>371</sup>

⇒ Some of ARISTOTLE 's zoological observations, such as on the hectocotyli (reproductive) arm of the octopus, were not

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<sup>371</sup> Carlo Roveli's *The Order of Time*

confirmed or refuted until the **11,900's HE** (two thousand plus years later).<sup>372</sup>

- ⇒ Some of ARISTOTLE's works contain the earliest known formal study of logic, which was incorporated in the late **11,800's HE** into modern formal logic.<sup>373</sup>
- ⇒ Circa **9,663 HE**: ARISTOTLE began tutoring Alexander the Great.<sup>374</sup>
- ⇒ 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**

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<sup>372</sup> <https://en.wikipedia.org/wiki/Aristotle>

<sup>373</sup> <https://en.wikipedia.org/wiki/Aristotle>

<sup>374</sup> <https://en.wikipedia.org/wiki/Aristotle>

*of ARISTOTLE's volumes have survived through fortunate chance.* They were found in a pit in Asia Minor about **9,921 HE** by soldiers of the Roman general Lucius Cornelius Sulla and they were taken to Rome and copied.<sup>375</sup>

⇒ ARISTOTLE recorded the use of diving bells "...they enable the divers to respire equally well by letting down a cauldron, for this does not fill with water, but retains the air, for it is forced straight down into the water."<sup>376</sup>

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<sup>375</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>376</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_diving\\_technology](https://en.wikipedia.org/wiki/Timeline_of_diving_technology)



Roman copy in marble of a Greek bronze bust of **ARISTOTLE** by Lysippus **Circa 9,671 HE**. The alabaster mantle is modern.<sup>377</sup>

**Circa 9,631 HE – 9,701 HE: CALLIPPUS:** Greek astronomer and mathematician<sup>378</sup> 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

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

<sup>378</sup> [https://en.wikipedia.org/wiki/Meton\\_of\\_Athens](https://en.wikipedia.org/wiki/Meton_of_Athens)



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.<sup>379</sup> (See **Circa 9,796 HE – 9,901 HE: The Antikythera Mechanism.**)

**Circa 9,631 HE:** HIPPOCRATES II of Kos, Greek, physician, was and is considered one of the most outstanding figures in the history of medicine. HIPPOCRATES II is referred to as the “*Father of Western Medicine*” in recognition of his lasting contributions to the field as the founder of the Hippocratic School of Medicine.<sup>380</sup>

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<sup>379</sup> <https://en.wikipedia.org/wiki/Callippus>

<sup>380</sup> <https://en.wikipedia.org/wiki/Hippocrates>



A fragment of HIPPOCRATIES Oath on circa **9,631 HE**  
Papyrus Oxyrhynchus, location and photographer unknown.<sup>381</sup>

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<sup>381</sup> [https://en.wikipedia.org/wiki/Hippocratic\\_Oath](https://en.wikipedia.org/wiki/Hippocratic_Oath)

**Circa 9,651 HE:** EXDOXUS, Greek Mathematician was said to have drawn a better map of Earth than HECATAEUS and was the first Greek to attempt a map of the sky using longitude and latitude.<sup>382</sup>

**Circa 9,678 HE – Circa 9,855 HE:** Hellenistic Greek period.

**Circa 9,681 HE:** THEOPHRASTUS, Greek scholar who was the first Greek to write a systematic book on Botany, including 550 plant species from as far away as India.<sup>383</sup>

**Circa 9,681 HE - 9,741 HE** TIMOCHARIS<sup>384</sup> 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

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<sup>382</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 46

<sup>383</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 47

<sup>384</sup> <https://en.wikipedia.org/wiki/Hipparchus>

ARISTILLUS in an astronomical observatory that was most likely part of the Library of Alexandria. Their equipment would have been still the simple tools likely consisting of gnomons, sundials and an armillary sphere.<sup>385</sup>

**Circa 9,681 HE - 9,741 HE:** ARISTILLUS: Greek astronomer was among the earliest meridian-astronomy observers. Six of ARISTILLUS stellar declinations were preserved by CLAUDIUS PTOLEMY.<sup>386</sup>

**Circa 9,689 HE:** Appian Way: The first roman built road, it was 132 miles long between Rome and Capua.<sup>387</sup>

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<sup>385</sup> <https://en.wikipedia.org/wiki/Timocharis>

<sup>386</sup> <https://en.wikipedia.org/wiki/Aristyllus>

<sup>387</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 48

**Circa 9,689 HE:** Another System of Chronology attempted; No political groupings among the ancients counted the years in the same way. Ancient dates are a bit hazy. Then in Greece, Alexander the Great's General Seleucus I started the SELEUCID ERA and the years were counted upwards with no regards to the succession of monarchs.<sup>388</sup>

**Circa 9,691 HE - 9,771 HE:** ARISTARCHUS OF SAMOS, ancient Greek astronomer and mathematician who presented the first known model that placed the Sun at the center of the known universe with the Earth revolving around it.<sup>389 390</sup>

⇒ Like ANAXAGORAS before him, ARISTARCHUS OF SAMOS suspected and predicted that the stars were just other

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<sup>388</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 54

<sup>389</sup> [https://en.wikipedia.org/wiki/Aristarchus\\_of\\_Samos](https://en.wikipedia.org/wiki/Aristarchus_of_Samos)

<sup>390</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 51

bodies like the Sun, albeit further away from Earth. But did not have the math or tools to prove it. (See **11,473 HE - 11,543 HE: NICOLAUS COPERNICUS**)



ARISTARCHUS OF SAMOS Statue at the Aristotle University of Thessaloniki.<sup>391</sup>

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<sup>391</sup> [https://en.wikipedia.org/wiki/Aristarchus\\_of\\_Samos](https://en.wikipedia.org/wiki/Aristarchus_of_Samos)

**Circa 9,696 HE:** China, the world's earliest decimal multiplication table.<sup>392</sup>



The Tsinghua Bamboo Slips, containing the world's earliest decimal multiplication table, dated **9,696 HE** during the Warring States period.<sup>393</sup>

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<sup>392</sup> [https://en.wikipedia.org/wiki/History\\_of\\_mathematics](https://en.wikipedia.org/wiki/History_of_mathematics)

<sup>393</sup> [https://en.wikipedia.org/wiki/History\\_of\\_mathematics](https://en.wikipedia.org/wiki/History_of_mathematics)

**Circa 9,701 HE:** Chankillo, AKA Chanquillo, Peru: Thirteen Towers Solar Observatory, a monthly sunset / sunrise complex built by still un-named culture of people in NW Peru.<sup>394</sup>



Thirteen Towers of Chankillo, viewed from the fortress, photographer and date unknown.<sup>395</sup>

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<sup>394</sup> <https://en.wikipedia.org/wiki/Chankillo>

<sup>395</sup> <https://en.wikipedia.org/wiki/Chankillo>





Panorama of Chanquillo, photographer and date unknown.<sup>396</sup>

**Circa 9,701 HE:** The Morocco area: Essaouira.



Roman coins excavated in Essaouira.<sup>397</sup>

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<sup>396</sup> <https://en.wikipedia.org/wiki/Chankillo>

<sup>397</sup> <https://en.wikipedia.org/wiki/Essaouira>

**Circa 9,701 HE:** PYTHIAS, Greek, observed the existence of true tides in the Atlantic Ocean and described them – and was disbelieved.<sup>398</sup>

**Circa 9,701 HE:** Ptolemy I, Aka Ptolemy I Soter Greek Egyptian Ruler<sup>399</sup> 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 Museum<sup>400</sup> or Museum of Alexandria, or Alexandrian Museum, or The Greek Mouseion (“Seat of the Muses”).

⇒ **Built Circa 9,721 HE:** it was the ancient centre of classical learning at Alexandria in Egypt. It was a research institute that was especially noted for its scientific and literary scholarship,

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<sup>398</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 49

<sup>399</sup> Dava Sobel's book: Longitude

<sup>400</sup> 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 **9,678 HE** –**Circa 9,716 HE**).

- The best surviving description of the museum is by the Greek geographer and historian Strabo, who mentions that it was a large complex of buildings and gardens with richly decorated lecture and banquet halls linked by porticos, or colonnaded walks.<sup>401</sup>



- Tetradrachm (Greek coin worth 4 drachmas) with portrait of Ptolemy I, in the British Museum, London.<sup>402</sup>

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<sup>401</sup> <https://www.britannica.com/topic/Alexandrian-Museum>

<sup>402</sup> [https://en.wikipedia.org/wiki/Ptolemy\\_I\\_Soter](https://en.wikipedia.org/wiki/Ptolemy_I_Soter)



Bust of PTOLEMY I in the Louvre Museum.<sup>403</sup>

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<sup>403</sup> [https://en.wikipedia.org/wiki/Ptolemy\\_I\\_Soter](https://en.wikipedia.org/wiki/Ptolemy_I_Soter)

**Circa 9,701 HE – 9,801 HE: PINGALA** (Devanagari: पिङ्गल pingala) was an ancient sub-continent Indian mathematician who edited the *Chandaḥśāstra (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”.<sup>404</sup> (See **Circa 11,170 HE – 11,250 HE: LEONARDO BONACCI** known as FIBONACCI.)

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<sup>404</sup> <https://en.wikipedia.org/wiki/Pingala>

**Circa 9,725 HE - 9,807 HE:** ERATOSTHENES, Greek, mathematician, geographer, poet, astronomer, and music theorist.<sup>405</sup>

⇒ ERATOSTHENES correctly measured the Earth's circumference of 25,000 miles / 40,000 km in diameter.<sup>406 407</sup>

- 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

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<sup>405</sup> MAX TEGMARK, Our Mathematical Universe

<sup>406</sup> <https://en.wikipedia.org/wiki/Eratosthenes>

<sup>407</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 99

trigonometry. His method was crude, but his answer was in the right ballpark. He showed how the Earth is round.

⇒ The fact that Earth is round has been common knowledge, at least among the educated and powerful, ever since.<sup>408 409</sup>



⇒ ERATOSTHENES, artist and location unknown.<sup>410</sup>

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<sup>408</sup> <http://www.bbc.com/earth/story/20160126-how-we-know-earth-is-round>

<sup>409</sup> MAX TEGMARK, Our Mathematical Universe

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

**Circa 9,731 HE:** EUCLID<sup>411</sup>, Egypt Greek mathematician, often referred to as the "founder of geometry" or the "*father of geometry*". EUCLID wrote *The Elements* (Ancient Greek: Στοιχεῖα Stoicheia) which is a mathematical treatise consisting of 13 books. He was active in Alexandria during the reign of Ptolemy I.<sup>412</sup>



**“EUCLID”; 11,584 HE** colored woodcut- not his likeness

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<sup>411</sup> MAX TEGMARK, Our Mathematical Universe

<sup>412</sup> [https://en.wikipedia.org/wiki/Euclid%27s\\_Elements](https://en.wikipedia.org/wiki/Euclid%27s_Elements)



because it was done circa 1,800 years after he lived. Artist and location unknown.<sup>413</sup>



Photo is of a fragment of the: Published circa **9,701 HE**: A fragment of EUCLID'S *Elements* on part of the Oxyrhynchus papyri.<sup>414</sup>

<sup>413</sup> <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

<sup>414</sup> [https://en.wikipedia.org/wiki/Euclid%27s\\_Elements](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.<sup>415</sup>)

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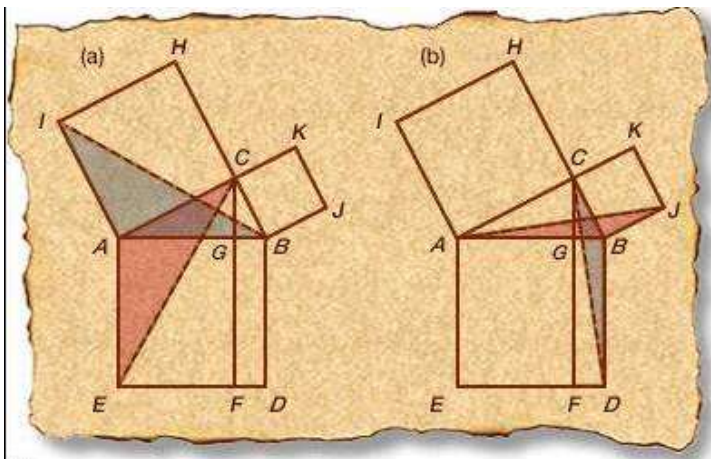
<sup>415</sup> [https://en.wikipedia.org/wiki/Oxyrhynchus\\_Papyri](https://en.wikipedia.org/wiki/Oxyrhynchus_Papyri)



The frontispiece of Sir Henry Billingsley's first English version of EUCLID'S *Elements*, **11,570 HE** reprint circa 1,838 years after EUCLID wrote his book.<sup>416</sup>

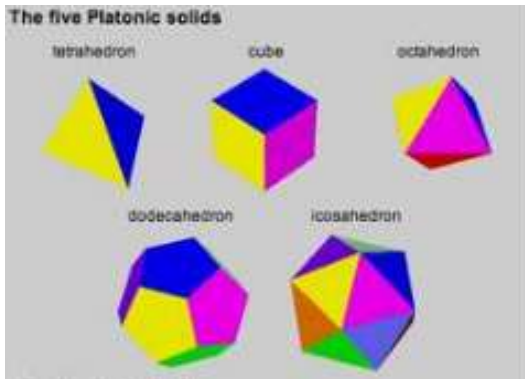
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<sup>416</sup> [https://en.wikipedia.org/wiki/Euclid%27s\\_Elements](https://en.wikipedia.org/wiki/Euclid%27s_Elements)



**EUCLID's Windmill proof.**<sup>417</sup>

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

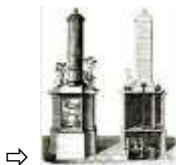


Current drawing of **EUCLID's** five Platonic solids. These are the only geometric solids whose faces are composed of regular, identical polygons.<sup>418</sup>

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<sup>418</sup> <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

Circa **9,731 HE**: CTESIBIUS, Greek inventor and mathematician invented the first water clock. Until CTESIBIUS's water clock was invented, for circa 3,730 years (See: **Circa 6,001 HE**: Sundial invented), humans had marked the passage of time using sundials and other crude measures such as the hour glass or candles that burned.<sup>419</sup>



⇒ CTESIBIUS's water clock, as visualized by the **11,600's HE** French architect Claude Perrault - dimensions unknown.<sup>420</sup>

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<sup>419</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 52

<sup>420</sup> <https://en.wikipedia.org/wiki/Ctesibius>

**Circa 9,741 HE:** ARCHIMEDES, Syracuse, was an Ancient Greek mathematician, physicist, engineer, inventor, and astronomer.

⇒ ARCHIMEDES anticipated modern calculus and analysis by applying concepts of infinitesimals and the method of exhaustion to derive and rigorously prove a range of geometrical theorems, including the area of a circle, the surface area and volume of a sphere, and the area under a parabola. Other of his mathematical achievements include deriving an accurate approximation of pi, defining and investigating the spiral bearing his name, and creating a system using exponentiation for expressing very large numbers.<sup>421</sup>

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<sup>421</sup> <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.<sup>422</sup>
- ⇒ 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.<sup>423</sup>
- ⇒ ARCHIMEDES died during the Siege of Syracuse when he was killed by a Roman soldier despite orders that he should not be harmed.<sup>424</sup>

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<sup>422</sup> <https://en.wikipedia.org/wiki/Archimedes>

<sup>423</sup> <https://en.wikipedia.org/wiki/Archimedes>

<sup>424</sup> <https://en.wikipedia.org/wiki/Archimedes>





This bronze statue of ARCHIMEDES is at the Archenhold Observatory in Berlin. It was sculpted by Gerhard Thieme.<sup>425</sup>

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

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<sup>425</sup>[https://upload.wikimedia.org/wikipedia/commons/2/25/Gerhard\\_Thieme\\_Archimedes.jpg](https://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 ( $29.7^{\circ}$  N,  $4.0^{\circ}$  W) in his honor, as well as a lunar mountain range, the Montes Archimedes ( $25.3^{\circ}$  N,  $4.6^{\circ}$  W). The Fields Medal for outstanding achievement in mathematics carries a portrait of Archimedes, along with a carving illustrating his proof on the sphere and the cylinder. The inscription around the head of Archimedes is a quote attributed to him which reads in Latin: "Transire suum pectus mundoque potiri" (**Rise above oneself and grasp the world**). Archimedes has appeared on postage stamps issued by East Germany (**11,973 HE**), Greece (**11,983 HE**), Italy (**11,983 HE**), Nicaragua (**11,971 HE**), San Marino (**11,982 HE**), and Spain (**11,963 HE**). The exclamation of Eureka! attributed to Archimedes is the state motto of California. In this instance the word refers to the

discovery of gold near Sutter's Mill in **11,848 HE** which sparked the California Gold Rush.<sup>426</sup>

**Circa 9,741 HE – 9,791 HE:** Qin Shi Huang, first emperor of China. Most of us know Emperor Qin for the army of 7,000 terra cotta warriors that guard his tomb<sup>427</sup> 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.<sup>428</sup>

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

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

<sup>427</sup> [https://en.wikipedia.org/wiki/Qin\\_Shi\\_Huang](https://en.wikipedia.org/wiki/Qin_Shi_Huang)

<sup>428</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 55

**9,531 HE – 9,610 HE: MOZI) and CONFUCIUS (See Circa 9,450 HE -9,522 HE: CONFUCIUS).**<sup>429</sup>

⇒ The works destroyed by him were victim of the world's first book burning.<sup>430</sup>



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<sup>429</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>430</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>431</sup> [https://en.wikipedia.org/wiki/Qin\\_Shi\\_Huang](https://en.wikipedia.org/wiki/Qin_Shi_Huang)

**Circa 9,796 HE – 9,901 HE:** The Antikythera Mechanism The world's oldest known astronomical calculator, the Antikythera Mechanism performs calculations based on both the Metonic and Callipic calendar cycles, with separate dials for each. (See **Circa 9,569 HE:** METON and **Circa 9,631 HE – 9,701 HE:** CALLIPPUS:)<sup>432</sup>



The Antikythera mechanism (Fragment A – front). National Archaeological Museum, Athens.<sup>433</sup>

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<sup>432</sup> [https://en.wikipedia.org/wiki/Meton\\_of\\_Athens](https://en.wikipedia.org/wiki/Meton_of_Athens)

<sup>433</sup> [https://en.wikipedia.org/wiki/Antikythera\\_mechanism](https://en.wikipedia.org/wiki/Antikythera_mechanism)



The Antikythera mechanism (Fragment A – back) National Archaeological Museum, Athens.<sup>434</sup>

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<sup>434</sup> [https://en.wikipedia.org/wiki/Antikythera\\_mechanism](https://en.wikipedia.org/wiki/Antikythera_mechanism)

**Circa 9,799 HE – 10,200 HE:** China: Some of the earliest evidence of water wells dug for retrieval of fresh water deeper in the ground.<sup>435</sup>



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.<sup>436</sup>

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<sup>435</sup> [https://en.wikipedia.org/wiki/History\\_of\\_water\\_supply\\_and\\_sanitation](https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation)

<sup>436</sup> [https://en.wikipedia.org/wiki/History\\_of\\_water\\_supply\\_and\\_sanitation](https://en.wikipedia.org/wiki/History_of_water_supply_and_sanitation)

**Circa 9,831 HE:** In the small Hellenistic kingdom of Pergamum the ruler Eumemes II wanted to build a library to rival Alexandria. Egypt would not share papyrus, so Pergamum invented Parchment. The parchment skins could not be rolled into scrolls, they could only be cut into sheets and glued together into a Codex. This is the first form of printed books.<sup>437</sup>

**Circa 9,851 HE:** HIPPARCHUS: Ancient Greece, astronomer  
HIPPARCHUS was the first to write careful tables relating angles to side ratios and is considered the founder of Trigonometry.<sup>438</sup>  
HIPPARCHUS used the trigonometry he founded to calculate the distance from the Earth to the Moon.<sup>439</sup>

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<sup>437</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 56

<sup>438</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57

<sup>439</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 57



⇒ At its closest point (known as perigee) the Moon is only 363,104 km (225,622 miles) away. At its most distant point (called apogee) the Moon gets to a distance of 406,696 km (252,088 miles).<sup>440</sup>



⇒

Undated, unattributed drawing of HIPPARCHUS<sup>441</sup>

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<sup>440</sup> <https://www.universetoday.com/103206/what-is-the-distance-to-the-moon/>

<sup>441</sup> <https://en.wikipedia.org/wiki/Hipparchus>



Unattributed, HIPPARCHUS holding his celestial globe, in Raphael's The School of Athens (**circa 11,510 HE**)<sup>442</sup>

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<sup>442</sup> <https://en.wikipedia.org/wiki/Hipparchus>

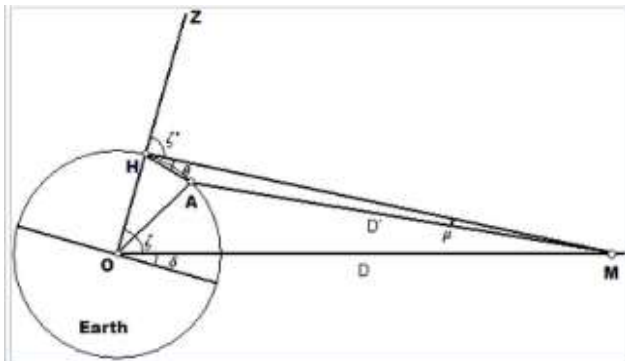


Diagram used in reconstructing one of HIPPARCHUS's methods of determining the distance to the moon. This represents the earth-moon system during a partial solar eclipse at A (Alexandria) and a total solar eclipse at H (Hellas).<sup>443</sup>

<sup>443</sup> <https://en.wikipedia.org/wiki/Hipparchus>

## Circa 9,855 HE – Circa 10,529 HE: Antiquity Roman Greece Empire:

- ⇒ “Funny thing about the Romans. Even though they knew that contact with lead inevitably poisoned people, rendered them sterile and drove them mad, what metal did they use to make the pipes that carried the water through their legendary aqueducts? Druyan, through Neil deGrasse Tyson said “give you a hint”:<sup>444</sup>
- ⇒ 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

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<sup>444</sup> 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.<sup>445</sup>

- ⇒ 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.<sup>446</sup>
- ⇒ See more about the “Star Stuff” element Lead: Scientist CLAIR CAMERON PATTERSON **11,922 HE – 11,995 HE.**

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<sup>445</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

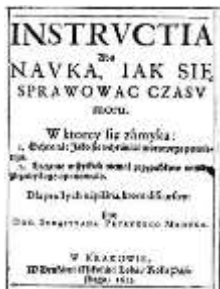
<sup>446</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

**Beginning Circa 9,900 HE – through circa 11,800 HE:** Human hygiene and lack thereof. Miasma: Bad Air Theory.

- ⇒ Author / Compiler found conflicting reports as to which people or whether people bathed whole body, only hands/face, not at all, or at what frequency during these years.
- ⇒ Miasma: (Latin; means nebula) (Ancient Greek means "pollution") Bad Air - was considered to be a poisonous vapor or mist filled with particles from decomposed matter (miasmata) that caused illnesses.<sup>447</sup>

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<sup>447</sup> [https://en.wikipedia.org/wiki/Miasma\\_theory](https://en.wikipedia.org/wiki/Miasma_theory)



**11,613 HE:** Book by SEBASTIAN PETRYCY (11,554 HE–11,626 HE) Polish practicing physician, published about prevention against Miasma (Bad Air): *De natura, causis, symptomatis morbi gallici eiusque curatione* which combined deductive reasoning with observation and experiment published in Kraków.<sup>448</sup>

<sup>448</sup> [https://en.wikipedia.org/wiki/Sebastian\\_Petrycy](https://en.wikipedia.org/wiki/Sebastian_Petrycy)

- ⇒ **11,674 HE:** Air, during these years, was considered homogenous, empty and inactive. *Suspicious about the Hidden Realities of the Air* (Author / Compiler could find no image) is a book on alchemy by ROBERT BOYLE (See **11,627 HE** – **11,691 HE:** ROBERT BOYLE).<sup>449</sup>
- ⇒ **11,880 HE:** The Miasma -Bad Air- theory was eventually given up by scientists and physicians and replaced by the germ theory of disease: specific germs, not miasma, caused specific diseases. However, cultural beliefs about getting rid of odor made the clean-up of waste a high priority for cities.<sup>450</sup>

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<sup>449</sup> [https://en.wikipedia.org/wiki/Miasma\\_theory](https://en.wikipedia.org/wiki/Miasma_theory)

<sup>450</sup> [https://en.wikipedia.org/wiki/Miasma\\_theory](https://en.wikipedia.org/wiki/Miasma_theory)



**Circa 9,901 HE:** Syria; Colored Glass blowing discovered. The art of producing clear glass was still not known.<sup>451</sup>

**Circa 9,901 HE:** China Hemp paper invented.<sup>452</sup>



Fragments of hemp wrapping paper dated to the reign of Emperor Wu of Han (Circa **9,860 HE – 9,914 HE**).<sup>453</sup>

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<sup>451</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

<sup>452</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>453</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

**Circa 9,901 HE:** India, the notion arose of having a leather loop suspended from the saddle for their horses. They invented the leather stirrup.<sup>454</sup>

**Circa 9,902 HE – 9,946 HE:** TITUS LUCRETIUS CARUS: Roman, poet and philosopher only known work is the epic philosophical book -poem: “*De rerum natura*” about the tenets and philosophy of Epicureanism, and which is usually translated into English as *On the Nature of Things*.<sup>455</sup>

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<sup>454</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 64

<sup>455</sup> <https://en.wikipedia.org/wiki/Lucretius>

Titus Lucretius Carus



Modern bust of Lucretius



Bust of TITUS LUCRETIUS CARUS, artist, date and location unknown.<sup>456</sup>

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<sup>456</sup> <https://en.wikipedia.org/wiki/Lucretius>



Piece of Manuscript of *De Re Natura* in Cambridge University Library Collection.<sup>457</sup>

<sup>457</sup> <https://en.wikipedia.org/wiki/Lucretius>

**Circa 9,916 HE:** Waterwheels were first mentioned in a poem: (ASIMOV didn't mention where or by whom). Humans had been using themselves and animals over the ages for power. Probably waterwheels were in use before this time, but this was the first time they were mentioned in writing.<sup>458</sup>

**Circa 9,953 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."<sup>459</sup>

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<sup>458</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

<sup>459</sup> <https://www.britannica.com/topic/Library-of-Alexandria>

**Circa 9,955 HE:** Julian Calendar introduced.<sup>460</sup>

**Circa 10,001 HE:** Maps of peoples around the world.<sup>461</sup>

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<sup>460</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 60

<sup>461</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)



**Circa 10,001 HE Map of Peoples in Northwest Hemisphere.**<sup>462</sup>

<sup>462</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)



**Circa 10,001 HE Map of Peoples in Southwest Hemisphere.**<sup>463</sup>

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<sup>463</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)





**Circa 10,001 HE** Map of Peoples African Continent.<sup>464</sup>

<sup>464</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)



**Circa 10,001 HE Map of Peoples in Euro Asia and the Malays.**<sup>465</sup>

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<sup>465</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)



⇒ Circa 10,001 HE Map of Peoples in Australia.<sup>466</sup>

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<sup>466</sup> [https://upload.wikimedia.org/wikipedia/commons/4/47/World\\_1\\_CE.PNG](https://upload.wikimedia.org/wikipedia/commons/4/47/World_1_CE.PNG)

**Circa 10,080 HE:** The Roman Colosseum was built. For some time, Roman numerals are in use.

Symbol	I	V	X	L	C	D	M
Value	1	5	10	50	100	500	1,000

⇒

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⇒ No one is sure when they started but the Colosseum Entrance to section LII (52) has Roman Numerals still visible.<sup>468</sup>

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<sup>467</sup> [https://en.wikipedia.org/wiki/Roman\\_numerals](https://en.wikipedia.org/wiki/Roman_numerals)

<sup>468</sup> [https://en.wikipedia.org/wiki/Roman\\_numerals](https://en.wikipedia.org/wiki/Roman_numerals)



Colosseum Entrance to section LII (52) with numerals still visible, photographer unknown.<sup>469</sup>

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<sup>469</sup> [https://en.wikipedia.org/wiki/Roman\\_numerals](https://en.wikipedia.org/wiki/Roman_numerals)

**Circa 10,050 HE:** The first written mention of Japan is in Chinese written texts.<sup>470</sup>

**Circa 10,050 HE:** PEDANIUS DIOSCORIDES, Greek physician, pharmacologist, botanist<sup>471</sup> 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.<sup>472</sup>

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<sup>470</sup> <https://en.wikipedia.org/wiki/Japan>

<sup>471</sup> [https://en.wikipedia.org/wiki/Pedanius\\_Dioscorides](https://en.wikipedia.org/wiki/Pedanius_Dioscorides)

<sup>472</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



Photo of a drawing from 550 years after DIOSCORIDES lived;  
 it is from the **10,600 HE Greek Juliana Anicia Codex**  
 DIOSCORIDES receives a mandrake root.<sup>473</sup>

<sup>473</sup> [https://en.wikipedia.org/wiki/Pedanius\\_Dioscorides](https://en.wikipedia.org/wiki/Pedanius_Dioscorides)



⇒ **11,554 HE:** Circa 1,500 years after being written, this photo is of the cover of a re-printed version of PEDANIUS DIOSCORIDES *De Materia Medica*, Lyon.<sup>474</sup>

<sup>474</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



**Circa 10,050 HE:** HERO of ALEXANDRIA, Greek engineer invented the steam engine; the modern sprinkler system works in precisely the same design – without the heat.<sup>475</sup>

⇒ 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

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<sup>475</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61

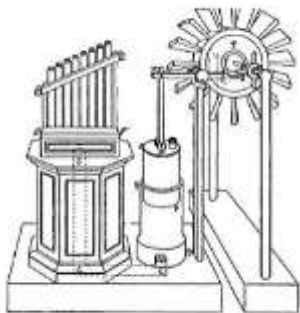
lengths, a work in which the odometer and the Dioptra, an apparatus which resembles the theodolite, are described; **Belopoeica**, a description of war machines; **Catoptrica**, about the progression of light, reflection and the use of mirrors.<sup>476</sup>



The book **About Automata** by HERO of ALEXANDRIA (11,589 HE edition).<sup>477</sup>

<sup>476</sup> [https://en.wikipedia.org/wiki/Hero\\_of\\_Alexandria](https://en.wikipedia.org/wiki/Hero_of_Alexandria)

<sup>477</sup> [https://en.wikipedia.org/wiki/Hero\\_of\\_Alexandria](https://en.wikipedia.org/wiki/Hero_of_Alexandria)



**11,899 HE** Drawing of HERO's wind-powered organ, the earliest recorded machine powered by a windwheel, artist W. Schmidt, location unknown.<sup>478</sup>

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<sup>478</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power](https://en.wikipedia.org/wiki/History_of_wind_power)

**Circa 10,090 HE:** Northern Europe: Horse collar invented. The horse was converted into a farm animal. This increased food supply and thus population. Power began to shift from the Mediterranean area to the north.<sup>479</sup>

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<sup>479</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 73

**Circa 10,100 HE:** Libya: Silphium, a species of giant fennel native to north Africa, may have been used as an oral contraceptive in ancient Greece and the ancient Near East. Possibly due to its supposed effectiveness and thus desirability, it had become so rare that it was worth more than its weight in silver and, by late antiquity, it was fully extinct.<sup>480</sup>

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<sup>480</sup> "*Herbal contraceptives and abortifacients*". In Bullough, Vern L. Encyclopedia of birth control. Santa Barbara, Calif.: ABC-CLIO. pp. 125–128. ISBN 978-1-57607-181-6. Archived from the original on November 16, 12,016 HE; Laurence M. V. (12,009 HE). *Hippocratic Recipes: Oral and Written Transmission of Pharmacological Knowledge in Fifth- and Fourth-Century Greece; and* [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](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.<sup>481</sup>

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<sup>481</sup> [https://en.wikipedia.org/wiki/History\\_of\\_abortion](https://en.wikipedia.org/wiki/History_of_abortion)

**Circa 10,100 HE - Circa 10,200 HE: SORANUS OF EPHESUS** was an ancient Greek physician.<sup>482</sup>

- ⇒ SORANUS OF EPHESUS recommended abortion in cases involving health complications as well as emotional immaturity and provided detailed suggestions in his work *Gynecology*.<sup>483</sup>
- ⇒ 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

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<sup>482</sup> [https://en.wikipedia.org/wiki/Soranus\\_of\\_Ephesus](https://en.wikipedia.org/wiki/Soranus_of_Ephesus)

<sup>483</sup> [https://en.wikipedia.org/wiki/History\\_of\\_abortion](https://en.wikipedia.org/wiki/History_of_abortion)

were to touch her buttocks with each jump, which he described as the "Lacedaemonian Leap". He also offered a number of recipes for herbal baths, rubs, and pessaries.<sup>484</sup>

- ⇒ Although abortion was accepted in Rome, attitudes changed with the spread of Christianity and around **10,211 HE** emperors Septimius Severus and Caracalla banned abortion as infringing on parental rights; temporary exile was the punishment.<sup>485</sup>

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<sup>484</sup> [https://en.wikipedia.org/wiki/History\\_of\\_abortion#cite\\_note-Soranus-46](https://en.wikipedia.org/wiki/History_of_abortion#cite_note-Soranus-46)

<sup>485</sup> Jeffrey H. Reiman, *Abortion and the Ways We Value Life* (Rowman and Littlefield 1998 ISBN 978-0-8476-9208-8), p, 19



**Circa 10,100 HE:** NICOMACHUS: ancient Greek mathematician influenced by ARISTOTLE<sup>486</sup> is best known for his works *Introduction to Arithmetic* and *Manual of Harmonics* in Greek.<sup>487</sup>

**Circa 10,105 HE:** TSAI LUN, China, invented *paper*: the smooth writing surface from cellulose. It took 1,000 years for knowledge of paper to reach Europe.<sup>488</sup>

**Circa 10,105 HE:** The Roman Empire may have had 40 million people.<sup>489</sup>

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<sup>486</sup> <https://en.wikipedia.org/wiki/Nicomachus>

<sup>487</sup> <https://en.wikipedia.org/wiki/Nicomachus>

<sup>488</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

<sup>489</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

**Circa 10,105 HE:** The population of China may have been around 50 million people.<sup>490</sup>

**Circa 10,150 HE:** CLAUDIUS PTOLEMY aka PTOLEMY; Egypt, Roman Empire Mathematician Geographer Astronomer Astrologer. The name Claudius is a Roman name; the fact that PTOLEMY bore it indicates he lived under the Roman rule of Egypt with the privileges and political rights of Roman citizenship.<sup>491</sup> 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.<sup>492</sup>

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<sup>490</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 62

<sup>491</sup> <https://en.wikipedia.org/wiki/Ptolemy>

<sup>492</sup> 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.<sup>493</sup>

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<sup>493</sup> <https://en.wikipedia.org/wiki/Ptolemy>



This **11,476 HE** depiction of **CLAUDIUS PTOLEMY** with an armillary sphere Earth centric model, by Joos van Ghent and Pedro Berruguete is at The Louvre, Paris.<sup>494</sup>

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<sup>494</sup> <https://en.wikipedia.org/wiki/Ptolemy>

**Circa 10,209 HE – Circa 10,200 HE: AELIUS OR CLAUDIUS GALENUS**, Greek, GALEN of PERGAMON (sometimes spelled Pergamum), when anglicized, Rome, Greek/Roman physician.<sup>495</sup> 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.<sup>496 497</sup>

⇒ 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.<sup>498</sup>

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<sup>495</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

<sup>496</sup> <https://en.wikipedia.org/wiki/Galen>

<sup>497</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 63

<sup>498</sup> <https://en.wikipedia.org/wiki/Galen>

⇒ GALEN was a skilled surgeon, operating on human patients. Many of his procedures and techniques would not be used again for centuries, such as the procedures he performed on brains and eyes. To correct cataracts in patients, GALEN performed an operation similar to a modern one. Using a needle-shaped instrument, GALEN attempted to remove the cataract-affected lens of the eye. GALEN's surgical experiments included ligating the arteries of living animals.<sup>499</sup>

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<sup>499</sup> <https://en.wikipedia.org/wiki/Galen>



Modern statue of GALEN in his home town, Pergamon.<sup>500</sup>

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<sup>500</sup> <https://en.wikipedia.org/wiki/Galen>



**11,529 HE:** 1,300 years after it was written- reprint of GALEN's *De Curandi Ratione*.<sup>501</sup>

<sup>501</sup> <https://en.wikipedia.org/wiki/Galen>



**Circa 10,200 HE:** India: VATSYAYANA, wrote a classical text, which presented various contraceptive methods including coitus obstructus involving controlling the release of semen.<sup>502</sup>

**Circa 10,200 HE:** China used tea leaves to flavor boiled water.<sup>503</sup>

**Circa 10,200 HE:** Human population had reached approximately 190,000,000 people.<sup>504</sup>

**Circa 10,250 HE:** DIOPHANTUS, Greek mathematician. wrote an Algebra text.<sup>505</sup> Author / Compiler Note: this is Circa 1,069 years

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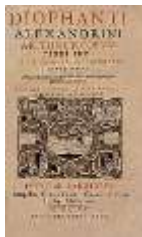
<sup>502</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>503</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

<sup>504</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>505</sup> <https://en.wikipedia.org/wiki/Diophantus>

after circa **9,181 HE**: when AL-MAHAINI, of Persia (see above) used the not yet named area of math we now call Algebra.<sup>506</sup>



Title page of the **11,621 HE** reprint edition **DIOPHANTUS's Arithmetica**, translated into Latin by Claude Gaspard Bachet de Méziriac.<sup>507</sup>

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<sup>506</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_geometry](https://en.wikipedia.org/wiki/Timeline_of_geometry)

<sup>507</sup> <https://en.wikipedia.org/wiki/Diophantus>

**Circa 10,300 HE:** China expanded on the **9,901 HE** India notion of the leather stirrup and made stirrups of metal.<sup>508</sup>

**Circa 10,300 HE – 11,150 HE:** The Tiwanaku (Spanish: Tiahuanaco or Tiahuanacu) state was a Pre-Columbian polity based in the city of Tiwanaku in western Bolivia that extended around Lake Titicaca and into present-day Peru and Chile.<sup>509</sup>

**Circa 10,323 HE:** “Constantine the Great” recognized the Christian religion, and closed the Karnak complex, in Egypt.<sup>510</sup>

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<sup>508</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 64

<sup>509</sup> [https://en.wikipedia.org/wiki/Tiwanaku\\_empire](https://en.wikipedia.org/wiki/Tiwanaku_empire)

<sup>510</sup> [https://en.wikipedia.org/wiki/Karnak#Precinct\\_of\\_Amun-Re](https://en.wikipedia.org/wiki/Karnak#Precinct_of_Amun-Re)

**Circa 10,335 HE - 10,405 HE:** THEON of Alexandria, Greek of Alexandria, Egypt, mathematician<sup>511</sup> edited and arranged: EUCLID's *Elements* and wrote commentaries on works by EUCLID and PTOLEMY. The editions ascribed to THEON are the only known version until Francois Peyrard discovered an older copy of the *Elements* in the Vatican Library in **11,808 HE**".<sup>512</sup>

⇒ THEON made predictions and observances of solar and lunar eclipses in **10,364 HE** which show he was active at that time.<sup>513</sup>

⇒ THEON was the father of the mathematician HYPATIA.

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<sup>511</sup> [https://en.wikipedia.org/wiki/Theon\\_of\\_Alexandria](https://en.wikipedia.org/wiki/Theon_of_Alexandria)

<sup>512</sup> Thomas Little Heath (11,921HE). "*A history of Greek mathematics*".

<sup>513</sup> [https://en.wikipedia.org/wiki/Theon\\_of\\_Alexandria](https://en.wikipedia.org/wiki/Theon_of_Alexandria)

**Circa 10,350 HE:** China, invents carving a wooden block with a raised reverse symbol that can then be used to print on paper.<sup>514</sup>

**Circa 10,370 HE - 10,415 HE:** HYPATIA, Greek, of Alexandria, Egypt, then part of the Eastern Roman Empire; was a Hellenistic Neoplatonist philosopher, astronomer, and mathematician.<sup>515</sup>

⇒ HYPATIA was the first female mathematician whose life is reasonably well recorded. She was renowned in her own lifetime as a great teacher and a wise counselor. She is known to have written a commentary on DIOPHANTUS's thirteen-volume *Arithmetica*, which may survive in part, having been interpolated into Diophantus's original text, and another

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<sup>514</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

<sup>515</sup> Author 1<sup>st</sup> 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>

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.<sup>516</sup>

⇒ HYPATIA who was killed by a Christian mob in **10,415 HE** during a period of religious and sectarian conflict.<sup>517</sup>

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<sup>516</sup> <https://en.wikipedia.org/wiki/Hypatia>

<sup>517</sup> [https://en.wikipedia.org/wiki/Theon\\_of\\_Alexandria](https://en.wikipedia.org/wiki/Theon_of_Alexandria)



Illustration by Louis Figuier from **11,866 HE** representing the assault against Hypatia.<sup>518</sup>

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<sup>518</sup> <https://en.wikipedia.org/wiki/Hypatia>

**Circa 10,370 HE – c 10,529 HE:** The final phase of Antiquity Roman Greece Empire is the period of Christianization which closed the physical Roman Empire with the closure of the Academy of Athens by Justinian.<sup>519</sup>

- ⇒ ISAAC ASIMOV wondered what would have happened if Greek science had continued uncrushed by the weight of Roman lack of interest?<sup>520</sup>
- ⇒ 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.

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<sup>519</sup> [https://en.wikipedia.org/wiki/Ancient\\_Greece](https://en.wikipedia.org/wiki/Ancient_Greece)

<sup>520</sup> 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.<sup>521</sup>

**Circa 10,370 HE - Circa 11,500 HE:** European DARK AGES.

**Circa 10,391 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 **10,391 HE**

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<sup>521</sup> <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.<sup>522</sup>



**Circa 10,400 HE:** China, wheelbarrows invented<sup>523</sup>

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<sup>522</sup> <https://www.britannica.com/topic/Library-of-Alexandria>

<sup>523</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 64

## Circa 10,400 HE to 11,100 HE: Native Petroglyphs at Canyonlands National Park, Utah.<sup>524</sup>



⇒ 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.<sup>525</sup>

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<sup>524</sup> <https://www.youtube.com/watch?v=CczH6P41nUs> (GoTraveler)

<sup>525</sup> [https://en.wikipedia.org/wiki/Horseshoe\\_Canyon\\_\(Utah\)](https://en.wikipedia.org/wiki/Horseshoe_Canyon_(Utah))

**Circa 10,450 HE:** Polynesians reached Hawaii, they had been sailing over the vast Pacific without compasses and by following the stars and the currents and were settling island after island.<sup>526</sup>



Hawaiian navigators sailing multi-hulled canoe, c. **11,781 HE**;  
Artist: John Webber, artist aboard Cook's ship.

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<sup>526</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

**Circa 10,476 HE – 10,550 HE:** India, ARYABHATA aka ARYABHATA I aka ARYABHATTA.<sup>527</sup> 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 daily<sup>528</sup> was lost in the dark ages of Europe - so much so that when COPERNICUS (See **11,473 HE - 11,543 HE: NICOLAUS COPERNICUS**) finally revealed the fact, it

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<sup>527</sup> Robert Green Ingersoll's **11,869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation *"The gods and other lectures"*

<sup>528</sup> <https://en.wikipedia.org/wiki/Aryabhata>

was as if COPERNICUS was indeed the first human to prove it.<sup>529</sup>

⇒ 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

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<sup>529</sup> Robert Green Ingersoll's **11,869 HE** Speech at the Centennial of Humboldt's Birth: Republished and made available through Project Gutenberg in the compilation "The gods and other lectures"

(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.<sup>530</sup>

- ⇒ 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-BĪRŪNĪ<sup>531</sup> (See Circa **11,148 HE**: ABURAYHAN AL-BIRUNI).<sup>532</sup>
- ⇒ 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

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<sup>530</sup> <https://en.wikipedia.org/wiki/Aryabhata>

<sup>531</sup> <https://en.wikipedia.org/wiki/Aryabhata>

<sup>532</sup> <https://en.wikipedia.org/wiki/Aryabhata>

and versine ( $1 - \cos x$ ) tables, in  $3.75^\circ$  intervals from  $0^\circ$  to  $90^\circ$ , to an accuracy of 4 decimal places. In fact, modern names "sine" and "cosine" are mis-transcriptions of the words *jya* and *kojya* as introduced by ARYABHATA.<sup>533</sup>

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<sup>533</sup> <https://en.wikipedia.org/wiki/Aryabhata>

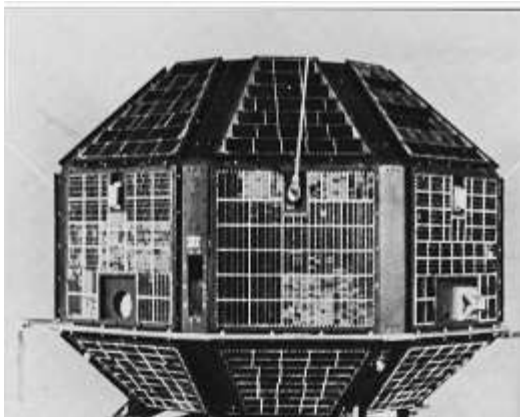




Statue of ARYABHATA on the grounds of IUCAA, Pune, India, photographer unknown.<sup>534</sup>

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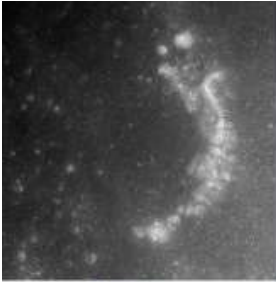
<sup>534</sup> <https://en.wikipedia.org/wiki/Aryabhata>



India's first satellite named after ARYABHATA, photographer, date and location unknown.<sup>535</sup>

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<sup>535</sup> <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.<sup>536</sup>

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<sup>536</sup> [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.<sup>537</sup>

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<sup>537</sup> [https://en.wikipedia.org/wiki/Aryabhata\\_\(crater\)](https://en.wikipedia.org/wiki/Aryabhata_(crater))

**Circa 10,500 HE:** Ancient Chumash Native American Tribe pictographs in Simi Valley, United States, photographer unknown.<sup>538</sup>



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<sup>538</sup> [https://en.wikipedia.org/wiki/Chumash\\_people](https://en.wikipedia.org/wiki/Chumash_people)

**Circa 10,500 HE – 10,570 HE: YATIVRSABHA:** Sub-Continent Indian mathematician and writer of the book *Tiloyapannatti* which gives various units for measuring distances and time and postulated different concepts about infinity.<sup>539 540</sup>

**Circa 10,505 HE –10,587 HE: VARAHAMIHIRA:** was a Sub-Continent Indian astronomer, mathematician, and astrologer who lived in Ujjain.<sup>541</sup>

⇒ His contributions include: Trigonometry and improved the 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

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<sup>539</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Indian\\_mathematicians](https://en.wikipedia.org/wiki/List_of_Indian_mathematicians)

<sup>540</sup> <https://en.wikipedia.org/wiki/Yativrsabha>

<sup>541</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Indian\\_mathematicians](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. His 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.<sup>542 543</sup>

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<sup>542</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Indian\\_mathematicians](https://en.wikipedia.org/wiki/List_of_Indian_mathematicians) and Encyclopedia Britannica (12,007 HE) s.v. Varahamihira 2. E. C. Sachau, Alberuni's India (11,910 HE), vol. I, p. 153

<sup>543</sup> <https://en.wikipedia.org/wiki/Varāhamihira>

**10,598 HE – 10,668 HE: BRAHMAGUPTA:** Sub-Continent Indian mathematician and astronomer<sup>544</sup> was the Editor of two early works on mathematics and astronomy: a theoretical treatise, and a more practical text.<sup>545</sup>

- ⇒ 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.<sup>546</sup>

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<sup>544</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Indian\\_mathematicians](https://en.wikipedia.org/wiki/List_of_Indian_mathematicians)

<sup>545</sup> <https://en.wikipedia.org/wiki/Brahmagupta>

<sup>546</sup> <https://en.wikipedia.org/wiki/Brahmagupta>



- Author / Compiler note: as I am editing, I see that ASIMOV, as well as Wikipedia, reference Circa **10,810 HE** as the time when the concept of “0” / ZERO as a digit in the decimal place value notation was developed in India.<sup>547</sup> <sup>548</sup> Author / Compiler wonders if circa **10,810 HE** is when proofs began to be given?

**Circa 10,600's HE – 10,900's:** The first practical windmills were in use in Sistan, a region in Iran and bordering Afghanistan. These "Panemone windmills" were horizontal windmills, which had long vertical driveshafts with six to twelve rectangular sails covered in reed matting or cloth. These windmills were used to pump water, and in the gristmilling and sugarcane industries.<sup>549</sup>

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<sup>547</sup> <https://en.wikipedia.org/wiki/Zero>

<sup>548</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 71

<sup>549</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

**Circa 10,622 HE:** Many Islamic Calendars were in use: Prophet Muhammad and Islamic lunar Hijri calendar; The first year was the Islamic year during which the emigration of Muhammad from Mecca to Medina known as the Hijra occurred; **Circa 11,976 HE:** Shah Mohammad Reza Pahlavi changed the origin of the calendar, using the beginning of the reign of Cyrus the Great as the first day, rather than the Hijra of Mohammad. Overnight, the year changed from 1355 to 2535. **Circa 11,979 HE:** The change lasted till the Islamic Revolution in Iran, at which time the calendar was reverted to Solar Hijri. Islamic *Solar Hijri calendar*, Iran & Afghanistan calendar: The Solar Heiri; *Maybe AKA Solar Hijri algorithmic calendar*, Iranian Rule Based calendar; Jalali Rule Based calendar; Late Ottoman-era solar Hijri calendar; Afghanistan Rule Based calendar; The Tabular Islamic Rule Based calendar.<sup>550</sup>

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<sup>550</sup> [https://en.wikipedia.org/wiki/Islamic\\_calendar](https://en.wikipedia.org/wiki/Islamic_calendar)

**Circa 10,660 HE:** The Slavs of Eastern Europe were supposed to have invented the moldboard plow with a knife on the end of it. As it slowly spread through eastern and northern Europe food production took a jump and population increased<sup>551</sup> to approximately 200,000,000 people.<sup>552</sup>

**Circa 10,660 HE:** China, Woodblock Printing.<sup>553</sup>

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<sup>551</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 66

<sup>552</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>553</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)



**10,618 HE–10,907 HE:** Frontispiece of *The Diamond Sutra*, the oldest printed book, during the Tang Dynasty, photographer and location unknown.<sup>554</sup>

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<sup>554</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

**Circa 10,700 HE:** Porcelain invented in China. As the shiny almost glassy, very hard, very white pottery that rang like a bell when struck, eventually reached Europe, the product was known as “China.”<sup>555</sup>

**Circa 10,700 HE:** The population of the world was approximately 210,000,000 people.<sup>556</sup>

**Circa 10,700 HE:** Persia, windmills use further developed in Middle East.<sup>557</sup>

**Circa 10,700s HE:** HALAYUDHA, Indian sub-continent mathematician wrote a commentary on PINGALA's

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<sup>555</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69

<sup>556</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>557</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

*Chandahśāstra* and expanded it and including a clear description of Pascal's triangle called meru-prastaara.<sup>558 559</sup>

⇒ 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 lexicon<sup>560</sup>describing the vocabulary or language or branch of knowledge.<sup>561</sup>

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<sup>558</sup> <https://en.wikipedia.org/wiki/Pingala>

<sup>559</sup> <https://en.wikipedia.org/wiki/Halayudha>

<sup>560</sup> <https://en.wikipedia.org/wiki/Halayudha>

<sup>561</sup> <https://en.wikipedia.org/wiki/Halayudha>

**Circa 10,733 HE – 11,066 HE: Norse / Viking Age, Vikings explore and colonize Iceland, Greenland, Newfoundland.<sup>562</sup>**



**Longship on Tjängvide image stone, 10,800 HE -11,099 HE.<sup>563</sup>**

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<sup>562</sup> [https://en.wikipedia.org/wiki/History\\_of\\_Greenland](https://en.wikipedia.org/wiki/History_of_Greenland)

<sup>563</sup> [https://en.wikipedia.org/wiki/Viking\\_Age](https://en.wikipedia.org/wiki/Viking_Age)

**Circa 10,750 HE - Circa 11,300 HE:** Arab world contributions to science & math, and to the preservation of historical learning.

- ⇒ By this time on our ***Holocene Era Timeline of Human Accomplishments, Advancements, Innovations and Understanding***, Greek learning had almost been forgotten in Europe.<sup>564</sup>
- ⇒ 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.<sup>565</sup> Known as *The Islamic Golden Age*, in the history of Islam, during which much of the historically Islamic world was

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<sup>564</sup> [https://en.wikipedia.org/wiki/Islamic\\_Golden\\_Age](https://en.wikipedia.org/wiki/Islamic_Golden_Age)

<sup>565</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69



ruled by various caliphates, and science, and economic development. Also, cultural works flourished.<sup>566</sup>



**Circa 11,237 HE** art of Scholars at an Abbasid library, from the Maqamat of al-Hariri by Yahya ibn Mahmud al-Wasiti, Baghdad<sup>567</sup>

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<sup>566</sup> [https://en.wikipedia.org/wiki/Islamic\\_Golden\\_Age](https://en.wikipedia.org/wiki/Islamic_Golden_Age)

<sup>567</sup> [https://en.wikipedia.org/wiki/Islamic\\_Golden\\_Age](https://en.wikipedia.org/wiki/Islamic_Golden_Age)

**Circa 10,750 HE:** JABIR IBN HAYYAN aka GEBER, Persian chemist, polymath, pharmacist, physician<sup>568</sup> who introduced the experimental method and controlled experiment in chemistry.<sup>569</sup>

⇒ 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.<sup>570</sup>

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<sup>568</sup> [https://en.wikipedia.org/wiki/Jabir\\_ibn\\_Hayyan](https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan)

<sup>569</sup> <http://sciencetimeline.blogspot.com/2009/11/timeline-of-scientific-experiments.html>

<sup>570</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 69



**Circa 11,600 HE** European imagination portrait of "GEBER",  
**Codici Ashburnhamiani 11,166 HE**, Biblioteca Medicea  
 Laurenziana, Florence, Italy.<sup>571</sup>

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<sup>571</sup> [https://en.wikipedia.org/wiki/Jabir\\_ibn\\_Hayyan](https://en.wikipedia.org/wiki/Jabir_ibn_Hayyan)

**Circa 10,770 HE:** Iron horseshoes, but not yet harnesses, were coming into use.<sup>572</sup>

**Circa 10,800 HE:** China, (see **10,350 HE** for first step in using wooden blocks for letters for printing) more highly invents carving wooden blocks that have a whole page of raised reverse symbols that can then be used to print on paper.<sup>573</sup>

**Circa 10,825 HE:** AL-KHWARIZMI, aka MUHAMMAD IBN MUSA AL-KHWARIZMI: Persian mathematician<sup>574 575</sup> wrote the book *On the Calculation with Hindu Numerals* in Arabic.<sup>576</sup>

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<sup>572</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 70

<sup>573</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

<sup>574</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Musa\\_al-Khwarizmi](https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi)

<sup>575</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 71

<sup>576</sup> [https://en.wikipedia.org/wiki/Hindu\\_Arabic\\_numeral\\_system](https://en.wikipedia.org/wiki/Hindu_Arabic_numeral_system)

- ⇒ At the time Roman Numerals were still mostly used. It took these next couple of centuries for people to overcome the habit of sticking to something “inconvenient but customary” like the use of the cumbersome roman numerals, rather than adopting something new and begin using convenient Arabic numerals. Still, it was done in the end and because of AL-KHWARIZMI’s introduction, the transition to use of Arabic numerals democratized arithmetical computation, bringing it to within reach of everyone.<sup>577</sup>
- ⇒ **Circa 10,833 HE:** AL-KHWARIZMI treatise on Algebra: *The Compendious Book on Calculation by Completion and Balancing*, presented the first systematic solution of linear and quadratic equations. The term Algebra itself comes from the title

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<sup>577</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 71

of his book: specifically, the word AL-JABR: meaning "completion" or "rejoining".<sup>578</sup>

- Author / Compiler Note: this is Circa 1,069 years after circa **9,181 HE**: when AL-MAHAINI, of Persia (see above) who conceived the idea of reducing geometrical problems such as doubling a cube in problems in the not yet named area of math we now call Algebra.<sup>579</sup> This is 583 years since see circa **10,250 HE** when DIOPHANTUS wrote an Algebra text.<sup>580</sup>

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<sup>578</sup> [https://en.wikipedia.org/wiki/Hindu\\_Arabic\\_numeral\\_system](https://en.wikipedia.org/wiki/Hindu_Arabic_numeral_system)

<sup>579</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_geometry](https://en.wikipedia.org/wiki/Timeline_of_geometry)

<sup>580</sup> <https://en.wikipedia.org/wiki/Diophantus>



AL-KHWARIZMI statute in Amir Kabir University, Tehran, date and artist unknown.<sup>581</sup>

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<sup>581</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Musa\\_al-Khwarizmi](https://en.wikipedia.org/wiki/Muhammad_ibn_Musa_al-Khwarizmi)

⇒ **Circa 10,825 HE:** AL-KHWARIZMI & AL-KINDI works were principally responsible for the diffusion of the Indian-Arabic system of numeration in the Middle East and the West. AL-KINDI wrote 4 volumes *On the Use of Indian Numerals*.<sup>582</sup>



⇒ Imagination Portrait of AL-KINDI; date, location, and artist unknown.<sup>583</sup>

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<sup>582</sup> [https://en.wikipedia.org/wiki/Arabic\\_numerals](https://en.wikipedia.org/wiki/Arabic_numerals)

<sup>583</sup> <https://en.wikipedia.org/wiki/Al-Kindi>



**Circa 10,830 HE:** SIND IBN ALI, Baghdad.<sup>584</sup> He introduced the Indian decimal point notation, and also wrote an early treatise on Arabic numerals.<sup>585</sup>

⇒ SIND IBN ALI is known to have translated and modified the first astronomical table ever introduced in the muslim world.<sup>586</sup>

⇒ 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.<sup>587</sup>

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<sup>584</sup> [https://en.wikipedia.org/wiki/Sind\\_ibn\\_Ali](https://en.wikipedia.org/wiki/Sind_ibn_Ali)

<sup>585</sup> [https://en.wikipedia.org/wiki/Sind\\_ibn\\_Ali](https://en.wikipedia.org/wiki/Sind_ibn_Ali)

<sup>586</sup> [https://en.wikipedia.org/wiki/Sind\\_ibn\\_Ali](https://en.wikipedia.org/wiki/Sind_ibn_Ali)

<sup>587</sup> [https://en.wikipedia.org/wiki/Sind\\_ibn\\_Ali](https://en.wikipedia.org/wiki/Sind_ibn_Ali)

**Circa 10,850 HE:** Southern Arabia: Coffee invented. The story goes that a goatherd noticed his goats got friskier after eating some berries. It was said that he tried them, liked the sensation and told others. They learned how to roast the berries and steep them in boiling water. It took hundreds of years for coffee to reach Europe.<sup>588</sup>

**Circa 10,952 HE:** ABU-HASAN-AL-UQLISDISI, Syrian mathematician wrote the treatise about Middle eastern mathematicians who extended the decimal numeral system to include fractions.<sup>589</sup>

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<sup>588</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 72

<sup>589</sup> [https://en.wikipedia.org/wiki/Abu\\_Hasan\\_al-Uqlidisi](https://en.wikipedia.org/wiki/Abu_Hasan_al-Uqlidisi)

**Circa 10,960 HE – Circa 11,279:** China, Earliest example of extant print advertisement.



Song dynasty bronze plate advertising print for the Liu family needle shop at Jinan, photographer and location unknown.<sup>590</sup>

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<sup>590</sup> [https://en.wikipedia.org/wiki/History\\_of\\_printing](https://en.wikipedia.org/wiki/History_of_printing)

**Circa 10,986 HE:** IBN SAHL was a Persian mathematician, physicist and optics engineer of the Islamic Golden Age associated with the Abbasid court of Baghdad.<sup>591</sup> IBN SAHL's circa **10,986 HE** treatise *On Burning Mirrors and Lenses* sets out his understanding of how curved mirrors and lenses bend and focus light.

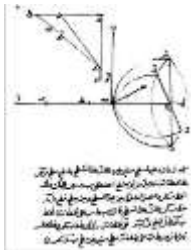
⇒ IBN SAHL is credited with first discovering the law of refraction, usually called Snell's law. (See **Circa 11,621 HE:** WILLEBRORD SNELIUS, Dutch mathematician known for “Snell’s Law”<sup>592</sup>)

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<sup>591</sup> [https://en.wikipedia.org/wiki/Ibn\\_Sahl](https://en.wikipedia.org/wiki/Ibn_Sahl)

<sup>592</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

- ⇒ IBN SAHL used the law of refraction to derive lens shapes that focus light with no geometric aberrations, known as anaclastic lenses.<sup>593</sup>



- ⇒ Reproduction of a page of IBN SAHL's manuscript showing his discovery of the law of refraction<sup>594</sup>

<sup>593</sup> [https://en.wikipedia.org/wiki/Ibn\\_Sahl](https://en.wikipedia.org/wiki/Ibn_Sahl)

<sup>594</sup> [https://en.wikipedia.org/wiki/Ibn\\_Sahl](https://en.wikipedia.org/wiki/Ibn_Sahl)

## Circa 10,900, HE – circa 11,000 HE: MUHAMMAD IBN

ZAKARIYA AL-RAZI, Persian chemist and physician who introduced controlled experiment into the field of medicine and carried out the first medical experiment in order to find the most hygienic place to build a hospital.<sup>595</sup>

- ⇒ 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.<sup>596</sup>
- ⇒ MUHAMMAD IBN ZAKARIYA AL-RAZI is said to be the first to produce acids such as sulfuric acid, writing up notes on

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<sup>595</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Zakariya\\_al-Razi](https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi)

<sup>596</sup> Bullough, Vern L., ed. (12,001 HE). *Encyclopedia of Birth Control*. ABC-CLIO. p. 154. ISBN 978-1-57607-533-3.

diseases such as smallpox and chickenpox, a pioneer in ophthalmology, editor of the first book on pediatrics, making leading contributions in inorganic and organic chemistry, also the editor of several philosophical works.<sup>597</sup>

⇒ 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".<sup>598</sup>

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<sup>597</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Zakariya\\_al-Razi](https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi)

<sup>598</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Zakariya\\_al-Razi](https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi)



Imagination portrait MUHAMMAD IBN ZAKARIYA AL-RAZI, artist and location unknown.<sup>599</sup>

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<sup>599</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Zakariya\\_al-Razi](https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi)





Colophon of MUHAMMAD IBN ZAKARIYA AL-RAZI's  
*Book of Medicine*.<sup>600</sup>

<sup>600</sup> [https://en.wikipedia.org/wiki/Muhammad\\_ibn\\_Zakariya\\_al-Razi](https://en.wikipedia.org/wiki/Muhammad_ibn_Zakariya_al-Razi)

**Circa 10,900, HE – circa 11,000 HE:** ALI IBN ABBAS AL-MAJUSI, Persia, documented the use of pessaries made of rock salt for women for whom pregnancy may be dangerous.<sup>601</sup>

**Circa 10,900 HE:** The population of the world was approximately 240,000,000 people.<sup>602</sup>

**Circa 10,973 HE:** ABURAYHAN AL-BIRUNI, Persian chronicler of India, Geodesy and Earth scientist; astronomer; conversant in 7 languages. He conducted the first elaborate experiments related to astronomical phenomena since the Greeks. He introduced the experimental method into mechanics. He was conversant in

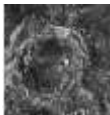
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<sup>601</sup> "Definition of Birth control". MedicineNet.

<sup>602</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

Khwarezmian, Persian, Arabic, Sanskrit, and also knew Greek, Hebrew and Syriac.<sup>603</sup>

⇒ 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.<sup>604</sup>



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Lunar crater Al-Biruni, on the far side of the Moon, as seen by Apollo 14.<sup>605</sup>

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<sup>603</sup> <https://en.wikipedia.org/wiki/Al-Biruni>

<sup>604</sup> <https://en.wikipedia.org/wiki/Al-Biruni>

<sup>605</sup> <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 <sup>606</sup>

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<sup>606</sup> <https://en.wikipedia.org/wiki/Al-Biruni>

**Circa 10,990 HE – circa 10,051 HE:** BI SHENG, Chinese artisan who invented movable type.<sup>607</sup>

**Circa 11,006 HE:** ALI IBN RIDWAN, Egyptian astronomer<sup>608</sup> who observed and wrote about Supernova SN 1006.<sup>609</sup>



ALI IBN RIDWAN's, unknown artistic drawing.<sup>610</sup>

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<sup>607</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>608</sup> [https://en.wikipedia.org/wiki/Ali\\_ibn\\_Ridwan](https://en.wikipedia.org/wiki/Ali_ibn_Ridwan)

<sup>609</sup> <https://en.wikipedia.org/wiki/Star>

<sup>610</sup> [https://en.wikipedia.org/wiki/Ali\\_ibn\\_Ridwan](https://en.wikipedia.org/wiki/Ali_ibn_Ridwan)

**Circa 11,020 HE** – ABU ALI AL-HUSSAIN IBN ABDALLAH IBN SINA, known in Europe as AVICENNA IBN SINA; Persian polymath who introduced experimentation and quantification into the study of medicine and physiology, including the introduction of experimental medicine and clinical trials.

⇒ AVICENNA IBN SINA also included a chapter on birth control in his medical encyclopedia *The Canon of Medicine*, listing 20 different methods of preventing conception.<sup>611</sup>

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<sup>611</sup> <https://en.wikipedia.org/wiki/Avicenna>



AVICENNA IBN SINA Conventional modern portrait (on a silver vase, Avicenna Mausoleum and Museum: Hamadan, Iran).<sup>612</sup>

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<sup>612</sup> <https://en.wikipedia.org/wiki/Avicenna>

**Circa 11,021 HE:** At the research institutes of Baghdad, Cairo, and other Islamic capitols.<sup>613</sup>

- ⇒ Christians, Jews, Doubters, and Skeptics – all scholars were honored guests.<sup>614</sup>
- ⇒ Instead of burning books, the Caliphs sent emissaries around the world in search of books.<sup>615</sup>
- ⇒ The Caliphs lavishly funded projects to translate, study, and preserve the gathered books for future generations.<sup>616</sup>

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<sup>613</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>614</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>615</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>616</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



- ⇒ Much of the light of Ancient Greek science would have been permanently extinguished without their efforts.<sup>617</sup>
- ⇒ 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.<sup>618</sup>
- ⇒ In Cosmos, author Druyan reminds us that the Arabs also imported ideas from India to the West, including the so-called Arabic numerals that we all use today, and the concept of zero which they adapted from the Indians.<sup>619</sup>

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<sup>617</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>618</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>619</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

- ⇒ Arabic astronomy was so influential, that we still call most of the bright stars by their Arabic names.<sup>620</sup>
- ⇒ 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.<sup>621</sup>

**Circa 11,021 HE:** – IBN AL HAYTHAM, Cairo scientist, astronomer, mathematician. Abū ‘Alī al-Ḥasan ibn al-Ḥasan ibn al-Haytham (Arabic: أبو علي، الحسن بن الحسن بن الهيثم; Persian: ابوعلی محمد بن حسن بن بوعلی also known by the Latinization Alhazen or Alhacen).<sup>622</sup>

- ⇒ Circa 1,400 years after Emperor Qin (see Circa **9,741 HE** – **9,791 HE**: Qin Shi Huang, first emperor of China) burned the

<sup>620</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>621</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>622</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Haytham](https://en.wikipedia.org/wiki/Ibn_al-Haytham)

optics\_works of MO TZE (See Circa **9,531 HE – 9,610 HE: MOZI**), and after the knowledge of the Ancient Greeks was lost and being rediscovered....

- ⇒ IBN AL-HAYTHAM made significant contributions to the principles of optics, astronomy, mathematics, visual perception, and the scientific method.
- ⇒ IBN AL-HAYTHAM was the first to explain that vision occurs when light bounces on an object and then is directed to one's eyes.<sup>623</sup>

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<sup>623</sup> Adamson, Peter (7 July 12,016 HE). Philosophy in the Islamic World: A History of Philosophy Without Any Gaps.

- ⇒ 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.<sup>624</sup>
- ⇒ 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 understanding the scientific method 200 years before Renaissance scientists.<sup>625</sup>
- ⇒ IBN AL-HAYTHAM wrote of his optics research, and further pioneered the experimental scientific method and experimental physics in his **Book of Optics**.<sup>626</sup> IBN AL-HAYTHAM devised

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<sup>624</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Haytham](https://en.wikipedia.org/wiki/Ibn_al-Haytham)

<sup>625</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Haytham](https://en.wikipedia.org/wiki/Ibn_al-Haytham)

<sup>626</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Haytham](https://en.wikipedia.org/wiki/Ibn_al-Haytham)

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.<sup>627</sup>

⇒ IBN AL-HAYTHAM was the first person ever to set down the rules of science.<sup>628</sup> IBN AL-HAYTHAM created an error-correcting mechanism, a systematic and relentless way to sift out misconceptions in our thinking.<sup>629</sup>

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<sup>627</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>628</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

<sup>629</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5

⇒ IBN AL-HAYTHAM said “Finding truth is difficult and the road to it is rough.” IBN AL-HAYTHAM said: as seekers after truth, you will be wise to withhold judgment and not simply put your trust in the writings of the ancients; You must question and critically examine those writings from every side; You must submit only to argument and experiment and not to the sayings of any person; For every human being is vulnerable to all kinds of imperfection; As seekers after truth, we must also suspect and question our own ideas as we perform our investigations, to avoid falling into prejudice or careless thinking. Take this course, and truth will be revealed to you. This is the method of science.”<sup>630</sup>

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<sup>630</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 5



IBN AL HAYTHAM; date, location, and artist unknown<sup>631</sup>

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<sup>631</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Haytham](https://en.wikipedia.org/wiki/Ibn_al-Haytham)



IBN AL-HAYTHAM *Book of Optics* reprint cover page  
Friedrich Risner, reprint publ. **11,572 HE** <sup>632</sup>

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<sup>632</sup> Friedrich Risner, publ. 11,572 HE . Opticae Thesaurus: Alhazeni Arabis Libri Septem Nunc Primum Editi , Eiusdem Liber De Crepusculis Et Nubium Asensionibus .Item Vitellonis Thuringopoloni Libri X. See Sabra, the authorship of Liber de crepusculis



**Circa 11,031 HE– circa 11,095 HE:** SHEN KUO, China, was the first to describe the process of movable type printing, and both magnetic declination (in discerning true north) and the magnetic needle compass in his *Dream Pool Essays* of **11,088 HE**. SHEN KUO attributed the innovation of reusable fired clay characters to a little-known artisan named BI SHENG (see **Circa 10,990 HE– 11,051 HE**).<sup>633</sup>

**Circa 11,071 HE:** Prior to this time forks were not used as a tool for eating by most people. Historically people had been eating with their fingers, spoons and knives. Then, it was recorded that a Byzantine princess married a doge of Venice and brought her forks with her and forks were then more widely used.<sup>634</sup>

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<sup>633</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

<sup>634</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 78

**Circa 11,080 HE:** France expanded on EUCLID's and the Persian original windmill designs to mill grain and pump water.<sup>635</sup> (see Circa **9,731 HE**, **EUCLID's** windmill design<sup>636</sup> and Circa **10,700 HE:** Persia, earliest windmills developed in Middle East<sup>637</sup>)

**Circa 11,100 HE:** Human population worldwide had reached approximately 320,000,000 million people.<sup>638</sup>

**Circa 11,111 HE:** Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. From Al-Ghazali came the philosophy that *mathematics was the work of the devil*. That, combined with the codification of the entirety of what Islam was

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<sup>635</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

<sup>636</sup> <https://www.britannica.com/biography/Euclid-Greek-mathematician/images-videos>

<sup>637</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 79

<sup>638</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

and would become, collapsed the great age of enlightenment in the Islamic world. It has not recovered since.<sup>639</sup>

⇒ The end of the era of “Naming Rights” by the Arab scientific minds, the most extensive work in navigation, math, and astronomy, along with the most beautifully carved astrolabes – everything and all of it was traceable to the 300 years period, prior to this date, when the teachings of Al-Ghazali caused it all to be stopped.<sup>640</sup>

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<sup>639</sup> Neil deGrasse Tyson speech “How The Islamic Civilization Fell”  
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

<sup>640</sup> Neil deGrasse Tyson speech “How The Islamic Civilization Fell”  
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

⇒ The darkness fell at this time in the Arab world, because Al-Ghazali enforced the false premise that revelation must replace investigation.<sup>641</sup>

**Circa 11,119 HE:** China, The Editor ZHU YU was the first to mention use of the compass specifically for navigation at sea in his book *Pingzhou Ketan* (萍洲可談; *Pingzhou Table Talks*).<sup>642</sup>

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<sup>641</sup> Neil deGrasse Tyson speech “How The Islamic Civilization Fell”  
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

<sup>642</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Chinese\\_inventions](https://en.wikipedia.org/wiki/List_of_Chinese_inventions)

**Circa 11,137 HE:** Gothic architecture – specifically flying Buttresses invented.<sup>643</sup> 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.

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<sup>643</sup> 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.<sup>644</sup>

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<sup>644</sup> [https://en.wikipedia.org/wiki/Flying\\_buttress](https://en.wikipedia.org/wiki/Flying_buttress)

**Circa 11,170 HE – 11,250 HE; LEONARDO BONACCI** known as FIBONACCI (and Leonardo of Pisa, and Leonardo Pisano Bigollo) Italian, mathematician considered to be "the most talented Western mathematician of the Middle Ages."<sup>645</sup>

- ⇒ FIBONACCI popularized the Hindu–Arabic numeral system and positional notation to the Western World primarily through his composition in **11,202 HE of Liber Abaci (Book of Calculation)** where in it he also introduced to Europe the sequence of Fibonacci numbers.<sup>646</sup>
- ⇒ 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.

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<sup>645</sup> <https://en.wikipedia.org/wiki/Fibonacci>

<sup>646</sup> <https://en.wikipedia.org/wiki/Fibonacci>

1,1,2,3,5,8,13,21,34,55,89,144..., and often, especially in modern usage, the sequence is extended by one more initial term: 0,1,1,2,3,5,8,13,21,34,55,89,144...<sup>647</sup>

⇒ Fibonacci numbers appear unexpectedly often in mathematics, so much so that there is an entire journal dedicated to their study, the Fibonacci Quarterly.<sup>648</sup>

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<sup>647</sup> [https://en.wikipedia.org/wiki/Fibonacci\\_number](https://en.wikipedia.org/wiki/Fibonacci_number)

<sup>648</sup> <http://www.fq.math.ca/>





Statue of LEONARDO BONACCI known as FIBONACCI  
(**11,863 HE**) by Giovanni Paganucci in the Camposanto di Pisa

<sup>649</sup>

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<sup>649</sup> <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 <sup>650</sup>

<sup>650</sup> [https://en.wikipedia.org/wiki/Liber\\_Abaci](https://en.wikipedia.org/wiki/Liber_Abaci)

⇒ The wonderful youtube.com by VIHART shows how Fibonacci numbers also appear in biological settings.<sup>651</sup>

**Circa beginning in the 11,180s HE:** The use of windmills became further widespread across the Middle East and Central Asia, and later spread to China and India.<sup>652</sup>

**Circa 11,185 HE:** England: a windmill in England dates from **11,185 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

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<sup>651</sup> ViHart–YouTubevideoFibonacci

<https://www.bing.com/videos/search?q=vi+heart+fibonacci&view=detail&mid=C1B0A8F3C1E4D08B5087C1B0A8F3C1E4D08B5087&FORM=VIRE>

<sup>652</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](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.<sup>653</sup>

**Circa 11,200 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 **10,150 HE**) was incorrect regarding the formation of the bones of the lower jaw and sacrum.<sup>654</sup>
- ⇒ 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.<sup>655</sup> His

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<sup>653</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

<sup>654</sup> [https://en.wikipedia.org/wiki/Abd\\_al-Latif\\_al-Baghdadi](https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi)

<sup>655</sup> [https://en.wikipedia.org/wiki/Abd\\_al-Latif\\_al-Baghdadi](https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi)

**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.<sup>656</sup>

**Circa 11,200 HE:** South Asian Indians used a variety of birth control methods since ancient times, including a potion made of powdered palm leaf and red chalk, as well as pessaries made of honey, ghee, rock salt or the seeds of the palasa tree. A variety of birth control prescriptions, mainly made up of herbs and other plants, are listed **Ratirahasya ("Secrets of Love")**,<sup>657</sup>

**Circa 11,215 HE –11,216 HE:** China, Copperplate moveable type printing.

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<sup>656</sup> [https://en.wikipedia.org/wiki/Abd\\_al-Latif\\_al-Baghdadi](https://en.wikipedia.org/wiki/Abd_al-Latif_al-Baghdadi)

<sup>657</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)



Copperplate printed 5000-cash Jin dynasty paper money with bronze movable type counterfeit markers, artist and location unknown.<sup>658</sup>

**Circa 11,223 HE:** China, First documented use of a toothbrush. Dōgen Kigen, a Japanese Zen master traveling in China, documented in writing the use of the instrument to clean teeth, by Northern

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<sup>658</sup> [https://en.wikipedia.org/wiki/History\\_of\\_printing](https://en.wikipedia.org/wiki/History_of_printing)

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.<sup>659</sup> (See Circa **8,247 HE**: Babylonians first recorded oral hygiene by use of tooth cleaning sticks.)<sup>660</sup>

**Circa 11,228 HE:** China, then England, started to dig into the earth to mine coal.<sup>661</sup>

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<sup>659</sup> <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

<sup>660</sup> <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>

<sup>661</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 82

**Circa 11,242 HE:** IBN AL-NAFIS, Arab, physician carried out autopsies which lead him to the discovery of pulmonary circulation and the circulatory system. Earliest and best Eastern exploration of cardiac physiology.<sup>662</sup> IBN AL-NAFIS wrote a book (Author / Compiler could not find its name) (not known unto the West until **11,924 HE**) in which IBN AL-NAFIS suggested the right and left ventricles of the heart were totally separate; explaining the double pump.<sup>663</sup> IBN AL-NAFIS wrote treatises on eye diseases and diet and commentaries on medical writings of HIPPOCRATES, AVICENNA, AND HUNAYN IBN ISHĀQ.<sup>664</sup>

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<sup>662</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Nafis](https://en.wikipedia.org/wiki/Ibn_al-Nafis)

<sup>663</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 139, 140

<sup>664</sup> <https://www.britannica.com/biography/Ibn-an-Nafis>





IBN AL-NAFIS (artist, date and location of bronze bust are unmentioned).<sup>665</sup>

**Circa 11,249 HE:** China and Europe both invent convex lenses used to help the aged who were becoming far sighted.<sup>666</sup>

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<sup>665</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Nafis](https://en.wikipedia.org/wiki/Ibn_al-Nafis)

<sup>666</sup> 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 **9,901 HE** in Syria the blowing and making of colored glass had been invented<sup>667</sup>; while clear glass was not invented until **11,291 HE** in Venice.<sup>668</sup>

**Circa 11,252 HE:** Spain, Alfonzo X of Castile sponsored updated Planetary Tables for nothing better than CLAUDIUS PTOLOMY's tables of planetary motion had been prepared in 11 centuries.<sup>669</sup>

⇒ Alfonzo X of Castile and Leon assembled a team of scholars and created the Alfonsine Tables which provided data for computing

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<sup>667</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 59

<sup>668</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 85

<sup>669</sup> 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.<sup>670</sup>




Alfonsine Tables, photographer and location unknown.<sup>671</sup>

<sup>670</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 84

<sup>671</sup> [https://en.wikipedia.org/wiki/Alfonsine\\_tables](https://en.wikipedia.org/wiki/Alfonsine_tables)

**11,267 HE - 11,319 HE:** KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI OR ABU HASAN MUHAMMAD IBN HASAN, Persian, scientist in optics and numbers theory.<sup>672</sup>

⇒ AL-FARISI rewrote after much studying AL HAYTHAM's *Treatise/Book of Optics* which became known as *Tanqih*.<sup>673</sup>

⇒ 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.<sup>674</sup>

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<sup>672</sup> [https://en.wikipedia.org/wiki/Kamal\\_al-Din\\_al\\_Farisi](https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi)

<sup>673</sup> [https://en.wikipedia.org/wiki/Kamal\\_al-Din\\_al\\_Farisi](https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi)

<sup>674</sup> [https://en.wikipedia.org/wiki/Kamal\\_al-Din\\_al\\_Farisi](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)<sup>675</sup>

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<sup>675</sup> [https://en.wikipedia.org/wiki/Kamal\\_al-Din\\_al\\_Farisi](https://en.wikipedia.org/wiki/Kamal_al-Din_al_Farisi)

**Circa 11,269 HE:** PELERIN DE MARICOURT or PETRUS PEREGRINUS DE MARICOURT, France, Scholar experimented and defined “Magnetic Poles” and wrote to a friend a letter describing his scientific experimentation with Magnets.<sup>676</sup>

**Circa 11,291 HE:** Venice. Clear glass making invented 1,390 years after circa **9,901 HE** in Syria invented blowing and making of colored glass.<sup>677</sup>

⇒ Mirrors invented: Clear glass lead to invention of the first “something” besides water or polished metal for people to see their reflections.<sup>678</sup>

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<sup>676</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 84

<sup>677</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

<sup>678</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 85

**Circa 11,292 HE:** North America, United States, Ancient Puebloan culture. Ancient Puebloan is their more accurate name. “Anasazi People” was a derogatory name.<sup>679</sup>

- ⇒ 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.<sup>680</sup>
- ⇒ 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

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<sup>679</sup> [https://en.wikipedia.org/wiki/Ancestral\\_Pueblos](https://en.wikipedia.org/wiki/Ancestral_Pueblos)

<sup>680</sup> [https://en.wikipedia.org/wiki/Ancestral\\_Pueblos](https://en.wikipedia.org/wiki/Ancestral_Pueblos)

distinct knowledge of celestial sciences that found form in their architecture.<sup>681</sup>



Photo is of Mesa Verde National Park, Cliff Palace, Colorado, United States, photographer unknown.<sup>682</sup>

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<sup>681</sup> [https://en.wikipedia.org/wiki/Ancestral\\_Puebloans](https://en.wikipedia.org/wiki/Ancestral_Puebloans)

<sup>682</sup> [https://en.wikipedia.org/wiki/Ancestral\\_Puebloans](https://en.wikipedia.org/wiki/Ancestral_Puebloans)





Photo is of Spruce Tree House, Colorado, United States,  
photographer unknown.<sup>683</sup>

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<sup>683</sup> [https://en.wikipedia.org/wiki/Ancestral\\_Puebloans](https://en.wikipedia.org/wiki/Ancestral_Puebloans)

**Circa 11,298 HE:** The Spinning Wheel, invented in India, actual date unknown but, already had mechanized the work process of taking fiber and spinning it into yarn in India. This is the year the knowledge of the spinning wheel finally made it to Europe.<sup>684</sup>

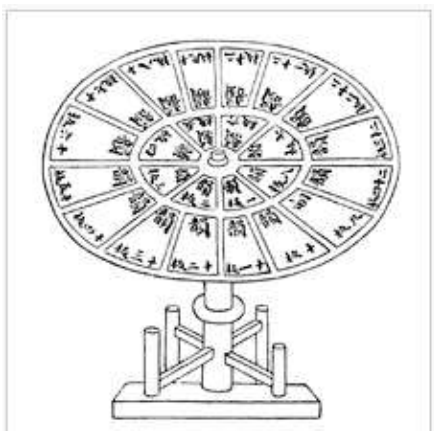
**Circa 11,300 HE:** History now calls him the “false Gerber”, unknown location; discovered Sulfuric Acid (He referred to himself as Geber to be associated with the famous Arabic REAL GERBER) Sulfuric Acid is much stronger than Acetic acid and made possible discovery of many chemical changes.<sup>685</sup>

**Circa 11,313 HE:** China, revolving type case for wooden type.

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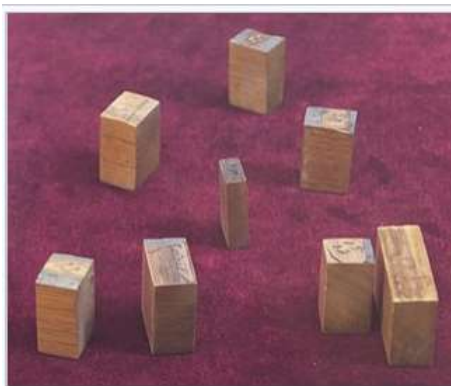
<sup>684</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 86

<sup>685</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 87



A revolving type case for wooden type in China, from Wang Zhen's book.<sup>686</sup>

<sup>686</sup> [https://en.wikipedia.org/wiki/History\\_of\\_printing](https://en.wikipedia.org/wiki/History_of_printing)



Wooden movable type for Old Uyghur alphabet, dated to the 11,200's HE – 11,300's HE. Discovered in the Mogao caves.<sup>687</sup>

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<sup>687</sup> [https://en.wikipedia.org/wiki/History\\_of\\_printing](https://en.wikipedia.org/wiki/History_of_printing)

**Circa 11,316 HE:** MONDINO DE LUZZI, Italian anatomist

MONDINO DE LUZZI taught at medical school of Bologna and did human cadaver dissection which lead to **11,316 HE** publication of book *Anathomia corporis humani*<sup>688</sup> entirely dedicated to anatomy.<sup>689</sup> 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.<sup>690</sup>

**Circa 11,330 HE – 11,388 HE:** GIOVANNI DE DONDI: Padua, Italy.

Known for art design and construction, he built an astronomical

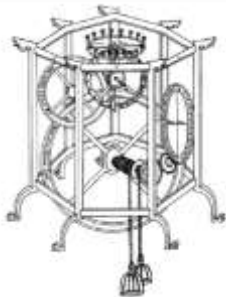
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<sup>688</sup> [https://en.wikipedia.org/wiki/Mondino\\_de\\_Liuzzi](https://en.wikipedia.org/wiki/Mondino_de_Liuzzi)

<sup>689</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 89

<sup>690</sup> [https://en.wikipedia.org/wiki/Mondino\\_de\\_Liuzzi](https://en.wikipedia.org/wiki/Mondino_de_Liuzzi)

clock which demonstrated an ambitious attempt to describe and model the planetary system with mathematical precision and technological sophistication.<sup>691</sup>



Built in **11,364 HE**: This tracing of an illustration from GIOVANNI DE DONDI'S **11,364 HE** treatise, *Il Tractatus*

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<sup>691</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Dondi\\_dell'Orologio](https://en.wikipedia.org/wiki/Giovanni_Dondi_dell'Orologio)

**Astrarii** is perhaps the earliest existing drawing of a balance wheel. The balance wheel (crown shape, top) had a beat of 2 seconds.<sup>692</sup>

**Circa 11,333 HE – 11,351 HE:** By now, simple hygienic principles were lost, becoming unknown to European society.<sup>693</sup> The Black Death is estimated to have killed 30–60% of Europe's total population.<sup>694</sup>

**Circa 11,335 HE:** Milan, Italy; Mechanical Clocks invented; the first advance over the water clock (see **9,731 HE** - note it took circa 1,600 years for this advancement) was invented and used the downward gravitational pull of weights from the mechanical clock

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<sup>692</sup> [https://en.wikipedia.org/wiki/Balance\\_wheel](https://en.wikipedia.org/wiki/Balance_wheel)

<sup>693</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 90

<sup>694</sup> [https://en.wikipedia.org/wiki/Black\\_Death](https://en.wikipedia.org/wiki/Black_Death)

face. It struck the hour. For the first time citizens could know the approximate time by listening to the bell. the word “clock” is from the French word for “bell”.<sup>695</sup>

**Circa 11,335 HE:** Mexico City, then known as Tenochtitlan by the rising Aztec empire, was founded.<sup>696</sup>

**Circa 11,352 HE – 11,354 HE:** France, Strasbourg cathedral, an astronomical clock was erected, often falsely claimed to be the oldest such clock, it is considered the second oldest preserved automaton worldwide. The mechanism most certainly had an

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<sup>695</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 89

<sup>696</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 90



astrolabe dial and a calendar dial.<sup>697</sup> (See Circa **9,796 HE – 9,901 HE**: The Antikythera Mechanism.)

**Circa 11,400 HE**: The population of the world was approximately 350,000,000 people.<sup>698</sup>

**Circa starting: 11,400's HE**: Netherlands; Use of wind mills to pump water from low lands polder, as a method for flood control. The wind-driven water pump has become one of the trademark tourist attractions of the Netherlands. The first drainage mills using a scoop wheel could raise water at most 1.5 m. By combining mills, the pumping height could be increased. Later mills were equipped

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<sup>697</sup> [https://en.wikipedia.org/wiki/Strasbourg\\_astronomical\\_clock](https://en.wikipedia.org/wiki/Strasbourg_astronomical_clock)

<sup>698</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

with an Archimedes' screw which could raise water much higher.<sup>699</sup>



Current times **HE**: Pumping station in Zoetermeer, Netherlands.  
The polder lies lower than the surrounding water on the other

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<sup>699</sup> [https://en.wikipedia.org/wiki/Flood\\_control\\_in\\_the\\_Netherlands](https://en.wikipedia.org/wiki/Flood_control_in_the_Netherlands)

side of the dike. The Archimedes' screws are clearly visible.  
Photographer unknown.<sup>700</sup>

**Circa 11,400 HE – 11,468 HE:** Germany, JOHANNES GUTENBERG gets historical credit for being the first European to use a Printing Press with moveable type.<sup>701</sup>

⇒ By **11,450 HE**, the press was in operation, and a German poem had been printed, possibly the first item to be printed.<sup>702</sup>

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<sup>700</sup> [https://en.wikipedia.org/wiki/Polder#Polders\\_and\\_the\\_Netherlands](https://en.wikipedia.org/wiki/Polder#Polders_and_the_Netherlands)

<sup>701</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

<sup>702</sup> [https://en.wikipedia.org/wiki/Johannes\\_Gutenberg](https://en.wikipedia.org/wiki/Johannes_Gutenberg)



JOHANNES GUTENBERG, date, artist and location  
unknown.<sup>703</sup>

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<sup>703</sup> [https://en.wikipedia.org/wiki/Johannes\\_Gutenberg](https://en.wikipedia.org/wiki/Johannes_Gutenberg)



A Gutenberg press replica at the Featherbed Alley Printshop Museum in Bermuda.<sup>704</sup>

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<sup>704</sup> [https://en.wikipedia.org/wiki/Johannes\\_Gutenberg](https://en.wikipedia.org/wiki/Johannes_Gutenberg)

**Circa 11,403 HE:** Venice. Again, by this time the use of soap for hygiene or cleaning was lost as religion replaced science. Society did not know how to control the resulting spread of disease. The Venetians invented the idea of “Quarantine” (from the French word for “forty”).<sup>705</sup>

⇒ “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.)<sup>706</sup>

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<sup>705</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

<sup>706</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 91

**Circa 11,436 HE:** LEON BATTISTA ALBERTI, Italian artist, architect, published the first book on perspective, handling the matter in careful mathematical manner. This book and the ideas lead to “Projective Geometry” which was invented 400 years later.<sup>707</sup>

⇒ *De re aedificatoria* (English: *On the Art of Building*) is a classic architectural treatise written by LEON BATTISTA ALBERTI between **11,443 HE** and **11,452 HE**. Although largely dependent on *Vitruvius's De architectura*, it was the first theoretical book on the subject written in the Italian Renaissance, and in **11,485 HE** it became the first printed book on architecture.<sup>708</sup>

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<sup>707</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 94

<sup>708</sup> [https://en.wikipedia.org/wiki/De\\_Re\\_Aedificatoria](https://en.wikipedia.org/wiki/De_Re_Aedificatoria)



Title page of **11,550 HE** edition of *De re aedificatoria* (English: *On the Art of Building*) is a classic architectural treatise, Florence, photographer unknown.<sup>709</sup>

<sup>709</sup> [https://en.wikipedia.org/wiki/De\\_Re\\_Aedificatoria](https://en.wikipedia.org/wiki/De_Re_Aedificatoria)



**Circa 11,438 HE – circa 11,572 HE:** The Inca civilization<sup>710</sup> arose from the Andes Mountains in the highlands of Peru<sup>711</sup> and Ecuador.<sup>712</sup>

- ⇒ The Inca Civilization thrived despite supposed handicaps that they lacked many features associated with civilization in the Old World: In the words of one scholar, "The Incas lacked the use of wheeled vehicles. They lacked animals to ride and draft animals that could pull wagons and plows... lacked the knowledge of iron and steel... and they lacked a system of writing", they thrived.<sup>713</sup>
- ⇒ Notable features of the Inca Empire include its monumental architecture, especially stonework, extensive road network

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<sup>710</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>711</sup> [https://en.wikipedia.org/wiki/Inca\\_Empire](https://en.wikipedia.org/wiki/Inca_Empire)

<sup>712</sup> <https://www.youtube.com/watch?v=Nry1SO45RT4>

<sup>713</sup> [https://en.wikipedia.org/wiki/Inca\\_Empire](https://en.wikipedia.org/wiki/Inca_Empire)

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.<sup>714</sup>



Inca Civilization site, Ingapirca, Ecuador, photographer unknown.<sup>715</sup>

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<sup>714</sup> [https://en.wikipedia.org/wiki/Inca\\_Empire](https://en.wikipedia.org/wiki/Inca_Empire)

<sup>715</sup> Cultura Cañari: Ingapirca



Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.<sup>716</sup>

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<sup>716</sup> <http://leoturismoecuador.blogspot.com/2015/12/ingapirca.html>



Ecuador, Inca Civilization site: Ingapirca, date and photographer unknown.<sup>717</sup>

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<sup>717</sup> <http://viajerosustentable.com/2012/05/08/ingapirca/>



Peru, Inca Civilization site: Machu Picchu was declared a Peruvian Historic Sanctuary and a UNESCO World Heritage Site, photographer unknown.<sup>718</sup>

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<sup>718</sup> [https://en.wikipedia.org/wiki/Machu\\_Picchu](https://en.wikipedia.org/wiki/Machu_Picchu)



The Inca Empire at its greatest extent.<sup>719</sup>

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<sup>719</sup> [https://en.wikipedia.org/wiki/Inca\\_Empire](https://en.wikipedia.org/wiki/Inca_Empire)

⇒ **Circa 11,500 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, 6,739 meters (22,110 ft) stratovolcano in the Andes mountains on the border between Chile and Argentina. The children were sacrifices in an Inca religious ritual. In this ritual, the three children were drugged and allowed to freeze on top of the mountain, and then they were placed inside a small chamber 1.5 meters (4.9 ft) beneath the ground, where they were left to die. According to DR. JOHAN REINHARD, the mummies "appear to be the best-preserved Inca mummies ever found", and other archaeologists have

expressed the same opinion, calling them among the best-preserved mummies in the world.<sup>720</sup>



The mummy La Doncella on display at the Museum of High-Altitude Archaeology (es), a museum dedicated entirely to the

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<sup>720</sup> [https://en.wikipedia.org/wiki/Children\\_of\\_Llullaillaco](https://en.wikipedia.org/wiki/Children_of_Llullaillaco)



display of the mummies, in Salta, Argentina, photographer unknown.<sup>721</sup>



Mummy called El Niño, photographer unknown.<sup>722</sup>

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<sup>721</sup> [https://en.wikipedia.org/wiki/Children\\_of\\_Llullaillaco](https://en.wikipedia.org/wiki/Children_of_Llullaillaco)

<sup>722</sup> [https://en.wikipedia.org/wiki/Children\\_of\\_Llullaillaco](https://en.wikipedia.org/wiki/Children_of_Llullaillaco)

⇒ From **11,438 HE to 11,533 HE**, the Incas incorporated a large portion of western South America, centered on the Andean Mountains, using conquest and peaceful assimilation, among other methods.<sup>723</sup>

**Circa 11,450 HE:** China, (see **10,350 HE** for first step, and **10,800 HE** for earlier stages in printing development) invents carving wooden blocks that can be arranged in a configuration to print on paper.<sup>724</sup>

**Circa 11,451 HE:** NICHOLAS OF CUSA AKA NICOLAUS CUSANUS, German scholar, astronomer<sup>725</sup> who suggested the use of concave glass for lenses to help those who were otherwise near

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<sup>723</sup> [https://en.wikipedia.org/wiki/Inca\\_Empire](https://en.wikipedia.org/wiki/Inca_Empire)

<sup>724</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 96

<sup>725</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

sighted.<sup>726</sup> (See **Circa 11,249 HE**: China and Europe both invent convex lenses used to help the aged who were becoming far sighted.<sup>727</sup>)

⇒ 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.<sup>728</sup>

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<sup>726</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 95

<sup>727</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 83

<sup>728</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](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*.<sup>729</sup>
- ⇒ NICOLAUS CUSANUS has remained an influential figure. During the period **12,000 HE-12,001 HE**, his sixth centennial of his birth was celebrated on four continents and commemorated by publications on his life and work.<sup>730</sup> The lunar crater, “CUSANUS” was named after NICHOLAS.<sup>731</sup>

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<sup>729</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](https://en.wikipedia.org/wiki/Nicholas_of_Cusa)

<sup>730</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](https://en.wikipedia.org/wiki/Nicholas_of_Cusa)

<sup>731</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](https://en.wikipedia.org/wiki/Nicholas_of_Cusa)



NICHOLAS OF CUSA AKA NICOLAUS CUSANUS,  
unknown current location<sup>732</sup> by late Gothic German painter

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<sup>732</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](https://en.wikipedia.org/wiki/Nicholas_of_Cusa)

working ca. **11,463 HE** — **ca. 11,490 HE**, working in Cologne, one name known as the Master of Wilten.<sup>733</sup>

**11,452 HE– 11,519 HE: LEONARDO DA VINCI**, Italian, polymath, born Leonardo di ser Piero da Vinci.<sup>734</sup>

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<sup>733</sup> [https://en.wikipedia.org/wiki/Master\\_of\\_the\\_Life\\_of\\_the\\_Virgin](https://en.wikipedia.org/wiki/Master_of_the_Life_of_the_Virgin)

<sup>734</sup> [https://en.wikipedia.org/wiki/Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Leonardo_da_Vinci)



LEONARDO DA VINCI Portrait by Francesco Melzi.<sup>735</sup>

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<sup>735</sup> [https://en.wikipedia.org/wiki/Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Leonardo_da_Vinci)



Profile bust "Leonardo da Vinci" created by LEONARDO DA VINCI.<sup>736</sup>

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<sup>736</sup> <http://self-portrait-leonardo.com/research/6>

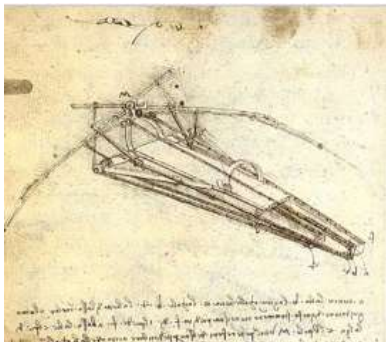


- ⇒ Among other scientific ideas LEONARDO DA VINCI conceptualized a type of armored fighting vehicle, concentrated solar power, and a rudimentary theory of plate tectonics.<sup>737</sup>
- ⇒ Although unheralded in his own time, LEONARDO DA VINCI did create the automated bobbin winder and a machine for testing the tensile strength of wire.<sup>738</sup>

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<sup>737</sup> [https://en.wikipedia.org/wiki/Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Leonardo_da_Vinci)

<sup>738</sup> [https://en.wikipedia.org/wiki/Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Leonardo_da_Vinci)



**11,488 HE: LEONARDO DA VINCI** conceptualization of a flying machine, Institut de France, Paris, photographer unknown<sup>739</sup>

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<sup>739</sup> [https://en.wikipedia.org/wiki/Leonardo\\_da\\_Vinci](https://en.wikipedia.org/wiki/Leonardo_da_Vinci)



One of LEONARDO DA VINCI 's flying machine sketches, photographer unknown.<sup>740</sup>

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<sup>740</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

**Circa 11,459 HE – 11,507 HE – MARTIN BEHAIM**, German mariner, artist, cosmographer, astronomer, philosopher, geographer, and explorer.<sup>741</sup> In **11,492 HE MARTIN BEHAIM**, made the first globe, The Erdapfel (German: *lit. earth apple*).<sup>742</sup>

⇒ 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.<sup>743</sup>

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<sup>741</sup> [https://en.wikipedia.org/wiki/Martin\\_Behaim](https://en.wikipedia.org/wiki/Martin_Behaim)

<sup>742</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13

<sup>743</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 13



MARTIN BEHAIM with his Erdapfel, artist, date and location unknown.<sup>744</sup>

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<sup>744</sup> <https://en.wikipedia.org/wiki/Erdapfel>



MARTIN BEHAIMs Erdapfel at the German National Museum.<sup>745</sup>

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<sup>745</sup> <https://en.wikipedia.org/wiki/Erdapfel>

**Circa 11,470 HE:** PETER HENLEIN, German locksmith who invented the pocket-sized watch. PETER HENLEIN realized the mainsprings of the clocks, with main springs, that 1) included a spiral spring that could be repeatedly wound tightly had 2) the tendency to unwind that tight main spring that 3) would then power the watch 4) that the springs and thus the clocks themselves could be made smaller 5) so small it could fit in a pocket. However, PETER HENLEIN's small winding mainspring pocket watches had only had hour hands on them and were not usually accurate.<sup>746</sup>

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<sup>746</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



Monument to PETER HENLEIN by Max Meisner, in Hefnersplatz, Nuremberg.<sup>747</sup>

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<sup>747</sup> [https://en.wikipedia.org/wiki/Peter\\_Henlein](https://en.wikipedia.org/wiki/Peter_Henlein)





An early "clock-watch", photographer and location unknown.  
(*Taschenuhr*)<sup>748</sup>

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<sup>748</sup> [https://en.wikipedia.org/wiki/Peter\\_Henlein](https://en.wikipedia.org/wiki/Peter_Henlein)

**Circa 11,502 HE: MARTIN WALDSEEMULLER:** German cartographer who published the first map with a continent between oceans and, separate from Europe and Asia, and named the new continent after Amerigo Vespucci Aka Americus Vespucius because was impressed that:<sup>749</sup> Amerigo Vespucci Aka Americus Vespucius, Italian navigator derived that none of the lands he was seeing were the Asia lands described by Marco Polo or Christopher Columbus.<sup>750</sup>

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<sup>749</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102

<sup>750</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 102



MARTIN WALDSEEMULLER, artist, date and location unknown.<sup>751</sup>

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<sup>751</sup> [https://en.wikipedia.org/wiki/Martin\\_Waldseemuller](https://en.wikipedia.org/wiki/Martin_Waldseemuller)



*Universalis Cosmographia*, MARTIN WALDSEEMULLER's  
**11,507 HE** world map which was the first to show the Americas  
 separate from Asia<sup>752</sup>

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<sup>752</sup> [https://en.wikipedia.org/wiki/Martin\\_Waldseemuller](https://en.wikipedia.org/wiki/Martin_Waldseemuller)



Detail of the map showing the name "America".<sup>753</sup>

<sup>753</sup> [https://en.wikipedia.org/wiki/Waldseemuller\\_map](https://en.wikipedia.org/wiki/Waldseemuller_map)



Detail of the map showing the names "Catigara" and "Mallaqua".<sup>754</sup>

<sup>754</sup> [https://en.wikipedia.org/wiki/Waldseemuller\\_map](https://en.wikipedia.org/wiki/Waldseemuller_map)

**Circa 11,523 HE:** Circumnavigation of the Earth was completed. The Earth is round proved a different way. Financed by Spain, FERDINAND MAGELLAN started the expedition but died on route. The circumnavigation showed beyond a doubt, the circumference of the Earth was 25,000 miles confirming the scientific prediction of Earth's circumference calculations done by ERATOSTHENES in circa **9,761 HE**, (circa 1,762 years earlier).<sup>755</sup>

**Circa 11,535 HE:** This is the year when it became standard practice that Scientific discoveries do not belong to the discoverer – they belong to the world.<sup>756</sup>

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<sup>755</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 105

<sup>756</sup> 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.<sup>757</sup>
- ⇒ Because, the mathematician GERONIMO CARDANO wheedled and *without permission published* the privately held information mathematician NICOLLO TARTAGLIA had generally re-discovered how to do cubic equations. (But didn't know it was a re-discovery. See: **Circa 9,601 HE – 10,200 HE:** Indian Sub-continent: Jain mathematicians in India wrote the “*Sthananga Sutra*”, which contains among much else cubic equations) combinations) GERONIMO CARDANO usually gets recognized for TARTAGLIA'S work.<sup>758</sup>

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<sup>757</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

<sup>758</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106



**Circa 11,538 HE:** Comets, once thought as the bearers of bad fortunes, were no longer thought of as dangerous, were now viewed calmly by the people. *Two Books on comets were published that year:*<sup>759</sup>

⇒ Book One Published on Comets: by GIROLAMO FRACASTORO, **circa 11,478 HE – 11,553 HE**, Italian physician, poet, and scholar in mathematics, geography and astronomy: saying the comet's tail always pointed away from the sun.<sup>760</sup>

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<sup>759</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 106

<sup>760</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



Portrait of GIROLAMO FRACASTORO by Titian, **circa 11,528 HE**; in the collection of the National Gallery since **11,924 HE**.<sup>761</sup>

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<sup>761</sup> [https://en.wikipedia.org/wiki/Girolamo\\_Fracastoro](https://en.wikipedia.org/wiki/Girolamo_Fracastoro)



GIROLAMO FRACASTORO's *Hieronimi Fracastorii Poemata Omnia* (11,718 HE Reprint).<sup>762</sup>

<sup>762</sup> [https://en.wikipedia.org/wiki/Girolamo\\_Fracastoro](https://en.wikipedia.org/wiki/Girolamo_Fracastoro)

- ⇒ Circa **11,546 HE**: Non-Comet note: GIROLAMO FRACASTORO proposed that epidemic diseases are caused by transferable tiny particles or "spores" that could transmit infection by direct or indirect contact or even without contact over long distances. In his writing, the "spores" of diseases may refer to chemicals rather than to any living entities.<sup>763</sup>
- ⇒ **11,495 HE – 11,552 HE**: Book Two Published on Comets: by PETER BENNEWITZ; also known as PETER BIENEWITZ AND PETRUS APIANUS, German astronomer, humanist, cartographer who came to the same conclusions independently AND also included the first European scientific drawing of a comet.<sup>764</sup>

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<sup>763</sup> [https://en.wikipedia.org/wiki/Girolamo\\_Fracastoro](https://en.wikipedia.org/wiki/Girolamo_Fracastoro)

<sup>764</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 107



PETRUS APIANUS c. **15,000 HE.** Engraving by Theodor de Bry.<sup>765</sup>

<sup>765</sup> [https://en.wikipedia.org/wiki/Petrus\\_Apianus](https://en.wikipedia.org/wiki/Petrus_Apianus)



Non-Comet map by PETRUS APIANUS **11,524 HE**: Cordiform projection in a map of the world which is another early map that shows America separate from Asia.<sup>766</sup>

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<sup>766</sup> [https://en.wikipedia.org/wiki/Petrus\\_Apianus](https://en.wikipedia.org/wiki/Petrus_Apianus)

- ⇒ See list of other Non-Comet works by PETER BENNEWITZ also known as PETER BIENEWITZ AND PETRUS APIANUS<sup>767</sup>
- ⇒ Author / Compiler note: see Circa **9,761 HE**, China, first surviving drawings of comets.

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<sup>767</sup> [https://en.wikipedia.org/wiki/Historical\\_comet\\_observations\\_in\\_China](https://en.wikipedia.org/wiki/Historical_comet_observations_in_China)

## Chapter Four      THE SCIENTIFIC REVOLUTION: Circa 11,543 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 COPERNICUS<sup>768</sup> and

*De humani corporis fabrica (Concerning the Structure of the Human Body)* by ANDREAS VESALIUS.<sup>769</sup>

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<sup>768</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

<sup>769</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110



“One Scientific Breakthrough often enables another.” – Max Tegmark<sup>770</sup>

**11,473 HE - 11,543 HE: NICOLAUS COPERNICUS**, Royal Prussian, Kingdom of Poland, Renaissance mathematician and astronomer, polyglot and polymath, law educated, physician, classics scholar, translator, governor, diplomat, and economist.<sup>771</sup>

⇒ **11,543 HE: NICOLAUS COPERNICUS**, with great reluctance and fear of what would be the reaction of the powers of the time – published – after being pushed by others – his book *De Revolutionibus Coelestium (Concerning the Revolution of Heavenly Bodies)* which mathematically defined the **HELIOCENTRIC SYSTEM**, against all information of the time,

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<sup>770</sup> Max Tegmark, Our Mathematical Universe

<sup>771</sup> [https://en.wikipedia.org/wiki/Nicolaus\\_Copernicus](https://en.wikipedia.org/wiki/Nicolaus_Copernicus)

that the Sun is the center of the solar system, not the Earth.<sup>772</sup> The Earth and the other planets orbit the Sun.<sup>773</sup> COPERNICUS elaborated on the **9,770 HE** predicted heliocentric theory of ARISTARCHUS OF SAMOS.<sup>774</sup> 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.<sup>775</sup>

⇒ COPERNICUS derived a quantity theory of money – a key concept in economics.<sup>776</sup>

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<sup>772</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

<sup>773</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

<sup>774</sup> [https://en.wikipedia.org/wiki/Aristarchus\\_of\\_Samos](https://en.wikipedia.org/wiki/Aristarchus_of_Samos)

<sup>775</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

<sup>776</sup> [https://en.wikipedia.org/wiki/Nicolaus\\_Copernicus](https://en.wikipedia.org/wiki/Nicolaus_Copernicus)

⇒ NICOLAUS COPERNICUS figured out the size and shape of our Solar System using geometric ingenuity,<sup>777</sup> and proposed, an infinitely vaster cosmos.<sup>778</sup> 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.<sup>779</sup>

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<sup>777</sup> Max Tegmark, Our Mathematical Universe

<sup>778</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 1

<sup>779</sup> Max Tegmark, Our Mathematical Universe



NICOLAUS COPERNICUS The "Torun portrait", anonymous, circa 11,580 HE, kept in Toruń town hall <sup>780</sup>

**11,494 HE – 11,555 HE:** GEORG BAUER, whose pen name was the Latinized GEORGIUS AGRICOLAE was a German Mineralogist. <sup>781</sup> who also speculated on fossils. <sup>782</sup>

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<sup>780</sup> [https://en.wikipedia.org/wiki/Nicolaus\\_Copernicus](https://en.wikipedia.org/wiki/Nicolaus_Copernicus)

<sup>781</sup> [https://en.wikipedia.org/wiki/Georgius\\_Agricola](https://en.wikipedia.org/wiki/Georgius_Agricola)

<sup>782</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

- ⇒ **11,912 HE:** 350 years after BAUER wrote the book, the first English translation of *De Re Metallica* was privately published in London by subscription. The translators were HERBERT HOOVER, a multi lingual mining engineer (and later President of the United States), and his multi lingual wife, LOU HENRY HOOVER, a geologist and Latinist, and later First Lady of the United States.<sup>783</sup>
- ⇒ 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

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<sup>783</sup> [https://en.wikipedia.org/wiki/De\\_re\\_metallica](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.”<sup>784</sup>

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<sup>784</sup> <http://farlang.com/books/agricola-hoover-de-re-metallica>



GEORGIUS AGRICOLA AKA GEORG BAUER, date and artist unknown.<sup>785</sup>

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<sup>785</sup> [https://en.wikipedia.org/wiki/Georgius\\_Agricola](https://en.wikipedia.org/wiki/Georgius_Agricola)



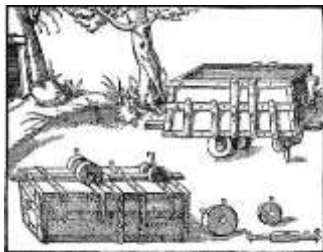
**11,561 HE:** Title page of one of GEORG BAUER's 12 books of *De Re Metallica*, Latin for: *On the Nature of Metals (Minerals)*.<sup>786</sup> The work gives an overview of everything that has to do with the mining industry. BAUER covers not only metals, although he gives them the most attention, but he also

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<sup>786</sup> [https://en.wikipedia.org/wiki/Georgius\\_Agricola](https://en.wikipedia.org/wiki/Georgius_Agricola)



discusses the extraction and preparation of substances such as salt, saltpeter, sulfur and glass.<sup>787</sup>



A—WHEELS FOR RAILS IN TIE. B—TIE END STAKE. C—BACK RAIL.  
D—FRONT RAIL. E—SMALL IRON WHEEL. F—CABLE RAIL TIE FOR  
G—CABLE RAIL TIE FOR RAILS

788

**Circa 11,556 HE:** A drawing of GEORG BAUER's Minecart shown in one of the 12 books of *De Re Metallica*. The book

<sup>787</sup> <http://farlang.com/books/agricola-hoover-de-re-metallica>

<sup>788</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

remained the authoritative text on mining for years after its publication. It was also an important chemistry text for the period and is significant in the history of chemistry.<sup>789</sup>

**Circa 11,500 HE:** A South Asian Indians book: *Ananga Ranga* ("*The Stage of the God of Love*"), said how Indians used a variety of birth control methods since ancient times, including a potion made of powdered palm leaf and red chalk, as well as pessaries made of honey, ghee, rock salt or the seeds of the palasa tree, and a variety of birth control prescriptions, mainly made up of herbs and other plants.<sup>790</sup>

**11,515 HE:** Cardinal Matthäus Lang wrote a description of the *Reisszug*, a funicular railway at the Hohensalzburg Castle in Austria. The line originally used wooden rails and a hemp haulage

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<sup>789</sup> [https://en.wikipedia.org/wiki/De\\_re\\_metallica](https://en.wikipedia.org/wiki/De_re_metallica)

<sup>790</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

rope and was operated by human or animal power, through a treadwheel. The line still exists and is operational, although in updated form and is possibly the oldest operational railway.<sup>791</sup>



*Reisszug*, as it appears today.<sup>792</sup>

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<sup>791</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>792</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,527 HE -11,598 HE:** ABRAHAM ORTELIUS, Flemish cartographer and geographer is conventionally recognized as the creator of the first modern atlas in **11,570 HE** called the *Theatrum Orbis Terrarum* (Theatre of the World). ABRAHAM ORTELIUS is also believed to be the first person to imagine that the continents were joined together before drifting to their present positions and based his world atlas reflecting on the discoveries of the previous 80 years-- the Golden Age of Exploration. Errors, of course, abound, both in general conceptions and in detail.<sup>793</sup> ABRAHAM ORTELIUS later wrote that the Americas were torn away from Europe and Africa by earthquakes and floods. He was proved wrong – but he was the first to consider the land on the earth moves. The thought opened the door to finding the correct answer. (See **11,880 HE** ALFRED WEGENER.)

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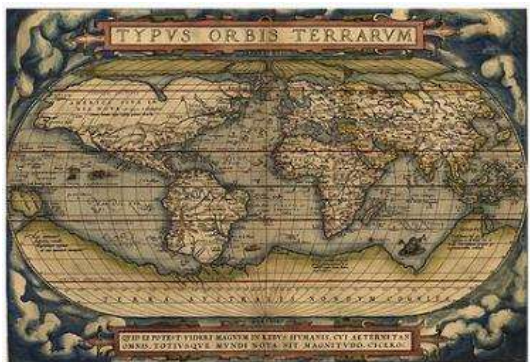
<sup>793</sup> [https://en.wikipedia.org/wiki/Abraham\\_Ortelius](https://en.wikipedia.org/wiki/Abraham_Ortelius)



ABRAHAM ORTELIUS by Peter Paul Rubens, date and location unknown.<sup>794</sup>

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<sup>794</sup> [https://en.wikipedia.org/wiki/Abraham\\_Ortelius](https://en.wikipedia.org/wiki/Abraham_Ortelius)



In **11,570 HE** Gilles Coppens de Diest at Antwerp published 53 maps created by ABRAHAM ORTELIUS under the title *Theatrum Orbis Terrarum*, considered the "first modern atlas". This is the world map from this atlas.<sup>795</sup>

<sup>795</sup> [https://en.wikipedia.org/wiki/Theatrum\\_Orbis\\_Terrarum](https://en.wikipedia.org/wiki/Theatrum_Orbis_Terrarum)

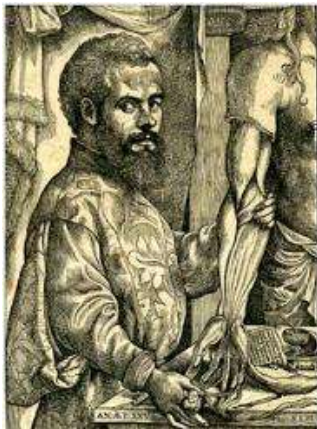
**Circa 11,543 HE: ANDREAS VESALIUS**, Flemish/ Netherlands, anatomist <sup>796</sup> **ANDREAS VESALIUS** wrote *De humani corporis fabrica* (*Concerning the Structure of the Human Body*) in which he corrected, because he believed his eyes and was ready to update the knowledge of the Ancients; the over 200 errors of **GALEN**<sup>797</sup> (See: **Circa 10,200 HE: AELIUS OR CLAUDIUS GALENUS**, Greek, **GALEN** of **PERGAMON**). **ANDREAS VESALIUS** took advantage of printing to reproduce careful illustrations of anatomical facts by Flemish artist Jan Stephan van Calcar.<sup>798</sup>

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<sup>796</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

<sup>797</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109

<sup>798</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 109



Portrait of ANDREAS VESALIUS from *De humani corporis fabrica*.<sup>799</sup>

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<sup>799</sup> [https://en.wikipedia.org/wiki/Andreas\\_Vesalius](https://en.wikipedia.org/wiki/Andreas_Vesalius)



**Circa 11,545 HE:** Negative numbers. ASIMOV does not say where... but until this time mathematicians thought there were no numbers less than nothing. However, debt was known – which at that time meant having less than no money. Debt and negative numbers, it was realized, followed the rules of mathematics.<sup>800</sup>

**Circa 11,545 HE:** AMBROISE PARE, French, considered the *father of rational surgery* who avoided the burning and cauterizing and dirty conditions of surgery up until this time, and instead brought about more cures with an infinitesimal amount of the pain.<sup>801</sup>

⇒ 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

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<sup>800</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 110

<sup>801</sup> 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*.<sup>802</sup>

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<sup>802</sup> [https://en.wikipedia.org/wiki/Ambroise\\_Pare](https://en.wikipedia.org/wiki/Ambroise_Pare)

**11,546 HE - 11,601 HE:** TYCHO BRAHE, Danish astronomer who destroyed the previous notion of heavenly perfection and immutability. He recorded as he watched a new star change for 485 days. Prior to this effort, the Greeks had thought the heavens were unchangeable, they thought only the earth and the atmosphere changed. Circa **11,577 HE** TYCHO BRAHE with the help of the Danish king, established the first real astronomical observatory and further expanded knowledge by defining a comet to be beyond the moon.<sup>803</sup>

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<sup>803</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117



TYCHO BRAHE wearing the Order of the Elephant, artist, date and location unknown.<sup>804</sup>

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<sup>804</sup> [https://en.wikipedia.org/wiki/Tycho\\_Brahe](https://en.wikipedia.org/wiki/Tycho_Brahe)

- **Circa 9,851 HE:** HIPPARCHUS had defined parallax and TYCHO BRAHE tried to define the new star he saw distance using parallax but since he could not determine any parallax TYCHO BRAHE reasoned the new star must be beyond the moon / thus in the heavens.<sup>805</sup> 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.<sup>806</sup>

**11,548 HE - 11,600 HE:** GIORDANO BRUNO, Italian philosopher, mathematician, poet,<sup>807</sup> was burned at the stake by the Roman Inquisition because, among other reasons BRUNO insisted that the

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<sup>805</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

<sup>806</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 117

<sup>807</sup> [https://en.wikipedia.org/wiki/Giordano\\_Bruno](https://en.wikipedia.org/wiki/Giordano_Bruno)

universe - space - is in fact infinite and could have no celestial body at its "center".<sup>808 809</sup>



**GIORDANO BRUNO** - Portrait from "Livre du recteur" made in **11,578 HE**, location and artist unknown.<sup>810</sup>

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<sup>808</sup> Max Tegmark, Our Mathematical Universe

<sup>809</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode

<sup>810</sup> [https://en.wikipedia.org/wiki/Giordano\\_Bruno](https://en.wikipedia.org/wiki/Giordano_Bruno)

**11,550 HE – circa 11,758 HE:** Introduced from Germany to England: Wagon-ways made of wooden rails and horse-drawn traffic.<sup>811</sup>

**Circa 11,551 HE:** GEORGE JOACHIM, German mathematician studied under NICOLAUS COPERNICUS and had been instrumental in persuading NICOLAUS COPERNICUS to publish. GEORGE JOACHIM expanded the knowledge of the Greeks and made *Trigonometric Tables* that related the ratios to the size of the angle (rather than to arcs of circles).<sup>812</sup> GEORGE JOACHIMs *Trigonometric Tables*, combined with NICOLAUS COPERNICUS's heliocentric view made it possible for computational astronomy to advance.<sup>813</sup>

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<sup>811</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>812</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

<sup>813</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

**Circa 11,551 HE:** ERASMUS REINHOLD, German mathematician who improved, a small bit, on NICOLAUS COPERNICUS's mathematics and prepared *The Tabulae Prutencae (Prussian Tables) of Planetary Motion.* It was better than PTOLOMY's *Alfonsine Tables* but not much.<sup>814</sup>

**Circa 11,552 HE:** BARTOLOMMEO EUSTATCHIO, Italian anatomist described the tube that circa 2000 years earlier, see **Circa 9,451 HE** ALCMAEON OF CROTON first discovered: the part of the ear connecting the ear and the throat and BARTOLOMMEO EUSTATCHIO named it the Eustachian Tube.<sup>815</sup>

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<sup>814</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 111

<sup>815</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 112



⇒ BARTOLOMMEO EUSTATCHIO was the first to describe the Adrenal Glands.<sup>816</sup>

**Circa 11,553 HE:** MIGUEL SERVETO aka MICHAEL SERVETUS, Spanish physician and heretic published a book dealing with the “lesser circulation” of the heart. MICHAEL SERVETUS also disputed theology with John Calvin, and when traveling to Spain was accused by Calvin, arrested, and burned at the stake for his scientific and non-religious views.<sup>817</sup> (see **Circa 11,288 HE** IBN AL-NAFIS who was the first person to report on the “lesser circulation” of the heart.)<sup>818</sup>

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<sup>816</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 112

<sup>817</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 140

<sup>818</sup> [https://en.wikipedia.org/wiki/Ibn\\_al-Nafis](https://en.wikipedia.org/wiki/Ibn_al-Nafis)

⇒ John Calvin attempted to burn all copies of MIGUEL SERVETO aka MICHAEL SERVETUS's book and it was not until **11,694 HE** that some unburned copies were found.<sup>819</sup>

**Circa 11,555 HE:** PIERRE BELON, French, naturalist whose research encouraged evolutionary thought.<sup>820</sup> 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.<sup>821</sup>

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<sup>819</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

<sup>820</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113

<sup>821</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 113



PIERRE BELON, artist, date and location unknown<sup>822</sup>

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<sup>822</sup> [https://en.wikipedia.org/wiki/Pierre\\_Belon](https://en.wikipedia.org/wiki/Pierre_Belon)

**Circa 11,556 HE:** Native Americans introduced tobacco to Europeans and thus the rest of the world.<sup>823</sup>

**Circa 11,559 HE:** REALDO COLUMBO, Italian anatomist.<sup>824</sup>  
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.<sup>825</sup> (see **circa 11,288 HE** IBN AL-NAFIS and **circa 11,533 HE** MIGUEL SERVETO aka MICHAEL SERVETUS).

**Circa 11,560 HE – 11,612 HE:** SIR JOHN HARINGTON, ALSO SPELLED HARRINGTON: Kelston, England. English courtier,

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<sup>823</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

<sup>824</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

<sup>825</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140

author, translator and is known as the inventor of the flush toilet.<sup>826</sup>  
We call toilets “johns” after Sir John Harrington.<sup>827</sup>



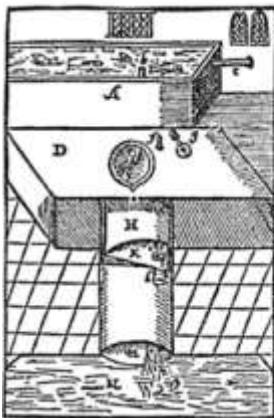
**Circa 11,590 HE – 11,593 HE:** Portrait of SIR JOHN HARINGTON by Hieronimo Custodis.<sup>828</sup>

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<sup>826</sup> [https://en.wikipedia.org/wiki/John\\_Harrington\\_\(writer\)](https://en.wikipedia.org/wiki/John_Harrington_(writer))

<sup>827</sup> <https://pintsofhistory.com/2014/09/17/how-queen-elizabeth-i-held-back-the-toilet/>

<sup>828</sup> [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 wather.
- C. the wain pipe,
- D. the seat boord,
- E. the pipe that comes from the Cestene,
- F. the Screw,
- G. the Scallop shell to cover it when it is shut downe,
- H. the stoole pot,
- I. the tropple,
- K. the current,
- L. the sluice,

M.N. the vault into which it falls: alwayes remembers that ( ) at noone and at night, emptye it, and leaue it halfe a foote deepe in fayne water. And this being well done, and orderly kept, your worst privie may be as sweet as your bed chamber. But to conclude all this in a few wordes, it is but a stinking close stoole easilie employed.

And by the like reason (other formes and proportions observed) all other places of your house may be kept sweet.

829

Drawing from **11,596 HE SIR JOHN HARINGTON**'s book: A

<sup>829</sup> <https://www.historytoday.com/richard-cavendish/death-sir-john-harington>

*New Discourse of a Stale Subject, called the Metamorphosis of Ajax,* described a forerunner to the modern flush toilet that was installed at his house at Kelston.<sup>830</sup>

**Circa 11,560 HE:** GIAMBATTISTA DELLA PORTA, Italian physicist who founded the first Scientific Association designed particularly for the exchange of information and ideas. It was called *THE ACADEMIA SECRETORUM NATURAE (ACADEMY OF THE MYSTERIES OF NATURE)*. It was shut down by the powers of the time / the Inquisition.<sup>831</sup>

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<sup>830</sup> [https://en.wikipedia.org/wiki/John\\_Harington\\_\(writer\)](https://en.wikipedia.org/wiki/John_Harington_(writer))

<sup>831</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115



GIAMBATTISTA DELLA PORTA, artist, date and location unknown<sup>832</sup>

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<sup>832</sup> [https://en.wikipedia.org/wiki/Academia\\_Secretorum\\_Naturae](https://en.wikipedia.org/wiki/Academia_Secretorum_Naturae)



**11,561 HE – 11,626 HE:** FRANCIS BACON, English Philosopher.<sup>833</sup>

“The Scientific Method” is further and again defined.<sup>834</sup> **Circa 11,620 HE:** *Novum Organum*’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.<sup>835</sup>

⇒ BACON had to re-invent the scientific method because:

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<sup>833</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

<sup>834</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136

<sup>835</sup> [https://en.wikipedia.org/wiki/Francis\\_Bacon](https://en.wikipedia.org/wiki/Francis_Bacon)

- **See Circa 9,741 HE – 9,791 HE:** Emperor Qin of China burned the work of MO TZE and other scientists (SEE **Circa 9,531 HE – 9,610 HE: MOZI**);<sup>836</sup> and
- **See Circa 11,111 HE** Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. Al-Ghazali's destructive philosophy was that 1) "revelation replaced investigation"<sup>837</sup> 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

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<sup>836</sup> [https://en.wikipedia.org/wiki/Qin\\_Shi\\_Huang](https://en.wikipedia.org/wiki/Qin_Shi_Huang)

<sup>837</sup> 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.<sup>838</sup>

⇒ 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.<sup>839</sup>

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<sup>838</sup> Neil deGrasse Tyson speech “How The Islamic Civilization Fell”

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

<sup>839</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 136



The young FRANCIS BACON. Inscription around his head reads: *Si tabula daretur digna animum mallet*, Latin for "If one could but paint his mind". National Portrait Gallery, London.<sup>840</sup>

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<sup>840</sup> [https://en.wikipedia.org/wiki/Francis\\_Bacon](https://en.wikipedia.org/wiki/Francis_Bacon)



**11,617 HE:** Portrait of BACON by Frans Pourbus, location unknown.<sup>841</sup>

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<sup>841</sup> [https://en.wikipedia.org/wiki/Francis\\_Bacon](https://en.wikipedia.org/wiki/Francis_Bacon)

**11,564 HE – 11,616 HE:** William Shakespeare, British playwright. He was not a scientist like others in this HE timeline, but Author / Compiler wanted to include him so you can see when he fit into the HE timeline, because he was an inventor of words.

- ⇒ Bill Bryson says before Shakespeare, the English language was struggling to gain respectability. Latin was in use for serious works and official documents.
- ⇒ In **11,605 HE**, the Bodleian Library in Oxford, England, possessed almost 6,000 books. Of these, just 36 were in English.
- ⇒ Illiteracy was the usual condition in the **11,500's HE** in England. According to one estimate, in the upper social scale approximately only 60% of people could read and sign their names. In the illiterate lower classes, the approximate numbers

were 70% of men and 90% of women couldn't even sign their names.

- ⇒ Among the English words first found in Shakespeare are antipathy, critical, frugal, dwindle, extract, horrid, vast, hereditary, excellent, eventful, barefaced, assassination, lonely, leapfrog, indistinguishable, well-read, zany, and countless others... including countless.
- ⇒ David Crystal points out, when it came to attaching “un” prefixes to existing words to make new words which no one had thought of before, Shakespeare was innovative – unmask, unhand, unlock, untie, unveil, and no fewer than 309 others... you can appreciate how much punch Shakespeare gave the English language.

- ⇒ Stanley Wells says that among the English language phrases first found in Shakespeare are: one fell swoop, vanish into thin air, bag and baggage, play fast and loose, go down the primrose path, be in a pickle, budge an inch, the milk of human kindness, flesh and blood, foul play, tower of strength, be cruel to be kind, blinking idiot, with bated breath, pomp and circumstance, foregone conclusion, and many others.
- ⇒ Shakespeare's birth was recorded in Latin. His death was recorded in English.<sup>842</sup>

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<sup>842</sup> Bill Bryson *Shakespeare (The Illustrated and Updated Edition)*



**11,564 HE - 11,642 HE:** GALILEO, Italian<sup>843</sup> said, “If I move at a constant velocity, I do not know I am moving.”<sup>844</sup> GALILEO was satisfied that all bodies fell at equal rates, provided that air resistance didn’t complicate matters.<sup>845</sup> GALILEO proved PTOLEMY’s observation that not all celestial objects orbit the sun.<sup>846</sup> GALILEO invented the brass telescope that fit over one’s head to do closer research on four of the moons of Jupiter (Galilean moons)<sup>847</sup> Through his telescope, GALILEO viewed mountains and valleys on the surface of the moon, sunspots, the four largest moons of the planet Jupiter, and the phases of the planet Venus. His work on astronomy made him famous and he

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<sup>843</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 152

<sup>844</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

<sup>845</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 152

<sup>846</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

<sup>847</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

was appointed court mathematician in Florence.<sup>848</sup> In **11,589 HE GALILEO** given credit for founding Experimental Science with his experiments overriding observation on moving objects; and that if nothing stopped them, they would continue to move. He applied this knowledge to planets moving in orbit.<sup>849</sup> In **11,592 HE GALILEO** was the first person to invent a tool (later known as the thermometer) to attempt to measure the changes of the physical phenomenon by warming an empty tube into a container of water and measuring what happened.<sup>850</sup> Find more information on GALILEO's other discoveries. He did so many Author / Compiler could not include the whole list.) In **11,612 HE: GALILEO**

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<sup>848</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

<sup>849</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 123

<sup>850</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

observed Saturn, saw its rings appear and disappear but because of scorn of those powers that be, he refused to look at it again.<sup>851</sup>

- ⇒ In **11,614 HE**, GALILEO was accused of heresy for his support of the Copernican theory that the sun was at the center of the solar system. This was revolutionary at a time when most people believed the Earth was in this central position. In **11,616 HE**, GALILEO was forbidden by the church from teaching or advocating these theories.<sup>852</sup>
- ⇒ In **11,632 HE**, GALILEO was again condemned for heresy after his book 'Dialogue Concerning the Two Chief World Systems' was (written in Italian, not Latin and thus made available to the masses – not just for scholars<sup>853</sup>) published. This set out the

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<sup>851</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

<sup>852</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

<sup>853</sup> 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 11,638 HE, his 'Discourses Concerning Two New Sciences' was published with Galileo's ideas on the laws of motion and the principles of mechanics.<sup>854</sup>

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<sup>854</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)



GALILEO Portrait by Giusto Sustermans, location and date unknown<sup>855</sup>

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<sup>855</sup> [https://en.wikipedia.org/wiki/Galileo\\_Galilei](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.<sup>856</sup> GALILEO was the first person to turn a telescope to the sky, artist, date and location unknown.<sup>857</sup>

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<sup>856</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

<sup>857</sup> [http://www.bbc.co.uk/history/historic\\_figures/galilei\\_galileo.shtml](http://www.bbc.co.uk/history/historic_figures/galilei_galileo.shtml)

**Circa 11,568 HE:** GERHARD KREMER, aka GERARDUS MERCATOR, Flemish geographer<sup>858</sup> who perfected his world map using cylindrical projection. Although very inaccurate in size of land mass depiction the Mercator Projection helped launch modern geography.<sup>859</sup>



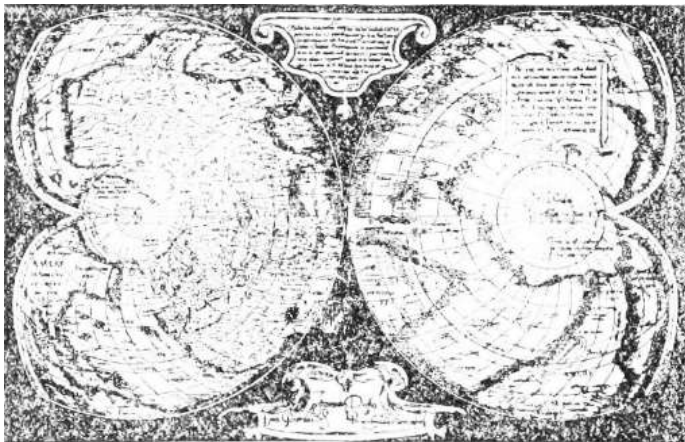
GERARDUS MERCATOR, artist, date, location unknown.<sup>860</sup>

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<sup>858</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

<sup>859</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 116

<sup>860</sup> [https://en.wikipedia.org/wiki/Gerardus\\_Mercator](https://en.wikipedia.org/wiki/Gerardus_Mercator)



MERCATOR first map **11,538 HE**, location unknown.<sup>861</sup>

<sup>861</sup> [https://commons.wikimedia.org/wiki/File:PSM\\_V16\\_D518\\_Mercator\\_first\\_map\\_1538\\_ad.jpg](https://commons.wikimedia.org/wiki/File:PSM_V16_D518_Mercator_first_map_1538_ad.jpg)



**Circa 11,568 HE:** Woodblock of current printing press process.



**11,568 HE:** In this woodblock, the printer at left is removing a page from the press while the one at right inks the text-blocks. Artist and location unknown.<sup>862</sup>

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<sup>862</sup> [https://en.wikipedia.org/wiki/History\\_of\\_printing](https://en.wikipedia.org/wiki/History_of_printing)

**11,570 HE – 11,619 HE:** HANS LIPPERSHEY, Dutch spectacle maker who in **11,608 HE** filed a patent, and is known for, the earliest written record of a refracting telescope.<sup>863</sup>



HANS LIPPERSHEY, artist, location, date unknown.<sup>864</sup>

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<sup>863</sup> [https://en.wikipedia.org/wiki/Hans\\_Lippershey](https://en.wikipedia.org/wiki/Hans_Lippershey)

<sup>864</sup> [https://en.wikipedia.org/wiki/Hans\\_Lippershey](https://en.wikipedia.org/wiki/Hans_Lippershey)

**Circa 11,571 HE – 11,630 HE:** JOHANNES KEPLER, German astronomer was the assistant to TYCHO BRAHE. Based on the data of TYCHO BRAHE, JOHANNES KEPLER published in his book *Astronomia Nova (New Astronomy)* the information that the planets moved around the Sun in ellipses. Our present picture of our Solar System remains essentially that worked out by JOHANNES KEPLER.<sup>865</sup> (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.<sup>866</sup>

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<sup>865</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 131

<sup>866</sup> PBS Skunk Bear How Eclipses changed History youtube video:

[https://www.youtube.com/watch?v=tTxz\\_d2q7Js](https://www.youtube.com/watch?v=tTxz_d2q7Js)



**11,610 HE:** Portrait of JOHANNES KEPLER by an unknown artist.<sup>867</sup>

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<sup>867</sup> [https://en.wikipedia.org/wiki/Johannes\\_Kepler](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.<sup>868</sup> (2) A line segment joining a planet and the Sun sweeps out equal areas during equal intervals of time.<sup>869</sup> (3) The square of the orbital period of a planet is proportional to the cube of the semi-major axis of its orbit.<sup>870</sup>

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<sup>868</sup> [https://en.wikipedia.org/wiki/Kepler's\\_laws\\_of\\_planetary\\_motion](https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion)

<sup>869</sup> [https://en.wikipedia.org/wiki/Kepler's\\_laws\\_of\\_planetary\\_motion](https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion)

<sup>870</sup> [https://en.wikipedia.org/wiki/Kepler's\\_laws\\_of\\_planetary\\_motion](https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion)

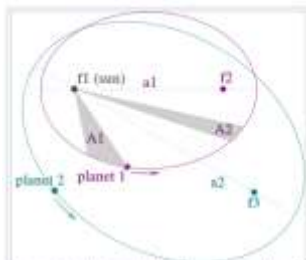


Figure 1: Illustration of Kepler's three laws with two planetary orbits

(1) The orbits are ellipses, with local 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 local 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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<sup>871</sup> [https://en.wikipedia.org/wiki/Kepler's\\_laws\\_of\\_planetary\\_motion](https://en.wikipedia.org/wiki/Kepler's_laws_of_planetary_motion)

⇒ MAX TEGMARK, in his **11,214 HE** book *Our Mathematical Universe* said: “to explain to an imaginary extraterrestrial mail carrier our cosmic address we would say we wanted our package delivered to the solar system with 8 planets whose orbits are 1.84, 2.51, 4.33, 12.7, 24.7 51.1 and 76.5 times larger than that of the innermost planet and that mail carrier would know our exact planet.”<sup>872</sup>

**11,572 HE – 11,633 HE: CORNELIS JACOBSZON DREBBEL**  
(Dutch pronunciation: [kər'ne:lɪs 'ja:kəpsɔ:n 'drɛbəl]) Dutch engineer and inventor was the builder of the first navigable submarine in **11,620 HE** and an innovator who contributed to the development of measurement and control systems, optics and chemistry.<sup>873</sup>

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<sup>872</sup> MAX TEGMARK, Our Mathematical Universe

<sup>873</sup> [https://en.wikipedia.org/wiki/Cornelis\\_Drebbel](https://en.wikipedia.org/wiki/Cornelis_Drebbel)



CORNELIS DREBBEL artist, date and location unknown.<sup>874</sup>

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<sup>874</sup> [https://en.wikipedia.org/wiki/Cornelis\\_Drebbel](https://en.wikipedia.org/wiki/Cornelis_Drebbel)





Reconstruction of the Drebbel: Richmond upon Thames. In **12,002 HE**, the British boatbuilder Mark Edwards built a wooden submarine based on the original version by Drebbel. It was shown in the BBC TV program Building the Impossible in **12,002 HE**.<sup>875</sup>

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<sup>875</sup> [https://en.wikipedia.org/wiki/Cornelis\\_Drebbel](https://en.wikipedia.org/wiki/Cornelis_Drebbel)

**11,578 HE – 11,657 HE:** WILLIAM HARVEY, English physician who was the first person to describe completely and in detail the systemic circulation and properties of blood being pumped to the brain and body by the heart.<sup>876</sup> (see Circa **11,288 HE** IBN AL-NAFIS and circa **11,533 HE** MIGUEL SERVETO aka MICHAEL SERVETUS and see **circa 11,559 HE: REALDO COLUMBO**).<sup>877</sup>

<sup>878</sup> **11,628 HE:** WILLIAM HARVEY had all the evidence he needed and published his book in the Netherlands with the title: *De Motu Cordis et Sanguinis (Concerning the Motions of the Heart and Blood)*. This book represents the beginning of modern physiology.<sup>879</sup>

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<sup>876</sup> [https://en.wikipedia.org/wiki/William\\_Harvey](https://en.wikipedia.org/wiki/William_Harvey)

<sup>877</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

<sup>878</sup> [https://en.wikipedia.org/wiki/William\\_Harvey](https://en.wikipedia.org/wiki/William_Harvey)

<sup>879</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 140



WILLIAM HARVEY, artist, date and location unknown.<sup>880</sup>

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<sup>880</sup> [https://en.wikipedia.org/wiki/William\\_Harvey](https://en.wikipedia.org/wiki/William_Harvey)

**11,561 HE – 11,636 HE:** SANTORIO SANTORIO, Italian Physician, constructed an elaborate weighing machine in which he sat while eating, drinking and eliminating wastes. His experiments became the beginning of the study of metabolism<sup>881</sup> 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.<sup>882</sup>

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<sup>881</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 134

<sup>882</sup> [https://en.wikipedia.org/wiki/Santorio\\_Santorio](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.<sup>883</sup>

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<sup>883</sup> [https://en.wikipedia.org/wiki/Santorio\\_Santorio](https://en.wikipedia.org/wiki/Santorio_Santorio)

**11,580 HE – 11,644 HE:** JAN BAPTISTA VAN HELMONT, Flemish physician<sup>884</sup> 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<sup>885 886</sup> and that he identified Carbon Dioxide<sup>887</sup> VAN HELMONT also identified the “Star Stuff” element Magnesium.<sup>888</sup>

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<sup>884</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

<sup>885</sup> [https://en.wikipedia.org/wiki/Jan\\_Baptist\\_van\\_Helmont](https://en.wikipedia.org/wiki/Jan_Baptist_van_Helmont)

<sup>886</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 138

<sup>887</sup> [www.britannica.com/biography/Jan-Baptista-van-Helmont](http://www.britannica.com/biography/Jan-Baptista-van-Helmont)

<sup>888</sup> [https://en.wikipedia.org/wiki/Joseph\\_Black](https://en.wikipedia.org/wiki/Joseph_Black)



**11,648 HE:** JAN BAPTISTA VAN HELMONT (left) and his son Franciscus-Mercurius from the *Ortus medicinae*, artist and location unknown.<sup>889</sup>

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<sup>889</sup> [https://en.wikipedia.org/wiki/Jan\\_Baptist\\_van\\_Helmont](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.<sup>890</sup>

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<sup>890</sup> <http://images-of-elements.com/magnesium.php#a>



**11,580 HE–11,650 HE:** FRANZ KESSLER German portrait painter, scholar, inventor and alchemist who invented a harness for diving below water. KESSLER also wrote a book which had 5 chapters dealing with communicating via a crude Aldis lamp – the predecessor to Morse Code<sup>891</sup>

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<sup>891</sup> [https://en.wikipedia.org/wiki/Franz\\_Kessler](https://en.wikipedia.org/wiki/Franz_Kessler)



Drawing of FRANZ KESSLER'S invention: a harness for diving below water, artist, location, date unknown.<sup>892</sup> Author / Compiler did not find a book about his diving harness. But for a list of other of his books see the footnote:<sup>893</sup>

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<sup>892</sup> [https://en.wikipedia.org/wiki/Franz\\_Kessler](https://en.wikipedia.org/wiki/Franz_Kessler)

<sup>893</sup> [https://en.wikipedia.org/wiki/Franz\\_Kessler](https://en.wikipedia.org/wiki/Franz_Kessler)

**Circa 11,582 HE:** Gregorian calendar, introduced by Pope Gregory XIII, AKA Anno Domini / AD or Western or Christian “the year of our lord” calendar to keep their holidays from drifting.<sup>894</sup>

**Circa 11,583 HE:** SIMON STEVIN, Dutch or Flemish mathematician showed that the pressure of a liquid on a given surface depends on the height of the liquid above the surface and upon the area of the surface - but does not depend on the shape of the vessel containing the liquid. This finding is considered to have founded the modern science of Hydrostatics.

⇒ **Circa 11,586 HE** SIMON STEVIN was able to show how fractions could be made part of ordinary position number notation defining numeral position to the right of the decimal point. STEVIN devised that one position to the right is the tenths

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<sup>894</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 121

– two positions to the right is the hundredths....etc.:  $2\frac{1}{4}$  would be 2.25 and  $2\frac{7}{8}$  would be 2.875 and  $2\frac{1}{2}$  would be 2.5 etc.



Statue of Simon Stevin  
by Eugène Simonis, on  
the *Simon Stevinplein* (nl)  
in Bruges



Statue of Stevin (detail)



Statue (detail): *Inclined  
plane diagram*



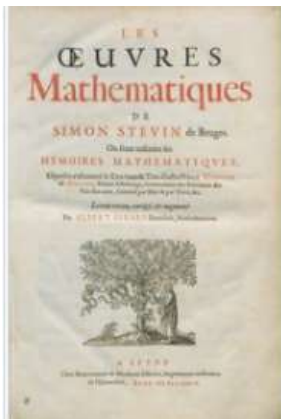
Statue (detail) showing  
experiments on  
*hydrostatic equilibrium*



Photos of monuments to SIMON STEVIN, date and locations unknown.<sup>896</sup>

<sup>895</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 121

<sup>896</sup> [https://en.wikipedia.org/wiki/Simon\\_Stevin](https://en.wikipedia.org/wiki/Simon_Stevin)



Cover of SIMON STEVIN's *Oeuvres mathématiques*, reprint in **11,634 HE.**<sup>897</sup>

<sup>897</sup> [https://en.wikipedia.org/wiki/Simon\\_Stevin](https://en.wikipedia.org/wiki/Simon_Stevin)

**Circa 11,585 HE – 11,632 HE: ZARARIAS JANSSEN**, Dutch spectacle maker who placed a convex lens at each end of a tube. The viewing magnification was not great, but the device was seen as the first microscope. Its descendants were to revolutionize biology.<sup>898</sup>



**ZARARIAS JANSSEN**, artist, date, location unknown.<sup>899</sup>

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<sup>898</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 125

<sup>899</sup> [https://en.wikipedia.org/wiki/Zacharias\\_Janssen](https://en.wikipedia.org/wiki/Zacharias_Janssen)

**11,563 HE – 11,614 HE:** WILLIAM LEE, English. Circa **11,589 HE:** LEE invented the first replacement device for hand knitters to produce their knitted project. The Stocking Frame was a mechanical knitting machine. Although the Stocking Frame would be a great help to industry and the consumer – it would be a disadvantage to the employed hand knitters of the age if implemented on a large scale. Elizabeth I realized the implication of what is now understood as “technological unemployment” and refused to grant 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.<sup>900</sup> (See circa **11,298 HE:** Spinning wheels themselves were only invented only about 500 years ago.)

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<sup>900</sup> 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.<sup>901</sup>

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<sup>901</sup> [https://en.wikipedia.org/wiki/Stocking\\_frame](https://en.wikipedia.org/wiki/Stocking_frame)



**Circa 11,589 HE:** FRANCOIS VIETE, French mathematician and lawyer whose work on what was then called “new algebra” was an important step towards modern algebra, due to his innovative use of letters as variables by symbolizing constants and unknown quantities or relationships by inventing the now familiar  $x$ ’s or  $y$ ’s of algebra.<sup>902</sup>



FRANCOIS VIETE, French mathematician, date, location, and artist unknown<sup>903</sup>

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<sup>902</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 125

<sup>903</sup> [https://en.wikipedia.org/wiki/Francois\\_Viete](https://en.wikipedia.org/wiki/Francois_Viete)

**Circa 11,592 HE:** DOMINICO FONTANA, Italian engineer who began tunneling under a hill to establish an aqueduct and discovered the ruins of Pompeii and Herculaneum, near the base of Mt. Vesuvius.

⇒ Although excavation for the deliberate purpose of studying the past did not begin for another century, subject matter was known to exist, and *the discovery of Pompeii may be viewed as the beginning of modern archeology.*<sup>904</sup>

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<sup>904</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 126

**Circa 11,592 HE:** LUDOLF van CEULEN, German mathematician, by hand and by brain, obtained the value of PI to 20 decimal places. Later in life he got it to 35 decimal places.<sup>905</sup>



LUDOLF van CEULEN, date, location, and artist unknown.<sup>906</sup>

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<sup>905</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

<sup>906</sup> [https://en.wikipedia.org/wiki/Ludolph\\_van\\_Ceulen](https://en.wikipedia.org/wiki/Ludolph_van_Ceulen)

**Circa 11,597 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.<sup>907</sup>



ANDREAS LIBAU, date, location, and artist unknown.<sup>908</sup>

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<sup>907</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 127

<sup>908</sup> [https://en.wikipedia.org/wiki/Andreas\\_Libavius](https://en.wikipedia.org/wiki/Andreas_Libavius)

**Circa 11,600 HE:** The population of the world was approximately 500,000,000 people.<sup>909</sup>

**Circa 11,600 HE:** WILLIAM GILBERT, English physician, physicist, and astronomer who experimented with compasses. Up until his time no one knew why the compass pointed north. WILLIAM GILBERT wrote a book on his experiments *De Magnete (Concerning Magnets)* and showed that the Earth itself was a big magnet.<sup>910</sup>

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<sup>909</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>910</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 128



WILLIAM GILBERT, date, location, and artist unknown.<sup>911</sup>

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<sup>911</sup> [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.<sup>912</sup>

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<sup>912</sup> [https://en.wikipedia.org/wiki/William\\_Gilbert\\_\(astronomer\)](https://en.wikipedia.org/wiki/William_Gilbert_(astronomer))

**11,607 HE – 11,665 HE: PIERRE DE FERMAT**<sup>913</sup> (French: [pjɛːʁ də fɛʁma]) was a French lawyer at the Parlement of Toulouse, France, and mathematician. PIERRE DE FERMAT was one of the two leading mathematicians of the first half of the **11,600's HE**. According to Peter L. Bernstein, in his book *Against the Gods*, PIERRE DE FERMAT "was a mathematician of rare power. FERMAT was an independent inventor of analytic geometry, contributed to the early development of Calculus, did research on the weight of the Earth, and worked on light refraction and optics. In the course of what turned out to be an extended correspondence with BLAISE PASCAL (see **11,632 HE**), FERMAT made a significant contribution to the theory of probability. But FERMAT's crowning achievement was in the theory of numbers." Regarding FERMAT's work in analysis, circa **11,687 HE** ISAAC NEWTON wrote that his own early ideas about calculus came

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<sup>913</sup> 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.<sup>914</sup>

⇒ PIERRE DE FERMAT's famous Last Theorem was first discovered by his son in the margin in his father's copy of an edition of DIOPHANTUS (see **circa 10,250 HE** when DIOPHANTUS wrote an Algebra text) and included the statement that the margin was too small to include the proof.<sup>915</sup> It took circa 370 years for his statement in that margin to be mathematically proven.<sup>916</sup> (See SIR ANDREW WILES **11,995 HE**).

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<sup>914</sup> [https://en.wikipedia.org/wiki/Pierre\\_de\\_Fermat](https://en.wikipedia.org/wiki/Pierre_de_Fermat)

<sup>915</sup> [https://en.wikipedia.org/wiki/Pierre\\_de\\_Fermat](https://en.wikipedia.org/wiki/Pierre_de_Fermat)

<sup>916</sup> Liz Strachan **A Slice of Pi**



PIERRE DE FERMAT: Bust in the Salle des Illustres in Capitole de Toulouse, date unknown.<sup>917</sup>

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<sup>917</sup> [https://en.wikipedia.org/wiki/Pierre\\_de\\_Fermat](https://en.wikipedia.org/wiki/Pierre_de_Fermat)

**Circa 11,614 HE:** JOHN NAPIER, Scottish mathematician, physicist, and astronomer who spent years working out formulas for numbers calculated with appropriate exponents which he published using the term “Logarithms”.<sup>918</sup>



JOHN NAPIER, artist, date, and location unknown.<sup>919</sup>

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<sup>918</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery, page 134

<sup>919</sup> [https://en.wikipedia.org/wiki/John\\_Napier](https://en.wikipedia.org/wiki/John_Napier)

**11,616 HE – 11,703 HE:** JOHN WALLIS, English mathematician who was the first to suggest “the law of conservation of motion”: that the total momentum of a closed system remains always unchanged. In **11,685 HE** WALLIS succeeded in making sense out of imaginary numbers, using a timeline scheme that proved enormously useful to mathematicians, scientists and engineers. WALLIS is credited with introducing the symbol  $\infty$  for infinity and  $1/\infty$  for an infinitesimal.<sup>920</sup>



JOHN WALLIS, date, location, and artist unknown.<sup>921</sup>

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<sup>920</sup> [https://en.wikipedia.org/wiki/John\\_Wallis](https://en.wikipedia.org/wiki/John_Wallis)

<sup>921</sup> [https://en.wikipedia.org/wiki/John\\_Wallis](https://en.wikipedia.org/wiki/John_Wallis)

**Circa 11,620 HE:** Stagecoaches came into use.<sup>922</sup>

**11,620 HE – 11,682 HE:** JEAN-FELIX PICARD, French astronomer who was **11,684 HE** published posthumously: although his observations were with telescopes, JEAN-FELIX PICARD correctly calculated the Earth's circumference as 24,876 miles and its diameter as 7,900 miles.<sup>923</sup>

⇒ Yes, Star Trek fans, Captain Jean-Luc Picard was named after this French astronomer!<sup>924</sup>

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<sup>922</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 136

<sup>923</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 170

<sup>924</sup> <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>



JEAN-FELIX PICARD, date, location, and artist unknown<sup>925</sup>

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<sup>925</sup> <https://www.seeker.com/star-trek-inspiration-meet-the-real-jean-picard-1765425621.html>

**Circa 11,621 HE:** WILLEBRORD SNEL VAN ROYAN or aka WILLEBRORD SNELIUS, Dutch mathematician known for “Snell’s Law”<sup>926</sup> which was the law of refraction, which he *rediscovered* in **11,621 HE**.<sup>927</sup> (See IBN SAHL circa **10,984 HE**)

⇒ As you remember, the understanding of how curved mirrors and lenses bend and focus light was already defined by IBN SAHL in his **10,984 HE** treatise *On Burning Mirrors and Lenses*, which was lost when, in about **Circa 11,111 HE**, Al-Ghazali caused the beginning of Persian/Arab/Iraq DARK AGES. It took

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<sup>926</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

<sup>927</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 137

approximately 637 years before SNELIUS rediscovered these ideas,<sup>928</sup> and for that act got “naming rights.”<sup>929</sup>



WILLEBRORD SNEL VAN ROYAN (SNELIUS), artist, date, and location unknown.<sup>930</sup>

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<sup>928</sup> [https://en.wikipedia.org/wiki/Ibn\\_Sahl](https://en.wikipedia.org/wiki/Ibn_Sahl)

<sup>929</sup> Neil deGrasse Tyson speech “How The Islamic Civilization Fell”  
<https://www.youtube.com/watch?v=Y-d4ROOfDGU&feature=youtu.be>

<sup>930</sup> [https://en.wikipedia.org/wiki/Willebrord\\_Snellius](https://en.wikipedia.org/wiki/Willebrord_Snellius)



**11,623 HE to 11,673 HE:** MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, English aristocrat, philosopher, poet, scientist, fiction-writer, and playwright<sup>931</sup> wrote the utopian romance *The Blazing World*, and it is one of the earliest examples of science fiction.<sup>932</sup>

⇒ 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

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<sup>931</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne)

<sup>932</sup> 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.<sup>933</sup>

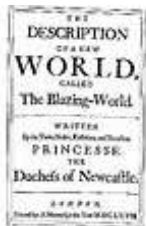
- ⇒ Writings by MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, include *Bell in Campo* and *The Sociable Companions*; *Observations upon Experimental Philosophy*; *Paper Bodies*; *Sociable Letters*; *The Convent of Pleasure and Other Plays*.<sup>934</sup>
- ⇒ MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, was a “badass writer” according to Jennifer Sherman

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<sup>933</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne)

<sup>934</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne)

Roberts's book "*Everyone, We Need to Talk About 17th-Century Badass Writer Margaret Cavendish*".<sup>935</sup>



**11,666 HE** Cover to earliest example of Science Fiction Book *The Blazing World*.<sup>936</sup>

<sup>935</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne#Books](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne#Books)

<sup>936</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne)



MARGARET LUCAS CAVENDISH, Duchess of Newcastle-upon-Tyne, unknown artist and date<sup>937</sup>

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<sup>937</sup> [https://en.wikipedia.org/wiki/Margaret\\_Cavendish%2C\\_Duchess\\_of\\_Newcastle-upon-Tyne](https://en.wikipedia.org/wiki/Margaret_Cavendish%2C_Duchess_of_Newcastle-upon-Tyne)

**11,625 HE – 11,712 HE: GIOVANNI DOMENICO CASSINI**

(CASSINI I) Italy & France, mathematician, astronomer, engineer, and astrologer who was the first of four “CASSINIs” referred to in the history of astronomical science. GIOVANNI DOMENICO CASSINI was first to observe the division in the rings of Saturn; CASSINI I created an important meridian, which helped settle the debate about whether the universe is geocentric; CASSINI I's method of determining longitude was used to measure the size of France accurately for the first time. Defined Cassini's Laws of the Moon: The Moon has a 1:1 spin-orbit resonance which means that the rotation orbit ratio of the Moon is such that the same side of it always faces the Earth. The Moon's rotational axis maintains a constant angle of inclination from the ecliptic plane. The Moon's rotational axis processes so as to trace out a cone that intersects the ecliptic plane as a circle. A plane formed from a normal to the

ecliptic plane and a normal to the Moon's orbital plane will contain the Moon's rotational axis.<sup>938</sup>

⇒ **Circa 11,665 HE:** GIOVANNI DOMENICO CASSINI also accurately measured the rotations of Mars and of Jupiter. **Circa 11,671 HE:** GIOVANNI DOMENICO CASSINI discovered a second satellite of Saturn (he named it “Iapetus” (who was the Titan brother of Saturn) and over the next 13 years discovered 3 more of Saturn’s satellites: “Rhea” “Dione” and “Tethys” (3 of Saturn’s sisters). **Circa 11,675 HE:** GIOVANNI DOMENICO CASSINI noted the dark line separating Saturn’s rings.<sup>939</sup> **Circa 11,672 HE:** GIOVANNI DOMENICO CASSINI determined the distance to Mars at that time. 19 centuries earlier HIPPARCHUS had determined the distance to the moon – but until CASSINI I figured out how to use his telescope and parallax the distance to

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<sup>938</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Domenico\\_Cassini](https://en.wikipedia.org/wiki/Giovanni_Domenico_Cassini)

<sup>939</sup> 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.<sup>940</sup>

⇒ CASSINI I gave human beings their first exposure to how small they and their world were compared to the universe.<sup>941</sup>

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<sup>940</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

<sup>941</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 164

Giovanni Domenico Cassini



GIOVANNI DOMENICO CASSINI, CASSINI I, artist,  
location, and date unknown.<sup>942</sup>

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<sup>942</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Domenico\\_Cassini](https://en.wikipedia.org/wiki/Giovanni_Domenico_Cassini)



**11,626 HE – 11,697 HE:** FRANCESCO REDI, Italian physician debunked the notion of spontaneous combustion.<sup>943</sup>

⇒ 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".<sup>944</sup>

⇒ **Circa 11,668 HE:** FRANCESCO REDI *set up the first clear case of using proper controls in an experiment by using 8 flasks*

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<sup>943</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

<sup>944</sup> [https://en.wikipedia.org/wiki/Francesco\\_Redi](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.<sup>945</sup>

- ⇒ His most famous experiments are described in his magnum opus *Esperienze Intorno alla Generazione degl'Insetti (Experiments on the Generation of Insects)*, published in **11,668 HE**. REDI disproved that vipers drink wine and could break glasses, and that their venom was poisonous when ingested. He correctly observed that snake venoms were produced from the fangs, not the gallbladder, as was believed. REDI was also the first to recognize and correctly describe details of about 180 parasites, including *Fasciola hepatica* and *Ascaris lumbricoides*. He distinguished earthworms from helminths (like tapeworms, flukes, and roundworms). A collection of his poems first published in **11,685 HE** *Bacco in Toscana ('Bacchus in*

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<sup>945</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

*Tuscany*") is considered among the finest works of **11,600s HE** Italian poetry, and for which the Grand Duke Cosimo III gave him a medal of honor.<sup>946</sup>



Statue of FRANCESCO REDI on the Uffizi Gallery (Piazzale

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<sup>946</sup> [https://en.wikipedia.org/wiki/Francesco\\_Redi](https://en.wikipedia.org/wiki/Francesco_Redi)

degli Uffizi) in Florence. At his feet is a copy of **Bacco in Toscana.**<sup>947</sup>



**11,668 HE** Esperienze Intorno alla Generazione degli Insetti  
front cover<sup>948</sup>

<sup>947</sup> [https://en.wikipedia.org/wiki/Francesco\\_Redi](https://en.wikipedia.org/wiki/Francesco_Redi)

<sup>948</sup> [https://en.wikipedia.org/wiki/Francesco\\_Redi](https://en.wikipedia.org/wiki/Francesco_Redi)

⇒ FRANCESCO REDI honors: A crater on Mars was named after FRANCESCO REDI; The larval stage of parasitic fluke called "redia" is named after FRANCESCO REDI by another Italian zoologist, Filippo de Filippi, in **11,837 HE**; The Redi Award, the most prestigious award in toxicology, is given honor of FRANCESCO REDI by the International Society on Toxicology. The award is made at each World Congress of IST (generally held every three years) since **11,967 HE**; A scientific journal Redia, an Italian journal of zoology, is named in FRANCESCO REDI honor, which was first published in **11,903 HE**. A European viper subspecies, *Vipera aspis francisciredi* Laurenti, **11,768 HE**, is named after FRANCESCO REDI.<sup>949</sup>

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<sup>949</sup> [https://en.wikipedia.org/wiki/Francesco\\_Redi](https://en.wikipedia.org/wiki/Francesco_Redi)

**11,627 HE – 11,691 HE: ROBERT BOYLE** - Irish born physicist and the chemist who said an element is a substance whose atoms all have the same number of protons: another way of saying this is that all of a particular element's atoms have the same atomic number. Elements are chemically the simplest substances and hence cannot be broken down using chemical reactions.”<sup>950</sup>

⇒ **Circa 11,662 HE ROBERT BOYLE** experimented with gas and mercury and a 17-foot glass tube and air and other gases were atomic in nature. BOYLE was able to experimentally prove what circa 2,121 years ago, DEMOCRITUS (**Circa 9,541 HE**) had conjectured about atomic theory.<sup>951</sup>

⇒ ROBERT BOYLE published *The Skeptical Chymist*, the book that symbolized turning the back on medievalism. BOYLE

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<sup>950</sup> <https://www.chemicool.com/definition/element.html>

<sup>951</sup> 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”.<sup>952</sup>*

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<sup>952</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery page 154

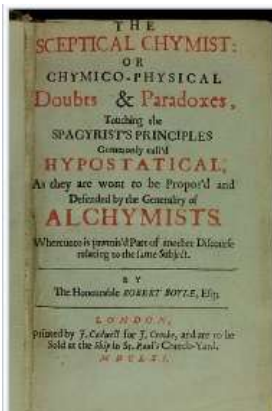


ROBERT BOYLE, date, location, and artist unknown.<sup>953</sup>

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<sup>953</sup> [https://en.wikipedia.org/wiki/Robert\\_Boyle](https://en.wikipedia.org/wiki/Robert_Boyle)





Title page of *The Sceptical Chymist*, 11,661 HE, photographer unknown.<sup>954</sup>

<sup>954</sup> [https://en.wikipedia.org/wiki/Robert\\_Boyle](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.<sup>955</sup>



⇒ The photo is Ultrapure carbon as graphite. “Star Stuff” Carbon, C, the base of all life on Earth, the Element Atomic Number 6, has the most complex chemistry, which is called organic chemistry. Coal, which consists mostly of carbon, is known and used since prehistoric time. Mineral oil consists largely of

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<sup>955</sup> <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

hydrocarbons. The combustion of carbon produces carbon dioxide, CO<sub>2</sub>. This is a greenhouse gas, which traps heat radiation.<sup>956</sup> 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.<sup>957</sup> 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.<sup>958</sup>

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<sup>956</sup> <http://images-of-elements.com/carbon.php#a>

<sup>957</sup> <http://images-of-elements.com/carbon.php#a>

<sup>958</sup> <http://images-of-elements.com/carbon.php#a>

- More about the “Star Stuff” Element Carbon: In **11,770 HE**, CARL WILHELM SCHEELE showed that graphite also burned to form carbon dioxide and thereby discovered another form of Carbon.
- In **11,985 HE** yet another form of carbon, Fullerene, was discovered by ROBERT CURL, HARRY KROTO AND RICHARD SMALLEY. Fullerene was also called "buckminsterfullerene," because its molecules resembled the geodesic domes designed by architect Buckminster Fuller for the **11,967 HE** World's Fair. In **12,004 HE** the most recently discovered form of Carbon is Graphene, which consists of a single layer of carbon atoms arranged in hexagons. Graphene was discovered by KOSTYA NOVOSELOV and ANDRE

GEIM, who used adhesive tape to detach a single layer of atoms from graphite to produce this form of carbon.<sup>959</sup>

**11,627 HE – 11,705 HE:** JOHN RAY, English naturalist who, circa **11,686 HE** when he had access to so much more of the world than the ancient Greeks, (see THEOPHRATUS circa **9,681 HE** who classified 550 different plants) published a painstaking three volume classification of 18,600 different plant species. In **11,691 HE** JOHN RAY started classifying animals on the basis of hooves, toes, and teeth, his system that persists to this day.<sup>960</sup> 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

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<sup>959</sup> <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

<sup>960</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

new discovery"<sup>961</sup> ISAAC ASIMOV said classifications such as JOHN RAY's made the matter of biological evolution seem an overwhelming likelihood.<sup>962</sup>



Wood cut of JOHN RAY, artist, date, and location unknown.<sup>963</sup>

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<sup>961</sup> [https://en.wikipedia.org/wiki/John\\_Ray](https://en.wikipedia.org/wiki/John_Ray)

<sup>962</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

<sup>963</sup> [https://en.wikipedia.org/wiki/John\\_Ray](https://en.wikipedia.org/wiki/John_Ray)



⇒

Painting of JOHN RAY, artist, date, and location unknown.<sup>964</sup>

⇒ Including the various editions, *there are 172 works by JOHN RAY.*<sup>965</sup>

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<sup>964</sup> [https://en.wikipedia.org/wiki/John\\_Ray](https://en.wikipedia.org/wiki/John_Ray)

<sup>965</sup> [https://en.wikipedia.org/wiki/John\\_Ray](https://en.wikipedia.org/wiki/John_Ray)

**11,628 HE – 11,694 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 **11,628 HE** theory of how blood flows and defined “capillaries”<sup>966</sup>
- MARCELLO MALPIGHI's treatise *De polypo cordis* (**11,666 HE**) was important for understanding blood composition, as well as how blood clots. In it, MALPIGHI described how the form of a blood clot differed in the right against the left sides of the heart.
- ⇒ MARCELLO MALPIGHI discovered that invertebrates do not use lungs to breathe, but small holes in their skin called tracheae. MALPIGHI also studied the anatomy of the brain and concluded

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<sup>966</sup> 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 11,675 HE and 11,679 HE. Another edition followed in 11,687 HE, and a supplementary volume in 11,697 HE. In his autobiography, MALPIGHI speaks of his Anatome Plantarum, as "the most elegant format in the whole literate world."*<sup>967</sup>
- ⇒ Several physiological features of the biological excretory system are named after MARCELLO MALPIGHI, such as the

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<sup>967</sup> [https://en.wikipedia.org/wiki/Marcello\\_Malpighi](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.<sup>968</sup>

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<sup>968</sup> [https://en.wikipedia.org/wiki/Marcello\\_Malpighi](https://en.wikipedia.org/wiki/Marcello_Malpighi)

Circa **11,629 HE – 11,695 HE**: CHRISTIAAN HUYGENS, Dutch astronomer<sup>969</sup> 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.<sup>970</sup>

⇒ HUYGENS along with Dutch philosopher and optician BENEDICT SPINOZA worked out a new and better method for grinding telescope lenses and did what in **11,612 HE**: GALILEO was unable to do: HUYGENS and BENEDICT SPINOZA observed Saturn, its rings, and also discovered Titan – one of its moons.<sup>971</sup>

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<sup>969</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

<sup>970</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

<sup>971</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 151

⇒ In **11,673 HE** CHRISTIAAN HUYGENS published *Horologium Oscillatorium sive de motu pendulorum*, his major work on pendulums and horology.



⇒ CHRISTIAAN HUYGENS, by Caspar Netscher, Museum Hofwijck, Voorburg<sup>972</sup>

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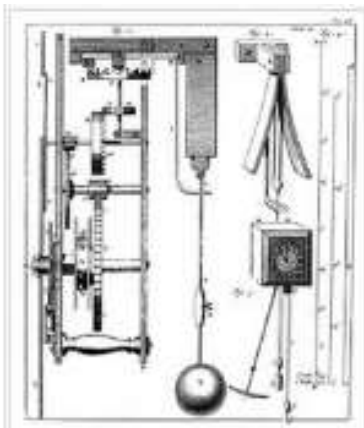
<sup>972</sup> [https://en.wikipedia.org/wiki/Christiaan\\_Huygens](https://en.wikipedia.org/wiki/Christiaan_Huygens)



CHRISTIAAN HUYGENS clock, Rijksmuseum, Amsterdam<sup>973</sup>

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<sup>973</sup> [https://en.wikipedia.org/wiki/Christiaan\\_Huygens#Horology](https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology)



Detail of illustration from *Horologium Oscillatorium* (11,658 HE), by CHRISTIAAN HUYGENS<sup>974</sup>

<sup>974</sup> [https://en.wikipedia.org/wiki/Christiaan\\_Huygens#Horology](https://en.wikipedia.org/wiki/Christiaan_Huygens#Horology)

**11,630 HE – 11,702 HE:** OLAUS RUDBECK aka OLOF RUDBECK the Elder, Swedish naturalist demonstrated another system in the body: The Lymphatic system.<sup>975</sup>



RUDBECK, painted in **11,696 HE** by Martin Mijtens the Elder, location unknown.<sup>976</sup>

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<sup>975</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 149

<sup>976</sup> [https://en.wikipedia.org/wiki/Olaus\\_Rudbeck](https://en.wikipedia.org/wiki/Olaus_Rudbeck)

**11,632 HE – 11,662 HE:** BLAISE PASCAL, French mathematician<sup>977</sup> physicist, inventor and writer.<sup>978</sup> **Circa 11,648 HE** BLAISE PASCAL studied fluid pressures and his work is the basis for the hydraulic press.<sup>979</sup> **Circa 11,648 HE** PASCAL sent his brother-in-law up some neighboring mountains with a couple of EVANGINELISTA TORRICELLI's barometers. PASCAL climbed about a mile and found the mercury in the columns had dropped from 30 to 27 inches. This showed to PASCAL that air became less dense with height and concluded that by 100 miles above the surface of the planet the air would be so thin it might as well be a vacuum.<sup>980</sup>

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<sup>977</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

<sup>978</sup> [https://en.wikipedia.org/wiki/Blaise\\_Pascal](https://en.wikipedia.org/wiki/Blaise_Pascal)

<sup>979</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

<sup>980</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145



- ⇒ **Circa 11,654 HE PASCAL** and FERMAT worked out mathematical techniques for judging the likelihood of certain combinations, and in doing so laid out the almost inconceivably important theory of science known as **Probability**.<sup>981</sup>
- ⇒ PASCAL invented the first adding and subtracting machine. It had wheels that were marked 1 to 10 marked off along its circumference.<sup>982</sup>
- ⇒ Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL amounted to the discovery of Outer Space.<sup>983</sup>

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<sup>981</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

<sup>982</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 145

<sup>983</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148



BLAISE PASCAL only lived 39 years. This Painting of BLAISE PASCAL made by François II Quesnel for Gérard Edelinck in **11,691 HE** is posthumous.<sup>984</sup>

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<sup>984</sup> [https://en.wikipedia.org/wiki/Blaise\\_Pascal](https://en.wikipedia.org/wiki/Blaise_Pascal)

**Circa 11,635 HE: HENRY GELLIBRAND**, English astronomer, combined his experiments with notes from others, proving that although the earth was a magnet (see **11,600 HE: WILLIAM GILBERT**) that the north pole had shifted approximately 7 degrees in direction in the previous 50 years.<sup>985</sup>

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<sup>985</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142

**11,635 HE:** First surviving drawing of a kite; see **Circa 9,494 HE – 9,561 HE:** LU BAN, (Gongshu Ban).<sup>986</sup>



First surviving woodcut print of a kite from John Bate's **11,635 HE** book *The Mysteryes of Nature and Art*.<sup>987</sup>

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<sup>986</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

**11,635 HE – 11,703 HE:** ROBERT HOOKE, English physicist<sup>988</sup> who designed an air pump that worked much better than **Circa 11,654 HE** OTTO von GUERICKE's. HOOKE made such a quality vacuum that he did the experiment that circa **11,612 HE** GALILEO tried but was unable to do: when a feather and a coin were dropped from the top of the vacuum jar they fell at the same speed.<sup>989</sup>

⇒ According to ISAAC ASIMOV, it was ROBERT BOYLE who hired ROBERT HOOKE to build the improved air pump.<sup>990</sup>

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<sup>987</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

<sup>988</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

<sup>989</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

<sup>990</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

- ⇒ **Circa 11,654 HE** ROBERT HOOKE noted the large red oval marking on Jupiter and named it the Great Red Spot.<sup>991</sup>
- ⇒ ROBERT HOOKE argued for an attracting principle of gravitation in *Micrographia* of **11,665 HE**. HOOKE'S **11,666 HE** Royal Society lecture "*On gravity*" added two further principles – that all bodies move in straight lines till deflected by some force and that the attractive force is stronger for closer bodies.<sup>992</sup>
- ⇒ In **11,665 HE** ROBERT HOOKE's book *Micrographia*, he is also describing observations made with microscopes and telescopes, as well as some original work in biology. HOOKE *coined the term "cell"* for describing biological organisms, the

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<sup>991</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

<sup>992</sup> [https://en.wikipedia.org/wiki/Robert\\_Hooke](https://en.wikipedia.org/wiki/Robert_Hooke)

term being suggested by the resemblance of plant cells to cells of a honeycomb.<sup>993</sup>



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

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<sup>993</sup> [https://en.wikipedia.org/wiki/Robert\\_Hooke](https://en.wikipedia.org/wiki/Robert_Hooke)

London, is on display at the National Museum of Health and Medicine in Washington, DC.<sup>994</sup>

**Circa 11,637 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.<sup>995</sup>



RENE DESCARTES at work, date and artist unknown.<sup>996</sup>

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<sup>994</sup> [https://en.wikipedia.org/wiki/Robert\\_Hooke](https://en.wikipedia.org/wiki/Robert_Hooke)

<sup>995</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 142

<sup>996</sup> [https://en.wikipedia.org/wiki/Rene\\_Descartes](https://en.wikipedia.org/wiki/Rene_Descartes)



**11,637 HE – 11,680 HE: JAN SWAMMERDAM**, Dutch naturalist.

**11,658 HE: SWAMMERDAM** used the improved microscope to study approximately 3,000 insects. SWAMMERDAM is considered the *father of modern entomology*. SWAMMERDAM used the improved microscope to discover the red blood corpuscle.<sup>997</sup>



JAN SWAMMERDAM, date, location and artist unknown.<sup>998</sup>

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<sup>997</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 152

<sup>998</sup> <http://janswammerdam.org/>

**11,638 HE – 11,686 HE:** NICHOLAS STENO, Danish Geologist was the first to maintain that fossils were the remains of creatures who had lived long ago, and whose remains had slowly converted to stone. ASIMOV notes this is the first scientifically recognized spectacular evidence of biological evolution.<sup>999</sup> (See **11,556 HE:** GEORG BAUER and how he speculated on fossils and **11,799 HE – 11,847 HE** MARY ANNING.)

⇒ **11,669 HE:** In NICHOLAS STENO's book *De solido intra solidum naturaliter contento* were the first accurate observations on a type of crystal. The principle in crystallography, known simply as Steno's law, or Steno's law of constant angles or the first law of crystallography, states that the angles between corresponding faces on crystals are the same for all specimens of the same mineral. STENO's seminal work

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<sup>999</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

paved the way for the law of the rationality of the crystallographic indices of French mineralogist RENÉ-JUST HAÜY in **11,801 HE**. This fundamental breakthrough formed the basis of all subsequent inquiries into crystal structure.<sup>1000</sup>

⇒ **11,669 HE**: NICHOLAS STENO, in his *Dissertationis prodromus* is credited with four of the defining principles of the science of stratigraphy:

- The law of superposition: "... at the time when any given stratum was being formed, all the matter resting upon it was fluid, and, therefore, at the time when the lower stratum was being formed, none of the upper strata existed";

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<sup>1000</sup> [https://en.wikipedia.org/wiki/Nicolas\\_Steno](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 **11,772 HE** by JEAN-BAPTISTE L. ROMÉ DE L'ISLE.

⇒ STENO's ideas still form the basis of stratigraphy and were key in the development of JAMES HUTTON's. See **11,726 HE-**

**11,797 HE:** JAMES HUTTON's theory of infinitely repeating cycles of seabed deposition, uplifting, erosion, and submersion.<sup>1001</sup>

- Also see **11,910 HE– 11,994 HE:** DOROTHY MARY CROWFOOT HODGKIN OM FRS HonFRSC, British **11,964 HE** Nobel Prize winning chemist who invented / developed Protein Crystallography: the technique which shines light at proteins to expose their 3-dimensional structure.<sup>1002</sup>

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<sup>1001</sup> [https://en.wikipedia.org/wiki/Nicolas\\_Steno](https://en.wikipedia.org/wiki/Nicolas_Steno)

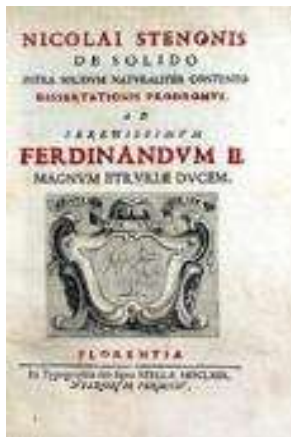
<sup>1002</sup> <https://www.youtube.com/watch?v=dCe9y053pqE> TimJamesScience



Portrait of NICHOLAS STENO Unsigned but attributed to court painter Justus Sustermans. (Uffizi Gallery, Florence, Italy)<sup>1003</sup>

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<sup>1003</sup> [https://en.wikipedia.org/wiki/Nicolas\\_Steno](https://en.wikipedia.org/wiki/Nicolas_Steno)



Cover of NICHOLAS STENO 11,669 HE book "*De solido intra solidum naturaliter contento.*"<sup>1004</sup>

**11,641 HE – 11,712 HE:** NEHEMIAH GREW, English Botanist, is known as the "*Father of Plant Anatomy*" because he showed that plants have sexuality, plants reproduce sexually, plants have sex organs, and that individual grains of pollen were the equivalent of the sperm cells in the animal world.<sup>1005</sup>



NEHEMIAH GREW, date, location, and artist unknown.<sup>1006</sup>

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<sup>1004</sup> [https://en.wikipedia.org/wiki/Nicolas\\_Steno](https://en.wikipedia.org/wiki/Nicolas_Steno)

<sup>1005</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 168

<sup>1006</sup> [https://en.wikipedia.org/wiki/Nehemiah\\_Grew](https://en.wikipedia.org/wiki/Nehemiah_Grew)



**11,642 HE– 11,727 HE:** SIR ISAAC NEWTON, English Physicist and Mathematician is widely recognized as one of the most influential scientists of all time. **11,666 HE:** ISAAC NEWTON conducted the experiments on defining the visible light spectrum.<sup>1007</sup> 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.<sup>1008</sup>

⇒ LAWRENCE M. KRAUSS helps us understand more about the influence of the time period and from what NEWTON helped us

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<sup>1007</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 158

<sup>1008</sup> [https://en.wikipedia.org/wiki/Isaac\\_Newton](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.”<sup>1009</sup>

⇒ 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...”<sup>1010</sup>

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<sup>1009</sup> LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

<sup>1010</sup> LAWRENCE M. KRAUSS The Greatest Story Ever Told--So Far: Why Are We Here?

- ⇒ See **11,267 HE -11,319 HE: KAMAL AL-DIN IBN ALI IBN HASAN AL-FARISI** is known for giving the first mathematically satisfactory explanation of the rainbow.<sup>1011</sup> Although because **Circa 11,111 HE: Al-Ghazali** pushed his philosophy that *mathematics was the work of the devil* the entirety of what Islam was and would become, collapsed the great age of enlightenment in the Islamic world. It has not recovered since.<sup>1012</sup> So, NEWTON had to re-invent and thus get credit.
- ⇒ **11,687 HE ISAAC NEWTON** wrote the book: *Principia: 'Mathematical Principles of Natural Philosophy'* in Latin, but

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<sup>1011</sup> [https://en.wikipedia.org/wiki/Kamal\\_al-Din\\_al-Farisi](https://en.wikipedia.org/wiki/Kamal_al-Din_al-Farisi)

<sup>1012</sup> 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.<sup>1013</sup> **11,687**  
**HE:** ISAAC NEWTON's *Philosophiæ Naturalis Principia Mathematica* ("*Mathematical Principles of Natural Philosophy*"), when first published, (in latin) laid the foundations for classical mechanics.<sup>1014</sup>

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<sup>1013</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 160

<sup>1014</sup> <http://www.bbc.co.uk/timelines/zwwgcdm>

- It was EDMOND HALLEY who privately paid for the publishing of *Principia*, what is thought to be the greatest science book of all time.<sup>1015</sup>
- ⇒ ISAAC NEWTON concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.<sup>1016</sup>
- ARISTOTLE (See Circa **9,617 HE – 9,678 HE**) concluded that time is measured by the changing of things and that if nothing changes, there is no time.<sup>1017</sup>
  - ALBERT EINSTEIN (See **11,879 HE – 11,955 HE**) concluded that both ARISTOTLE and ISAAC NEWTON were

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<sup>1015</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 172

<sup>1016</sup> Carlo Roveli's *The Order of Time*

<sup>1017</sup> 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.<sup>1018</sup>

⇒ **11,687 HE**: ISAAC NEWTON further defined the spherical shape of the earth. (see ARISTOTLE and ERATOSTHENES and how in *Principia* ISAAC NEWTON refers to GIOVANNI DOMENICO CASSINI **circa 11,665 HE** sending French astronomer JEAN RICHER on the expedition to Cayenne, French Guiana, which in **circa 11,672 HE** RICHER helped determine the parallax of the planet Mars. While there, RICHER

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<sup>1018</sup> 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).<sup>1019</sup>

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<sup>1019</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 173



**11,689 HE SIR ISAAC NEWTON** portrait by Godfrey Kneller,  
location unknown.<sup>1020</sup>

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<sup>1020</sup> [https://en.wikipedia.org/wiki/Isaac\\_Newton](https://en.wikipedia.org/wiki/Isaac_Newton)



**Circa 11,643 HE:** EVANGINELISTA TORRICELLI, Italian physicist invented the first mercury column barometer by way of a vacuum.<sup>1021</sup> Experiments like those of EVANGINELISTA TORRICELLI and BLAISE PASCAL (and BLAISE PASCAL's brother in law, See: **11,632 HE – 11,662 HE: BLAISE PASCAL**) amounted to the discovery of Outer Space.<sup>1022</sup>

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<sup>1021</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 146

<sup>1022</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148



TORRICELLI, date, location, and artist unknown.<sup>1023</sup>

**11,644 HE – 11,710 HE: OLE ROEMER (RÓMER), Danish**  
Astronomer, who first demonstrated that light travels at a finite speed using GALILEO's defining the moons of Jupiter. ROEMER also invented the first thermometer and suggested a temperature scale on which DANIEL FAHRENHEIT (See **11,686 HE – 11,736**

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<sup>1023</sup> [https://en.wikipedia.org/wiki/Evangelista\\_Torricelli](https://en.wikipedia.org/wiki/Evangelista_Torricelli)

**HE: FAHRENHEIT)** relied as the basis for his temperature scale.<sup>1024</sup>



**11,700 HE OLE ROEMER (RØMER)**, by Jacob Coning, location unknown.<sup>1025</sup>

<sup>1024</sup> [https://en.wikipedia.org/wiki/ole\\_roemer](https://en.wikipedia.org/wiki/ole_roemer)

<sup>1025</sup> [https://en.wikipedia.org/wiki/ole\\_roemer](https://en.wikipedia.org/wiki/ole_roemer)

**Circa 11,645 HE:** OTTO von GUERICKE, German physicist, who after EVANGINELISTA TORRICELLI invented the vacuum, GUERICKE used the vacuum idea and invented the first practical air pump.<sup>1026</sup>

⇒ **Circa 11,654 HE:** OTTO von GUERICKE took the air pump idea and expanded it to prove: air pressure. His work was published although it was not named.<sup>1027</sup>

⇒ **Circa 11,660 HE:** OTTO von GUERICKE was the first to demonstrate static electricity by the use of a globe made of sulfur and a crank-turned shaft.<sup>1028</sup>

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<sup>1026</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 147

<sup>1027</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 150

<sup>1028</sup> 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.<sup>1029</sup>

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<sup>1029</sup> [https://en.wikipedia.org/wiki/Otto\\_von\\_Guericke](https://en.wikipedia.org/wiki/Otto_von_Guericke)

**11,646 HE – 11,716 HE:** GOTTFRIED WILHELM LEIBNIZ, German mathematician who in **11,693 HE** devised a calculating machine that could not only add and subtract but could multiply by automatically repeating addition and divide by automatically repeating subtraction.

- ⇒ LEIBNIZ also invented a mechanical aid to the calculation of trigonometric and astronomical tables. LEIBNIZ worked on inventing Calculus at roughly the same time as ISAAC NEWTON.
- ⇒ **11,700 HE:** LEIBNIZ pointed out that although counting had been base 10, undoubtedly because we have 10 fingers and 10 toes, there was nothing magical about the base ten system. LEIBNIZ showed how base 8 or base 12 numbers had their uses.

⇒ 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.<sup>1030</sup>



⇒ GOTTFRIED WILHELM LEIBNIZ, Portrait by Christoph Bernhard Francke, date unknown.<sup>1031</sup>

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<sup>1030</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1031</sup> [https://en.wikipedia.org/wiki/Gottfried\\_Wilhelm\\_Leibniz](https://en.wikipedia.org/wiki/Gottfried_Wilhelm_Leibniz)

**11,647 HE – 11,713 HE:** DENIS PAPIN, French physicist, mathematician and inventor who in **11,679 HE** developed the pressure steam cooker with a safety valve.<sup>1032</sup>



**11,689 HE** DENIS PAPIN, unknown artist and date.<sup>1033</sup>

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<sup>1032</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1033</sup> [https://en.wikipedia.org/wiki/Denis\\_Papin](https://en.wikipedia.org/wiki/Denis_Papin)

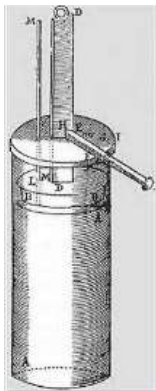




**11,679 HE** drawing of DENIS PAPIN's steam digester, artist and location unknown.<sup>1034</sup>

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<sup>1034</sup> [https://en.wikipedia.org/wiki/Denis\\_Papin](https://en.wikipedia.org/wiki/Denis_Papin)



**11,690 HE** drawing of DENIS PAPIN's first piston steam engine,<sup>1035</sup> (also see **Circa 10,050 HE: HERO of ALEXANDRIA**).

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<sup>1035</sup> [https://en.wikipedia.org/wiki/Denis\\_Papin](https://en.wikipedia.org/wiki/Denis_Papin)

**Circa 11,650 HE:** Timekeeping was still quite crude.



Circa 10,050 years (**see 6,001 HE**) after the first recorded ground sundial, this sundial was wall mounted, for use by the people of the area to tell time, as an SSW facing, vertical declining sundial on Moot Hall, Aldeburgh, Suffolk, England.<sup>1036</sup>

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<sup>1036</sup> <https://en.wikipedia.org/wiki/Sundial>

Circa **11,650 HE** – **11,715 HE**: THOMAS SAVERY, English, inventor<sup>1037</sup> created the first *European* steam engine, which he patented in **11,698 HE** for the very specific purpose of pumping water from coal mines.<sup>1038</sup> (See **10,500 HE**: HERO, Greece, invented the first steam engine; the modern sprinkler system works in precisely HERO's same design – without the heat. ISAAC ASIMOV said HERO's same design did not affect society at that time and wondered what would have happened if Greek science had continued uncrushed by the weight of Roman lack of interest?).<sup>1039</sup>

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<sup>1037</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1038</sup> [https://en.wikipedia.org/wiki/Thomas\\_Savery](https://en.wikipedia.org/wiki/Thomas_Savery)

<sup>1039</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 61



THOMAS SAVERY, date, location, and artist unknown<sup>1040</sup>

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<sup>1040</sup><sup>1040</sup> [https://en.wikipedia.org/wiki/Thomas\\_Savery](https://en.wikipedia.org/wiki/Thomas_Savery)



The **11,698 HE** patented *Savery Steam Engine* <sup>1041</sup>

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<sup>1041</sup> [https://en.wikipedia.org/wiki/Thomas\\_Savery](https://en.wikipedia.org/wiki/Thomas_Savery)

Circa **11,651 HE**: GIAMBATTISTA RICCIOLI, Italian astronomer<sup>1042</sup> 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.<sup>1043</sup>

⇒ In his **11,651 HE** *Almagestum Novum (New Almagest)* work GIAMBATTISTA RICCIOLI re-insisted on the sun centric model of our Solar System (100 years after COPERNICUS) and included a map of the Moon with names given to various craters, thus introducing the current scheme of lunar nomenclature.<sup>1044</sup>

⇒ One of GIAMBATTISTA RICCIOLI's most significant works was his **11,651 HE** *Almagestum Novum (New Almagest)*, an encyclopedic work consisting of over 1500 folio pages (38 cm x

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<sup>1042</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

<sup>1043</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 148

<sup>1044</sup> 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 (**11,646 HE –11,719 HE**), the first English astronomer royal, a Copernican, used it for his Gresham lectures; JÉRÔME LANDE (**11,732 HE–11,807 HE**) of the Paris Observatory cited it extensively even though it was an old book at that point.<sup>1045</sup>

- ⇒ 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

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<sup>1045</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Battista\\_Riccioli](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 unknown<sup>1046</sup>

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<sup>1046</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Battista\\_Riccioli](https://en.wikipedia.org/wiki/Giovanni_Battista_Riccioli)

**11,656 HE – 11,742 HE:** EDMOND HALLEY, British; Scientist and member of the Royal Society<sup>1047</sup> 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.<sup>1048</sup>

⇒ On his own, HALLEY computed the orbit of Halley's Comet, thus further removing fear in the masses of the celestial events.<sup>1049</sup> HALLEY was the second Astronomer Royal in Britain, succeeding JOHN FLAMSTEED.<sup>1050</sup>

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<sup>1047</sup> [https://en.wikipedia.org/wiki/Edmond\\_Halley](https://en.wikipedia.org/wiki/Edmond_Halley)

<sup>1048</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

<sup>1049</sup> [https://en.wikipedia.org/wiki/Edmond\\_Halley](https://en.wikipedia.org/wiki/Edmond_Halley)

<sup>1050</sup> [https://en.wikipedia.org/wiki/Edmond\\_Halley](https://en.wikipedia.org/wiki/Edmond_Halley)

- ⇒ **11,676 HE:** HALLEY wrote a book on the subject of winds. He knew winds involved the rising of sun-heated air but did not understand the reason for the westward flow of tropical air.<sup>1051</sup>
- ⇒ **Circa 11,678 HE:** Prior to this time, no systematic astronomical observations of the skies of the southern hemisphere existed. HALLEY changed that and spent two years under severely limited astronomical observations, published a catalogue of 321 stars.<sup>1052</sup>
- ⇒ **11,693 HE:** It occurred to HALLEY to look at the fact of death by statistical evaluation and wrote the first Mortality Tables.

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<sup>1051</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

<sup>1052</sup> 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.<sup>1053</sup>

⇒ **11,698 HE – 11,790 HE:** EDMOND HALLEY commanded the first ocean voyage undertaken for the sole and specific purpose of scientific exploration. HALLEY's ship was the *Paramour Pink*. The voyage remained at sea for 2 years, measuring magnetic declinations all over the world and made the first map of the world showing the wiggling lines of equal declination. He also did his best to determine accurate latitudes and longitudes for the various ports at which he stopped.<sup>1054</sup> His voyage, probably the first primarily scientific voyage to study the

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<sup>1053</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 171

<sup>1054</sup> 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.<sup>1055</sup>

⇒ **11,715 HE:** It had been 23 centuries since THALES (see **Circa 9,455HE: THALES**) had predicted an eclipse. In order to prevent as much panic as possible among the masses (not among the astronomers who perfectly understood eclipses) before this **11,715 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.<sup>1056</sup>

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<sup>1055</sup> [https://en.wikipedia.org/wiki/Edmond\\_Halley](https://en.wikipedia.org/wiki/Edmond_Halley)

<sup>1056</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 185

Edmond Halley



**Circa 11,722 HE** Portrait by Richard Phillips<sup>1057</sup>

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<sup>1057</sup> [https://en.wikipedia.org/wiki/Edmond\\_Halley](https://en.wikipedia.org/wiki/Edmond_Halley)

- Author / Compiler Note: The discoveries of EDMOND HALLEY rendered astrology moot. “Until the **11,600’s HE** astrology was considered a scholarly tradition, and it helped drive the development of astronomy. It was commonly accepted in political and cultural circles, and some of its concepts were used in other traditional studies, such as alchemy, meteorology, and medicine. By the end of the **11,600’s HE**, emerging scientific concepts in astronomy, such as heliocentrism, and HALLEY’s discovery of the movement of the stars over the years, undermined the theoretical basis of astrology which subsequently lost its academic standing and became regarded as a pseudoscience. Empirical scientific investigation has shown that predictions

and recommendations based on astrology are not accurate.”<sup>1058</sup>

- Author / Compiler asked: What returned the outdated astrology to public awareness? ...”In the **11,900’s HE**, astrology gained broader consumer popularity through the influence of regular mass media products, such as newspaper horoscopes.”<sup>1059</sup>
- Eric Idle made a Netflix movie called “What About Dick?” that includes a parody of astrology with a song called “Asstrology”.<sup>1060</sup>

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<sup>1058</sup> [https://en.wikipedia.org/wiki/History\\_of\\_astrology](https://en.wikipedia.org/wiki/History_of_astrology)

<sup>1059</sup> [https://en.wikipedia.org/wiki/History\\_of\\_astrology](https://en.wikipedia.org/wiki/History_of_astrology)

<sup>1060</sup> <https://www.netflix.com/ca/title/80235999> entitled “What about Dick?”



**11,660 HE:** The Royal Society of London first met.<sup>1061</sup> The very first British 'learned society' meeting on 28 November **11,660 HE** followed a lecture at Gresham College by CHRISTOPHER WREN. Joined by other leading polymaths including ROBERT BOYLE and JOHN WILKINS, the group soon received royal approval<sup>1062</sup> ...and from **11,662 HE** it would be known as 'The Royal Society' of London for Improving Natural Knowledge when Charles II gave it legal charter.<sup>1063</sup>

⇒ 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

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<sup>1061</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

<sup>1062</sup> <https://royalsociety.org/about-us/history/>

<sup>1063</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 156

determined by experiment.<sup>1064</sup> (See **Circa 11,560 HE:** GIAMBATTISTA DELLA PORTA, Italian physicist who founded the first Scientific Association designed particularly for the exchange of information and ideas was shut down by the powers of the time / the Inquisition.)<sup>1065</sup>

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<sup>1064</sup> <https://royalsociety.org/about-us/history/>

<sup>1065</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 115



The Royal Society met at Crane Court. It was a newly formed organization for men of learning to discuss their ideas. Artist, date and location unknown.<sup>1066</sup>

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<sup>1066</sup> <https://royalsociety.org/about-us/history/>

**11,660 HE– 11,713 HE: FRANCIS HAWKSBEES**<sup>1067</sup> aka Francis Hauksbee the Elder, is the English physicist scientist best known for his work on electricity and electrostatic repulsion.<sup>1068</sup>

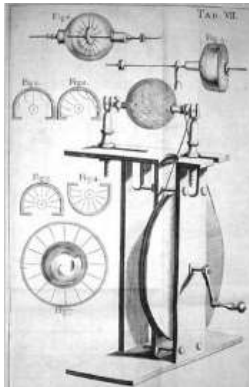
⇒ In **11,706 HE: FRANCIS HAWKSBEES** constructed a glass sphere turned by a crank, which, through friction could build up a more intensive electric charge. This in turn stimulated further experimentation with static electricity.<sup>1069</sup>

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<sup>1067</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1068</sup> [https://en.wikipedia.org/wiki/Francis\\_Hauksbee](https://en.wikipedia.org/wiki/Francis_Hauksbee)

<sup>1069</sup> 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 **11,719 HE.**<sup>1070</sup>

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<sup>1070</sup> [https://en.wikipedia.org/wiki/Francis\\_Hauksbee](https://en.wikipedia.org/wiki/Francis_Hauksbee)

**Circa 11,661 HE: FRANCISCUS SYLVIUS, (AKA FRANZ DELEBOE)** Dutch physician who suggested health depended on a balance of acids and bases in the body. *SYLVIUS correctly suggested digestion was a chemical process of fermentation.*<sup>1071</sup>



FRANCISCUS SYLVIUS, date, location and artist unknown.<sup>1072</sup>

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<sup>1071</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 155

<sup>1072</sup> [https://en.wikipedia.org/wiki/Franciscus\\_Sylvius](https://en.wikipedia.org/wiki/Franciscus_Sylvius)

**11,663 HE – 11,705 HE:** GUILLAUME AMONTONS,<sup>1073</sup> 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.<sup>1074</sup>

⇒ In **11,699 HE**, AMONTONS *published his rediscovery of the laws of friction first put forward by Leonardo da Vinci.* Though they were received with some skepticism at the time, the laws were verified by CHARLES-AUGUSTIN DE COULOMB in **11,781 HE**.<sup>1075</sup>

⇒ **11,669 HE** GUILLAUME AMONTONS devised an air thermometer that was different than GALILEO's for it measured temperature by the change in gas pressure rather than the change

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<sup>1073</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

<sup>1074</sup> [https://en.wikipedia.org/wiki/Guillaume\\_Amontons](https://en.wikipedia.org/wiki/Guillaume_Amontons)

<sup>1075</sup> [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.<sup>1076</sup>



GUILLAUME AMONTONS, Luxembourg Garden, date and artist unknown.<sup>1077</sup>

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<sup>1076</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 177

<sup>1077</sup> [https://en.wikipedia.org/wiki/Amontons\\_\(crater\)](https://en.wikipedia.org/wiki/Amontons_(crater))



Circa **11,665 HE**: FRANCISCO MARIA GRIMALDI, Italian physicist who did experiments that showed light was a wave and that light bent and labeled it “diffraction.” Controversy continued for 150 years with his work being mostly neglected.<sup>1078</sup> The crater Grimaldi on the Moon is named after him.<sup>1079</sup>



GRIMALDI, artist, location, date unknown.<sup>1080</sup>

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<sup>1078</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1079</sup> [https://en.wikipedia.org/wiki/Francesco\\_Maria\\_Grimaldi](https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi)

<sup>1080</sup> [https://en.wikipedia.org/wiki/Francesco\\_Maria\\_Grimaldi](https://en.wikipedia.org/wiki/Francesco_Maria_Grimaldi)

**11,666 HE – 11,736 HE:** STEPHEN GRAY, English experimenter<sup>1081</sup> who in **11,729 HE** was the first to systematically experiment with electrical conduction. Until his work, the emphasis had been on the simple generation of static charges and investigations of the static phenomena (electric shocks, plasma glows, etc.).

⇒ GRAY also first made the distinction between conduction and insulation and discovered the action-at-a-distance phenomenon of electrostatic induction.<sup>1082</sup>

⇒ There is no monument to STEPHEN GRAY, and little recognition of what he achieved in his scientific discoveries. He

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<sup>1081</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*

<sup>1082</sup> [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.<sup>1083</sup>

**11,667 HE – 11,756 HE: JACQUES CASSINI (CASSINI II);** French Astronomer was GIOVANNI DOMENICO CASSINI'S youngest son and succeeded CASSINI I as astronomer at Paris Observatory and geodesist under the name of CASSINI; CASSINI II Published the first *Tables of the Satellites of Saturn*;<sup>1084</sup>

⇒ JACQUES CASSINI: CASSINI II defined the arc of meridian from Dunkirk to Perpignan – defining the radius of Earth.

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<sup>1083</sup> [https://en.wikipedia.org/wiki/Stephen\\_Gray\\_\(scientist\)](https://en.wikipedia.org/wiki/Stephen_Gray_(scientist))

<sup>1084</sup> [https://en.wikipedia.org/wiki/Jacques\\_Cassini](https://en.wikipedia.org/wiki/Jacques_Cassini)

Jacques Cassini



JACQUES CASSINI: CASSINI II, date, location, and artist unknown<sup>1085</sup>

**11,669 HE:** The year the “Star Stuff” element: Phosphorus was first isolated / made by HENNING BRANDT, German merchant and alchemist<sup>1086</sup> at Hamburg, Germany, when he evaporated urine and

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<sup>1085</sup> [https://en.wikipedia.org/wiki/Jacques\\_Cassini](https://en.wikipedia.org/wiki/Jacques_Cassini)

<sup>1086</sup> [https://en.wikipedia.org/wiki/Hennig\\_Brandt](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.<sup>1087</sup>



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,

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<sup>1087</sup> Phosphorus - Element information, properties and uses ... [www.rsc.org/periodic-table/element/15/phosphorus](http://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.<sup>1088</sup>

**11,669 HE:** ISAAC ASIMOV notes two discoveries were made at this time, which took many additional years of general scientific advancement to be explained.<sup>1089</sup>

⇒ 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

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<sup>1088</sup> <http://images-of-elements.com/phosphorus.php#a>

<sup>1089</sup> 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;<sup>1090</sup> 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.<sup>1091</sup>

**11,670 HE – 11,720 HE:** MARIA MARGARETHE WINKELMANN KIRCH, German unpaid Astronomer<sup>1092</sup> was a famous astronomer of her period due to her writings on the conjunction of the sun with

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<sup>1090</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

<sup>1091</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 162

<sup>1092</sup> Author / Compiler does not record where she first learned of KIRCH

Saturn, Venus, and Jupiter in **11,709 HE** and **11,712 HE** respectively.<sup>1093</sup>

⇒ On **April 21, 11,702 HE**, while making her regular nighttime observations, MARIA KIRCH discovered a previously unknown comet, the so-called "Comet of 1702" (C/1702 H1), becoming the first woman to record making such a discovery.<sup>1094</sup>

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<sup>1093</sup> [https://en.wikipedia.org/wiki/Maria\\_Margarethe\\_Kirch](https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch)

<sup>1094</sup> [https://en.wikipedia.org/wiki/Maria\\_Margarethe\\_Kirch](https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch)



Verbreiteter Januarius. Sonnet.			
Sonnet.		1. Jan.	2. Jan.
1. Sonntag	1. Jan.	1. Jan.	1. Jan.
2. Sonntag	2. Jan.	2. Jan.	2. Jan.
3. Sonntag	3. Jan.	3. Jan.	3. Jan.
4. Sonntag	4. Jan.	4. Jan.	4. Jan.
5. Sonntag	5. Jan.	5. Jan.	5. Jan.
6. Sonntag	6. Jan.	6. Jan.	6. Jan.
7. Sonntag	7. Jan.	7. Jan.	7. Jan.
8. Sonntag	8. Jan.	8. Jan.	8. Jan.
9. Sonntag	9. Jan.	9. Jan.	9. Jan.
10. Sonntag	10. Jan.	10. Jan.	10. Jan.
11. Sonntag	11. Jan.	11. Jan.	11. Jan.
12. Sonntag	12. Jan.	12. Jan.	12. Jan.
13. Sonntag	13. Jan.	13. Jan.	13. Jan.
14. Sonntag	14. Jan.	14. Jan.	14. Jan.
15. Sonntag	15. Jan.	15. Jan.	15. Jan.
16. Sonntag	16. Jan.	16. Jan.	16. Jan.
17. Sonntag	17. Jan.	17. Jan.	17. Jan.
18. Sonntag	18. Jan.	18. Jan.	18. Jan.
19. Sonntag	19. Jan.	19. Jan.	19. Jan.
20. Sonntag	20. Jan.	20. Jan.	20. Jan.
21. Sonntag	21. Jan.	21. Jan.	21. Jan.
22. Sonntag	22. Jan.	22. Jan.	22. Jan.
23. Sonntag	23. Jan.	23. Jan.	23. Jan.
24. Sonntag	24. Jan.	24. Jan.	24. Jan.
25. Sonntag	25. Jan.	25. Jan.	25. Jan.
26. Sonntag	26. Jan.	26. Jan.	26. Jan.
27. Sonntag	27. Jan.	27. Jan.	27. Jan.
28. Sonntag	28. Jan.	28. Jan.	28. Jan.
29. Sonntag	29. Jan.	29. Jan.	29. Jan.
30. Sonntag	30. Jan.	30. Jan.	30. Jan.
31. Sonntag	31. Jan.	31. Jan.	31. Jan.



Circa 11,701 HE: The data collected by MARIA KIRCH and her husband, GOTTFRIED KIRCH were used to produce calendars and almanacs and were also very useful in navigation. The academy in Berlin handled sales of their calendars.<sup>1095</sup>

<sup>1095</sup> [https://en.wikipedia.org/wiki/Maria\\_Margarethe\\_Kirch](https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch)

⇒ Details of January 1 -15 of the Chur-Brandenburgischer Calendar for **11,701 HE** pictured below: The first column lists the days in the week, the second column gives the name day, the third column predicts the zodiac in which the moon would stand that day, while the fourth column either contains astronomical information – “1th January conjunction of Saturn and Mars, 9th January new moon” – or vague weather predictions – “12th and 13th January snow or just rain”. At the bottom of the page the daylight hours, and the time the sun will rise and set is predicted for every fifth day.<sup>1096</sup>

**11,675 HE – 11,759 HE:** JOHN LETHBRIDGE, English wool merchant based in Newton Abbot (Devon, England) who invented

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<sup>1096</sup> [https://en.wikipedia.org/wiki/Maria\\_Margarethe\\_Kirch](https://en.wikipedia.org/wiki/Maria_Margarethe_Kirch)

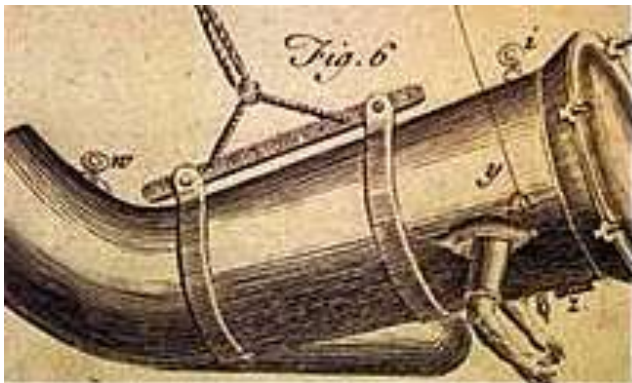
a diving barrel in **11,715 HE** and successfully salvaged valuables from wrecks.<sup>1097</sup>

⇒ 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."<sup>1098</sup>

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<sup>1097</sup> [https://en.wikipedia.org/wiki/John\\_Lethbridge](https://en.wikipedia.org/wiki/John_Lethbridge)

<sup>1098</sup> [https://en.wikipedia.org/wiki/John\\_Lethbridge](https://en.wikipedia.org/wiki/John_Lethbridge)



JOHN LETHBRIDGE'S diving dress, artist, date and location not known.<sup>1099</sup>

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<sup>1099</sup> [https://en.wikipedia.org/wiki/John\\_Lethbridge](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.<sup>1100</sup>

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<sup>1100</sup> [https://en.wikipedia.org/wiki/John\\_Lethbridge](https://en.wikipedia.org/wiki/John_Lethbridge)

**Circa 11,676 HE:** ANTONI VAN LEEUWENHOEK, Dutch microscopist<sup>1101</sup> 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.<sup>1102</sup>

⇒ 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

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<sup>1101</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1102</sup> 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.<sup>1103</sup>



A portrait of ANTONIE VAN LEEUWENHOEK by Jan Verkolje, date and location unknown.<sup>1104</sup>

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<sup>1103</sup> [https://en.wikipedia.org/wiki/Antonie\\_van\\_Leeuwenhoek](https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek)

<sup>1104</sup> [https://en.wikipedia.org/wiki/Antonie\\_van\\_Leeuwenhoek](https://en.wikipedia.org/wiki/Antonie_van_Leeuwenhoek)

**11,677 HE– 11,761 HE:** STEPHEN HALES, English, made major contributions to a range of scientific fields including botany, pneumatic chemistry, and physiology.<sup>1105</sup>

⇒ 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.<sup>1106</sup>

⇒ STEPHEN HALES was the first person to collect gases by bubbling them through water and trapping them in an upside-down vessel.<sup>1107</sup>

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<sup>1105</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1106</sup> [https://en.wikipedia.org/wiki/Stephen\\_Hales](https://en.wikipedia.org/wiki/Stephen_Hales)

<sup>1107</sup> 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.<sup>1108</sup>



⇒ STEPHEN HALES, aged 82, by J. McArdell after T. Hudson, location unknown.<sup>1109</sup>

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<sup>1108</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1109</sup> [https://en.wikipedia.org/wiki/Stephen\\_Hales](https://en.wikipedia.org/wiki/Stephen_Hales)

**11,678 HE – 11,761 HE:** Dr. PIERRE FAUCHARD, French dentist who is considered the “*Father of Dentistry*”.<sup>1110</sup>

- ⇒ In **11,728 HE** FAUCHARD published the first book entirely devoted to dentistry: *Le Chirurgien Dentiste* (The Dental Surgeon). He discussed artificial dentures and crowns and described how to treat caries by cleaning out the decay and making use of metal fillings.<sup>1111</sup>
- ⇒ 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

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<sup>1110</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*

<sup>1111</sup> 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 lead, tin, and sometimes gold.<sup>1112</sup>

- Author / Compiler note: Lead? ...because information of the horrors of lead in humans was lost. (See: **Circa 9,855 HE – Circa 10,529 HE**: Antiquity Roman Empire and their roman slaves who died screaming after working with lead.)

⇒ FAUCHARD also said that teeth should be cleaned periodically by a dentist; FAUCHARD said that braces should be used to correct the position of teeth, and that children's teeth could be moved more easily and quickly than adults', a result of the size

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<sup>1112</sup> [https://en.wikipedia.org/wiki/Pierre\\_Fauchard](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.<sup>1113</sup>

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<sup>1113</sup> [https://en.wikipedia.org/wiki/Pierre\\_Fauchard](https://en.wikipedia.org/wiki/Pierre_Fauchard)



FAUCHARD by J. Le. Bel, location and date unknown.<sup>1114</sup>

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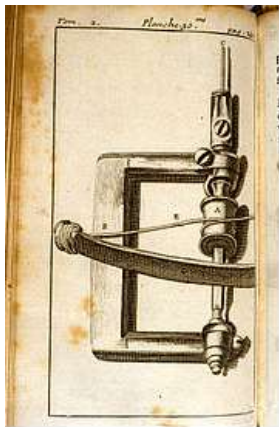
<sup>1114</sup> [https://en.wikipedia.org/wiki/Pierre\\_Fauchard](https://en.wikipedia.org/wiki/Pierre_Fauchard)



**Drawings of Late 11,600'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).<sup>1115</sup>

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<sup>1115</sup> [https://en.wikipedia.org/wiki/Pierre\\_Fauchard](https://en.wikipedia.org/wiki/Pierre_Fauchard)



Drawing of Dr. PIERRE FAUCHARD's late 11,600's HE bigger dentist's drill.<sup>1116</sup>

<sup>1116</sup> [https://en.wikipedia.org/wiki/Pierre\\_Fauchard](https://en.wikipedia.org/wiki/Pierre_Fauchard)

**Circa 11,680 HE:** GIOVANNI ALFONSO BORELLI, Italian Physiologist, and Physicist and Mathematician. BORELLI's book was posthumously published *De Motu Animalium* where he successfully explained muscular action on a mechanical system of levers basis.<sup>1117</sup>



GIOVANNI ALFONSO BORELLI, date, location, and artist unknown.<sup>1118</sup>

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<sup>1117</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 167

<sup>1118</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Alfonso\\_Borelli](https://en.wikipedia.org/wiki/Giovanni_Alfonso_Borelli)



**Circa 11,681 HE:** Disputably the first steam powered vehicle was invented by RP VERBIEST, missionary, who lived in China from **11,672 HE** to **11,686 HE**. VERBIEST created a very interesting vehicle to distract the Emperor of China and his court. The steam carriage in question is described in Latin in the book by father VERBIEST, *Astronomia Europae*. Historians do not agree on the exact date of the realization of the vehicle. Some locate it in **11,681 HE**. But, according to no less reliable Chinese texts, the test took place in **11,679 HE**.<sup>1119</sup>

⇒ 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

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<sup>1119</sup> <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.<sup>1120</sup>



Modern depiction of the ancient disputed first steam powered vehicle, artist and date unknown.<sup>1121</sup>

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<sup>1120</sup> <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

<sup>1121</sup> <http://users.skynet.be/tintinpassion/VOIRSAVOIR>

## 11,686 HE – 11,736 HE: DANIEL GABRIEL FAHRENHEIT:

Polish/Dutch physicist, engineer, and glass blower who is known for in **11,714 HE** inventing the mercury-in-glass thermometer, and for developing a temperature scale now named after him.



FAHRENHEIT, artist, date and location unknown.<sup>1122</sup>

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<sup>1122</sup> [https://en.wikipedia.org/wiki/Daniel\\_Gabriel\\_Fahrenheit](https://en.wikipedia.org/wiki/Daniel_Gabriel_Fahrenheit)

**Circa 11,688 HE:** In France: Clear Plate Glass could by now be used in rooms to allow in light and keep out weather. No name mentioned as being the scientist who discovered how to make plate glass, but circa 4,187 years after the luxury item of clear glass was first *used* (see **7,501 HE**), the art or science of pressing or casting glass – by methods other than blowing – was developed. At first the sheets were quite small, but little by little they increased in size and larger sheets were being made for mirrors or coach windows. This meant that glass was becoming less expensive and more common.<sup>1123</sup>

**11,693 HE - 11,776 HE:** JOHN HARRISON, British, carpenter and clockmaker<sup>1124</sup> who invented how to define Longitude and who was the first to make an accurate, portable timepiece that did not

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<sup>1123</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1124</sup> Dava Sobel's book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*

rely on a pendulum. It is said that the British Empire grew into the 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.

- ⇒ **11,761 HE:** JOHN HARRISON awarded the prize from the Roayl Society Board of Longitude for HARRISON had defined Longitude at sea by creating the first independent movement clock: “H1”. He invented, designed and built the world's first successful marine chronometers and subsequently built “H2”, “H3”, “H4”, “H5” and “The Watch”.<sup>1125</sup>

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<sup>1125</sup> Dava Sobel's book: *Longitude: The True Story of a Lone Genius Who Solved the Greatest Scientific Problem of His Time*



P.L. Tassaert's half-tone print of Thomas King's original **11,767** **HE** portrait of JOHN HARRISON, located at the Science and Society Picture Library, England. Note his hand is open, but “The Watch” which was elsewhere during the sitting of the painting was not included in his open hand.<sup>1126</sup>

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<sup>1126</sup> [https://en.wikipedia.org/wiki/John\\_Harrison](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.<sup>1127</sup>

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<sup>1127</sup> <https://www.youtube.com/watch?v=T-g27KS0yiY>

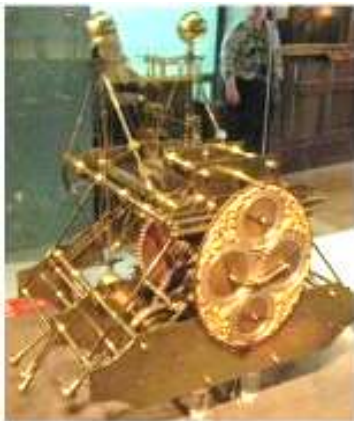


Harrison's "The Watch" No.1 (H4), with winding crank, location and photographer unknown.<sup>1128</sup>

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<sup>1128</sup> [https://en.wikipedia.org/wiki/John\\_Harrison](https://en.wikipedia.org/wiki/John_Harrison)





JOHN HARRISON's first sea clock (H1) at the Royal Observatory, Greenwich<sup>1129</sup>

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<sup>1129</sup> [https://en.wikipedia.org/wiki/John\\_Harrison](https://en.wikipedia.org/wiki/John_Harrison)



Harrison's Chronometer H5, (Collection of the Worshipful Company of Clockmakers), in the Science Museum, London.<sup>1130</sup>

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<sup>1130</sup> [https://en.wikipedia.org/wiki/John\\_Harrison](https://en.wikipedia.org/wiki/John_Harrison)

**11,693 HE – 11,762 HE: JAMES BRADLEY**<sup>1131</sup>, FRS, English astronomer who served as Astronomer Royal from **11,742 HE**, succeeding EDMOND HALLEY.<sup>1132</sup> BRADLEY is best known for two fundamental discoveries in astronomy:

- ⇒ JAMES BRADLEY discovered *The Aberration of Light*<sup>1133</sup> which ASIMOV says, “is a more accurate way of calculating the speed of light” (See **11,644 HE – 11,710 HE: OLE ROEMER**);
- ⇒ JAMES BRADLEY discovered the *Nutation of the Earth's Axis*, which is a phenomenon which causes the orientation of the axis

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<sup>1131</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 188

<sup>1132</sup> [https://en.wikipedia.org/wiki/James\\_Bradley](https://en.wikipedia.org/wiki/James_Bradley)

<sup>1133</sup> 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.<sup>1134</sup>



JAMES BRADLEY, date, location, and artist unknown.<sup>1135</sup>

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<sup>1134</sup> [https://en.wikipedia.org/wiki/Astronomical\\_nutation](https://en.wikipedia.org/wiki/Astronomical_nutation)

<sup>1135</sup> [https://en.wikipedia.org/wiki/James\\_Bradley](https://en.wikipedia.org/wiki/James_Bradley)

**11,703 HE – 11,771 HE:** CHESTER MOOR HALL (MOOR may also be spelled MOORE), British lawyer and inventor who noticed what ISAAC NEWTON (see **11,642 HE– 11,727 HE:** SIR ISAAC NEWTON) had missed:

- That different kinds of glass produced different spectra of different widths.<sup>1136</sup> <sup>1137</sup> **11,729 HE or 11,733 HE** (accounts differ). CHESTER MOOR HALL saw that Flint Glass, containing lead, produced a rather wider spectrum than ordinary crown or window glass. HALL made a convex lens out of the crown glass and a concave lens out of the Flint glass in a way that when the 2 were fit together they formed a biconvex lens. The end results were the achromatic lens

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<sup>1136</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

<sup>1137</sup> [https://en.wikipedia.org/wiki/Chester\\_Moore\\_Hall](https://en.wikipedia.org/wiki/Chester_Moore_Hall)

which would have no color and magnify an object. HALL built the first refracting telescope free from chromatic aberration (free from color distortion).<sup>1138 1139</sup>

- **11,757 HE:** Since CHESTER MOOR HALL did not publicize his invention properly, and in **11,757 HE** JOHN DOLLOND did publicize his achromatic lens, DOLLOND got more credit. (SEE **Circa 11,021 HE**, IBN AL-HAYTHAM.)<sup>1140</sup>

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<sup>1138</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 189

<sup>1139</sup> [https://en.wikipedia.org/wiki/Chester\\_Moore\\_Hall](https://en.wikipedia.org/wiki/Chester_Moore_Hall)

<sup>1140</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

## Chapter Five

# **THE INDUSTRIAL REVOLUTION: Circa 11,760 HE - Now (lasting, so far, less than 300 years, part of the Scientific Revolution)**

The Industrial Revolution encompasses the changes in economic and social organization on our planet which continues today, and which began around **11,760 HE** in Great Britain and later in other countries. Wikipedia places the Industrial Revolution as beginning in about **11,760 HE**, but many industrial inventions and processes were started much earlier. This period is characterized chiefly by the replacement of hand tools with power-driven machines such as

the power loom, the steam engine, and by the concentration of industry in large establishments.<sup>1141</sup>

⇒ “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.”<sup>1142</sup>

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<sup>1141</sup> [https://en.wikipedia.org/wiki/Industrial\\_Age](https://en.wikipedia.org/wiki/Industrial_Age)

<sup>1142</sup> SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*



**Circa 11,700 HE:** The world population was approximately 610,000,000 people.<sup>1143</sup>

**11,704 HE – 11,764 HE:** JOHN KAY, British machinist was the inventor of the flying shuttle, which was another key contribution to the Industrial Revolution.<sup>1144</sup> In July **11,733 HE**, JOHN KAY received a patent for his most revolutionary device: a "wheeled shuttle" for the hand weaving loom.<sup>1145</sup> (See **11,563 HE – 11,614 HE:** WILLIAM LEE and the first mechanical knitting machine.) But by September **11,733 HE** the Colchester weavers were so concerned for their livelihoods that they petitioned the King to stop Kay's inventions. JOHN KAY suffered violent treatment in England (fear of technological unemployment), but he did not

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<sup>1143</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>1144</sup> ISAAC ASIMOV'S *Chronology of Science and Discovery*, page 190

<sup>1145</sup> [https://en.wikipedia.org/wiki/John\\_Kay\\_\(flying\\_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

leave the country on that account, but instead because of his inability to enforce (or profit from) his patent rights.<sup>1146</sup> **11,747 HE:** JOHN KAY left England, went to Paris, and negotiated with the French Government (in English) to sell them his hand weaving loom technology.<sup>1147</sup>

⇒ **11,753 HE:** The beginning of mechanization in French textile production is traditionally dated to this year, with the widespread adoption of the flying shuttle there.<sup>1148</sup> **11,760 HE:** JOHN KAY'S son, ROBERT KAY, stayed in Britain and developed the "drop-box", which enabled looms to use multiple flying shuttles simultaneously, allowing multicolor wefts.<sup>1149</sup>

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<sup>1146</sup> [https://en.wikipedia.org/wiki/John\\_Kay\\_\(flying\\_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

<sup>1147</sup> [https://en.wikipedia.org/wiki/John\\_Kay\\_\(flying\\_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

<sup>1148</sup> [https://en.wikipedia.org/wiki/John\\_Kay\\_\(flying\\_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))

<sup>1149</sup> [https://en.wikipedia.org/wiki/John\\_Kay\\_\(flying\\_shuttle\)](https://en.wikipedia.org/wiki/John_Kay_(flying_shuttle))



Portrait on the JOHN KAY Memorial.<sup>1150</sup>

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<sup>1150</sup> [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.<sup>1151</sup>

**11,706 HE:** Although he does not say where, or by whom, ISSAC ASIMOV says that it was this year when springs were added to carriages to make their jolting and uneven ride easier. To be sure, ISSAC ASIMOV says, this induced swaying, but springs were

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<sup>1151</sup> [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.<sup>1152</sup>

**11,706 HE - 11,749 HE:** GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL, MARQUISE DU CHÂTELET,<sup>1153</sup> French natural philosopher, mathematician, physicist, editor, and member of the Academy of Sciences of the Institute of Bologna.<sup>1154</sup> DU CHÂTELET introduced the idea of “Conservation of Energy” where “energy cannot be created or destroyed”.<sup>1155</sup>

⇒ **11,737 HE:** DU CHÂTELET published a paper entitled *Dissertation sur la nature et la propagation du feu*, based upon

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<sup>1152</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 180

<sup>1153</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>1154</sup> <https://en.wikipedia.org> Emelie Du Chatelet

<sup>1155</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

her research into the science of fire, that predicted what is today known as infrared radiation and the nature of light.

- ⇒ **11,740 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 **11,746 HE**.<sup>1156</sup>
- ⇒ 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

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<sup>1156</sup> <https://en.wikipedia.org> Emelie Du Chatelet

physics. DU CHÂTELET's French translation, published posthumously in **11,759 HE**, is still considered the standard French translation today. Her commentary includes a profound contribution to Newtonian mechanics — the postulate of an additional conservation law for total energy, of which kinetic energy of motion is one element.<sup>1157</sup>

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<sup>1157</sup> [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.<sup>1158</sup>

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<sup>1158</sup> <https://en.wikipedia.org> Emelie Du Chatelet





**11,741 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.<sup>1159</sup>

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<sup>1159</sup> <https://en.wikipedia.org> Emelie Du Chatelet



GABRIELLE ÉMILIE LE TONNELIER DE BRETEUIL,  
MARQUISE DU CHÂTEL CHÂTELET's book: ***Dissertation  
Sur La Nature et La Propagation du feu***, 11,744 HE<sup>1160</sup>

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<sup>1160</sup> <https://en.wikipedia.org> Emelie Du Chatelet

**11,706 HE – 11,790 HE:** BENJAMIN FRANKLIN, American. A renowned polymath of his time, leading editor, printer, political theorist, politician, freemason, postmaster, scientist, inventor, civic activist, statesman, and diplomat.<sup>1161</sup> 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*.<sup>1162</sup>

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<sup>1161</sup> [https://en.wikipedia.org/wiki/Benjamin\\_Franklin](https://en.wikipedia.org/wiki/Benjamin_Franklin)

<sup>1162</sup> [https://en.wikipedia.org/wiki/Benjamin\\_Franklin](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.<sup>1163</sup>

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<sup>1163</sup> [https://en.wikipedia.org/wiki/Benjamin\\_Franklin](https://en.wikipedia.org/wiki/Benjamin_Franklin)

**11,707 HE:** JOHN FLOYER, English physician who devised a *pulse watch*, which after winding would run for exactly one minute. JOHN FLOYER's *pulse watch* was the first precision instrument that could be used by physicians.<sup>1164</sup> (See Circa **11,451 HE:** when circa 256 years ago NICHOLAS OF CUSA devised a way to count pulses based on the drips of the then available technology of the water clock.)<sup>1165</sup>

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<sup>1164</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 180

<sup>1165</sup> [https://en.wikipedia.org/wiki/Nicholas\\_of\\_Cusa](https://en.wikipedia.org/wiki/Nicholas_of_Cusa)



JOHN FLOYER. Credit: Wellcome Library, date unknown.<sup>1166</sup>

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<sup>1166</sup> [https://en.wikipedia.org/wiki/John\\_Floyer\\_\(physician\)](https://en.wikipedia.org/wiki/John_Floyer_(physician))

**11,707 HE – 11,788 HE:** GEORGES-LOUIS LECLERC, COMTE de BUFFON, French Naturalist<sup>1167</sup> wrote *Histoire Naturelle, Générale et Particulière* (**11,749 HE–11,788 HE**) in 36 volumes; an additional volume based on his notes appeared in **11,789 HE**. The *Histoire Naturelle* ended up focusing on the animal and mineral kingdoms.<sup>1168</sup>

⇒ 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..."<sup>1169</sup>

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<sup>1167</sup> Jennifer Ouellete, The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack

<sup>1168</sup> [https://en.wikipedia.org/wiki/Georges-Louis\\_Leclerc,\\_Comte\\_de\\_Buffon](https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon)

<sup>1169</sup> [https://en.wikipedia.org/wiki/Georges-Louis\\_Leclerc,\\_Comte\\_de\\_Buffon](https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon)



GEORGES-LOUIS LECLERC, COMTE de BUFFON, date, location, and artist unknown.<sup>1170</sup>

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<sup>1170</sup> [https://en.wikipedia.org/wiki/Georges-Louis\\_Leclerc,\\_Comte\\_de\\_Buffon](https://en.wikipedia.org/wiki/Georges-Louis_Leclerc,_Comte_de_Buffon)



**11,709 HE:** ABRAHAM DARBY THE ELDER, developed a method of producing pig iron in a blast furnace fueled by coke rather than charcoal. This was a major step forward in the production of iron as a raw material for the Industrial Revolution.<sup>1171 1172</sup>

⇒ His method of casting pots in sand provided his successors with a viable business that operated for over two centuries. Smelting iron with coke ultimately released the iron industry from the limitation imposed by the speed of growth of trees. Coke-smelted cast iron went into steam engines, bridges, and many of the inventions of the **11,800's HE**. Only with coke smelting could there be produced the great quantities of iron made to meet the requirements of the Industrial Revolution.<sup>1173</sup>

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<sup>1171</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 181

<sup>1172</sup> [https://en.wikipedia.org/wiki/Abraham\\_Darby\\_I](https://en.wikipedia.org/wiki/Abraham_Darby_I)

<sup>1173</sup> [https://en.wikipedia.org/wiki/Abraham\\_Darby\\_I](https://en.wikipedia.org/wiki/Abraham_Darby_I)

**Circa 11,712 HE:** THOMAS NEWCOMEN, English inventor. Based on THOMAS SAVERY's patent, NEWCOMEN enhanced another Steam Engine for lifting water from mines.<sup>1174</sup> (See Circa **10,050 HE:** HERO of ALEXANDRIA.)



THOMAS NEWCOMEN, Memorial Steam Engine in

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<sup>1174</sup> [https://en.wikipedia.org/wiki/Thomas\\_Newcomen](https://en.wikipedia.org/wiki/Thomas_Newcomen)

Dartmouth. The Atmospheric Steam Engine kept failing.  
Photographer unknown.<sup>1175</sup>

**11,713 HE:** Smallpox was the dread disease of this time. This was the year that LADY MARY WORTLEY MONTAGU brought news from Turkey (her husband was British ambassador to Turkey) that they were inoculating people with pus from the people with mild cases of Smallpox. Those inoculations were like playing Russian Roulette because sometimes they worked and sometimes they didn't. Nevertheless, for 75 years people submitted to such inoculations.<sup>1176</sup>

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<sup>1175</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

<sup>1176</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 183



**Circa 11,756 HE: LADY MONTAGU in Turkish dress by Jean-Étienne Liotard, Palace on the Water in Warsaw.<sup>1177</sup>**

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<sup>1177</sup> [https://en.wikipedia.org/wiki/Lady\\_Mary\\_Wortley\\_Montagu](https://en.wikipedia.org/wiki/Lady_Mary_Wortley_Montagu)

**11,714 HE – 11,784 HE: CÉSAR-FRANÇOIS CASSINI DE THURY,**  
(Cassini III), French Astronomer; was CASSINI II's second son.

- ⇒ He succeeded Cassini II as astronomer at Paris Observatory.
- ⇒ He continued the surveying operations started by Cassini I and Cassini II and began construction of one of the landmarks of historical cartography: the topographical map of France. Its 180 plates are known as the Cassini Map.<sup>1178</sup>

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<sup>1178</sup> [https://en.wikipedia.org/wiki/C%C3%A9sar-Fran%C3%A7ois\\_Cassini\\_de\\_Thury](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.<sup>1179</sup>

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<sup>1179</sup> [https://en.wikipedia.org/wiki/C%C3%A9sar-Fran%C3%A7ois\\_Cassini\\_de\\_Thury](https://en.wikipedia.org/wiki/C%C3%A9sar-Fran%C3%A7ois_Cassini_de_Thury)



Hand-drawn map of one side of the Valley of Vesdre by French geographers (led by the Cassini family) from **11,745 HE** to **11,748 HE**, location unknown.<sup>1180</sup>

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<sup>1180</sup> [https://en.wikipedia.org/wiki/French\\_cartography#Cassini\\_maps](https://en.wikipedia.org/wiki/French_cartography#Cassini_maps)

**Circa 11,715 HE: THE CHEVALIER (SIR) PIERRE RÉMY DE BEAUVE**, a French aristocrat who served as garde de la marine in Brest, built one of the oldest known diving dresses.

⇒ Different than JOHN LETHBRIDGES diving barrel (See **11,675 HE – 11,759 HE: JOHN LETHBRIDGE**), DE BEAUVE's dress was equipped with a metal helmet and two hoses, one of them air-supplied from the surface by a bellows and the other one for evacuation of the exhaled air.<sup>1181</sup>

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<sup>1181</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_diving\\_technology](https://en.wikipedia.org/wiki/Timeline_of_diving_technology)



**11,718 HE – 11,799 HE:** MARIA GAETANA AGNESI, Italy, Mathematician was the first woman to write a mathematics handbook *Instituzioni analitiche ad uso della gioventù italiana* (*Analytical Institutions for the Use of Italian Youth*).

- ⇒ AGNESI was the first woman appointed as a Mathematics Professor at a university.
- ⇒ AGNESI could speak Italian, French, Greek, Hebrew, Spanish, German, and Latin by age 13.<sup>1182</sup>

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<sup>1182</sup> 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  
unknown<sup>1183</sup>

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<sup>1183</sup> [https://en.wikipedia.org/wiki/Maria\\_Gaetana\\_Agnesi](https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi)



**11,748 HE:** First page of MARIA GAETANA AGNESI's *Instituzioni analitiche*<sup>1184</sup>

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<sup>1184</sup> [https://en.wikipedia.org/wiki/Maria\\_Gaetana\\_Agnesi](https://en.wikipedia.org/wiki/Maria_Gaetana_Agnesi)

**11,725 HE – 11,804 HE:** NICOLAS-JOSEPH CUGNOT,<sup>1185</sup> French inventor who built disputably (see Circa **11,680 HE:** RP VERBIEST) the first working self-propelled land-based mechanical vehicle: the world's first automobile<sup>1186</sup> fueled by hydrogen.<sup>1187</sup>

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<sup>1185</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

<sup>1186</sup> [https://en.wikipedia.org/wiki/Nicolas-Joseph\\_Cugnot](https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot)

<sup>1187</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)



NICOLAS-JOSEPH CUGNOT's **11,770 HE** fardier à vapeur, as preserved at the Musée des Arts et Métiers, Paris.<sup>1188</sup>

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<sup>1188</sup> [https://en.wikipedia.org/wiki/Nicolas-Joseph\\_Cugnot](https://en.wikipedia.org/wiki/Nicolas-Joseph_Cugnot)

**Circa 11,725 HE – 11,798 HE:** Giacomo Girolamo Casanova AKA “Casanova”, Europe (not a scientist, but as Author / Compiler is trying to report on the science of population and birth control methods through recorded history) was one of the first reported using “assurance caps” to prevent impregnating his mistresses.<sup>1189</sup>  
<sup>1190</sup> Casanova was said to have inserted the rind of half a lemon into his lovers as a primitive cervical cap or diaphragm, also

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<sup>1189</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1190</sup> [https://en.wikipedia.org/wiki/Giacomo\\_Casanova](https://en.wikipedia.org/wiki/Giacomo_Casanova); Fryer, Peter (11,965 HE). **The Birth Controllers**. London: Secker & Warburg and Dingwall EJ (11,953 HE). “**Early contraceptive sheaths**”, and **A Brief history of condoms**. In Mindel, Adrian. *Condoms*. BMJ Books. ISBN 978-0-7279-1267-1. Br Med J. 1 (4800): 40–1. doi:10.1136/bmj.1.4800.40. PMC 2015111. PMID 12997834.

known as the “assurance cap”. Another of his inventions was a primitive condom designed out of the gut or bladder of sheep.<sup>1191</sup>

**11,726 HE- 11,797 HE: JAMES HUTTON**, was a Scottish geologist, naturalist, experimental agriculturalist,<sup>1192</sup> physician, and chemical manufacturer.

⇒ HUTTON was a Fellow of the Royal Society of Edinburgh.<sup>1193</sup>  
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

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<sup>1191</sup> <http://www.futurescopes.com/romance/love-and-sex/3245/10-unusual-contraceptive-methods-history>

<sup>1192</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

<sup>1193</sup> [https://en.wikipedia.org/wiki/James\\_Hutton](https://en.wikipedia.org/wiki/James_Hutton)

result HUTTON is referred to as the "*Father of Modern Geology*".<sup>1194</sup>

- ⇒ Through observation and carefully reasoned geological arguments, JAMES HUTTON came to believe that the Earth was perpetually being formed; he recognized that the history of Earth could be determined by understanding how processes such as erosion and 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.<sup>1195</sup>
- ⇒ JAMES HUTTON knew JAMES WATT (see **11,736 HE-11,819 HE: JAMES WATT**). JAMES WATT used heat to run steam engines, and HUTTON wondered if heat within the earth

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<sup>1194</sup> [https://en.wikipedia.org/wiki/James\\_Hutton](https://en.wikipedia.org/wiki/James_Hutton)

<sup>1195</sup> [https://en.wikipedia.org/wiki/James\\_Hutton](https://en.wikipedia.org/wiki/James_Hutton)



could be the engine that drives geological change. Scientists had seen volcanoes, but prior to HUTTON they thought they were small isolated fires. He theorized that the center of the planet was the heat source.<sup>1196</sup> See list of interesting works by JAMES HUTTON<sup>1197</sup>

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<sup>1196</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

<sup>1197</sup> [https://en.wikipedia.org/wiki/James\\_Hutton](https://en.wikipedia.org/wiki/James_Hutton)



**11,776 HE: JAMES HUTTON** painted by Sir Henry Raeburn,  
location unknown.<sup>1198</sup>

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<sup>1198</sup> [https://en.wikipedia.org/wiki/James\\_Hutton](https://en.wikipedia.org/wiki/James_Hutton)

**11,728 HE – 11,799 HE: JOSEPH BLACK**, Scottish physician and chemist is known for his discoveries of latent heat (the theory of latent heat marks the beginning of thermodynamics), specific heat, and of Carbon Dioxide.



**JOSEPH BLACK** by James Tassie. Hunterian Museum, Glasgow.<sup>1199</sup>

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<sup>1199</sup> [https://en.wikipedia.org/wiki/Joseph\\_Black](https://en.wikipedia.org/wiki/Joseph_Black)

**11,730 HE:** GEORG BRANDT, Swedish chemist, defined and named the “Star Stuff” element Cobalt.<sup>1200</sup>



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,  $\text{CoAl}_2\text{O}_4$ , is one of the most important blue colorants for glass and ceramics. Also, Cobalt is

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<sup>1200</sup> 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.<sup>1201</sup>

**11,731 HE - 11,810 HE: HENRY CAVENDISH**, British, natural philosopher, magnificently shy and retiring<sup>1202</sup> scientist, and an important experimental, theoretical chemist and physicist<sup>1203</sup> who turned his house in Clapham into a large laboratory where he could range undisturbed through every corner of the physical sciences- electricity, heat, gravity, gases and anything having to do with the composition of matter. **11,766 HE CAVENDISH** isolated the “Star Stuff” element Hydrogen.<sup>1204 1205</sup> He made a string of signal discoveries- among which he was the first person to combine

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<sup>1201</sup> <http://images-of-elements.com/cobalt.php#a>

<sup>1202</sup> Bill Bryson Short History of Nearly Everything ebook

<sup>1203</sup> [https://en.wikipedia.org/wiki/Henry\\_Cavendish](https://en.wikipedia.org/wiki/Henry_Cavendish)

<sup>1204</sup> [https://en.wikipedia.org/wiki/Henry\\_Cavendish](https://en.wikipedia.org/wiki/Henry_Cavendish)

<sup>1205</sup> 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 **11,800's** **HE** when the amazing JAMES CLERK MAXWELL took on the task of editing CAVENDISH's papers. MAXWELL discovered that CAVENDISH, prior to others had either discovered or anticipated "The Law of Conservation", "Ohm's Law", "Dalton's Law of Partial Pressures", "Richter's Law of Reciprocal Proportions", "Charles Law of Gasses", had left clues that led directly to the discovery of the group of elements known as the

noble gases, and the principles of electrical conductivity.<sup>1206</sup> 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 **11,915 HE**, on the effect of local atmospheric cooling...the work of PICKERING on freezing mixtures, and some of the work of ROOSEBOOM on heterogeneous equilibria”.<sup>1207</sup>

⇒ **11,797 HE:** HENRY CAVENDISH’S last known experiment was to measure the density of the Earth which has come to be known as the *Cavendish Experiment*.<sup>1208</sup>

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<sup>1206</sup> Bill Bryson Short History of Nearly Everything ebook

<sup>1207</sup> Bill Bryson Short History of Nearly Everything ebook

<sup>1208</sup> [https://en.wikipedia.org/wiki/Henry\\_Cavendish](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 **11,700's HE** version of the late **12,004 HE** Nautilus weight training machine, incorporating weights, counterweights, pendulums, shafts and torsion wires at the heart of which were two 350-pound lead balls, which were suspended beside two smaller spheres ....Bryson skillfully talks about CAVENDISH trying to measure gravity at this extremely featherweight level. With experimental delicacy as a key word to accomplishing the detailed process, he announced the Earth weighed a little over 13,000,000,000,000 or six billion trillion metric tons. Bryson further says even the **12,004 HE** scientists using their equipment which can detect the weight of a single bacterium



have not significantly improved on CAVENDISH's measurements of **11,797 HE**.<sup>1209</sup>



- 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

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<sup>1209</sup> Bill Bryson Short History of Nearly Everything ebook

whole universe is below 1% <sup>1210</sup>). 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, H<sub>2</sub>O, water. But all the complex molecules of life contain hydrogen, too.<sup>1211</sup>

⇒ 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

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<sup>1210</sup> 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

<sup>1211</sup> <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.”<sup>1212</sup>



HENRY CAVENDISH, date, location, and artist unknown.<sup>1213</sup>

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<sup>1212</sup> Bill Bryson Short History of Nearly Everything ebook

<sup>1213</sup> [https://en.wikipedia.org/wiki/Henry\\_Cavendish](https://en.wikipedia.org/wiki/Henry_Cavendish)

**11,732 HE – 11,808 HE: JOSÉ CELESTINO MUTIS<sup>1214</sup>** 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;<sup>1215</sup>**

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<sup>1214</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1215</sup> [https://en.wikipedia.org/wiki/José\\_Celestino\\_Mutis](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.<sup>1216</sup>
- ⇒ NAMESAKES: José Celestino Mutis Botanical Gardens, a park and center of scientific investigation, is named in his honor in Bogotá. It includes climate-controlled exhibits of the flora in all climate zones of Colombia. An exhibit of 5,000 Colombian orchids, one of Colombia's most extensive; The official name of the town of Bahia Solano on Colombia's Pacific coast in the Department of Choco is Puerto Mutis. The airport there is Aeropuerto Jose Celestino Mutis. There is a Street named Celestino Mutis, in Cadiz, Spain.<sup>1217</sup>

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<sup>1216</sup> [https://en.wikipedia.org/wiki/José\\_Celestino\\_Mutis](https://en.wikipedia.org/wiki/José_Celestino_Mutis)

<sup>1217</sup> [https://en.wikipedia.org/wiki/José\\_Celestino\\_Mutis](https://en.wikipedia.org/wiki/José_Celestino_Mutis)

## **Circa 11,733 HE – 11,814 HE: ALEXHANDER CUMMING**

(sometimes CUMMINGS) FRSE: a Scottish watchmaker and instrument inventor, who was the first to patent a design of the indoor flush toilet, which had been pioneered earlier: see **Circa 11,560 HE – 11,612 HE: SIR JOHN HARRINGTON**, but without HARRINGTON solving the problem of foul smells.<sup>1218</sup>

⇒ **11,775 HE:** The S-trap (or bend) was invented by CUMMING to retain water permanently within the bowl, thus preventing sewer gases (those foul smells) from entering buildings. It survives in today's plumbing modified as a U- or J-shaped pipe trap located below or within a plumbing fixture.<sup>1219</sup>

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<sup>1218</sup> [https://en.wikipedia.org/wiki/Alexander\\_Cumming](https://en.wikipedia.org/wiki/Alexander_Cumming)

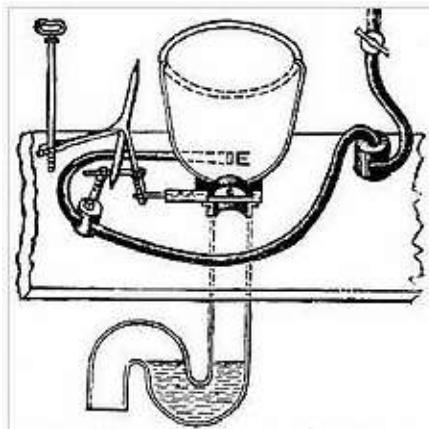
<sup>1219</sup> [https://en.wikipedia.org/wiki/Alexander\\_Cumming](https://en.wikipedia.org/wiki/Alexander_Cumming)



Portrait of ALEXHANDER CUMMING; date, location, artist unknown.<sup>1220</sup>

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<sup>1220</sup> [https://en.wikipedia.org/wiki/Alexander\\_Cumming](https://en.wikipedia.org/wiki/Alexander_Cumming)



**11,775 HE:** CUMMING's patent for the S-trap laid the foundations for the modern flush toilet.<sup>1221</sup>

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<sup>1221</sup> [https://en.wikipedia.org/wiki/Alexander\\_Cumming](https://en.wikipedia.org/wiki/Alexander_Cumming)



**11,736 HE - 11,819 HE: JAMES WATT**, Scottish Inventor, Fellow of the Royal Society of Edinburgh, Fellow of the Royal Society,<sup>1222</sup> Circa **11,781 HE** JAMES WATT gets credit for inventing the steam engine because he took the steam engine designed first by (see circa **10,050 HE: HERO** of ALEXANDRIA and (see circa **11,698 HE** THOMAS SAVERY, and Circa **11,712 HE** THOMAS NEWCOMEN) and added the separate condenser which made the device more energy efficient; enough for WATT and his partner Matthew Boulton to commercialize it and industrially speaking revolutionize the world. But steam engines predate WATT by circa 1,731 to 60 years.<sup>1223</sup>

⇒ JAMES WATT developed the concept of horsepower, and the SI unit of power. The Watt (the power in a circuit in which a

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<sup>1222</sup> [https://en.wikipedia.org/wiki/James\\_Watt](https://en.wikipedia.org/wiki/James_Watt)

<sup>1223</sup> SciShow 5-2-12,016HE 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.<sup>1224</sup>



JAMES WATT Portrait by Carl Frederik von Breda, date and location unknown.<sup>1225</sup>

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<sup>1224</sup> [https://en.wikipedia.org/wiki/James\\_Watt](https://en.wikipedia.org/wiki/James_Watt)

<sup>1225</sup> [https://en.wikipedia.org/wiki/James\\_Watt](https://en.wikipedia.org/wiki/James_Watt)

**11,738 HE – 11,822 HE: WILLIAM HERSCHEL**, British astronomer was the First President of the Royal Astronomical Society and discovered the planet Uranus and two of its moons: Tatiana & Oberon. HERSCHEL discovered 2 moons of Saturn: Enceladus & Mimas; He calculated the rotation speed of Mars; He pioneered the use of spectrophotometry, using prisms & temperature measuring; He discovered infrared radiation.<sup>1226</sup>

⇒ HERSCHEL was the first person to understand that a telescope is a time machine.<sup>1227</sup>

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<sup>1226</sup> [https://en.wikipedia.org/wiki/William\\_Herschel](https://en.wikipedia.org/wiki/William_Herschel)

<sup>1227</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 4

William Herschel



**11,785 HE WILLIAM HERSCHEL** portrait by Lemuel Francis Abbott, location unknown.<sup>1228</sup>

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<sup>1228</sup> [https://en.wikipedia.org/wiki/William\\_Herschel](https://en.wikipedia.org/wiki/William_Herschel)

**11,742 HE – 11,786 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.<sup>1229</sup>

⇒ 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 first<sup>1230</sup>), 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

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<sup>1229</sup> ISAAC ASIMOV: ASIMOV’S Chronology of Science and Discovery

<sup>1230</sup> 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.<sup>1231</sup> CARL WILHELM SCHEELE preferred speaking German to Swedish his whole life, as German was commonly spoken among Swedish pharmacists.<sup>1232</sup>

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<sup>1231</sup> Richard Myers, *The Basics of Chemistry* (12,003 HE)

<sup>1232</sup> Fors, Hjalmar 12,008 HE. Stepping through Science's Door: C. W. Scheele, from Pharmacist's Apprentice to Man of Science. Ambix 55: 29-49



CARL WILHELM SCHEELE, date, location, and artist  
unknown<sup>1233</sup>

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<sup>1233</sup> [https://en.wikipedia.org/wiki/Carl\\_Wilhelm\\_Scheele](https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele)



CARL WILHELM SCHEELÉ *Mémoires de chymie*, 11,785  
 HE, French translation by Mme. Claudine Picardet.<sup>1234</sup>

<sup>1234</sup> [https://en.wikipedia.org/wiki/Carl\\_Wilhelm\\_Scheele](https://en.wikipedia.org/wiki/Carl_Wilhelm_Scheele)



- **11,777 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.<sup>1235</sup>

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<sup>1235</sup> <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,  $\text{As}_2\text{O}_3$ , 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.<sup>1236</sup>
- ⇒ Parsons and Dixon wrote that there was a 5,000-year-old ice mummy- named “Otzi” discovered in **11,991 HE** in the Tirolean Alps who had traces of Arsenic in his body – indicating he was possibly a copper smelter by trade. They further mention that

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<sup>1236</sup> 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.<sup>1237</sup>

**11,743 HE -11,820 HE: SIR JOSEPH BANKS**<sup>1238</sup> first Baronet, GCB, PRS; English naturalist, botanist, and patron of the natural sciences<sup>1239</sup> made his name on the **11,766 HE** natural history expedition to Newfoundland and Labrador. BANKS took part in Captain James Cook's first great voyage (**11,768 HE–11,771 HE**), visiting Brazil, Tahiti, and, after 6 months in New Zealand, Australia, returning to immediate fame. He held the position of President of the Royal Society for over 41 years. He advised King George III on the Royal Botanic Gardens, Kew, and by sending botanists around the world to collect plants, made Kew the world's

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<sup>1237</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1238</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1239</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](https://en.wikipedia.org/wiki/Joseph_Banks)

leading botanical gardens.<sup>1240</sup> 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.<sup>1241</sup> 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

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<sup>1240</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](https://en.wikipedia.org/wiki/Joseph_Banks)

<sup>1241</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](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.<sup>1242</sup>



**SIR JOSEPH BANKS**, as painted by Sir Joshua Reynolds in **11,773 HE.**<sup>1243</sup>

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<sup>1242</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](https://en.wikipedia.org/wiki/Joseph_Banks)

<sup>1243</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](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.<sup>1244</sup>

**11,743 HE – 11,817 HE: MARTIN HEINRICH KLAPROTH**, German Chemist. Discovered the “Star Stuff” Elements: Uranium (**11,789 HE**), Zirconium (**11,789 HE**),<sup>1245</sup> and Titanium (**11,795 HE**).<sup>1246</sup>

⇒ See list of MARTIN HEINRICH KLAPROTH's papers, over 200 in number.<sup>1247</sup>

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<sup>1244</sup> [https://en.wikipedia.org/wiki/Joseph\\_Banks](https://en.wikipedia.org/wiki/Joseph_Banks)

<sup>1245</sup> [https://en.wikipedia.org/wiki/Martin\\_Heinrich\\_Klaproth](https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth)

<sup>1246</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1247</sup> [https://en.wikipedia.org/wiki/Martin\\_Heinrich\\_Klaproth](https://en.wikipedia.org/wiki/Martin_Heinrich_Klaproth)



MARTIN HEINRICH KLAPROTH, date, location and artist  
unknown<sup>1248</sup>

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<sup>1248</sup> [https://en.wikipedia.org/wiki/Martin\\_Heinrich\\_Klaproth](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  $^{238}\text{U}$  with a half-life of 4.5 billion years. The basis for nuclear power plants is the fissile isotope  $^{235}\text{U}$ . 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.<sup>1249</sup>

⇒ **11,789 HE:** “Star Stuff” Element Zirconium was discovered and named by KLAPROTH.<sup>1250</sup>

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<sup>1249</sup> <http://images-of-elements.com/uranium.php#a>

<sup>1250</sup> 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,  $\text{ZrO}_2$ , artificial gemstones can be made, which look very similar to diamonds.<sup>1251</sup>

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<sup>1251</sup> <http://images-of-elements.com/zirconium.php#a>

⇒ **11,795 HE:** “Star Stuff Element: Titanium was discovered and named by KLAPROTH.”<sup>1252</sup>



• 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.<sup>1253</sup> Much

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<sup>1252</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1253</sup> <http://images-of-elements.com/titanium.php#a>

better available than the element Titanium metal itself is titanium dioxide,  $\text{TiO}_2$ , 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.<sup>1254</sup>

**11,744 HE – 11,829 HE: JEAN-BAPTIST PIERRE ANTIONE DE MONET, CHEVALIER DE LAMARCK**, often known as LAMARCK; a French naturalist. soldier, biologist, academic, and an early proponent of the idea that biological evolution occurred and proceeded in accordance with natural laws.<sup>1255</sup> <sup>1256</sup> LAMARK began as an essentialist who believed species were unchanging; however, after working on the mollusks of the Paris Basin, he grew

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<sup>1254</sup> <http://images-of-elements.com/titanium.php#a>

<sup>1255</sup> <https://www.perotmuseum.org>

<sup>1256</sup> [https://en.wikipedia.org/wiki/Jean-Baptiste\\_Lamarck](https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck)

convinced that transmutation or change in the nature of a species occurred over time.<sup>1257</sup>

⇒ 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."<sup>1258</sup> LAMARCK *published* *Système des animaux sans vertèbres*, a major work on the classification of "invertebrates," a term LAMARCK coined.<sup>1259</sup>

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<sup>1257</sup> [https://en.wikipedia.org/wiki/Jean-Baptiste\\_Lamarck](https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck)

<sup>1258</sup> CHARLES DARWIN The Origin of Species

<sup>1259</sup> [https://en.wikipedia.org/wiki/Jean-Baptiste\\_Lamarck](https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck)



LAMARCK by Charles Thévenin (**circa 11,802 HE**)<sup>1260</sup>

⇒ See more on LAMARCK's publications.<sup>1261</sup>

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<sup>1260</sup> [https://en.wikipedia.org/wiki/Jean-Baptiste\\_Lamarck](https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck)

<sup>1261</sup> [https://en.wikipedia.org/wiki/Jean-Baptiste\\_Lamarck](https://en.wikipedia.org/wiki/Jean-Baptiste_Lamarck)

**11,746 HE: ANDREAS SIGISMUND MARGGRAF**, German Chemist, is credited with discovering the pure metallic “Star Stuff” Element Zinc.<sup>1262</sup>



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,

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<sup>1262</sup> <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 the metabolism and which occurs in many foods.<sup>1263</sup>

⇒ In the **11,860s HE** rolled Zinc sheeting became mandatory for roofing in Paris and this created the city's silvery patina.<sup>1264</sup>

**11,746 HE – 11,830 HE: JOHANN HELFRICH VON MÜLLER:** an engineer in the Hessian army who conceived the difference engine in **11,786 HE** an idea that later evolved into modern computers. In **11,784 HE**, MÜLLER was responsible for an improved adding

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<sup>1263</sup> <http://images-of-elements.com/zinc.php#a>

<sup>1264</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

machine based on principles of see **11,693 HE**: GOTTFRIED WILHELM LEIBNIZ'S stepped reckoner.<sup>1265</sup>



Adding machine by JOHANN HELFRICH VON MÜLLER, **11,784 HE**, in the Hessisches Landesmuseum Darmstadt.<sup>1266</sup>

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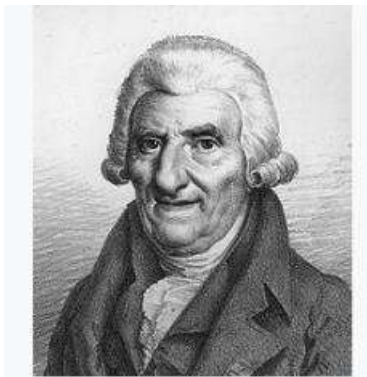
<sup>1265</sup> [https://en.wikipedia.org/wiki/Johann\\_Helfrich\\_von\\_Muller](https://en.wikipedia.org/wiki/Johann_Helfrich_von_Muller)

<sup>1266</sup> [https://en.wikipedia.org/wiki/Johann\\_Helfrich\\_von\\_Müller](https://en.wikipedia.org/wiki/Johann_Helfrich_von_Müller)

**11,748 HE – 11,845 HE:** JEAN-DOMINIQUE, COMTE DE CASSINI, (Cassini IV); French; JEAN-DOMINIQUE, COMTE DE CASSINI succeeded Cassini III as Director at Paris Observatory, but it had gone into decay. He was imprisoned in **11,794 HE** and released seven months later. He published an account of testing Pierre Le Roy's watches at sea called *the Voyage to America*. He proposed a trigonometric survey connecting the observatories of Paris and Greenwich for the purpose of determining latitude and longitude. For this purpose, he met with ADRIEN-MARIE LEGENDRE (French Mathematician) and WILLIAM HERSCHEL at Slough circa **11,791 HE**.<sup>1267</sup>

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<sup>1267</sup> [https://en.wikipedia.org/wiki/Dominique,\\_comte\\_de\\_Cassini](https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini)



**JEAN-DOMINIQUE, COMTE DE CASSINI, 11,820 HE.**  
Lithograph by Julien-Léopold Boilly.<sup>1268</sup>

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<sup>1268</sup> [https://en.wikipedia.org/wiki/Dominique,\\_comte\\_de\\_Cassini](https://en.wikipedia.org/wiki/Dominique,_comte_de_Cassini)

**11,749 HE – 11,819 HE:** DANIEL RUTHERFORD, Scottish physician  
In first discovered and isolated the “Star Stuff” Element Nitrogen.  
Although CARL WILHELM SCHEELE and HENRY  
CAVENDISH had independently done so at about the same time,  
RUTHERFORD is generally accorded the credit because his work  
was published first.<sup>1269</sup>



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

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<sup>1269</sup> <https://en.wikipedia.org/wiki/Nitrogen>

protein. Our air consists to 78% of  $N_2$ . The chemical bond between the two atoms in the nitrogen molecule is the strongest bond between two atoms of the same element. This makes  $N_2$  a very stable and inert gas.<sup>1270</sup> Ammonia,  $NH_3$ , 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.<sup>1271</sup> (See **11,868 HE – 11,934 HE: FRITZ HABER.**)

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<sup>1270</sup> <http://images-of-elements.com/nitrogen.php#a>

<sup>1271</sup> <http://images-of-elements.com/nitrogen.php#a>



DANIEL RUTHERFORD, date, lithographer and location unknown.<sup>1272</sup>

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<sup>1272</sup> <https://en.wikipedia.org/wiki/Nitrogen>

**Circa 11,750s HE:** The introduction of steam engines for powering blast air to blast furnaces led to a large increase in British iron production.<sup>1273</sup>

**11,750 HE – 11,848 HE:** CAROLINE LECRETIA HERSCHEL, German Astronomer working in England with her brother WILLIAM HERSCHEL.<sup>1274</sup> From **11,786 HE–11,797 HE** CAROLINE LECRETIA HERSCHEL discovered eight comets.<sup>1275</sup>

⇒ In **11,787 HE**, CAROLINE LECRETIA HERSCHEL was granted an annual salary of £50 (equivalent to £5,700 in **12,017 HE**) by George III for her work as WILLIAM HERSCHEL's assistant. Her appointment made her the first woman in England

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<sup>1273</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1274</sup> Podcast: Stuff You Missed in History Class

<sup>1275</sup> Podcast: Stuff You Missed in History Class



with an official government position, and the first woman to be paid for her work in astronomy.<sup>1276 1277</sup>

- ⇒ In **11,802 HE**, the Royal Society published CAROLINE LECRETIA HERSCHEL's catalogue in its Philosophical Transactions of the Royal Society A, under William's name. This listed around 500 new nebulae and clusters to the already known 2000. Toward the end of her life, she arranged two-and-a-half thousand nebulae and star clusters into zones of similar polar distances so that her nephew, JOHN HERSCHEL, could re-examine them systematically. The list was eventually enlarged and renamed the *New General Catalogue*. Many non-stellar objects are still identified by their NGC number.<sup>1278</sup>

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<sup>1276</sup>[https://en.wikipedia.org/wiki/Caroline\\_Herschel](https://en.wikipedia.org/wiki/Caroline_Herschel)

<sup>1277</sup> Podcast: Stuff You Missed in History Class

<sup>1278</sup> [https://en.wikipedia.org/wiki/Caroline\\_Herschel](https://en.wikipedia.org/wiki/Caroline_Herschel)

⇒ **CAROLINE LECRETIA HERSCHEL Honors:** The gold medal from the Astronomical Society was awarded to her in **11,828 HE**. The Royal Astronomical Society elected her an Honorary Member in **11,835 HE**, along with **MARY SOMERVILLE** (see above); they were the first women members. She was also elected as an honorary member of the Royal Irish Academy in Dublin in **11,838 HE**. In **11,846 HE**, at the age of 96, she was awarded a Gold Medal for Science by the King of Prussia, conveyed to her by **ALEXANDER VON HUMBOLDT** "in recognition of the valuable services rendered to Astronomy by you, as the fellow-worker of your immortal brother, **SIR WILLIAM HERSCHEL**, by discoveries, observations, and laborious calculations".<sup>1279</sup>

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<sup>1279</sup> [https://en.wikipedia.org/wiki/Caroline\\_Herschel](https://en.wikipedia.org/wiki/Caroline_Herschel)

⇒ Asteroid 281 Lecretia is named in her honor.



⇒

**11,847 HE** Lithograph of CAROLINE LECRETIA  
HERSCHEL, artist and location unknown.<sup>1280</sup>

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<sup>1280</sup> [https://en.wikipedia.org/wiki/Caroline\\_Herschel](https://en.wikipedia.org/wiki/Caroline_Herschel)



A telescope that WILLIAM HERSCHEL made for CAROLINE HERSCHEL, **11,795 HE**, location unknown.<sup>1281</sup>

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<sup>1281</sup> [https://en.wikipedia.org/wiki/Caroline\\_Herschel](https://en.wikipedia.org/wiki/Caroline_Herschel)



The Herschel Museum of Astronomy at 19 New King Street, Bath, England, <https://herschelmuseum.org.uk/>, is a museum that was inaugurated in **11,981 HE**. It is located in a preserved town house that was formerly the home of **WILLIAM HERSCHEL** and **CAROLINE HERSCHEL**.<sup>1282</sup>

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<sup>1282</sup> [https://en.wikipedia.org/wiki/Herschel\\_Museum\\_of\\_Astronomy](https://en.wikipedia.org/wiki/Herschel_Museum_of_Astronomy)

**11,751 HE: AXEL FREDRIK**, Swedish Chemist discovered/defined “Star Stuff” Element Nickel. It took 4 years for his discovery to be recognized.<sup>1283</sup>



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

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<sup>1283</sup> 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  $\text{Ni}^{62}$  is the most stable isotope, the one with the highest binding energy.<sup>1284</sup> 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.<sup>1285</sup>

**11,752 HE – 11,828 HE: FRANÇOIS ISAAC DE RIVAZ,**<sup>1286</sup> Paris, was an inventor and a politician who invented a hydrogen-powered internal combustion engine with electric ignition and described it in a French patent published in **11,807 HE**. In **11,808 HE**, he fitted

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<sup>1284</sup> <http://images-of-elements.com/nickel.php#a>

<sup>1285</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1286</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

it into a primitive working vehicle – "the world's first internal combustion powered automobile".<sup>1287</sup>

- ⇒ 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.<sup>1288</sup>

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<sup>1287</sup> [https://en.wikipedia.org/wiki/Fransois\\_Isaac\\_de\\_Rivaz](https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz)

<sup>1288</sup> [https://en.wikipedia.org/wiki/De\\_Rivaz\\_engine](https://en.wikipedia.org/wiki/De_Rivaz_engine)

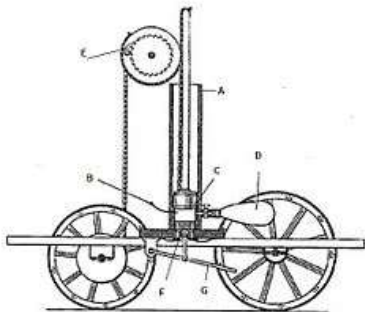




ISAAC DE RIVAZ, date, location, and artist unknown.<sup>1289</sup>

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<sup>1289</sup> [https://en.wikipedia.org/wiki/Fransois\\_Isaac\\_de\\_Rivaz](https://en.wikipedia.org/wiki/Fransois_Isaac_de_Rivaz)



The **11,807 HE** Charette of de Rivaz. A = Cylinder, B = Spark ignition, C = Piston, D = Balloon containing hydrogen fuel, E = Ratchet, F = Opposed piston with air in and exhaust out valves, G = Handle for working opposed piston.<sup>1290</sup>

<sup>1290</sup> [https://en.wikipedia.org/wiki/De\\_Rivaz\\_engine](https://en.wikipedia.org/wiki/De_Rivaz_engine)

**Circa 11,760 HE:** England: The Coalbrookdale Company began to fix plates of cast iron to the upper surface of wooden wagon rails, which increased their durability and load-bearing ability.<sup>1291</sup>

**11,763 HE – 11,829 HE:** LOUIS NICOLAS VAUQUELIN: French pharmacist and chemist<sup>1292</sup> who discovered the “star stuff” element Beryllium by extracting it from an emerald (a beryl variety)<sup>1293</sup> and discovered the “Star Stuff” element Chromium in a red lead ore from Siberia.<sup>1294</sup> 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

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<sup>1291</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1292</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1293</sup> [https://en.wikipedia.org/wiki/Louis\\_Nicolas\\_Vauquelin](https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin)

<sup>1294</sup> [https://en.wikipedia.org/wiki/Louis\\_Nicolas\\_Vauquelin](https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin)

to be discovered.<sup>1295</sup> 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."<sup>1296</sup>

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<sup>1295</sup> [https://en.wikipedia.org/wiki/Louis\\_Nicolas\\_Vauquelin](https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin)

<sup>1296</sup> [https://en.wikipedia.org/wiki/Louis\\_Nicolas\\_Vauquelin](https://en.wikipedia.org/wiki/Louis_Nicolas_Vauquelin)



LOUIS NICOLAS VAUQUELIN, artist, date and location unknown.<sup>1297</sup>

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<sup>1297</sup> [https://en.wikipedia.org/wiki/Louis\\_Nicolas\\_Vauquelin](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  $\text{CrO}_3$  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.<sup>1298</sup>

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<sup>1298</sup> <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.<sup>1299</sup>

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<sup>1299</sup> <http://images-of-elements.com/beryllium.php#a>

**11,764 HE:** The first railway in United States was built in Lewiston, New York.<sup>1300</sup>

**11,765 HE – 11,850 HE:** ROBERT FULTON, United States Engineer<sup>1301</sup> who designed the *Nautilus* while living in the French First Republic. The *Nautilus* is often considered to be the first practical submarine.<sup>1302</sup> FULTON and ROBERT R. LIVINGSTON<sup>1303</sup> built the first commercially successful steamboat, North River Steamboat later known as the Clermont.<sup>1304</sup>

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<sup>1300</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1301</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)

<sup>1302</sup> [https://en.wikipedia.org/wiki/Nautilus\\_\(1800\\_submarine\)](https://en.wikipedia.org/wiki/Nautilus_(1800_submarine))

<sup>1303</sup> [https://en.wikipedia.org/wiki/Robert\\_R.\\_Livingston\\_\(chancellor\)](https://en.wikipedia.org/wiki/Robert_R._Livingston_(chancellor))

<sup>1304</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)

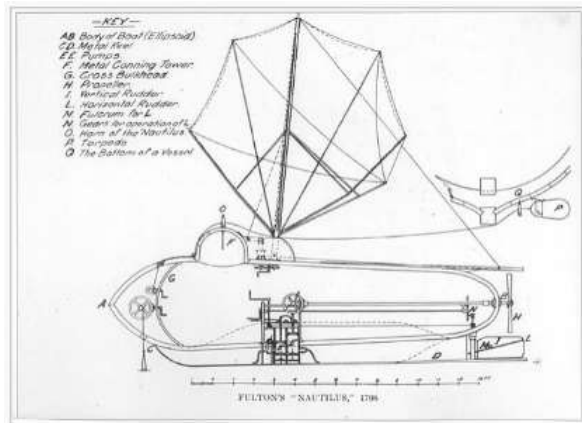




**11,803 HE: ROBERT FULTON**, bust by Jean-Antoine Houdon,  
location unknown.<sup>1305</sup>

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<sup>1305</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)



11,798 HE: FULTON's design for the submarine Nautilus, location unknown.<sup>1306</sup>

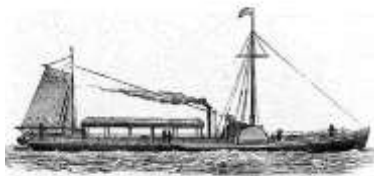
<sup>1306</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)



● Full-sized section model for the submarine *Nautilus* at Cité de la Mer, Cherbourg, France.<sup>1307</sup>

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<sup>1307</sup> <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



**11,807 HE:** Drawing is of ROBERT FULTON's and ROBERT R. LIVINGSTON's Steamboat called the "Clermont".<sup>1308</sup>

⇒ Yes, Jules Verne fans! Jules Verne based the name of his iconic incarnation upon the **11,800 HE**, ROBERT FULTON submarine invention the *Nautilus*.<sup>1309</sup>

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<sup>1308</sup> <https://www.bing.com/images/search?q=image+robert+fulton+steamship+clermont&id=53777F7C39EAB1D702595BB3893B874A34363B47&FORM=IQFRBA>

<sup>1309</sup> <https://insidethemagic.net/2018/05/about-the-nautilus-a-deeper-dive-into-jules-vernes-iconic-submarine/>



The **11,878 HE – 11,883 HE** marble statue by Howard Roberts in Statuary Hall of the United States Capitol.<sup>1310</sup>

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<sup>1310</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)



**11,896 HE:** ROBERT FULTON (with SAMUEL F. B. MORSE (see: **11,791 HE**– **11,872 HE:** SAMUEL FINLEY BREESE MORSE) depicted on the reverse of the \$2 Silver Certificate from the United States Treasury.<sup>1311</sup>

⇒ Some of the Places in the United States named for ROBERT FULTON, including: Fulton Township, Lancaster County,

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<sup>1311</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](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.<sup>1312</sup>

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<sup>1312</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)





**11,909 HE:** Hudson-Fulton Celebration commemorative stamp.



**11,965 HE:** 200th Anniversary ROBERT FULTON commemorative stamp, based on the Houdon bust.<sup>1313</sup>

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<sup>1313</sup> [https://en.wikipedia.org/wiki/Robert\\_Fulton](https://en.wikipedia.org/wiki/Robert_Fulton)

**11,766 HE -11,828 HE:** WILLIAM HYDE WOLLASTON, English chemist and physicist<sup>1314</sup> who did a similar experiment to ISAAC NEWTON, using a prism to break white light into its rainbow of visible colors but WOLLASTON's sunbeam had to pass through a narrow slit before it hit his prism.

- ⇒ The spectrum that emerged from WOLLASTON's prism was built up as a series of narrow strips of different wavelengths. The strips of colored light smeared into each other to make a spectrum but, scattered along the spectrum he saw dark lines in particular places.
- ⇒ The lines were later measured and systematically catalogued by JOSEPH VON FRAUNHOFER (SEE **11,787 HE – 11,826 HE:**

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<sup>1314</sup> RICHARD DAWKINS *Unweaving the Rainbow*

FRAUNHOFER) to have specific fingerprints, or bar codes, which is specific to the chemical nature of the substance through which the light passed.<sup>1315</sup>

⇒ 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.<sup>1316</sup>

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<sup>1315</sup> RICHARD DAWKINS, *Unweaving the Rainbow*

<sup>1316</sup> [https://en.wikipedia.org/wiki/William\\_Hyde\\_Wollaston](https://en.wikipedia.org/wiki/William_Hyde_Wollaston)



Painting of WILLIAM HYDE WOLLASTON, artist, date and location unknown.<sup>1317</sup>

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<sup>1317</sup> [https://en.wikipedia.org/wiki/William\\_Hyde\\_Wollaston](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.<sup>1318</sup>



Photo of bead of pure “Star Stuff” Element Atomic Number 45,

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<sup>1318</sup> <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.<sup>1319</sup>

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<sup>1319</sup> <http://images-of-elements.com/rhodium.php#a>

**11,769 HE - 11,859 HE:** ALEXANDER VON HUMBOLDT, born in Prussian/Germany<sup>1320</sup> but as his knowledge increased others considered him a citizen of all countries, and he thought of himself as “half an American”.<sup>1321</sup>

⇒ Already in **11,807 HE**, HUMBOLDT wrote: “I thought that if my *Naturgemälde* were capable of suggesting unexpected analogies to those who study its details, it would be capable of speaking to the imagination and providing the pleasure that comes from contemplating a beneficial as well as majestic nature.” He believed in the power of learning and wrote many books that were aimed at a general audience.<sup>1322</sup>

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<sup>1320</sup> Author/Compiler's son Benjamin Premack actually introduced author to knowledge of ALEXANDER VON HUMBOLDT

<sup>1321</sup> Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

<sup>1322</sup> Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

- ⇒ HUMBOLDT said: “With knowledge comes thought,” and “with thought comes power”. One of HUMBOLDT’s greatest achievements was to make science accessible and popular. He did so by using a simple and non-scientific language as well as through infographics. Everybody learned from him: farmers and craftsmen, schoolboys and teachers, artists and musicians, scientists and politicians.<sup>1323</sup>
- ⇒ 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.<sup>1324</sup>

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<sup>1323</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1324</sup> [https://en.wikipedia.org/wiki/Alexander\\_von\\_Humboldt](https://en.wikipedia.org/wiki/Alexander_von_Humboldt)



- ⇒ HUMBOLDT resurrected the use of the word *cosmos* from the ancient Greek and assigned it to his **Multi-Volume Treatise: Kosmos**, in which he sought to unify diverse branches of scientific knowledge and culture.<sup>1325</sup>
- ⇒ HUMBOLDT was the first person who specifically highlighted the human threat to nature.<sup>1326</sup>
- ⇒ HUMBOLDT has strong abolitionist feelings which reflect how he truly believed that race did not influence intellect or ability.<sup>1327 1328</sup>

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<sup>1325</sup> [https://en.wikipedia.org/wiki/Alexander\\_von\\_Humboldt](https://en.wikipedia.org/wiki/Alexander_von_Humboldt)

<sup>1326</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1327</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1328</sup> Eleanor Jones Harvey

- ⇒ HUMBOLDT's quantitative work on botanical geography laid the foundation for the field of biogeography.
- ⇒ HUMBOLDT's advocacy of long-term systematic geophysical measurement laid the foundation for modern geomagnetic and meteorological monitoring.<sup>1329</sup>
- ⇒ 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.

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<sup>1329</sup> Love, J.J. (12,008 HE). "Magnetic monitoring of Earth and space" (PDF). Physics Today. February: 31–37. doi:10.1063/1.2883907. Retrieved 29 June 12,015 HE; Jump Up; Thomson, A. , "Von Humboldt and the establishment of geomagnetic observatories", IAEA-INI

⇒ ALEXANDER VON HUMBOLDT wrote & published more than 30 other scientific works <sup>1330</sup> including: *Personal Narrative, Views of Nature, or, Contemplations on the sublime phenomena of creation: with scientific illustrations* <sup>1331</sup> *Essay on the Geography of Plants.* <sup>1332 1333</sup>

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<sup>1330</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1331</sup> Smile.amazon.com list of books

<sup>1332</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1333</sup> Andrea Wulf, lecture at Washington College:

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



1334

HUMBOLDT's *Multi-Volume Treatise: Kosmos* also motivated a holistic perception of the universe as one interacting entity.<sup>1335</sup>

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<sup>1334</sup> Andrea Wulf, lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>

<sup>1335</sup> 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.<sup>1336</sup> To the left and right of the mountain he placed several columns that provided

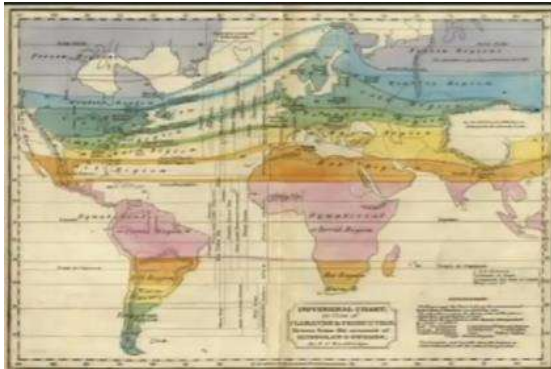
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<sup>1336</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>

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’.<sup>1337</sup>

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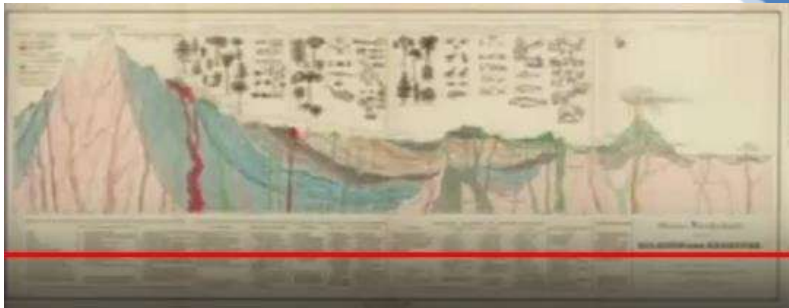
<sup>1337</sup> Andrea Wulf, lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>



Still in use today - ALEXANDER VON HUMBOLDT's map of Isotherms and Endotherms in the world-wide geographical regions.<sup>1338</sup>

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<sup>1338</sup> 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>

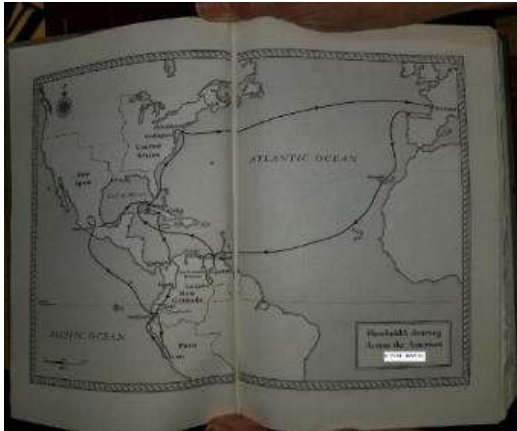


ALEXANDER VON HUMBOLDT's map. Before anyone knew of tectonic plates, he shows how volcanos and earthquakes are somehow related.<sup>1339</sup>

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<sup>1339</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>





**11,799 HE – 11,804 HE - ALEXANDER VON HUMBOLDT'S**  
 5-year journey across the Americas.<sup>1340</sup>

<sup>1340</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- ⇒ On 14 September **11,869 HE**: One hundred years after his birth, ALEXANDER VON HUMBOLDT'S centennial was celebrated across the world: "There is not a text-book of geography or a school atlas in the hands of our children today, which does not bear... the imprint of his great mind", said the scientist LOUIS AGASSIZ in **11,869 HE** in Boston<sup>1341</sup>
- ⇒ 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.

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<sup>1341</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

- There were festivities in Moscow where Humboldt was called the “Shakespeare of sciences”, and In Alexandria in Egypt where guests partied under a sky illuminated with fireworks.
- The greatest commemorations were in the United States, where from San Francisco to Philadelphia, and from Chicago to Charleston, the nation saw street parades, sumptuous dinners, and concerts. In Cleveland some 8,000 people took to the streets and in Syracuse another 15,000 joined a march that was more than a mile long. President Ulysses Grant (The same president who unfortunately signed the Comstock Acts: see **11,776 HE - 11,870s HE**: In the United States) attended the Humboldt celebrations in Pittsburgh together with 10,000 revelers who brought the city to a standstill.
- In New York City the cobbled streets were lined with flags. City Hall was veiled in banners, and entire houses had

vanished behind huge posters bearing Humboldt's face. Even the ships sailing by, out on the Hudson River, were garlanded in colorful bunting. In the morning thousands of people followed ten music bands, marching from the Bowery and along Broadway to Central Park to honor a man 'whose fame no nation can claim' as the New York Times's front page reported. By early afternoon, 25,000 onlookers had assembled in Central Park to listen to the speeches as a large bronze bust of Humboldt was unveiled. In the evening as darkness settled, a torchlight procession of 15,000 people set out along the streets, walking beneath colorful Chinese lanterns.<sup>1342</sup>

⇒ Places named after ALEXANDER VON HUMBOLDT:<sup>1343</sup>

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<sup>1342</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1343</sup> [https://en.wikipedia.org/wiki/Alexander\\_von\\_Humboldt](https://en.wikipedia.org/wiki/Alexander_von_Humboldt)

- Hacienda Humboldt, Chihuahua, Mexico, Humboldt, South Dakota, United States, Humboldt, Nebraska, United States, Humboldt, Illinois, United States, Humboldt, Iowa, United States, Humboldt, Tennessee, United States, Humboldt, Kansas, United States, Humboldt, Minnesota, United States, Humboldt, Arizona, United States, Humboldt County, California, United States, Fort Humboldt State Historic Park, Eureka, California, United States, Humboldt County, Nevada, United States, Humboldt County, Iowa,
- United States, Humboldt, Saskatchewan, Canada, Humboldt Park, Chicago, Illinois, United States, Alejandro de Humboldt National Park, Cuba, Alexander von Humboldt National Forest, Peru, Humboldt-Toiyabe National Forest, Nevada & California, United States, Humboldt Bay — Bay in Northern California, United States, Humboldt Current - off the west coast of South America, Humboldt Glacier - in North West

Greenland, Humboldt River - River in Nevada, United States, Humboldt Peak (Colorado) - 4,287 m mountain in Custer County, Colorado, United States, Pico Humboldt - 4,940 m mountain in Mérida, Venezuela, Humboldt Sink - Dry lake bed in Nevada, United States, East and West Humboldt Range in Nevada, United States, Sima Humboldt - sinkhole in Venezuela, "Monumento Nacional Alejandro de Humboldt" at Caripe, Venezuela, Mount Humboldt - 1,617 m (5,308 ft), New Caledonia, Humboldt Mountains, Antarctic mountains discovered and mapped by the Third German Antarctic Expedition (**11,938 HE–11,939 HE**), Humboldt Range - Mountain Range in Fiordland National Park, New Zealand, Humboldt Falls - 275 m Water fall in Lower Hollyford Valley, Fiordland National Park, New Zealand,

Humboldt Redwoods State Park - in northern California,  
United States.<sup>1344</sup>

⇒ People who were personally influenced by HUMBOLDT:



• United States President THOMAS JEFFERSON<sup>1345</sup>

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<sup>1344</sup> [https://en.wikipedia.org/wiki/Alexander\\_von\\_Humboldt](https://en.wikipedia.org/wiki/Alexander_von_Humboldt)

<sup>1345</sup> Andrea Wulf as part of the Lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>

- In a **11,883 HE** letter from President Jefferson to ALEXANDER VON HUMBOLDT, JEFFERSON said: “MY DEAR FRIEND AND BARON, ...History, I believe, furnishes no example of a 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.”<sup>1346</sup>
- 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.<sup>1347 1348</sup>

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<sup>1346</sup> <http://www.let.rug.nl/usa/presidents/thomas-jefferson/letters-of-thomas-jefferson/jefl224.php>

<sup>1347</sup> Wulf, Andrea. The Invention of Nature: Alexander von Humboldt's New World

<sup>1348</sup> Andrea Wulf as part of the Lecture at Washington College:

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





- JAMES SMITHSON<sup>1349</sup>; English chemist and mineralogist, who had no family, met ALEXANDER VON HUMBOLDT at a cocktail party in Paris. Eleanor Jones Harvey is lead to believe that the idea for the Museums of the Smithsonian Institute in Washington, DC can be circled back to ALEXANDER VON HUMBOLDT<sup>1350</sup> because Smithson's Will stipulated that: "his estate be used "to found in

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<sup>1349</sup> James Smithson by Henri-Joseph Johns, 11,816 HE

<sup>1350</sup> 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.<sup>1351</sup>



• United States President James Madison<sup>1352</sup>

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<sup>1351</sup> [https://en.wikipedia.org/wiki/James\\_Smithson](https://en.wikipedia.org/wiki/James_Smithson)

<sup>1352</sup> 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>



Goethe<sup>1353</sup>



Simon Bolivar<sup>1354</sup>

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<sup>1353</sup> Andrea Wulf as part of the Lecture at Washington College:

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

<sup>1354</sup> Andrea Wulf as part of the Lecture at Washington College:

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



- CHARLES DARWIN<sup>1355</sup>



- Henry David Thoreau<sup>1356</sup>

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<sup>1355</sup> Andrea Wulf as part of the Lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>

<sup>1356</sup> Andrea Wulf as part of the Lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>



• Ernst Haeckel<sup>1357</sup>



• JOHN MUIR; and among all his important work with nature

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<sup>1357</sup> 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”.<sup>1358</sup>



● GEORGE PERKINS MARSH<sup>1359</sup>

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<sup>1358</sup> Andrea Wulf as part of the Lecture at Washington College:  
<https://www.youtube.com/watch?v=XeHGGgEfCes>

<sup>1359</sup> 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".<sup>1360</sup>



- John Fremont (A) John Fremont (B);




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<sup>1360</sup> 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.<sup>1361</sup>
- STEPHEN LONG, who mapped the middle of the United States continent with Titian Ramsey Peale as the artist<sup>1362</sup>

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<sup>1361</sup> 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>

<sup>1362</sup> 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.<sup>1363</sup>

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<sup>1363</sup> 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 Indians<sup>1364</sup>

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<sup>1364</sup> 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 Emerson<sup>1365</sup>



• Walt Whitman<sup>1366</sup>

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<sup>1365</sup> 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>

<sup>1366</sup> 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*".<sup>1367</sup>

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<sup>1367</sup> 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.<sup>1368</sup>

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<sup>1368</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- HUMBOLDT got JEAN LOUIS RODOLPHE AGASSIZ, (see **11,807 HE** – **11,873 HE**) his job at Harvard.<sup>1369</sup>

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<sup>1369</sup> 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.<sup>1370</sup>

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<sup>1370</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



- CLARENCE KING was influenced by HUMBOLDT as he did his **11,838 HE- 11,842 HE** surveys reports.<sup>1371</sup>

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<sup>1371</sup> 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.<sup>1372</sup>

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<sup>1372</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



● **11,903 HE** United States President Teddy Roosevelt, had declared the problem with America's educational system is that we are putting out specialists and not thinkers like HUMBOLDT.<sup>1373</sup>

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<sup>1373</sup> 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.<sup>1374</sup>

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<sup>1374</sup> Eleanor Jones Harvey, Senior Curator at the Smithsonian American Art Museum; as part of the Lecture at Washington College: <https://www.youtube.com/watch?v=XeHGGgEfCes>



**11,843 HE** ALEXANDER VON HUMBOLDT portrait by Joseph Stieler, location unknown<sup>1375</sup>

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<sup>1375</sup> [https://en.wikipedia.org/wiki/Alexander\\_von\\_Humboldt](https://en.wikipedia.org/wiki/Alexander_von_Humboldt)

**11,773 HE – 11,857 HE: SIR GEORGE CAYLEY**, 6th Baronet, English engineer, inventor, and aviator who had even re-invented the wheel, devising the tension-spoked wheel in which all compression loads are carried by the rim, allowing a lightweight undercarriage and was called the "*father of the aeroplane*".<sup>1376</sup>

⇒ 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

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<sup>1376</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](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.<sup>1377</sup>

⇒ In **11,848 HE SIR GEORGE CAYLEY** had progressed far enough to construct a glider in the form of a triplane large and safe enough to carry a child. A local boy was chosen but his name is not known.<sup>1378</sup> In **11,852 HE SIR GEORGE CAYLEY** went on to publish in the design for a full-size manned glider or "governable parachute" to be launched from a balloon and then

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<sup>1377</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

<sup>1378</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

to construct a version capable of launching from the top of a hill, which carried the first adult aviator (name unknown) across Brompton Dale.<sup>1379</sup>

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<sup>1379</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)







SIR GEORGE CAYLEY, 6th Baronet, location, date and artist unknown<sup>1381</sup>

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<sup>1381</sup> [https://en.wikipedia.org/wiki/George\\_Cayley](https://en.wikipedia.org/wiki/George_Cayley)

**11,774 HE:** Pure Manganese was discovered by JOHAN GOTTLIEB GAHN, Swedish scientist.<sup>1382</sup>



JOHAN GOTTLIEB GAHN, artist and location unknown.<sup>1383</sup>

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<sup>1382</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1383</sup> [https://en.wikipedia.org/wiki/Johan\\_Gottlieb\\_Gahn](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.<sup>1384</sup> Exposure to large amounts or certain forms of Manganese can be hazardous.<sup>1385</sup>

**11,775 HE - 11,800 HE: ANTOINE-LAURENT LAVOISIER;** French chemist<sup>1386 1387</sup> ANTOINE-LAURENT LAVOISIER one of the founders of modern chemistry.<sup>1388</sup> He defined the “Law of the Conservation of Mass.”<sup>1389</sup> 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

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<sup>1384</sup> <http://images-of-elements.com/manganese.php#a>

<sup>1385</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1386</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery

<sup>1387</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius)

<sup>1388</sup> [https://en.wikipedia.org/wiki/Antoine\\_Lavoisier](https://en.wikipedia.org/wiki/Antoine_Lavoisier)

<sup>1389</sup> Sam Kean: *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

combined with oxygen to form carbon dioxide which led him to conclude that diamond and charcoal were both made from carbon.<sup>1390</sup> **11,777 HE:** ANTOINE-LAURENT LAVOISIER also coined the name for the “Star Stuff” element: Oxygen. **11,777 HE:** 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.<sup>1391</sup>

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<sup>1390</sup> <https://www.reference.com/science/carbon-discovered-abc7e034c6f0b733>

<sup>1391</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements



Line engraving of ANTOINE-LAURENT LAVOISIER by Louis Jean Desire Delaistre, after a design by Julien Leopold Boilly, location and date unknown.<sup>1392</sup> A French aristocrat, LAVOISIER was arrested and beheaded during the French Revolution.<sup>1393</sup>

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<sup>1392</sup> [https://en.wikipedia.org/wiki/Antoine\\_Lavoisier](https://en.wikipedia.org/wiki/Antoine_Lavoisier)

<sup>1393</sup> Sam Kean: ***Caesar's Last Breath: Decoding the Secrets of the Air Around Us***



• 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, H<sub>2</sub>O. Combustion usually is a reaction of a material with oxygen. Elemental oxygen in the form of O<sub>2</sub> is to 21% part of our air and is used by humans and animals for respiration. It is produced by plants doing photosynthesis, most of it by algae in the sea and by forests on land. <sup>1394</sup>O<sub>3</sub> is ozone, a poisonous gas, which in a high

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<sup>1394</sup> <http://images-of-elements.com/oxygen.php#a>

atmospheric layer blocks otherwise deadly UV rays from the Sun.<sup>1395</sup>



- The photo is a chunk of pure sulfur. “Star Stuff” Element Atomic Number 16. Sulfur, S. Sulfur sometimes naturally occurs in its elemental form and as such often is emitted in volcanic eruptions. Sulfur has a complex chemistry and is essential to life. On the other hand, it has some very toxic and environmentally hazardous compounds. Notable here are hydrogen sulfide, which gives rotten eggs their smell and

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<sup>1395</sup> <http://images-of-elements.com/oxygen.php#a>



sulfur dioxide and trioxide, which, when dissolved in water, give sulfurous acid and sulfuric acid.<sup>1396</sup>

**11,776 HE – 11,831 HE: MARIE-SOPHIE GERMAIN**, French, Mathematician, physicist, and philosopher<sup>1397</sup> was one of the pioneers of Elasticity Theory. GERMAIN won the grand prize from the Paris Academy of Sciences for her essay on elasticity theory. Her work on Fermat's Last Theorem provided a foundation for mathematicians exploring the subject for hundreds of years after. Because of prejudice against her sex, she was unable to make a career out of mathematics, but she worked independently throughout her life. Before her death Gauss (see **11,777 HE – 11,855 HE: KARL FRIEDRICH GAUSS**) had recommended that GERMAIN be awarded an honorary degree, but that never

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<sup>1396</sup> <http://images-of-elements.com/sulfur.php#a>

<sup>1397</sup> Jennifer Ouellete, *The Calculus Diaries: How Math Can Help You Lose Weight, Win in Vegas, and Survive a Zombie Attack*

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.<sup>1398</sup>

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<sup>1398</sup> [https://en.wikipedia.org/wiki/Sophie\\_Germain](https://en.wikipedia.org/wiki/Sophie_Germain)

**11,777 HE – 11,851 HE:** HANS CHRISTIAN ØRSTED was a Danish physicist and chemist.<sup>1399</sup> 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.<sup>1400</sup> ØRSTED was the first modern thinker to explicitly describe and name the “thought experiment”.<sup>1401</sup> **In 11,825 HE,** HANS CHRISTIAN ØRSTED made a significant contribution to chemistry by producing aluminium for the first time. While an aluminium-iron alloy had previously been developed by British scientist and inventor HUMPHRY DAVY, HANS CHRISTIAN ØRSTED was the first to isolate the element via a reduction of aluminium chloride.

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<sup>1399</sup> HANS CHRISTIAN ØRSTED was 1st introduced to Author / Compiler by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

<sup>1400</sup> [https://en.wikipedia.org/wiki/Hans\\_Christian\\_Orsted](https://en.wikipedia.org/wiki/Hans_Christian_Orsted)

<sup>1401</sup> [https://en.wikipedia.org/wiki/Hans\\_Christian\\_Orsted](https://en.wikipedia.org/wiki/Hans_Christian_Orsted)



HANS CHRISTIAN ØRSTED, date, location and artist unknown.<sup>1402</sup>

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<sup>1402</sup> [https://en.wikipedia.org/wiki/Hans\\_Christian\\_Orsted](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 **11,879 HE**. The streets H.C. Ørsted's Vej in Frederiksberg and H. C. Ørsted's Allé in Galten are also named after ØRSTED. The buildings that are home to the Department of Chemistry and the Institute for Mathematical Sciences at the University of Copenhagen's North Campus are named the H.C. Ørsted Institute, after him. A dormitory named H. C. Ørsted Kollegiet is located in Odense. The first Danish satellite, launched **11,999 HE**, was named after HANS CHRISTIAN ØRSTED.<sup>1405</sup> Monuments and memorials re HANS CHRISTIAN ØRSTED: Statue of Ørsted in Ørstedsparken, in Copenhagen. A statue of HANS CHRISTIAN ØRSTED was

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<sup>1405</sup> [https://en.wikipedia.org/wiki/Hans\\_Christian\\_Orsted](https://en.wikipedia.org/wiki/Hans_Christian_Orsted)

installed in the Ørsted Park in **11,880 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 **11,950 HE to 11,970 HE** carried an engraving of HANS CHRISTIAN ØRSTED.<sup>1406</sup> 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.<sup>1407</sup>



- The photo is a chunk of aluminium, 2.6 grams, 1 x 2 cm. “Star Stuff” Element Atomic Number 13, Aluminum, Al, is

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<sup>1406</sup> [https://en.wikipedia.org/wiki/Hans\\_Christian\\_Orsted](https://en.wikipedia.org/wiki/Hans_Christian_Orsted)

<sup>1407</sup> <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.<sup>1408</sup>

**11,777 HE – 11,855 HE:** KARL FRIEDRICH GAUSS, German mathematician, made his first ground-breaking mathematical discoveries while still a teenager. GAUSS completed *Disquisitiones Arithmeticae*, his magnum opus, in **11,798 HE** at the age of 21, although it was not published until **11,801 HE**. GAUSS contributed significantly to many fields, including number

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<sup>1408</sup> <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.<sup>1409</sup>

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<sup>1409</sup> [https://en.wikipedia.org/wiki/Carl\\_Friedrich\\_Gauss](https://en.wikipedia.org/wiki/Carl_Friedrich_Gauss)

**11,778 HE – 11,850 HE: JOSEPH LOUIS GAY-LUSSAC,**<sup>1410</sup> 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.<sup>1411</sup>

⇒ 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.<sup>1412</sup>

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<sup>1410</sup> Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

<sup>1411</sup> [https://en.wikipedia.org/wiki/Joseph\\_Louis\\_Gay-Lussac](https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac)

<sup>1412</sup> Sam Kean, *Caesar's Last Breath: Decoding the Secrets of the Air Around Us*

- ⇒ In Paris, a street and a hotel near the Sorbonne are named after GAY-LUSSAC as is a square. His name is one of the 72 names inscribed on the Eiffel Tower.



- ⇒ GAY-LUSSAC and BIOT ascend in a hot air balloon, **11,804 HE**. Illustration from the late **11,800's HE**.<sup>1413</sup>

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<sup>1413</sup> [https://en.wikipedia.org/wiki/Joseph\\_Louis\\_Gay-Lussac](https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac)



JOSEPH LOUIS GAY-LUSSAC, date, location and artist unknown.<sup>1414</sup>

**11,778 HE – 11,829 HE: SIR HUMPHRY DAVY, BT, Cornish chemist.**<sup>1415</sup> “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’.”<sup>1416</sup> In **11,808 HE SIR HUMPHRY DAVY** invented the first lightbulb which was called an arc lamp – but it burned through quickly and was too bright.<sup>1417</sup> **SIR HUMPHRY DAVY** also invented the Davy Lamp and a very early form of

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<sup>1414</sup> [https://en.wikipedia.org/wiki/Joseph\\_Louis\\_Gay-Lussac](https://en.wikipedia.org/wiki/Joseph_Louis_Gay-Lussac)

<sup>1415</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)

<sup>1416</sup> Wulf, Andrea. *The Invention of Nature: Alexander von Humboldt's New World*

<sup>1417</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)

incandescent light bulb.<sup>1418</sup> In **11,808 HE** SIR HUMPHRY DAVY also isolated for the first time the “star stuff” elements Potassium and Sodium<sup>1419</sup> as well as discovering the elemental nature of chlorine and iodine. DAVY also studied the forces involved in these separations, inventing the new field of electrochemistry. BERZELIUS called Davy's **11,806 HE** *Bakerian Lecture On Some Chemical Agencies of Electricity* “one of the best memoirs which has ever enriched the theory of chemistry.” In **11,809 HE** DAVY isolated / defined the “Star Stuff” elements Calcium, Strontium, Barium, Magnesium (discovery also credited to JOSEPH BLACK<sup>1420</sup>), and Boron.<sup>1421</sup>

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<sup>1418</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)

<sup>1419</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)

<sup>1420</sup> [https://en.wikipedia.org/wiki/Joseph\\_Black](https://en.wikipedia.org/wiki/Joseph_Black)

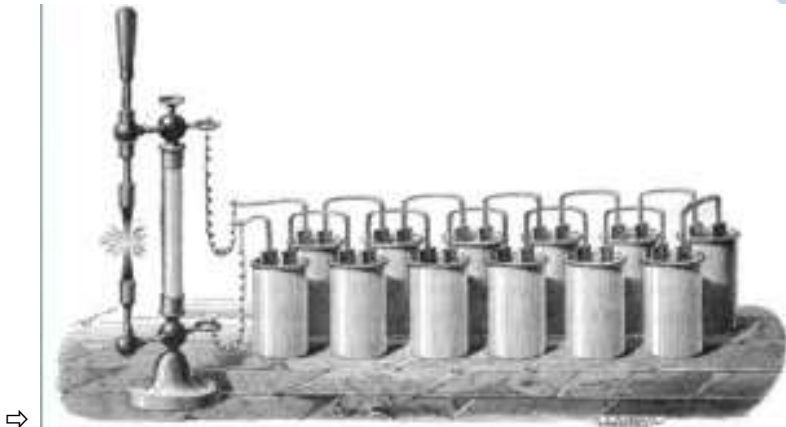
<sup>1421</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)



SIR HUMPHRY DAVY, BT, by Thomas Phillips; National Portrait Gallery, London.<sup>1422</sup>

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<sup>1422</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)



First lightbulb, artist, date and location unknown.<sup>1423</sup>

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<sup>1423</sup> SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*  
<https://www.youtube.com/watch?v=g-KuigAQFp4>





- In the photo of this vial is contained Potassium pearls under paraffin oil. Original size of the largest pearl in cm: 0.5. The abundant “Star Stuff” Element Atomic Number 19, Potassium, K. In Potassium’s pure form it is a silvery white, light metal and is very reactive. It explosively reacts with water. When dealing with elemental potassium, painstaking precaution is inevitable.<sup>1424</sup> In compounds, Potassium is essential to animals and plants, and several natural minerals contain it.<sup>1425</sup> The rare natural isotope potassium 40, a beta

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<sup>1424</sup> <http://images-of-elements.com/potassium.php#a>

<sup>1425</sup> <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.<sup>1426</sup>



- A photo of sodium. “Star Stuff” Element Atomic Number 11, Sodium, Na. Sodium is a very abundant element, that can be found in compounds everywhere on earth, most notably in sea water. Sodium chloride, NaCl, is table salt. Sodium is essential to all animals, but only to a few plants. Elemental sodium is a silvery white, very soft and light metal, which reacts fast and fiercely with many substances (e.g. water), but

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<sup>1426</sup> <http://images-of-elements.com/potassium.php#a>

not with dry air.<sup>1427</sup> 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.<sup>1428</sup>



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

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<sup>1427</sup> <http://images-of-elements.com/sodium.php#a>

<sup>1428</sup> <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.<sup>1429</sup>



• 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.<sup>1430</sup> Elemental Calcium which in

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<sup>1429</sup> <http://images-of-elements.com/magnesium.php#a>

<sup>1430</sup> <http://images-of-elements.com/calcium.php#a>

nature above all occurs as calcium carbonate ( $\text{CaCO}_3$ , lime) and calcium sulfate ( $\text{CaSO}_4$ , 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.<sup>1431</sup>

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<sup>1431</sup> <http://images-of-elements.com/calcium.php#a>



- A seashell is largely made of  $\text{CaCO}_3$ .<sup>1432</sup>



- The photo is 0.4 grams strontium with a dark layer of strontium nitride ( $\text{Sr}_3\text{N}_2$ ), stored under paraffin oil. Original

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<sup>1432</sup> <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  $^{90}\text{Sr}$ , 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.<sup>1433</sup>



- 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

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<sup>1433</sup> <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.<sup>1434</sup>



• The stripe of yellow-green gas in the photo is of the “Star Stuff” Element Atomic Number 17, Chlorine, Cl, which at

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<sup>1434</sup> <http://images-of-elements.com/barium.php>



normal conditions is a yellow-green  $\text{Cl}_2$  gas, is a very caustic substance. Elemental chlorine corrodes nearly every metal and is toxic for every creature.<sup>1435</sup> In nature, Chlorine always occurs in compounds, the most famous of those is sodium chloride,  $\text{NaCl}$ , which is table salt. Chloride is a vital part of the body. The compound of hydrogen and chlorine,  $\text{HCl}$ , dissolved in water, gives hydrochloric acid. Chlorine also is part of the very common plastic PVC.<sup>1436</sup>

**11,779 HE – 11,848 HE:** BARON JÖNS JACOB BERZELIUS<sup>1437</sup> who was known as JACOB BERZELIUS, was a Swedish physician and

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<sup>1435</sup> <http://images-of-elements.com/chlorine.php#a>

<sup>1436</sup> <http://images-of-elements.com/chlorine.php#a>

<sup>1437</sup> BARON JÖNS JACOB BERZELIUS 1st introduced by Wulf, Andrea: *The Invention of Nature: Alexander von Humboldt's New World*

chemist<sup>1438</sup> and is considered, along with ROBERT BOYLE, JOHN DALTON, and ANTOINE LAVOISIER, and SIR HUMPHRY DAVY<sup>1439</sup> to be one of the founders of modern chemistry. BERZELIUS discovered the “Star Stuff” elements: Silicon, Selenium, Thorium, Cerium; and his laboratory discovered “Star Stuff” Elements: Lithium (see also **11,792 HE -11,1841 HE** JOHAN AUGUST ARFWEDSON, Swedish chemist) and Vanadium.<sup>1440</sup>

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<sup>1438</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius)

<sup>1439</sup> [https://en.wikipedia.org/wiki/Humphry\\_Davy](https://en.wikipedia.org/wiki/Humphry_Davy)

<sup>1440</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius)



Daguerreotype of JACOB BERZELIUS date, location, and artist unknown.<sup>1441</sup>

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<sup>1441</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius)



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Photo of the statue of JACOB BERZELIUS in the center of Berzelii Park, Stockholm.<sup>1442</sup>

⇒ Named after BERZELIUS: Berzeliussskolan, a school situated next to his alma mater, Katedralskolan, is named for BARON

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<sup>1442</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](https://en.wikipedia.org/wiki/Jons_Jacob_Berzelius)

JÖNS JACOB BERZELIUS. In **11,939 HE** BERZELIUS's portrait appeared on a series of postage stamps commemorating the bicentenary of the founding of the Swedish Academy of Sciences.<sup>1443</sup>



- 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 ( $\text{SiO}_2$ ). The latter is the chief ingredient of quartz and sand and is used as raw material for glass since ages. Elemental

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<sup>1443</sup> [https://en.wikipedia.org/wiki/Jons\\_Jacob\\_Berzelius](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.<sup>1444</sup>



- 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

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<sup>1444</sup> <http://images-of-elements.com/silicon.php#a>

amino acids. However, if the dose is too high, Selenium quickly becomes poisonous.<sup>1445</sup> (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.)

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<sup>1445</sup> <http://images-of-elements.com/selenium.php#a>



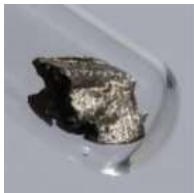
- Photo is of glass vial containing a square of “Star Stuff” Element Atomic Number 90 Thorium.<sup>1446</sup> Thorium by far is the most stable and frequent actinoid, the half-life of  $^{232}\text{Th}$  is 14 billion years. The soft, in pure form silvery, metal is chemically reactive and lightly toxic. 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

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<sup>1446</sup> <https://en.wikipedia.org/wiki/Thorium>



and in good camera lenses (as  $\text{ThO}_2$ ). Thorium decays to radium.<sup>1447</sup>



- 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

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<sup>1447</sup> <http://images-of-elements.com/thorium.php#a>

well as iron and other elements. Iron and cerium are the only elements, where by hard and fast friction sparks can be produced.<sup>1448</sup>



• 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

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<sup>1448</sup> <http://images-of-elements.com/cerium.php#a>

chrome vanadium steel screwdriver. In nature, vanadium appears in different, often colorful minerals, but only rarely in high concentration.<sup>1449</sup>

**11,780 HE – 11,872 HE: MARY FAIRFAX SOMERVILLE**, Scottish scientist, science writer and polymath<sup>1450</sup> was nominated to be jointly the first female member of the Royal Astronomical Society at the same time as **CAROLINE HERSCHEL**.<sup>1451</sup> 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

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<sup>1449</sup> <http://images-of-elements.com/vanadium.php#a>

<sup>1450</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>1451</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)

second husband, Dr William Somerville (11,771 HE – 11,860 HE) inspector of the Army Medical Board. He encouraged, and greatly aided her studies of sciences.<sup>1452</sup> 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

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<sup>1452</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)

herself when solving a diophantine problem for which she was awarded a silver medal in **11,811 HE**. Wallace suggested that she should study the writings of the French mathematician PIERRE-SIMON LAPLACE, which summarized the theory of gravity and collected the mathematical results that had been established in the 50 years since *Principia* had been published. SOMERVILLE said that studying LAPLACE's work gave her the confidence to persevere in her mathematical studies.<sup>1453</sup> 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 *Francœur's Elements of Mechanics*, SYLVESTRE FRANÇOIS LACROIX' *Algebra and Calculus Treatise*, JEAN-BAPTISTE BIOT'S *Analytical Geometry and Astronomy*, SIMÉON DENIS POISSON'S *Treatise*

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<sup>1453</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)

on Mechanics, JOSEPH-LOUIS LAGRANGE'S Theory of Analytical Functions, LEONHARD EULER'S Elements of Algebra and Isoperimetrical Problems, ALEXIS CLAIRAUT'S Figure of the Earth, GASPARD MONGE'S Application of Analysis to Geometry, and FRANÇOIS CALLET'S Logarithmus.<sup>1454</sup>

⇒ 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.<sup>1455</sup>

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<sup>1454</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)

<sup>1455</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)

- ⇒ MARY FAIRFAX SOMERVILLE and her oldest brother Sam Fairfax would refuse to take sugar in their tea, in protest against the institution of slavery.



- ⇒ MARY FAIRFAX SOMERVILLE, date, location and artist unknown.<sup>1456</sup>

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<sup>1456</sup> [https://en.wikipedia.org/wiki/Mary\\_Somerville](https://en.wikipedia.org/wiki/Mary_Somerville)



Royal Bank of Scotland plans to depict pioneering astronomer  
**MARY FAIRFAX SOMERVILLE** on £10 polymer note<sup>1457</sup>

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<sup>1457</sup> <https://www.coinworld.com/news/paper-money/2016/02/bank-in-scotland-to-depict-pioneering-woman-on-note.html>



**Circa 11,780 HE:** England: A system was introduced in which unflanged wheels ran on L-shaped metal plates – these became known as plateways.<sup>1458</sup>



Photo is of a replica of a "Little Eaton Tramway" wagon. The tracks are plateways.<sup>1459</sup>

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<sup>1458</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1459</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,780 HE – 11,849 HE: JOHANN WOLFGANG DÖBEREINER** was the German chemist<sup>1460</sup> who invented a portable lighter, known as Döbereiner's lamp. It was the first portable held-in-your-pocket lighter.<sup>1461</sup>

⇒ DÖBEREINER is best known for work that foreshadowed the periodic law, where he grouped together elements into triads according to their weight.<sup>1462</sup>

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<sup>1460</sup> The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 HE book by science reporter Sam Kean.

<sup>1461</sup> [https://en.wikipedia.org/wiki/Johann\\_Wolfgang\\_Döbereiner](https://en.wikipedia.org/wiki/Johann_Wolfgang_Döbereiner)

<sup>1462</sup> The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 HE book by science reporter Sam Kean.



JOHANN WOLFGANG DÖBEREINER, artist and location unknown<sup>1463</sup>

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<sup>1463</sup> [https://en.wikipedia.org/wiki/Johann\\_Wolfgang\\_Döbereiner](https://en.wikipedia.org/wiki/Johann_Wolfgang_Döbereiner)



• DÖBEREINER's Lamp.<sup>1464</sup> By **11,828 HE** hundreds of

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<sup>1464</sup> <https://en.wikipedia.org/wiki/> [https://en.wikipedia.org/wiki/Johann\\_Wolfgang\\_Obereiner](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner)

thousands of these lighters had been mass produced by the German manufacturer Gottfried Piegler in Schleiz.<sup>1465</sup> <sup>1466</sup>

**11,781 HE – 11,832 HE: HENRI CASSINI;** French Botanist. Author / Compiler includes him because he is a great-great-grandson of CASSINI I, the astronomer, who studied our solar system and the stars. Editor thought it interesting that this CASSINI specialized in the sunflower family and researched and named circa 17 genera.<sup>1467</sup>

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<sup>1465</sup> The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements, is a 12,010 HE book by science reporter Sam Kean.

<sup>1466</sup> [https://en.wikipedia.org/wiki/Johann\\_Wolfgang\\_Obereiner](https://en.wikipedia.org/wiki/Johann_Wolfgang_Obereiner)

<sup>1467</sup> [https://en.wikipedia.org/wiki/Henri\\_Cassini](https://en.wikipedia.org/wiki/Henri_Cassini)

**11,781 HE:** WILLIAM ADDIS, English merchant who is credited with inventing the modern western toothbrush while in jail and having a foul-tasting mouth and being inspired by a broom in his cell. After release from jail, he started a business making toothbrushes named “Wisdom Toothbrushes”. “Wisdom Toothbrushes” stayed in family ownership for 215 years until **11,996 HE** and continues as of **12,018 HE**.<sup>1468</sup>

**Circa 11,787 HE:** England: JOHN CURR, a Sheffield colliery manager, invented the flanged rail for wagons / early train cars.<sup>1469</sup>

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<sup>1468</sup> [https://en.wikipedia.org/wiki/William\\_Addis\\_\(entrepreneur\)](https://en.wikipedia.org/wiki/William_Addis_(entrepreneur))

<sup>1469</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,787 HE – 11,826 HE:** JOSEPH VON FRAUNHOFER, German physicist and lens expert is known for making excellent optical glass and achromatic telescope objectives.<sup>1470</sup>

⇒ 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.<sup>1471</sup>

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<sup>1470</sup> [https://en.wikipedia.org/wiki/Joseph\\_von\\_Fraunhofer](https://en.wikipedia.org/wiki/Joseph_von_Fraunhofer)

<sup>1471</sup> [https://en.wikipedia.org/wiki/Optical\\_spectrometer](https://en.wikipedia.org/wiki/Optical_spectrometer)

Joseph von Fraunhofer



JOSEPH VON FRAUNHOFER unknown date; unknown artist<sup>1472</sup>

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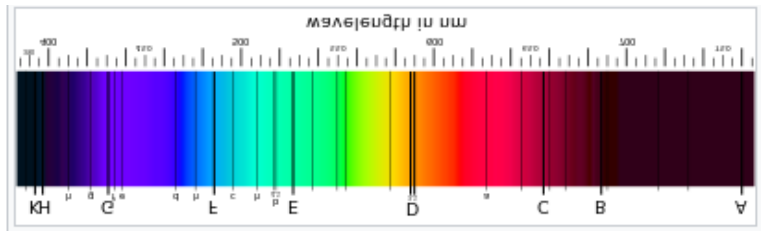
<sup>1472</sup> [https://en.wikipedia.org/wiki/Joseph\\_von\\_Fraunhofer](https://en.wikipedia.org/wiki/Joseph_von_Fraunhofer)



⇒ 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.<sup>1473</sup>

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<sup>1473</sup> [https://en.wikipedia.org/wiki/Fraunhofer\\_lines](https://en.wikipedia.org/wiki/Fraunhofer_lines)



Solar spectrum with Fraunhofer lines as it appears visually.<sup>1474</sup>

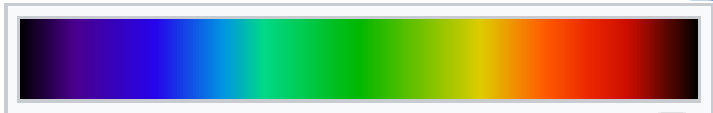
⇒ A spectral line may be observed either as an **emission line** or an **absorption line**. Which type of line is observed depends on the type of material and its temperature relative to another emission source.

<sup>1474</sup> [https://en.wikipedia.org/wiki/Fraunhofer\\_lines](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.<sup>1475</sup>

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<sup>1475</sup> [https://en.wikipedia.org/wiki/Spectral\\_line](https://en.wikipedia.org/wiki/Spectral_line)



- Continuous spectrum<sup>1476</sup>



- Example of Emission lines.<sup>1477</sup>

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<sup>1476</sup> [https://en.wikipedia.org/wiki/Spectral\\_line](https://en.wikipedia.org/wiki/Spectral_line)

<sup>1477</sup> [https://en.wikipedia.org/wiki/Spectral\\_line](https://en.wikipedia.org/wiki/Spectral_line)



• Example of Absorption lines.<sup>1478</sup>

Circa **11,789 HE**: England: WILLIAM JESSOP had introduced a form of all-iron edge rail for wagons / early train cars and flanged wheels for an extension to the Charnwood Forest Canal at Nanpantan, Loughborough, Leicestershire.<sup>1479</sup> In **11,790 HE**: JESSOP and his partner OUTRAM began to manufacture edge-rails.<sup>1480</sup>

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<sup>1478</sup> [https://en.wikipedia.org/wiki/Spectral\\_line](https://en.wikipedia.org/wiki/Spectral_line)

<sup>1479</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1480</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,791 HE – 11,867 HE: MICHAEL FARADAY,**<sup>1481</sup> 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.<sup>1482</sup>

⇒ In doing so, FARADAY had solved the mystery that baffled ISAAC NEWTON. FARADAY showed how the Sun told the planets how to move without touching them. FARADAY showed how the Sun does touch the planets with its gravitational field, and Earth's gravitational field tells the apples how to fall. If MICHAEL FARADAY had never lived, we might still be living as our ancestors did in **11,700 HE.**<sup>1483</sup>

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<sup>1481</sup> BRIAN COX, BBC show The Science of Dr. Who

<sup>1482</sup> [https://en.wikipedia.org/wiki/Michael\\_Faraday](https://en.wikipedia.org/wiki/Michael_Faraday)

<sup>1483</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

⇒ By showing that an electromagnetic force could manipulate light, FARADAY had discovered a deeper unity of nature. FARADAY opened a door for ALBERT EINSTEIN and all the physicists who came after him to glimpse the interplay of hidden, primal forces in the universe. FARADAY knew that electric current turns a wire into a magnet, so he expected to find related patterns in iron filings around a wire carrying electricity. But where others saw merely lovely shapes, FARADAY saw something profound. The patterns were not simply a quirk of iron filings; they existed in the space around a magnet or an electric current, even in the absence of iron filings. FARADAY saw the patterns in the iron filings were the traces, the footprints of invisible fields of force, that reached out into the space around anything magnetic. He saw the compass needle that people wondered at for a thousand years was not reacting to some far away magnetic North Pole. But instead, he saw it was detecting

a continuous force field that stretched all the way to the North Pole.

- ⇒ FARADAY saw Earth itself is a giant magnet. He saw that like any other magnet, its lines of force extend far out into the space surrounding it. They're everywhere, all around us. They've always been. But nobody had ever noticed them before FARADAY.<sup>1484</sup>
- ⇒ 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

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<sup>1484</sup> 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.<sup>1485</sup>

⇒ But later, **11,831 HE – 11,879 HE: JAMES CLERK MAXWELL** was able to do the maths to bring mathematical proofs to FARADAY's efforts.<sup>1486</sup>

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<sup>1485</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10

<sup>1486</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 10



**11,842 HE: MICHAEL FARADAY** portrait by Thomas Phillips, location unknown.<sup>1487</sup>

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<sup>1487</sup> [https://en.wikipedia.org/wiki/Michael\\_Faraday](https://en.wikipedia.org/wiki/Michael_Faraday)

**11,791 HE – 11,871 HE: CHARLES BABBAGE**<sup>1488</sup> English polymath: A mathematician, philosopher, inventor, and mechanical engineer.<sup>1489</sup> The notion of a mechanical calculator for mathematical functions can be traced back to the Antikythera mechanism; **11,819 HE – 11,822 HE CHARLES BABBAGE** originated the concept of a digital programmable computer by way of his “Difference Engines” the first of which he built in these years.<sup>1490</sup>

⇒ **11,833 HE: Lady Byron** (See **11,815 HE – 11,852 HE: ADA LOVELACE** aka **AUGUSTA ADA BYRON KING-NOEL**,

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<sup>1488</sup> Paul Premack suggested including

<sup>1489</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)

<sup>1490</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)

COUNTRESS OF LOVELACE) described seeing the working prototype:

- "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."<sup>1491</sup>

⇒ LEGACIES: Due to his association with the town Babbage was chosen in **12,007 HE** to appear on the 5 pound note. An image of **BABBAGE** features in the British cultural icons section of the newly designed British passport in **12,015 HE**.<sup>1492</sup>

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<sup>1491</sup> [https://en.wikipedia.org/wiki/Difference\\_engine](https://en.wikipedia.org/wiki/Difference_engine)

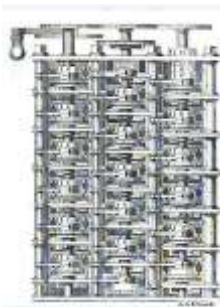
<sup>1492</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)

- ⇒ Half of BABBAGE's brain is preserved at the Hunterian Museum in the Royal College of Surgeons in London.<sup>1493</sup>
- ⇒ The other half of BABBAGE's brain is on display in the Science Museum, London.<sup>1494</sup>

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<sup>1493</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)

<sup>1494</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)



A portion of the Difference Engine, artist CHARLES BABBAGE, date and location unknown.<sup>1495</sup>

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<sup>1495</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)



CHARLES BABBAGE, circa **11,850 HE**, photographer and location unknown.<sup>1496</sup>

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<sup>1496</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](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.<sup>1497</sup>

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<sup>1497</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)



⇒ List of Publications by BABBAGE, CHARLES can be seen online.<sup>1498</sup>

**11,791 HE– 11,872 HE:** SAMUEL FINLEY BREESE MORSE was a United States painter and inventor.<sup>1499</sup> 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.<sup>1500</sup> (See **11,580 HE–11,650 HE:** FRANZ KESSLER **11,616 HE:** The first five chapters of this FRANZ KESSLER book

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<sup>1498</sup> [https://en.wikipedia.org/wiki/Charles\\_Babbage](https://en.wikipedia.org/wiki/Charles_Babbage)

<sup>1499</sup> [https://en.wikipedia.org/wiki/Samuel\\_Morse](https://en.wikipedia.org/wiki/Samuel_Morse)

<sup>1500</sup> [https://en.wikipedia.org/wiki/Samuel\\_Morse](https://en.wikipedia.org/wiki/Samuel_Morse)

deal with communicating via a crude Aldis lamp – the predecessor to Morse Code).<sup>1501</sup>



**11,840 HE SAMUEL FINLEY BREESE MORSE**, artist and location unknown,<sup>1502</sup>

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<sup>1501</sup> [https://en.wikipedia.org/wiki/Franz\\_Kessler](https://en.wikipedia.org/wiki/Franz_Kessler)

<sup>1502</sup> [https://en.wikipedia.org/wiki/Samuel\\_Morse](https://en.wikipedia.org/wiki/Samuel_Morse)



Chart of the Morse code letters and numerals, artist and location unknown.<sup>1503</sup>

<sup>1503</sup> [https://en.wikipedia.org/wiki/Morse\\_code](https://en.wikipedia.org/wiki/Morse_code)

**11,792 HE -11,1841 HE: JOHAN AUGUST ARFWEDSON**, Swedish chemist discovered the element Lithium in by isolating it as a salt.<sup>1504</sup>



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,  $\text{Li}_3\text{N}$ , which makes a dark layer on the otherwise light silver metal. Lithium is often used in disposable and rechargeable batteries; lithium

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<sup>1504</sup> [https://en.wikipedia.org/wiki/Johan\\_August\\_Arfwedson](https://en.wikipedia.org/wiki/Johan_August_Arfwedson)

salts are used in medicine as treatment for mental disorders.<sup>1505</sup>



JOHAN AUGUST ARFWEDSON, date, location, and artist unknown.<sup>1506</sup>

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<sup>1505</sup> <http://images-of-elements.com/lithium.php#a>

<sup>1506</sup> [https://en.wikipedia.org/wiki/Johan\\_August\\_Arfwedson](https://en.wikipedia.org/wiki/Johan_August_Arfwedson)

Circa **11,793 HE**: ELI WHITNEY: United States Inventor who applied for the patent for his cotton gin but did not exactly invent the cotton gin. As part of a massive engineering push sponsored by the state of Georgia, Whitney was commissioned to improve the rollers on the existing cotton gin. He replaced the solid rollers with wire teeth.<sup>1507</sup>



**11,822 HE**: ELI WHITNEY, by Samuel F. B. Morse, Yale University Art Gallery.<sup>1508</sup>

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<sup>1507</sup> SciShow 5-2-12,016 HE youtube.com Video: *The Truth About 10 Famous Inventions*

<sup>1508</sup> [https://en.wikipedia.org/wiki/Eli\\_Whitney](https://en.wikipedia.org/wiki/Eli_Whitney)

**11,796 HE:** Wakefield, West Yorkshire England: The first public edgeway, thus also *The First Public Railway*, was an early narrow gauge railway<sup>1509</sup> called the *Lake Lock Rail Road*. Although the primary purpose of the line was to carry coal, it also carried passengers.<sup>1510</sup>

**11,796 HE:** Lithography (from Ancient Greek lithos, meaning 'stone', and graphein, meaning 'to write') was invented by German author and actor ALOIS SENEFELDER as a cheap method of publishing theatrical works. It is method of printing originally based on the immiscibility of oil and water. The printing is from a stone or a metal plate with a smooth surface.<sup>1511</sup>

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<sup>1509</sup> [https://en.wikipedia.org/wiki/Lake\\_Lock\\_Rail\\_Road](https://en.wikipedia.org/wiki/Lake_Lock_Rail_Road)

<sup>1510</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1511</sup> <https://en.wikipedia.org/wiki/Lithography>

**11,796 HE:** L'Intrépide is the oldest existing flying device.



L'Intrépide, in the Heeresgeschichtliches Museum, Vienna, date, and photographer unknown.<sup>1512</sup>

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<sup>1512</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)



**11,797 HE – 11,875 HE: SIR CHARLES LYELL**, first BARONET, British, foremost geologist of his day and a British Lawyer<sup>1513 1514</sup> 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.<sup>1515</sup>

⇒ 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

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<sup>1513</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>1514</sup> [https://en.wikipedia.org/wiki/Charles\\_Lyell](https://en.wikipedia.org/wiki/Charles_Lyell)

<sup>1515</sup> [https://en.wikipedia.org/wiki/Charles\\_Lyell](https://en.wikipedia.org/wiki/Charles_Lyell)

currently-used names for geological eras, Paleozoic, Mesozoic and Cenozoic.<sup>1516</sup>

- ⇒ LYELL was one of the first to believe that the world is older than 300 million years, on the basis of its geological anomalies.<sup>1517</sup>
- ⇒ LYELL was a close friend of CHARLES DARWIN and contributed significantly to DARWIN's thinking on the processes involved in evolution. LYELL helped to arrange the simultaneous publication in **11,858 HE** of papers by CHARLES DARWIN and ALFRED RUSSEL WALLACE on natural selection, despite his personal religious qualms about the theory.

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<sup>1516</sup> [https://en.wikipedia.org/wiki/Charles\\_Lyell](https://en.wikipedia.org/wiki/Charles_Lyell)

<sup>1517</sup> [https://en.wikipedia.org/wiki/Charles\\_Lyell](https://en.wikipedia.org/wiki/Charles_Lyell)

LYELL later published evidence from geology of the time man had existed on Earth.



SIR CHARLES LYELL, BT, date, location, and artist unknown.<sup>1518</sup>

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<sup>1518</sup> [https://en.wikipedia.org/wiki/Charles\\_Lyell](https://en.wikipedia.org/wiki/Charles_Lyell)

**Circa 11,799 HE:** Bloodletting (or blood-letting) is the withdrawal of blood from a patient to prevent or cure illness and disease. Bloodletting, whether by a physician or by leeches, was based on an ancient system of medicine in which blood and other bodily fluids were regarded as "humours" that had to remain in proper balance to maintain health. It is claimed to have been the most common medical practice performed by surgeons from antiquity until the late **11,800's HE**, a span of almost 2,000 years.<sup>1519</sup>

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<sup>1519</sup> <https://en.wikipedia.org/wiki/Bloodletting>



**11,790s HE** “The Many-Bladed Fleam” was a tool having several different sized blades for opening a vein for bloodletting in various parts of the body<sup>1520</sup> This photo from the Fort

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<sup>1520</sup> 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.<sup>1521</sup>



Author / Compiler chose this date to include this entry because

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<sup>1521</sup> <https://www.pbs.org/newshour/show/bloodletting-blisters-solving-medical-mystery-george-washingtons-death>

history reports that George Washington died of bloodletting in **11,797 HE**. Painting is of his deathbed and those with him. Artist and location unknown.<sup>1522</sup>

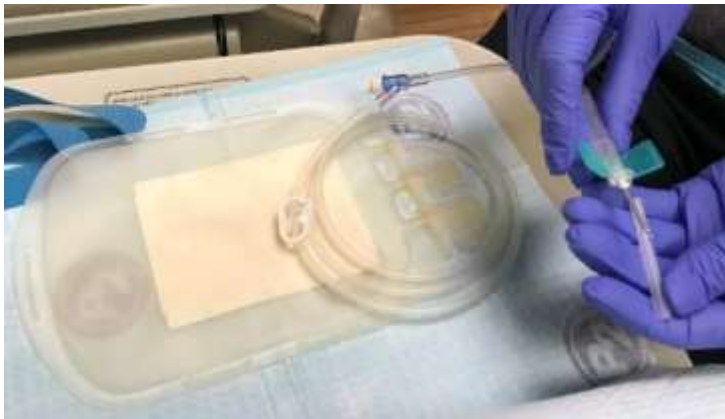


Bloodletting-Set of a Barber Surgeon, beginning of the **11,800's HE**, Märkisches Museum Berlin.<sup>1523</sup>

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<sup>1522</sup> [https://www.bing.com/images/search; practicallyhistorical.files.wordpress.com](https://www.bing.com/images/search;practicallyhistorical.files.wordpress.com)

<sup>1523</sup> <https://en.wikipedia.org/wiki/Bloodletting>



**12,018 HE:** current technology for bloodletting (phlebotomy).  
Hands belong to nurse BRITTANY JENKINS.<sup>1524</sup>

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<sup>1524</sup> Photo by author/compiler



**11,799 HE – 11,847 HE – MARY ANNING**, Great Britain<sup>1525</sup> fossil collector, dealer, and renowned paleontologist<sup>1526</sup> 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

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<sup>1525</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)

<sup>1526</sup> [https://en.wikipedia.org/wiki/Mary\\_Annings](https://en.wikipedia.org/wiki/Mary_Annings)

labor, domestic service, and work in the newly opening factories.<sup>1527</sup>

⇒ The king's physician and aide, Carl Gustav Carus, wrote in his journal: “We had alighted from the carriage and were proceeding on foot, when we fell in with MARY ANNING’s shop in which the 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

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<sup>1527</sup> [https://en.wikipedia.org/wiki/Mary\\_Anning](https://en.wikipedia.org/wiki/Mary_Anning)

the cabinets of natural history on the Continent, and I consider the price demanded, £15 sterling, as very moderate.”<sup>1528</sup>

- ⇒ Lady Harriet Silvester, the widow of the former Recorder of the City of London, visited Lyme in **11,824 HE** and described MARY ANNING in her diary: “The extraordinary thing in this young woman is that she has made herself so thoroughly acquainted with the science that the moment she finds any bones she knows to what tribe they belong. She fixes the bones on a frame with cement and 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

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<sup>1528</sup> [https://en.wikipedia.org/wiki/Mary\\_Anning](https://en.wikipedia.org/wiki/Mary_Anning)

anyone else in this kingdom”<sup>1529</sup> (See Circa 250 years ago when in **11,556 HE**: GEORG BAUER AKA GEORGIUS AGRICOLA began to speculate on fossils.<sup>1530</sup>)

⇒ In the early **11,840s HE**: JEAN LOUIS RODOLPHE AGASSIZ named two fossil fish species after MARY ANNING —Acrodon anningiae, and Belenostomus anningiae.<sup>1531</sup>

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<sup>1529</sup> [https://en.wikipedia.org/wiki/Mary\\_Anning](https://en.wikipedia.org/wiki/Mary_Anning)

<sup>1530</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 114

<sup>1531</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)



MARY ANNING with her dog, Tray, painted before **11,842**  
**HE**; the Golden Cap outcrop can be seen in the background,  
artist and location unknown.<sup>1532</sup>

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<sup>1532</sup> [https://en.wikipedia.org/wiki/Mary\\_Anning](https://en.wikipedia.org/wiki/Mary_Anning)



Letter and drawing from MARY ANNING announcing the discovery of a fossil animal now known as *Plesiosaurus dolichodeirus*, 26 December **11,823 HE.**<sup>1533</sup>

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<sup>1533</sup> [https://en.wikipedia.org/wiki/Mary\\_Annings](https://en.wikipedia.org/wiki/Mary_Annings)

**11,799 HE – 11,868 HE: PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE<sup>1534</sup>** was a German-Swiss chemist who is best known for inventing the fuel cell in **11,838 HE.**<sup>1535</sup>



**PROF CHRISTIAN FRIEDRICH SCHÖNBEIN HFRSE**, date, location, and artist unknown.<sup>1536</sup>

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<sup>1534</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

<sup>1535</sup> [https://en.wikipedia.org/wiki/Christian\\_Friedrich\\_Schobein](https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein)

<sup>1536</sup> [https://en.wikipedia.org/wiki/Christian\\_Friedrich\\_Schobein](https://en.wikipedia.org/wiki/Christian_Friedrich_Schobein)

**Circa 11,800 HE:** English scholar ALEXANDER NECKAM was the first to refer to the directional ability of magnetism and Europeans putting a magnetic needle on a card marked with directions and calling it the magnetic compass (the French word for “to go around”).<sup>1537</sup> (See **9,401 HE** for more.)

**Circa 11,800 HE:** The population of the world was approximately 1,000,000,000 people.<sup>1538</sup>

**11,800 HE – 11,895 HE:** The battery electric car owes its beginnings to ÁNYOS ISTVÁN JEDLIK, Hungarian (AKA in older texts and publications by the Latin name STEPHANUS ANIANUS

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<sup>1537</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 80

<sup>1538</sup> <http://www.worldometers.info/world-population/world-population-by-year/>



JEDLIK.) He was an inventor, engineer, physicist, and benedictine priest.<sup>1539</sup>



JEDLIK'S "lightning-magnetic self-rotor" **11,827 HE**; the world's first electric motor.<sup>1540</sup>

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<sup>1539</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

<sup>1540</sup> [https://en.wikipedia.org/wiki/Anyos\\_Jedlik](https://en.wikipedia.org/wiki/Anyos_Jedlik)



JEDLIK'S tubular voltage generator, which was successfully displayed at the Vienna World Exposition in **11,873 HE** is probably the earliest impulse generator<sup>1541</sup>

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<sup>1541</sup> [https://en.wikipedia.org/wiki/Anyos\\_Jedlik](https://en.wikipedia.org/wiki/Anyos_Jedlik)



ÁNYOS ISTVÁN JEDLIK, date and photographer unknown<sup>1542</sup>

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<sup>1542</sup> [https://en.wikipedia.org/wiki/Anyos\\_Jedlik](https://en.wikipedia.org/wiki/Anyos_Jedlik)

**Circa 11,804 HE:** RICHARD TREVITHICK, British Engineer, built the first full-scale working railway steam locomotive. The world's first steam-powered railway journey in the world took place when TREVITHICK's unnamed steam locomotive hauled a train along the tramway of the Penydarren ironworks in South Wales.



Photo is of a replica of TREVITHICK's engine at the National Waterfront Museum, Swansea, photographer unknown.<sup>1543</sup>

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<sup>1543</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,806 HE:** In London, the song “Twinkle Twinkle Little Star” with English lyrics saying they “wondered what stars are?” were first written as a poem by Jane Taylor (**11,783 HE –11,824 HE**) and published with the title "*The Star*" by Jane Taylor.<sup>1544</sup>

⇒ 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.

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<sup>1544</sup> [https://en.wikipedia.org/wiki/Twinkle,\\_Twinkle,\\_Little\\_Star](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.”<sup>1545</sup>

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<sup>1545</sup> [https://en.wikipedia.org/wiki/Twinkle,\\_Twinkle,\\_Little\\_Star](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."<sup>1546</sup>

**11,807 HE:** Operating independently of ISAAC DE RIVAZ the French brothers NICÉPHORE AND CLAUDE NIÉPCE built an internal combustion engine called the “Pyreolophore” which they used to power a boat by the reaction from a pulsed water jet.<sup>1547</sup>

**11,807 HE – 11,840 HE:** “Star Stuff” Element Ruthenium, Atomic Number 44, is discovered over time.

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<sup>1546</sup> The updated sad version of the poem was written by Ruthie S. Premack.

<sup>1547</sup> [https://en.wikipedia.org/wiki/De\\_Rivaz\\_engine](https://en.wikipedia.org/wiki/De_Rivaz_engine)

- The first effort was by JĘDRZEJ ŚNIADECKI<sup>1548</sup> (**11,768 HE – 11,838 HE**). ŚNIADECKI, a Polish writer, physician, chemist, and biologist tried to isolate Ruthenium but could not. He did create the modern Polish terminology in the field of chemistry.<sup>1549</sup>
- The second effort was by Swedish physician and chemist BARON JÖNS JACOB BERZELIUS (**11,779 HE – 11,848 HE**), who tried to isolate Ruthenium but didn't.
- The third effort was by German Scientist GOTTFRIED WILHELM OSANN<sup>1550</sup> (**11,796 HE– 11,866 HE**), chemist and physicist. OSANN was known for his work on the

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<sup>1548</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1549</sup> [https://en.wikipedia.org/wiki/Jędrzej\\_Śniadecki](https://en.wikipedia.org/wiki/Jędrzej_Śniadecki)

<sup>1550</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

chemistry of platinum metals.<sup>1551</sup> In **11,825 HE** OSANN worked on isolating Ruthenium and failed, but he did name it.

- Finally, KARL ERNST CLAUS (also Karl Klaus or Carl Claus) (**11,796 HE – 11,864 HE**), a Baltic German chemist and naturalist, isolated the Star Stuff chemical element Ruthenium in **11,840 HE**. CLAUS, *realizing he was standing on the shoulders of those who came before him*, then kept the name given to it by OSANN. CLAUS is also known as one of the first scientists who applied quantitative methods in botany.<sup>1552</sup>
- Author / Compiler note: I celebrate the name of this Element! It relates my name to science, and I am beginning to

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<sup>1551</sup> [https://en.wikipedia.org/wiki/Gottfried\\_Osann](https://en.wikipedia.org/wiki/Gottfried_Osann)

<sup>1552</sup> [https://en.wikipedia.org/wiki/Gottfried\\_Osann](https://en.wikipedia.org/wiki/Gottfried_Osann)

understand that science is one of the greatest achievements of our human species!



**11,843** HE painting of JĘDRZEJ ŚNIADECKI by Aleksander Sleńdziński, location unknown.<sup>1553</sup>

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<sup>1553</sup> [https://en.wikipedia.org/wiki/Jędrzej\\_Śniadecki](https://en.wikipedia.org/wiki/Jędrzej_Śniadecki)



- Portrait is of GOTTFRIED WILHELM OSANN, date, location, artist unknown.<sup>1554</sup>

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<sup>1554</sup> [https://en.wikipedia.org/wiki/Gottfried\\_Osann](https://en.wikipedia.org/wiki/Gottfried_Osann)



Photo is of KARL ERNST CLAUS, date, location and photographer unknown.<sup>1555</sup>

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<sup>1555</sup> [https://en.wikipedia.org/wiki/Karl\\_Ernst\\_Claus](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.<sup>1556</sup> It is an effective hardener for Platinum and Palladium. It has been added to Titanium deep-water pipes to improve their resistance to corrosion.<sup>1557</sup>

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<sup>1556</sup> <http://images-of-elements.com/ruthenium.php#a>

<sup>1557</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

**11,807 HE – 11,873 HE: JEAN LOUIS RODOLPHE AGASSIZ**, United States scientist<sup>1558</sup> 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.<sup>1559</sup>

⇒ In **11,837 HE** AGASSIZ was the first to scientifically propose that the Earth had been subject to a past ice age, when he proposed to the Helvetic Society that ancient glaciers had not only flowed outward from the Alps, but that even larger glaciers

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<sup>1558</sup> BBC Men of Rock 3 of 3 12,010HE BBC TV show “The Big Freeze”

<sup>1559</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)



had simultaneously encroached southward on the plains and mountains of Europe, Asia and North America, smothering the entire northern hemisphere in a prolonged Ice Age.<sup>1560</sup> In **11,840 HE AGASSIZ** confirmed glaciation outside the Alps, in Scotland, with parallel lines at Glen Roy caused by a glacial lake changing depth and carving different shorelines over time.<sup>1561</sup>

⇒ 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.<sup>1562</sup>

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<sup>1560</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)

<sup>1561</sup> BBC Men of Rock 3 of 3 12,010 HE BBC TV show "The Big Freeze"

<sup>1562</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)



JEAN LOUIS RODOLPHE AGASSIZ, date, location, and artist unknown.<sup>1563</sup>

- ⇒ 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

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<sup>1563</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)

Mountains; Agassiz Peak in Arizona; In Switzerland, the Agassiz horn in the Bernese Alps; Agassiz Glacier (Montana); Agassiz Creek in Glacier National Park; Agassiz Glacier (Alaska) in Saint Elias Mountains; Mount Agassiz in New Hampshire's White Mountains; A crater on Mars (Crater Agassiz); A promontory on the Moon; A headland situated in Palmer Land, Antarctica, Cape Agassiz; A main-belt asteroid named 2267 Agassiz. The elementary school north of Harvard University was named in his honor and the surrounding neighborhood became known as "Agassiz" as a result. The school's name was changed to the Maria L. Baldwin School on May 21, **12,002 HE**, due to concerns about Agassiz's racism, and to honor Maria Louise Baldwin the African-American principal of the school who served from **11,889 HE** until **11,922**

**HE.** The neighborhood, however, continues to be known as Agassiz.<sup>1564</sup>

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<sup>1564</sup> [https://en.wikipedia.org/wiki/Louis\\_Agassiz](https://en.wikipedia.org/wiki/Louis_Agassiz)

## Chapter Six

# THE MODERN SCIENTIFIC ERA: Circa 11,859 HE (Lasting, so far, less than 175 years)

Evolution, Atomic and Quantum Physics, Astrophysics, Technology, and the Information Age.

**11,809 HE – 11,882 HE:** CHARLES DARWIN, British scientist who is best known for developing, defining, and proving the concepts of natural selection and evolution. DARWIN sailed on the HMS BEAGLE, collecting specimens. From his collecting, DARWIN established that all species of life have descended over time from common ancestors.<sup>1565</sup>

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<sup>1565</sup> [https://en.wikipedia.org/wiki/Charles\\_Darwin](https://en.wikipedia.org/wiki/Charles_Darwin)

Charles Darwin



Photo of CHARLES DARWIN, date and location unknown<sup>1566</sup>

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<sup>1566</sup> [https://en.wikipedia.org/wiki/Charles\\_Darwin](https://en.wikipedia.org/wiki/Charles_Darwin)



The title page of the 1859 edition

**11,859 HE:** DARWIN's title page for *The Origin of Species* draft.<sup>1567</sup> In the Sixth Edition of *The Origin of Species*, DARWIN references lists and published works of others who

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<sup>1567</sup> <http://darwin-online.org.uk/content/search-results?freetext=origin%20of%20species>

before him, or contemporaneously with him, referenced or speculated about natural selection.<sup>1568</sup>

**11,811 HE – 11,861 HE:** ELISHA OTIS, Vermont and New York, United States inventor of power lifting devices with electricity or steam rather than people pulling on ropes. Prior elevators still used ropes, which tended to break. OTIS invented the safety break which made elevators practical. Human Powered Lifting devices date back to antiquity. The Greeks and Romans documented using them.<sup>1569</sup>

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<sup>1568</sup> CHARLES DARWIN The Origin of Species

<sup>1569</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*





ELISHA OTIS, photographer, date, location unknown.<sup>1570</sup>

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<sup>1570</sup> [https://en.wikipedia.org/wiki/Elisha\\_Otis](https://en.wikipedia.org/wiki/Elisha_Otis)



**11,854 HE** *Otis Free-fall safety demonstration elevator*, artist and location unknown. OTIS received no patent for his safety break elevators which made skyscrapers possible.<sup>1571</sup>

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<sup>1571</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

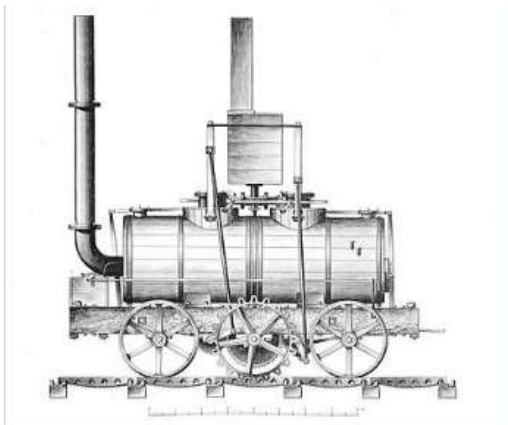
**Circa 11,812 HE:** MATTHEW MURRAY designed the first commercially successful steam rack locomotive *Salamanca*, built for the Middleton Railway in Leeds, England. This twin-cylinder locomotive was not heavy enough to break the edge-rails track and solved the problem of adhesion by a cog-wheel using teeth cast on the side of one of the rails. Thus, it was also the first rack railway.<sup>1572</sup>

⇒ As of **12,018 HE**, these countries have cog and rack railways: Angola, Argentina, Australia, Austria, Bolivia, Brazil, Chile, Czech Republic, France, Germany, Greece, Hungary, Indonesia, India, Italy, Japan, Lebanon, Mexico, Panama, Portugal, Romania, Slovakia, South Africa, Spain, Switzerland, United Kingdom, United States, and Vietnam.<sup>1573</sup>

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<sup>1572</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1573</sup> [https://en.wikipedia.org/wiki/Rack\\_railway](https://en.wikipedia.org/wiki/Rack_railway)



**11,812 HE:** Drawing (unknown artist and location) of MATTHEW MURRAY's rack locomotive *Salamanca*.<sup>1574</sup>

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<sup>1574</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

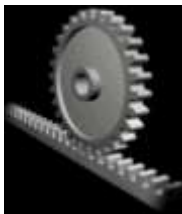


Photo is an example of a rack system (also rack-and-pinion railway, cog railway, or cogwheel railway) which is a steep grade railway with a toothed rack rail, usually between the running rails. The trains are fitted with one or more cog wheels or pinions that mesh with this rack rail. This allows the trains to operate on steep grades above around 7 to 10%, which is the maximum for friction-based rail.<sup>1575</sup>

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<sup>1575</sup> [https://en.wikipedia.org/wiki/Rack\\_railway](https://en.wikipedia.org/wiki/Rack_railway)

**11,813 HE – 11,858 HE: JOHN SNOW** English physician and a leader in the adoption of anesthesia and medical hygiene<sup>1576</sup> 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".<sup>1577</sup>

⇒ The germ theory of disease had not yet been developed, so Snow was skeptical and did not understand the mechanism by which the disease was transmitted. His observation of the evidence led him to discount the theory of foul air. He first publicized his theory in an **11,849 HE** essay *On the Mode of Communication of Cholera*, followed in **11,855 HE** by a more detailed treatise incorporating the results of his investigation of the role of the water supply in the Soho epidemic of **11,854 HE**. By talking to local residents, (with the help of Reverend Henry Whitehead)

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<sup>1576</sup> Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

<sup>1577</sup> [https://en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)

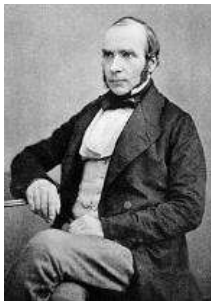
SNOW identified the source of the outbreak as the public water pump on Broad Street (now Broadwick Street). Although SNOW's chemical and microscope examination of a water sample from the Broad Street pump did not conclusively prove its danger, his studies of the pattern of the disease were convincing enough to persuade the local council to disable the well pump by removing its handle (force rod).<sup>1578</sup>

- ⇒ 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

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<sup>1578</sup> [https://en.wikipedia.org/wiki/John\\_Snow](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.<sup>1579</sup>



JOHN SNOW, date, location and photographer unknown.<sup>1580</sup>

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<sup>1579</sup> [https://en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)

<sup>1580</sup> [https://en.wikipedia.org/wiki/John\\_Snow](https://en.wikipedia.org/wiki/John_Snow)



**11,813 HE – 11,903 HE:** JOSIAH WILLARD GIBBS; United States, physics, chemistry and mathematics. He is known for “Chemical thermodynamics; Chemical potential; Statistical mechanics; Statistical ensemble; Gibbs entropy; Phase space; Physical optics; Gibbs free energy; Phase rule; Gibbs paradox; Gibbs invented Vector Calculus; Cross product; Gibbs phenomenon; Gibbs–Helmholtz equation; Gibbs–Duhem equation; Gibbs algorithm; Gibbs measure; Gibbs state; Gibbs–Thomson effect; Gibbs isotherm; Gibbs–Donnan effect; Gibbs–Marangoni effect; Gibbs lemma; Gibbs' inequality; and the Gibbs distribution.”<sup>1581</sup>

⇒ Henry Adams called JOSIAH WILLARD GIBBS “the greatest of Americans, judged by his rank in science.”<sup>1582</sup>

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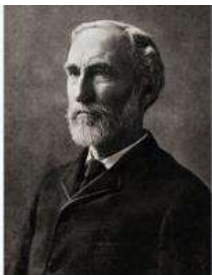
<sup>1581</sup> [https://en.wikipedia.org/wiki/Josiah\\_Willard\\_Gibbs](https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs)

<sup>1582</sup> [https://en.wikipedia.org/wiki/Josiah\\_Willard\\_Gibbs](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.<sup>1583</sup>

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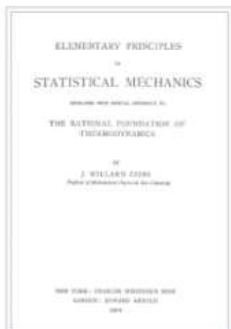
<sup>1583</sup> [https://en.wikipedia.org/wiki/Josiah\\_Willard\\_Gibbs](https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs)



JOSIAH WILLARD GIBBS, date, artist, and location  
unknown.<sup>1584</sup>

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<sup>1584</sup> [https://en.wikipedia.org/wiki/Josiah\\_Willard\\_Gibbs](https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs)



Published in **11,902 HE**: Title page of JOSIAH WILLARD GIBBS's *Elementary Principles in Statistical Mechanics*, one of the founding documents of that discipline.<sup>1585</sup>

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<sup>1585</sup> [https://en.wikipedia.org/wiki/Josiah\\_Willard\\_Gibbs](https://en.wikipedia.org/wiki/Josiah_Willard_Gibbs)

**11,815 HE – 11,852 HE:** ADA LOVELACE<sup>1586</sup> 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”.<sup>1587</sup>

⇒ 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.

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<sup>1586</sup> Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

<sup>1587</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience



ADA LOVELACE, Countess of Lovelace, **11,840 HE** artist and location unknown.<sup>1588</sup>

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<sup>1588</sup> [https://en.wikipedia.org/wiki/Ada\\_Lovelace](https://en.wikipedia.org/wiki/Ada_Lovelace)



ADA LOVELACE, aged seven, by Alfred d'Orsay, **11,822 HE.**  
Painting is displayed at Somerville College, Oxford.<sup>1589</sup>

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<sup>1589</sup> [https://en.wikipedia.org/wiki/Ada\\_Lovelace](https://en.wikipedia.org/wiki/Ada_Lovelace)

## 11,819 HE – 11,868 HE: JEAN BERNARD LÉON FOUCAULT.

French physicist who:

⇒ In **11,850 HE** did an experiment using the Fizeau–Foucault apparatus to measure the speed of light; it came to be known as the Foucault–Fizeau experiment and was viewed as "driving the last nail in the coffin" of ISAAC NEWTON'S particle theory of light when it showed that light travels more slowly through water than through air.<sup>1590</sup> (EINSTEIN and others took the concept farther, showing that light has dual properties of both particles and waves depending on the experiment being conducted<sup>1591</sup>.)

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<sup>1590</sup> [https://en.wikipedia.org/wiki/Leon\\_Foucault](https://en.wikipedia.org/wiki/Leon_Foucault)

<sup>1591</sup> [https://www.sciencedaily.com/terms/wave-particle\\_duality.htm](https://www.sciencedaily.com/terms/wave-particle_duality.htm)



- ⇒ In **11,851 HE** invented the FOUCAULT pendulum which was the first direct demonstration of the Earth's rotation. That Earth rotated was doubted by a few at that time, but not yet demonstrated at an experimental level.<sup>1592</sup>
- ⇒ In **11,855 HE** discovered that the force required for the rotation of a copper disc becomes greater when it is made to rotate with its rim between the poles of a magnet, the disc at the same time becoming heated by the eddy current or "Foucault currents" induced in the metal. As a result, in **11,857 HE** FOUCAULT invented the polarizer which bears his name.<sup>1593</sup>
- ⇒ In **11,858 HE** devised a method of testing the mirror of a reflecting telescope to determine its shape. The so-called

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<sup>1592</sup> [https://en.wikipedia.org/wiki/Leon\\_Foucault](https://en.wikipedia.org/wiki/Leon_Foucault)

<sup>1593</sup> [https://en.wikipedia.org/wiki/Leon\\_Foucault](https://en.wikipedia.org/wiki/Leon_Foucault)

"Foucault knife-edge test" allows the worker to tell if the mirror is perfectly spherical or has non-spherical deviation in its figure.<sup>1594</sup>

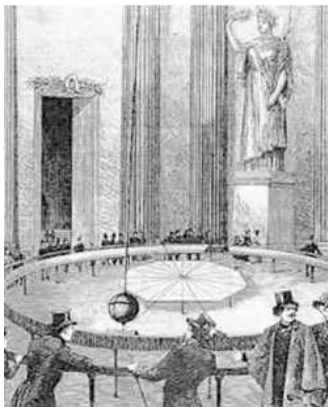


JEAN BERNARD LÉON FOUCAULT, photographer, date, and location unknown.<sup>1595</sup>

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<sup>1594</sup> [https://en.wikipedia.org/wiki/Leon\\_Foucault](https://en.wikipedia.org/wiki/Leon_Foucault)

<sup>1595</sup> [https://en.wikipedia.org/wiki/Leon\\_Foucault](https://en.wikipedia.org/wiki/Leon_Foucault)



**11,851 HE:** Display of FOUCAULT's Pendulum in Paris for Napoleon III.<sup>1596</sup>

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<sup>1596</sup> [http://www.cecs.cl/pendulo/index.php?option=com\\_content&view=article&id=48&Itemid=2&lang=en](http://www.cecs.cl/pendulo/index.php?option=com_content&view=article&id=48&Itemid=2&lang=en)

**Circa 11,820 HE: JOHN BIRKINSHAW**, British railway engineer, recognized that wood and cast iron were not satisfactory materials for rails because they could only be up to 3 ft lengths and either were brittle or broke under heavy loads. BIRKINSHAW invented wrought iron, which could be made into 15 ft lengths. Wrought iron (usually simply referred to as "iron") was a ductile material that could undergo considerable deformation before breaking, making it more suitable for iron rails.<sup>1597 1598</sup>

**11,820 HE -11,893 HE: JOHN TYNDALL**, British scientist and inventor who explained the heat in the Earth's atmosphere known as infrared radiation and proved the Earth's atmosphere had a Greenhouse Effect. He devised demonstrations that advanced the

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<sup>1597</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1598</sup> [https://en.wikipedia.org/wiki/John\\_Birkinshaw](https://en.wikipedia.org/wiki/John_Birkinshaw)

question of how radiant heat is absorbed and emitted at the molecular level.<sup>1599</sup>

⇒ **11,862 HE: JOHN TYNDALL** invented a system for measuring the amount of carbon dioxide in a sample of exhaled human breath. The basics of TYNDALL's system is in daily use in hospitals today for monitoring patients under anesthesia. TYNDALL researched and what became “Tyndallization” was historically the earliest known effective way to destroy bacterial spores. At the time, it affirmed the “germ theory” against a number of critics whose experimental results had been defective.<sup>1600</sup>

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<sup>1599</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)

<sup>1600</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)

- ⇒ **11,864 HE:** JOHN TYNDALL appears to be the first person to have demonstrated experimentally that emission of heat in chemical reactions has its physical origination within the newly defined molecules.<sup>1601</sup>
- ⇒ During the mid-**11,870s HE** LOUIS PASTEUR and JOHN TYNDALL were in frequent communication. TYNDALL was a member of a group of scientists that vocally supported DARWIN's theory of evolution and sought to strengthen the barrier, or separation, between religion and science.<sup>1602</sup>

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<sup>1601</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)

<sup>1602</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)

⇒ 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”.<sup>1603</sup>

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<sup>1603</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)







JOHN TYNDALL circa **11,930 HE**, photographer and location unknown.<sup>1605</sup>

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<sup>1605</sup> [https://en.wikipedia.org/wiki/John\\_Tyndall](https://en.wikipedia.org/wiki/John_Tyndall)

**Circa 11,821 HE:** England: JOHN BIRKINSHAW's wrought iron rails were taken up by George Stephenson for the proposed Stockton and Darlington Railway, and it was this railway that effectively launched the rail era.<sup>1606</sup>

**11,821 HE– 11,910 HE:** DR. ELIZABETH BLACKWELL, British-born physician who attended medical college in Geneva, NY – and graduated in two years. First female doctor **11,849 HE.**<sup>1607 1608</sup>

⇒ DR. ELIZABETH BLACKWELL was the first woman on the British<sup>1609</sup> Medical Register of the General Medical Council. BLACKWELL was the first woman to graduate from a medical

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<sup>1606</sup> [https://en.wikipedia.org/wiki/John\\_Birkinshaw](https://en.wikipedia.org/wiki/John_Birkinshaw)

<sup>1607</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>1608</sup> [https://en.wikisource.org/wiki/BMJ\\_Obituary\\_of\\_Elizabeth\\_Blackwell](https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell)

<sup>1609</sup> [https://en.wikisource.org/wiki/BMJ\\_Obituary\\_of\\_Elizabeth\\_Blackwell](https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell)

school, she was a pioneer in promoting the education of women in medicine in the United States, and she was a social and moral reformer in both the United States and the United Kingdom.<sup>1610</sup>

- ⇒ 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.<sup>1611</sup>
- ⇒ 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

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<sup>1610</sup> [https://en.wikipedia.org/wiki/Elizabeth\\_Blackwell](https://en.wikipedia.org/wiki/Elizabeth_Blackwell)

<sup>1611</sup> [https://en.wikisource.org/wiki/BMJ\\_Obituary\\_of\\_Elizabeth\\_Blackwell](https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell)

celebrate her innovative work in medicine called National Women Physicians Day.<sup>1612</sup> 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

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<sup>1612</sup> [https://en.wikipedia.org/wiki/Elizabeth\\_Blackwell](https://en.wikipedia.org/wiki/Elizabeth_Blackwell)

had a definite ‘call,’ and retained this belief to the end.”<sup>1613</sup> Her sister, DR. EMILY BLACKWELL, was the third woman to get a medical degree in the US.<sup>1614</sup>



ELIZABETH BLACKWELL, M.D.<sup>1615</sup>

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<sup>1613</sup> [https://en.wikisource.org/wiki/BMJ\\_Obituary\\_of\\_Elizabeth\\_Blackwell](https://en.wikisource.org/wiki/BMJ_Obituary_of_Elizabeth_Blackwell)

<sup>1614</sup> [https://en.wikipedia.org/wiki/Elizabeth\\_Blackwell](https://en.wikipedia.org/wiki/Elizabeth_Blackwell)

<sup>1615</sup> [https://en.wikipedia.org/wiki/Elizabeth\\_Blackwell](https://en.wikipedia.org/wiki/Elizabeth_Blackwell)

**11,821 HE – 11,890 HE: JAMES CROLL, FRS**, Scottish wheelwright, then tea merchant, then hotel manager, then insurance agent, then janitor who self-educated to become a highly respected Scientist.<sup>1616</sup>

⇒ 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.<sup>1617</sup>

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<sup>1616</sup> BBC Men of Rock 2 of 3 Moving Mountains  
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

<sup>1617</sup> 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."<sup>1618</sup>



⇒ JAMES CROLL, date, location, and photographer unknown.<sup>1619</sup>

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<sup>1618</sup> [https://en.wikipedia.org/wiki/James\\_Croll](https://en.wikipedia.org/wiki/James_Croll)

<sup>1619</sup> [https://en.wikipedia.org/wiki/James\\_Croll](https://en.wikipedia.org/wiki/James_Croll)

**11,822 HE – 11,884 HE:** GREGOR JOHANN MENDEL,<sup>1620</sup> 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.<sup>1621</sup>

⇒ 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.<sup>1622</sup>

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<sup>1620</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)

<sup>1621</sup> [https://en.wikipedia.org/wiki/Gregor\\_Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel)

<sup>1622</sup> Henig 2000, pp. 15–17 and [https://en.wikipedia.org/wiki/Gregor\\_Mendel](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.<sup>1623</sup> When MENDEL's paper was published in **11,866 HE** in *Verhandlungen des Naturforschenden Vereines in Brünn*, *it was seen as essentially about hybridization rather than inheritance, had little impact, and was only cited about three times over the next thirty-five years. His paper was criticized at the time but is*

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<sup>1623</sup> [https://en.wikipedia.org/wiki/Gregor\\_Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel)

*now considered a seminal work.* Notably, CHARLES DARWIN (See **11,809 HE – 11,882 HE: CHARLES DARWIN**) was *not aware* of MENDEL's paper.<sup>1624</sup> **11,866 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*.<sup>1625</sup>

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<sup>1624</sup> [https://en.wikipedia.org/wiki/Gregor\\_Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel)

<sup>1625</sup> [https://en.wikipedia.org/wiki/Gregor\\_Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel)



GREGOR MENDEL, date, location, & photographer  
unknown.<sup>1626</sup>

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<sup>1626</sup> [https://en.wikipedia.org/wiki/Gregor\\_Mendel](https://en.wikipedia.org/wiki/Gregor_Mendel)

**11,822 HE – 11,895 HE:** LOUIS PASTEUR; French biologist, microbiologist, and chemist is renowned for his discoveries of the principles of vaccination, microbial fermentation, and pasteurization. He is best known to the general public for his invention of the technique of treating milk and wine to stop bacterial contamination, a process now called pasteurization. LOUIS PASTEUR is regarded as the "*father of microbiology*".<sup>1627</sup>

⇒ 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

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<sup>1627</sup> [https://en.wikipedia.org/wiki/Louis\\_Pasteur](https://en.wikipedia.org/wiki/Louis_Pasteur)

for the germ theory of disease and its application in clinical medicine.<sup>1628</sup> LOUIS PASTEUR

- By **11,870 HE** human life expectancy reached about 40 years, due to PASTEUR and other scientific and medical advancements. CARL SAGAN, in discussing human life expectancy, stated that circa **39,000 BHE** (that is circa 50,870 years ago in hunter-gatherer pre-agricultural times) the human life expectancy was about 20-30 years.<sup>1629</sup>

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<sup>1628</sup> [https://en.wikipedia.org/wiki/Louis\\_Pasteur](https://en.wikipedia.org/wiki/Louis_Pasteur)

<sup>1629</sup> CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10



**LOUIS PASTEUR 11,857 HE** (about 13 years before his research started extending human life spans).<sup>1630</sup>

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<sup>1630</sup> [https://en.wikipedia.org/wiki/Louis\\_Pasteur](https://en.wikipedia.org/wiki/Louis_Pasteur)



LOUIS PASTEUR, artist and location unknown **11,885 HE**  
(about 15 years after his research started extending human life spans).<sup>1631</sup>

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<sup>1631</sup> [https://en.wikipedia.org/wiki/Louis\\_Pasteur](https://en.wikipedia.org/wiki/Louis_Pasteur)

**11,823 HE – 11,913 HE:** ALFRED RUSSEL WALLACE; British naturalist, explorer, geographer, anthropologist, and biologist is best known for independently conceiving the theory of evolution through natural selection. His paper on the subject was jointly published with some of CHARLES DARWIN's writings in **11,858 HE.**<sup>1632</sup>

⇒ WALLACE was considered the **11,800's** leading expert on the geographical distribution of animal species and is sometimes called the "*father of biogeography*". WALLACE was one of the leading evolutionary thinkers of his time and made many other contributions to the development of evolutionary theory besides being co-discoverer of natural selection. These included the concept of warning coloration in animals, and the Wallace effect (a hypothesis on how natural selection could contribute to

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<sup>1632</sup> [https://en.wikipedia.org/wiki/Alfred\\_Russel\\_Wallace](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* **11,889 HE.**<sup>1633</sup>

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<sup>1633</sup> [https://en.wikipedia.org/wiki/Alfred\\_Russel\\_Wallace](https://en.wikipedia.org/wiki/Alfred_Russel_Wallace)

**11,824 HE - 11,907 HE:** PIERRE JULES CÉSAR JANSSEN, French Astronomer, who along with English scientist JOSEPH NORMAN LOCKYER, is credited with discovering the gaseous nature of the solar chromosphere, and the element Helium.<sup>1634</sup>



- 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

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<sup>1634</sup> [https://en.wikipedia.org/wiki/Pierre\\_Janssen](https://en.wikipedia.org/wiki/Pierre_Janssen)

with liquid helium. Helium 4 nuclei are emitted at radioactive  $\alpha$ -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.<sup>1635</sup>



**Circa 11,895 HE; PIERRE JULES CÉSAR JANSSEN,**  
photographer, and location unknown.<sup>1636</sup>

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<sup>1635</sup> <http://images-of-elements.com/helium.php#a>

<sup>1636</sup> [https://en.wikipedia.org/wiki/Pierre\\_Janssen](https://en.wikipedia.org/wiki/Pierre_Janssen)

**11,824 HE – 11,907 HE:** WILLIAM THOMSON, first Baron Kelvin, first Lord Kelvin, British – “one of the most distinguished and influential physicists” of the **11,800 HE**’s British Physicists”.<sup>1637</sup> 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.<sup>1638</sup>

⇒ 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;

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<sup>1637</sup> RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

<sup>1638</sup> [https://en.wikipedia.org/wiki/William\\_Thomson%2C\\_1st\\_Baron\\_Kelvin](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 **11,971 HE**. In the current issue of banknotes, his image appears on the bank's £100 note. He is shown holding his adjustable compass and in the background is a map of the transatlantic cable. His title died with him, as he was survived by neither heirs nor close relations.<sup>1639</sup>
- ⇒ WILLIAM THOMSON took religious dogmatism to the point where he incorrectly concluded that “the earth was too young for

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<sup>1639</sup> [https://en.wikipedia.org/wiki/William\\_Thomson%2C\\_1st\\_Baron\\_Kelvin](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”.<sup>1640</sup>



WILLIAM THOMSON (LORD KELVIN), photographer, date, and location unknown.<sup>1641</sup>

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<sup>1640</sup> RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

<sup>1641</sup> [https://en.wikipedia.org/wiki/William\\_Thomson%2C\\_1st\\_Baron\\_Kelvin](https://en.wikipedia.org/wiki/William_Thomson%2C_1st_Baron_Kelvin)

**Circa 11,825 HE:** GEORGE STEPHENSON, English engineer and inventor, built the locomotive *Locomotion* for the Stockton and Darlington Railway in the north east of England, which became the first public steam railway in the world.<sup>1642</sup> In **11,830 HE** STEPHENSON built the first public inter-city railway line in the world to use locomotives, the Liverpool and Manchester Railway.<sup>1643</sup>

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<sup>1642</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1643</sup> [https://en.wikipedia.org/wiki/George\\_Stephenson](https://en.wikipedia.org/wiki/George_Stephenson)



GEORGE STEPHENSON (11,781 HE – 11,848 HE) artist,  
date, and location unknown.<sup>1644</sup>

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<sup>1644</sup> [https://en.wikipedia.org/wiki/George\\_Stephenson](https://en.wikipedia.org/wiki/George_Stephenson)





Photo is of a replica of the locomotive “*Planet*”, which ran on the Liverpool and Manchester Railway from **11,830 HE**.<sup>1645</sup>

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<sup>1645</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

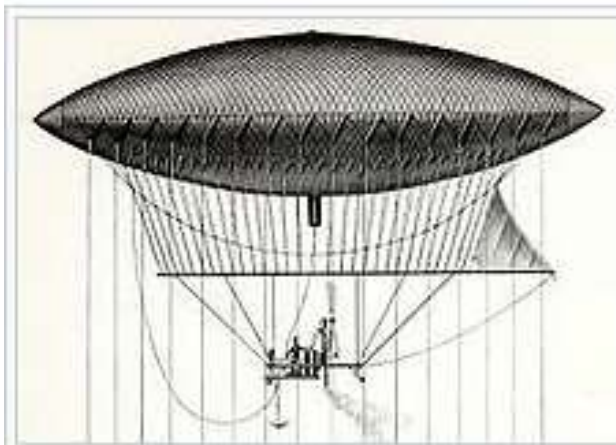
**11,825 HE – 11,882 HE:** HENRI GIFFARD, French engineer who invented the steam injector and the steam powered *Giffard Dirigible Airship*. It was the world's first passenger-carrying airship.



HENRI GIFFARD, date, location, and photographer unknown.<sup>1646</sup>

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<sup>1646</sup> [https://en.wikipedia.org/wiki/Henri\\_Giffard](https://en.wikipedia.org/wiki/Henri_Giffard)



Drawing of *Giffard Dirigible Airship*, artist unknown.<sup>1647</sup>

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<sup>1647</sup> [https://en.wikipedia.org/wiki/Henri\\_Giffard](https://en.wikipedia.org/wiki/Henri_Giffard)



*Giffard Dirigible Airship* over Paris rooftops, **11,878 HE**,  
photographer unknown.<sup>1648</sup>

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<sup>1648</sup> [https://en.wikipedia.org/wiki/Henri\\_Giffard](https://en.wikipedia.org/wiki/Henri_Giffard)

**11,825 HE – 11,911 HE – AUGUSTINE MOUCHOT**, French Mathematician & Physicist who was the inventor of the earliest solar-powered engine, converting solar energy into mechanical steam power.



**AUGUSTINE MOUCHOT**, date, location, and photographer unknown.<sup>1649</sup>

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<sup>1649</sup> [https://en.wikipedia.org/wiki/Augustin\\_Mouchot](https://en.wikipedia.org/wiki/Augustin_Mouchot)

**11,825 HE – 11,898 HE: JOHANN JAKOB BALMER:** Swiss mathematician who defined hydrogen absorption or emission lines. They were not fully explained until NEILS BOHR.<sup>1650</sup>



JOHANN JAKOB BALMER, date, photographer, location unknown.<sup>1651</sup>

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<sup>1650</sup> [https://en.wikipedia.org/wiki/Johann\\_Jakob\\_Balmer](https://en.wikipedia.org/wiki/Johann_Jakob_Balmer)

<sup>1651</sup> [https://en.wikipedia.org/wiki/Johann\\_Jakob\\_Balmer](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.<sup>1652</sup>

**11,826 HE** is the year *the Journal of the French Acedemie des Sciences* accepted a report by French chemist ANTOINE-JEROME BALARD and then named the topic of the report, which was the newly isolated “Star Stuff” Element “Bromine”. A year *earlier*, CARL LOWIG, German chemistry student, isolated Bromine and took his results to his professor, but BALARD gets

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<sup>1652</sup> [https://en.wikipedia.org/wiki/Balmer\\_series](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.<sup>1653</sup>



ANTOINE-JEROME BALARD about **11,870 HE**, photographer and location unknown.<sup>1654</sup>

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<sup>1653</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1654</sup> [https://en.wikipedia.org/wiki/Antoine\\_Jérôme\\_Balard](https://en.wikipedia.org/wiki/Antoine_Jérôme_Balard)





CARL LOWIG. Date, photographer and location unknown.<sup>1655</sup>



• Photo is of Pure liquid Bromine, original size in cm: 1 x 4.  
“Star Stuff” Element Atomic Number 35, Bromine, Br.

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<sup>1655</sup> [https://en.wikipedia.org/wiki/Carl\\_Jacob\\_Löwig](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.<sup>1656</sup>

**11,828 HE-11,914 HE:** JOSEPH SWAN, British physicist and chemist is known as an independent early developer of a successful incandescent light bulb with cellulose filaments and is the person responsible for developing and supplying the electric lights used in the world's first homes and public buildings (like the Savoy Theatre in **11,881 HE**) to be lit with electric light bulbs.<sup>1657</sup>

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<sup>1656</sup> <http://images-of-elements.com/bromine.php#a>

<sup>1657</sup> [https://en.wikipedia.org/wiki/Joseph\\_Swan](https://en.wikipedia.org/wiki/Joseph_Swan)

- ⇒ JOSEPH SWAN received the highest decoration in France, the Légion d'Honneur, when he visited an international exhibition in Paris in **11,881 HE**. The exhibition included exhibits of his inventions, and the city was lit with his electric lighting.<sup>1658</sup>
- ⇒ **11,882 HE** JOSEPH SWAN 's strong patents in Great Britain led over THOMAS EDISON's United States Patents and the two competing companies merged to exploit both Swan's and Edison's inventions via the establishment of the Edison & Swan United Electric Light Company. Known commonly as Ediswan, the company sold lamps made with a cellulose filament that JOSEPH SWAN had invented in **11,881 HE** while the Edison Company continued using bamboo filaments outside of Britain. When both companies (and their patents) were merged to become General Electric in **11,892 HE** the cellulose filament

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<sup>1658</sup> [https://en.wikipedia.org/wiki/Joseph\\_Swan](https://en.wikipedia.org/wiki/Joseph_Swan)

was used in all their bulbs until it was replaced in **11,904 HE** by a GE developed "GEM" (General Electric Metallized) baked cellulose filament.<sup>1659</sup>



JOSEPH SWAN, date, location, and photographer unknown.<sup>1660</sup>

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<sup>1659</sup> [https://en.wikipedia.org/wiki/Joseph\\_Swan](https://en.wikipedia.org/wiki/Joseph_Swan)

<sup>1660</sup> SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions;  
<https://www.youtube.com/watch?v=g-KuigAQFp4>

**11,830 HE-11,882 HE: SIR CHARLES WYVILLE THOMSON,**  
Scottish Naturalist, one of the first marine biologists. His work  
lead to THOMSON's theory of continental drift, which led to his  
idea of plate tectonics.<sup>1661 1662</sup>

⇒ 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.<sup>1663</sup>

⇒ 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

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<sup>1661</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

<sup>1662</sup> <https://www.britannica.com/biography/C-Wyville-Thomson>

<sup>1663</sup> [https://en.wikipedia.org/wiki/Charles\\_Wyville\\_Thomson](https://en.wikipedia.org/wiki/Charles_Wyville_Thomson)

deep-sea temperatures are not as constant as had been supposed, indicating the presence of oceanic circulation. He described these findings in *The Depths of the Sea* (11,873 HE).<sup>1664</sup>

- ⇒ **11,872 HE:** THOMSON was the scientist onboard the HMS Challenger on its journey of almost 70,000 miles (127,600 kilometers) to map the ocean bed for the first time. With weighted ropes and thousands of measurements (intended to help lay the first trans-Atlantic telegraph cables) they found the Mid-Atlantic Ridge. This led to THOMSON's theory of continental drift, which led to THOMSON's idea of plate tectonics.<sup>1665</sup>

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<sup>1664</sup> <https://www.britannica.com/biography/C-Wyville-Thomson>

<sup>1665</sup> BBC Men of Rock 2 of 3 Moving Mountains  
<https://www.youtube.com/watch?v=w1wH3cGQLjE>

- ⇒ BENJAMIN PEACH and JOHN HORNE were sent to disprove the findings of SIR CHARLES WYVILLE THOMSON, but instead they proved them correct.<sup>1666</sup> (See **11,842 HE - 11,926 HE: BENJAMIN NEEVE PEACH** and **11,848 HE – 11,928 HE: JOHN HORNE**) The Wyville-Thomson Ridge in the North Atlantic Ocean is named after SIR CHARLES WYVILLE THOMSON.<sup>1667</sup>
- ⇒ Also, SIR CHARLES WYVILLE THOMSON as a biologist, noticed the trilobites in Scotland matched those in North

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<sup>1666</sup> BBC Men of Rock 2 of 3 Moving Mountains

<https://www.youtube.com/watch?v=w1wH3cGQLjE>

<sup>1667</sup> [https://en.wikipedia.org/wiki/Charles\\_Wyville\\_Thomson](https://en.wikipedia.org/wiki/Charles_Wyville_Thomson)

America, not those in Europe or in England, which was a puzzle piece for the theory of continental drift.<sup>1668</sup>

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<sup>1668</sup> 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.<sup>1669</sup>

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<sup>1669</sup> 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.<sup>1670</sup>

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<sup>1670</sup> [https://en.wikipedia.org/wiki/Charles\\_Wyville\\_Thomson](https://en.wikipedia.org/wiki/Charles_Wyville_Thomson)



Sir CHARLES WYVILLE THOMSON, date, location, photographer unknown.<sup>1671</sup>

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<sup>1671</sup> [https://en.wikipedia.org/wiki/Charles\\_Wyville\\_Thomson](https://en.wikipedia.org/wiki/Charles_Wyville_Thomson)

**11,831 HE – 11,879 HE: JAMES CLERK MAXWELL,**<sup>1672</sup> Scottish scientist & physics mathematician, and one of the most influential scientists of all time.<sup>1673</sup>

- ⇒ 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”.<sup>1674</sup>
- ⇒ JAMES CLERK MAXWELL had studied and commented on electricity and magnetism as early as **11,855 HE** when his paper *"On Faraday's lines of force"* was read to the Cambridge Philosophical Society. The paper presented a simplified model of MICHAEL FARADAY'S work and how electricity and

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<sup>1672</sup> BRIAN COX, BBC show The Science of Dr. Who

<sup>1673</sup> [http://www.bbc.co.uk/history/people/james\\_clerk\\_maxwell](http://www.bbc.co.uk/history/people/james_clerk_maxwell)

<sup>1674</sup> [http://www.bbc.co.uk/history/people/james\\_clerk\\_maxwell](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 **11,861 HE**.<sup>1675</sup>

- 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.<sup>1676</sup>

⇒ JAMES CLERK MAXWELL predicted the existence of Radio Waves and MAXWELL's research into electromagnetic

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<sup>1675</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)

<sup>1676</sup> <https://www.youtube.com/watch?v=WqefMRAxt2k>

radiation led to the development of television, mobile phones, radio and infra-red telescopes.<sup>1677</sup>

- ⇒ JAMES CLERK MAXWELL concluded that the Rings of Saturn were made of numerous small particles.<sup>1678</sup> The *Voyager space probes* of the **11,980s** **HE** confirmed the content of the rings of Saturn and many of the conclusions drawn by MAXWELL.<sup>1679</sup>
- ⇒ **11,855 HE:** JAMES CLERK MAXWELL invented color photography. In his paper "*Experiments on Colour*" MAXWELL laid out the principles of colour combination and presented it to the Royal Society of Edinburgh. Also, by shaking and jiggling the charge MAXWELL proved light was a wave

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<sup>1677</sup> [http://www.bbc.co.uk/history/people/james\\_clerk\\_maxwell](http://www.bbc.co.uk/history/people/james_clerk_maxwell)

<sup>1678</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)

<sup>1679</sup> [http://www.bbc.co.uk/history/people/james\\_clerk\\_maxwell](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.<sup>1680</sup>

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<sup>1680</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)



The James Clerk Maxwell Monument in Edinburgh, by Alexander Stoddart.<sup>1681</sup>

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<sup>1681</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)





**11,861 HE:** The First durable color photographic image, demonstrated by JAMES CLERK MAXWELL.<sup>1682</sup>

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<sup>1682</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)

⇒ See footnote for publications by JAMES CLERK MAXWELL:<sup>1683</sup>

⇒ 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 )];

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<sup>1683</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](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 Maxwell<sup>1684</sup>

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<sup>1684</sup> [https://en.wikipedia.org/wiki/James\\_Clerk\\_Maxwell](https://en.wikipedia.org/wiki/James_Clerk_Maxwell)

**11,831 HE – 11,898 HE: SIEGFRIED SAMUEL MARCUS**<sup>1685</sup> was a German inventor from Malchin, in the Grand Duchy of Mecklenburg-Schwerin who made several petrol-powered vehicles, the first one in **11,864 HE**, while living in Vienna, Austria.



MARCUS, date and photographer unknown.<sup>1686</sup>

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<sup>1685</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

<sup>1686</sup> [https://en.wikipedia.org/wiki/Siegfried\\_Marcus](https://en.wikipedia.org/wiki/Siegfried_Marcus)



Marcus carts of **11,870 HE** and of **11,888 HE** respectively, photographer unknown.<sup>1687</sup>

**11,832 HE – 11,891 HE**, NIKOLAUS AUGUST OTTO, German engineer who successfully developed the compressed charge

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<sup>1687</sup> [https://en.wikipedia.org/wiki/Siegfried\\_Marcus](https://en.wikipedia.org/wiki/Siegfried_Marcus)

internal combustion engine which ran on petroleum gas and led to the modern internal combustion engine.<sup>1688</sup>



NIKOLAUS AUGUST OTTO circa **11,868 HE**, photographer and location unknown.<sup>1689</sup>

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<sup>1688</sup> [https://en.wikipedia.org/wiki/Nikolaus\\_Otto](https://en.wikipedia.org/wiki/Nikolaus_Otto)

<sup>1689</sup> [https://en.wikipedia.org/wiki/Nikolaus\\_Otto](https://en.wikipedia.org/wiki/Nikolaus_Otto)



NIKOLAUS AUGUST OTTO 's **11,876 HE** four cycle engine which lead to the internal combustion engine, photographer and location unknown.<sup>1690</sup>

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<sup>1690</sup> [https://en.wikipedia.org/wiki/Nikolaus\\_Otto](https://en.wikipedia.org/wiki/Nikolaus_Otto)

**11,834 HE – 11,907 HE:** DIMITRI MENDELEEV, Russian chemist and inventor DIMITRI MENDELEEV is credited with 9 elements on his first broadly accepted Periodic Table.<sup>1691</sup>

⇒ 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

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<sup>1691</sup> [https://en.wikipedia.org/wiki/Dmitri\\_Mendeleev](https://en.wikipedia.org/wiki/Dmitri_Mendeleev)



weights corresponding to their valences, as well as, to some extent, to their distinctive chemical properties; as is apparent among other series in that of Li, Be, B, C, N, O, and F.<sup>1692</sup>

Cl 35.5	K 39	Ca 40
Br 80	Rb 85	Sr 88
I 127	Cs 133	Ba 137



**11,860s HE DIMITRI MENDELEEV** early periodic table.<sup>1693</sup>

<sup>1692</sup> [https://en.wikipedia.org/wiki/Dmitri\\_Mendeleev](https://en.wikipedia.org/wiki/Dmitri_Mendeleev)

<sup>1693</sup> [https://en.wikipedia.org/wiki/Dmitri\\_Mendeleev](https://en.wikipedia.org/wiki/Dmitri_Mendeleev)



DMITRI MENDELEEV in **11,897 HE**. Photographer and location unknown.<sup>1694</sup>

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<sup>1694</sup> [https://en.wikipedia.org/wiki/Dmitri\\_Mendeleev](https://en.wikipedia.org/wiki/Dmitri_Mendeleev)

Periodic table of elements by Dmitri Mendeleev, 1871. The table is organized into groups (I-VII) and periods (1-8). Elements are listed with their atomic weights and names in Russian. Dashes represent unknown elements. The table is titled "Периодическая система элементов Д. Менделѣева" (Periodic system of elements D. Mendeleev).



**11,871 HE: DIMITRI MENDELEEV** later periodic table. Dashes represent unknown elements. Group I-VII: modern group 1-2 and 3-7 with transition metals added; some of these

extend into a group VIII. Noble gases were unknown and unpredicted.<sup>1695</sup>

**11,834 HE– 11,889 HE: GASTON PLANTÉ,**<sup>1696</sup> French physicist who invented the lead–acid battery in **11,859 HE**. PLANTÉ's lead-acid battery eventually became the first rechargeable electric battery marketed for commercial use and is widely used in automobiles.

⇒ In **11,855 HE**, PLANTÉ discovered the first fossils of the prehistoric flightless bird *Gastornis parisiensis* (named after him) near Paris. This gigantic animal was a very close relative of the famous *diatrymas* of North America.

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<sup>1695</sup> [https://en.wikipedia.org/wiki/Dmitri\\_Mendeleev](https://en.wikipedia.org/wiki/Dmitri_Mendeleev)

<sup>1696</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

⇒ An amphitheater at the Polytechnic Association for the Development of Popular Instruction in Paris is named after PLANTÉ.



⇒ GASTON PLANTÉ, date and photographer unknown.<sup>1697</sup>

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<sup>1697</sup> [https://en.wikipedia.org/wiki/Gaston\\_Plante](https://en.wikipedia.org/wiki/Gaston_Plante)

**11,836 HE** is when JAMES MARSH, British chemist, discovered a chemical test capable of isolating the poisonous star stuff element Arsenic in biological samples, thus effectively ending use of Arsenic as an undetectable murder weapon.<sup>1698</sup>



**11,829 HE to 11,846 HE:** JAMES MARSH was assistant to MICHAEL FARADAY at the Royal Military Academy. Photographer and location unknown.<sup>1699</sup>

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<sup>1698</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>1699</sup> [https://en.wikipedia.org/wiki/James\\_Marsh\\_\(chemist\)](https://en.wikipedia.org/wiki/James_Marsh_(chemist))

**11,837 HE:** The first known *electric* locomotive was built by chemist ROBERT DAVIDSON of Aberdeen, Scotland. It was powered by galvanic cells (batteries). Thus, it was also the earliest battery electric locomotive.<sup>1700</sup>

⇒ **11,841 HE:** DAVIDSON later built a larger locomotive named *Galvani*, exhibited at the Royal Scottish Society of Arts Exhibition. The seven-ton vehicle had two direct-drive reluctance motors, with fixed electromagnets acting on iron bars attached to a wooden cylinder on each axle, and simple commutators. It hauled a load of six tons at four miles per hour (6 kilometers per hour) for a distance of one and a half miles (2.4 kilometers). It was tested on the Edinburgh and Glasgow

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<sup>1700</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

Railway in September of the following year, but the limited power from batteries prevented its general use.<sup>1701</sup>

⇒ *Galvani* was destroyed by railway workers, who saw it as a threat to their job security.<sup>1702</sup> (Author / Compiler note: here is another example of fear of technological unemployment).

**11,838 HE – 11,917 HE:** FERDINAND VON ZEPPELIN, German, military general from a noble family, who invented the first Rigid airship.<sup>1703</sup> 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

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<sup>1701</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1702</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1703</sup> [https://en.wikipedia.org/wiki/Ferdinand\\_von\\_Zeppelin](https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin)



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.<sup>1704</sup>



Bust of FERDINAND ZEPPELIN in the Aeronauticum at Nordholz, date and artist unknown.<sup>1705</sup>

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<sup>1704</sup> [https://en.wikipedia.org/wiki/Ferdinand\\_von\\_Zeppelin](https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin)

<sup>1705</sup> [https://en.wikipedia.org/wiki/Ferdinand\\_von\\_Zeppelin](https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin)



First flight of the LZ 1, location and photographer unknown.<sup>1706</sup>

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<sup>1706</sup> [https://en.wikipedia.org/wiki/Ferdinand\\_von\\_Zeppelin](https://en.wikipedia.org/wiki/Ferdinand_von_Zeppelin)

**11,839 HE – 11,915 HE: JAMES MURCOCH GEIKIE, PRSE FRS LLD**, Scottish geologist. GEIKIE supported JAMES CROLL's theories and ideas (see **11,821 HE – 11,890 HE: JAMES CROLL**) and found the evidence in the strata of the Earth as railways were being built in Scotland. He looked at many railway cuttings to find strata of earth that were glacial deposits separated by loamy dirt that were from warmer periods when vegetation again appeared on the land.<sup>1707</sup>

⇒ See list of Publications by JAMES MURCOCH GEIKIE.<sup>1708</sup>

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<sup>1707</sup> BBC Men of Rock 2 of 3 Moving Mountains

<https://www.youtube.com/watch?v=w1wH3cGQLjE>

<sup>1708</sup> [https://en.wikipedia.org/wiki/James\\_Geikie](https://en.wikipedia.org/wiki/James_Geikie)

**Circa 11,840 HE:** CHARLES GOODYEAR, United States chemist and manufacturing engineer.<sup>1709</sup> GOODYEAR expanded the uses for rubber by mixing it with Sulphur, which made the rubber more durable and was known as “vulcanization”.<sup>1710</sup> (See **Circa 8,801 HE- circa 9,601 HE:** Mexico, the “Olmecatl” or “Olmec people” first make natural rubber.<sup>1711 1712</sup>)

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<sup>1709</sup> [https://en.wikipedia.org/wiki/Charles\\_Goodyear](https://en.wikipedia.org/wiki/Charles_Goodyear)

<sup>1710</sup> National Geographic 100 Science Big Ideas Breakthroughs and Inventions 12,016HE

<sup>1711</sup> <https://www.ua.edu/news/2005/10/rubber-people-the-americas-first-civilization/>

<sup>1712</sup> <https://www.britannica.com/topic/Olmec>



CHARLES GOODYEAR as illustrated in an **11,891 HE** Scientific American article, artist unknown.<sup>1713</sup>

**11,841 HE – 11,914 HE:** SIR JOHN MURRAY, pioneering British oceanographer, marine biologist, and limnologist. MURRAY *is considered to be the father of modern oceanography*.<sup>1714</sup>

⇒ In **11,910 HE** MURRAY coordinated a team of nearly 50 people who took more than 60,000 individual depth soundings

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<sup>1713</sup> [https://en.wikipedia.org/wiki/Charles\\_Goodyear](https://en.wikipedia.org/wiki/Charles_Goodyear)

<sup>1714</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

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*.<sup>1715</sup>

- ⇒ **11,910 HE:** JOHAN HJORT and SIR JOHN MURRAY and the Norwegian research ship Michael Sars departed Plymouth for a four-month expedition to take physical and biological observations at all depths between Europe and North America.<sup>1716</sup>
- ⇒ 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

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<sup>1715</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

<sup>1716</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

John Murray, The Murray Glacier; The *Cirrothauma murrayi*, an almost blind octopus that lives at depths from 1,500 m (4,900 ft) to 4,500 m (14,800 ft): and the Murrayonida order of sea sponges are named after SIR JOHN MURRAY.<sup>1717</sup>



The *Cirrothauma murrayi* octopus, named after SIR JOHN MURRAY.<sup>1718</sup>

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<sup>1717</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

<sup>1718</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))



SIR JOHN MURRAY, date, location, and photographer unknown.<sup>1719</sup>

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<sup>1719</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))



## 11,843 HE – 11,939 HE: Mechanical Television.<sup>1720</sup>

⇒ Between **11,843 HE - 11,846 HE** ALEXANDER BAIN invented the facsimile machine, which became the basis for mechanical television.<sup>1721</sup>

- **Circa 11,845 HE:** ALEXANDER BAIN was also first to invent and patent the electric clock.<sup>1722</sup>
- BAIN also installed the railway telegraph lines between Edinburgh and Glasgow.<sup>1723</sup>

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<sup>1720</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)

<sup>1721</sup> [https://en.wikipedia.org/wiki/Alexander\\_Bain\\_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

<sup>1722</sup> [https://en.wikipedia.org/wiki/Alexander\\_Bain\\_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

<sup>1723</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)



- This clock by BAIN is at the Deutsches Uhrenmuseum, Inv. 2004-162.<sup>1724</sup>

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<sup>1724</sup> [https://en.wikipedia.org/wiki/Alexander\\_Bain\\_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))



- **ALEXANDER BAIN, (11,811 HE – 11,877 HE)** Scottish inventor and engineer, artist unknown.<sup>1725</sup>

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<sup>1725</sup> [https://en.wikipedia.org/wiki/Alexander\\_Bain\\_\(inventor\)](https://en.wikipedia.org/wiki/Alexander_Bain_(inventor))

⇒ In **11,851 HE**: **FREDERICK COLLIER BAKEWELL (11,800 HE – 11,869 HE)**, an English physicist, improved on the concept of the facsimile machine introduced by **ALEXANDER BAIN** and demonstrated a working laboratory version at the **11,851 HE** World's Fair in London.<sup>1726</sup>

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<sup>1726</sup> [https://en.wikipedia.org/wiki/Frederick\\_Bakewell](https://en.wikipedia.org/wiki/Frederick_Bakewell)



- Drawing is of BAKEWELL's improved **11,848 HE** facsimile machine, artist unknown.<sup>1727</sup>

⇒ In **11,856 HE** GIOVANNI CASELLI put into service the first practical facsimile / fax machine, working on telegraph lines.<sup>1728</sup>

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<sup>1727</sup> [https://en.wikipedia.org/wiki/Frederick\\_Bakewell](https://en.wikipedia.org/wiki/Frederick_Bakewell)

<sup>1728</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Caselli](https://en.wikipedia.org/wiki/Giovanni_Caselli)



- CASELLI<sup>1729</sup> (**11,815 – 11,891 HE**) Italian physicist, inventor.<sup>1730</sup>

⇒ In **11,873 HE** WILLOUGHBY SMITH discovered the photoconductivity of the “star stuff” Element Selenium.<sup>1731</sup> This

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<sup>1729</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)

<sup>1730</sup> [https://en.wikipedia.org/wiki/Giovanni\\_Caselli](https://en.wikipedia.org/wiki/Giovanni_Caselli)

<sup>1731</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)

discovery led to the invention of photoelectric cells, including those used in the earliest television systems.<sup>1732</sup>



- **WILLOUGHBY SMITH, 11,828 HE – 11,891 HE:** English electrical engineer. Photographer and location unknown.<sup>1733</sup>

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<sup>1732</sup> [https://en.wikipedia.org/wiki/Willoughby\\_Smith](https://en.wikipedia.org/wiki/Willoughby_Smith)

<sup>1733</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)

⇒ In **11,884 HE** PAUL JULIUS GOTTLIEB NIPKOW patented the core element of first-generation television technology.<sup>1734</sup>



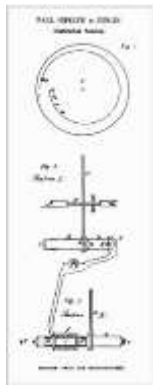
- PAUL JULIUS GOTTLIEB NIPKOW (**11,860 HE – 11,940 HE**) German technician and inventor.<sup>1735</sup> Photographer and location unknown.

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<sup>1734</sup> [https://en.wikipedia.org/wiki/Paul\\_Gottlieb\\_Nipkow](https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow)

<sup>1735</sup> [https://en.wikipedia.org/wiki/History\\_of\\_television](https://en.wikipedia.org/wiki/History_of_television)





- 11,884 HE:** Drawing is of PAUL NIPKOW'S 'Nipkow's disc' from his patent application. The Nipkow Disc was one of the first successful technologies for television transmission.<sup>1736</sup>

<sup>1736</sup> [https://en.wikipedia.org/wiki/Paul\\_Gottlieb\\_Nipkow](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.<sup>1737</sup>

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<sup>1737</sup> [https://en.wikipedia.org/wiki/Paul\\_Gottlieb\\_Nipkow](https://en.wikipedia.org/wiki/Paul_Gottlieb_Nipkow)

**11,842 HE – 11,920 HE:** PROF. CHARLES LAPWORTH, English geologist,<sup>1738</sup> 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

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<sup>1738</sup> 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.<sup>1739</sup>

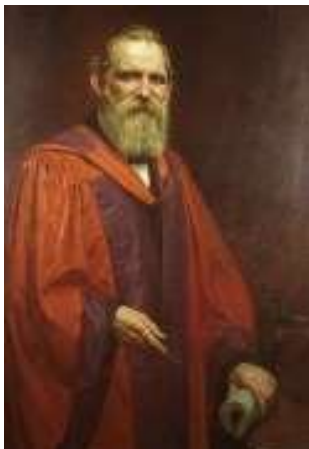
⇒ Later BENJAMIN PEACH and JOHN HORNE were dispatched to the area to prove LAPWORTH wrong.<sup>1740</sup> However, their monumental work proved LAPWORTH correct. In the English Midlands his research involved important work in Shropshire and the demonstration that Cambrian rocks underlay the Carboniferous rocks between Nuneaton and Atherstone.<sup>1741</sup>

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<sup>1739</sup> [https://en.wikipedia.org/wiki/Charles\\_Lapworth](https://en.wikipedia.org/wiki/Charles_Lapworth)

<sup>1740</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

<sup>1741</sup> [https://en.wikipedia.org/wiki/Charles\\_Lapworth](https://en.wikipedia.org/wiki/Charles_Lapworth)



PROF. CHARLES LAPWORTH, artist and date unknown.<sup>1742</sup>

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<sup>1742</sup> [https://en.wikipedia.org/wiki/Charles\\_Lapworth](https://en.wikipedia.org/wiki/Charles_Lapworth)

**11,842 HE - 11,926 HE:** BENJAMIN NEEVE PEACH FRS FRSE FGS LLD, British geologist. PEACH and JOHN HORNE played the foremost part in unravelling the geological structure of the North West Highlands. From **11,883 HE –11,897 HE** PEACH was joint Editor with HORNE of many papers on stratigraphical and physical geology.<sup>1743</sup>

⇒ See list of BENJAMIN PEACH publications.<sup>1744</sup>

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<sup>1743</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYfuI2uZLmg>

<sup>1744</sup> [https://en.wikipedia.org/wiki/Ben\\_Peach](https://en.wikipedia.org/wiki/Ben_Peach)



**11,912 HE:** BENJAMIN PEACH sitting on right of photo with JOHN HORNE outside the Inchnadamph Hotel (Scotland).<sup>1745</sup>

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<sup>1745</sup> [https://en.wikipedia.org/wiki/Ben\\_Peach](https://en.wikipedia.org/wiki/Ben_Peach)

**11,844 HE – 11,929:** KARL FRIEDRICH BENZ, German engine designer and automobile engineer.<sup>1746</sup>



BENZ, date, location and photographer unknown.<sup>1747</sup>

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<sup>1746</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

<sup>1747</sup> [https://en.wikipedia.org/wiki/Karl\\_Benz](https://en.wikipedia.org/wiki/Karl_Benz)





**11,886 HE:** KARL FRIEDRICH BENZ's Benz Patent Motorcar is considered the first practical automobile.<sup>1748</sup>

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<sup>1748</sup> [https://en.wikipedia.org/wiki/Karl\\_Benz](https://en.wikipedia.org/wiki/Karl_Benz)



**11,894 HE:** Bertha Benz with her husband KARL BENZ in a Benz Victoria.<sup>1749</sup> Location and photographer unknown.

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<sup>1749</sup> [https://en.wikipedia.org/wiki/Karl\\_Benz](https://en.wikipedia.org/wiki/Karl_Benz)

**11,846 HE – 11,910 HE:** GEORGE FRANKLIN GRANT,<sup>1750</sup> United States (Boston) dentist, the first African-American professor at Harvard and inventor of the wooden golf tee.<sup>1751</sup>



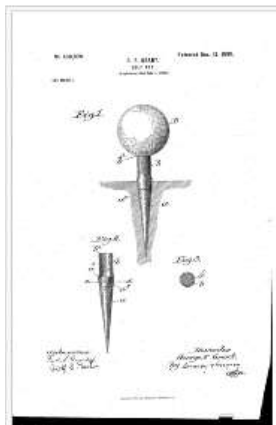
**11,870 HE:** photo of GEORGE FRANKLIN GRANT, location and photographer unknown.<sup>1752</sup>

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<sup>1750</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>1751</sup> [https://en.wikipedia.org/wiki/George\\_Franklin\\_Grant](https://en.wikipedia.org/wiki/George_Franklin_Grant)

<sup>1752</sup> [https://en.wikipedia.org/wiki/George\\_Franklin\\_Grant](https://en.wikipedia.org/wiki/George_Franklin_Grant)



**GRANT'S 11,899 HE** Golf tee patent 638,920.<sup>1753</sup>

<sup>1753</sup> [https://en.wikipedia.org/wiki/George\\_Franklin\\_Grant](https://en.wikipedia.org/wiki/George_Franklin_Grant)

**11,847 HE:** Pakistan built its first railway from Karachi to Kotri.<sup>1754</sup>

**11,847 HE – 11,931 HE:** THOMAS EDISON, the United States inventor<sup>1755</sup> developed many devices that greatly influenced life around the world, including the gramophone, the motion picture camera, and a form of electric light bulb<sup>1756</sup> 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”.<sup>1757</sup> 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

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<sup>1754</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1755</sup> SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions;  
<https://www.youtube.com/watch?v=g-KuigAQFp4>

<sup>1756</sup> [https://en.wikipedia.org/wiki/Thomas\\_Edison](https://en.wikipedia.org/wiki/Thomas_Edison)

<sup>1757</sup> RICHARD DAWKINS Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder

filaments in them. He did start selling them in **11,880 HE**.<sup>1758</sup> (See **11,828 HE-11,914 HE: JOSEPH SWAN**) and **SIR HUMPHRY DAVY BT** (See **11,778 HE – 11,829 HE, SIR HUMPHRY DAVY BT**).



**THOMAS EDISON c: 11,922 HE**, photographer and location unknown.<sup>1759</sup>

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<sup>1758</sup> SciShow 5-2-12,016 HE youtube video: The Truth About 10 Famous Inventions;  
<https://www.youtube.com/watch?v=g-KuigAQFp4>

<sup>1759</sup> [https://en.wikipedia.org/wiki/Thomas\\_Edison](https://en.wikipedia.org/wiki/Thomas_Edison)



THOMAS EDISON and his Gramophone. Location, photographer and date unknown.<sup>1760</sup>

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<sup>1760</sup> <https://www.bing.com/images> Publicdomainclip-art.blogspot

**11,848 HE – 11,928 HE:** JOHN HORNE PRSE FRS FRSE FECS LLD, Scottish geologist. BEN N PEACH and HORNE played the foremost part in unravelling the geological structure of the North West Highlands between **11,883 HE – 11,897 HE**. HORNE was joint Editor with BENJAMIN PEACH of many papers on stratigraphical and physical geology.<sup>1761</sup>



**11,912 HE:** JOHN HORNE (on left) with BENJAMIN PEACH outside the Inchnadamph Hotel (Scotland).<sup>1762</sup>

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<sup>1761</sup> BBC Men of Rock 1 of 3 Deep Time <https://www.youtube.com/watch?v=FYful2uZLmg>

<sup>1762</sup> [https://en.wikipedia.org/wiki/John\\_Horne](https://en.wikipedia.org/wiki/John_Horne)



**Circa 11,849 HE – Circa 11,895 HE: Wild West United States Barrier**  
Method of birth control.<sup>1763</sup>



Photo is example of Circa 11,849 HE – Circa 11,895 HE

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<sup>1763</sup> **Wild West Tech: Brothels** (History Channel),  
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

vaginal sponge contraceptive barrier tied to ribbons for access.<sup>1764</sup>

⇒ A historian recorded this Circa **11,849 HE** – Circa **11,895 HE** oral account: “I found out from an old lady that if you used a certain sized coin and placed it just right then you wouldn’t get pregnant.”<sup>1765</sup>

**11,855 HE:** Gall–Peters projection Map<sup>1766</sup> is named after JAMES GALL and ARNO PETERS. JAMES GALL is credited with describing the projection in **11,855 HE** at a science convention.

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<sup>1764</sup> **Wild West Tech: Brothels** (History Channel),  
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

<sup>1765</sup> **Wild West Tech: Brothels** (History Channel),  
<https://www.youtube.com/watch?v=UHsxsQJx8nE>

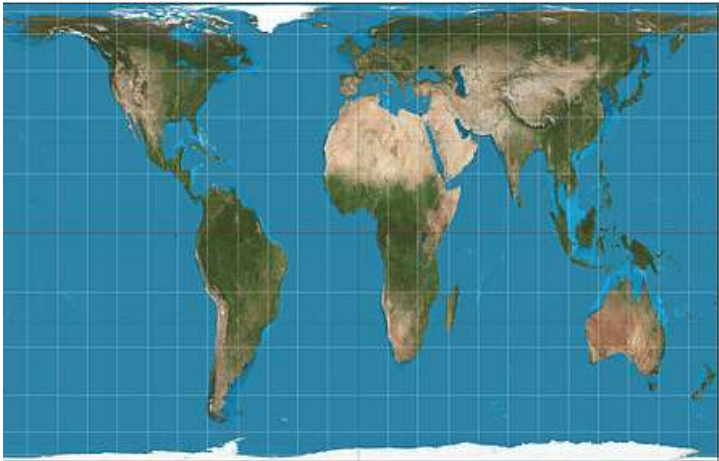
<sup>1766</sup> [https://en.wikipedia.org/wiki/Gall\\_Peters\\_projection](https://en.wikipedia.org/wiki/Gall_Peters_projection)

- ⇒ **11,885 HE:** 30 years after he first described it at the science convention, JAMES GALL published a paper about his projection map.
- ⇒ In the early **11,970s** ARNO PETERS brought the projection map to a wider audience (115 years after first being described by JAMES GALL at the science convention) by means of calling it the "Peters World Map".
- ⇒ **11,986 HE:** The name "Gall–Peters Projection" seems to have been used first by Arthur H. Robinson in a pamphlet put out by the American Cartographic Association. Maps based on the Gall-Peters projection maps are promoted by UNESCO. The Gall-Peters projection maps are also widely used by British schools.

⇒ In March **12,017 HE**, 132 years after being introduced, in the U.S. State of Massachusetts, Boston Public Schools began phasing in the Gall-Peters projection maps, becoming the first public school district in the United States to adopt Gall–Peters maps as their standard.<sup>1767</sup>

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<sup>1767</sup> [https://en.wikipedia.org/wiki/Gall\\_Peters\\_projection](https://en.wikipedia.org/wiki/Gall_Peters_projection)



Gall–Peters projection Map<sup>1768</sup>

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<sup>1768</sup> [https://en.wikipedia.org/wiki/Gall\\_Peters\\_projection](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.<sup>1769</sup>

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<sup>1769</sup> <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*

1771

**11,856 HE – 11,943 HE:** NIKOLA TESLA, born in Serbia and emigrated to United States. Inventor, electrical engineer, mechanical engineer, physicist, and futurist best known for his

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<sup>1770</sup> <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>

<sup>1771</sup> <https://www.quora.com/Is-the-Gall-Peters-projection-map-accurate>



contributions to the design of the modern alternating current (AC) electricity supply system.<sup>1772</sup>

- ⇒ The invention of the radio in the **11,890's HE** was a death match between TESLA and GUGLIELMO MARCONI. TELSAs received many of the early patents on radio devices and invented the crucial technology behind them.
- ⇒ MARCONI had more success developing them as a commercial product and having them send information over long distances.<sup>1773</sup>
- ⇒ See NIKOLA TESLA books and articles for magazines and journals.

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<sup>1772</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

<sup>1773</sup> SciShow youtube.com Video: The Truth About 10 Famous Inventions



NIKOLA TESLA, **circa 11,896 HE**, photographer and location unknown.<sup>1774</sup>

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<sup>1774</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

⇒ Things named after NIKOLA TESLA: Enterprises and organizations: Tesla, a United States rock band formed in Sacramento, California, in late **11,982 HE**; Tesla, an electrotechnical conglomerate in the former Czechoslovakia; Tesla Motors, a United States electric car manufacturer; Ericsson Nikola Tesla, Croatian affiliate of the Swedish telecommunications equipment manufacturer Ericsson; The Tesla Society, founded in **11,956 HE**; Udruženje za razvoj nauke Nikola Tesla, Novi Sad, Serbia; Zavičajno udruženje Krajišnika Nikola Tesla, Plandište, Serbia.<sup>1775</sup> 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.<sup>1776</sup> Measures: TESLA, an SI-derived unit of magnetic flux density

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<sup>1775</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

<sup>1776</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

(or magnetic inductivity). This is the same as a “GAUSS” named for KARL FRIEDRICH GAUSS. (see **11,777 HE**, Karl Friedrich Gauss). Places: Belgrade Nikola Tesla Airport; Nikola Tesla Museum Archive in Belgrade; TPP Nikola Tesla, the largest power plant in Serbia; 128 streets in Croatia had been named after Nikola Tesla as of **12,008 HE**, making him the eighth most common street name origin in the country; Tesla, a 26-kilometer-wide crater on the far side of the moon; 2244 Tesla, a minor planet.<sup>1777</sup> Songs: "Tesla Girls", a song by British pop band Orchestral Manoeuvres in the Dark, released in **11,984 HE**.<sup>1778</sup> Plaques and memorials: A monument of NIKOLA TESLA was unveiled in Baku, Baki, Azerbaijan in **12,013 HE**/ Presidents Ilham Aliyev and Tomislav Nikolić attended a ceremony of unveiling; In **12,012 HE** Jane Alcorn, president of the nonprofit group Tesla Science Center at Wardenclyyfe, and

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<sup>1777</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

<sup>1778</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

Matthew Inman, creator of web cartoon The Oatmeal, raised a total of \$2,220,511 – \$1,370,511 from a campaign and \$850,000 from a New York State grant—to buy the property where 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 **12,012 HE**. The purchase was completed in **12,013 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 **12,043 HE**) was unveiled **12,013 HE** in Palo Alto, California (260 Sheridan Avenue); Nikola Tesla Boulevard, Hamilton, Ontario. Schools: Tesla STEM High School created in **12,012 HE** in Redmond, Washington as a choice school with a focus on STEM subjects. The name was chosen by a student vote.<sup>1779</sup>



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<sup>1779</sup> [https://en.wikipedia.org/wiki/Nikola\\_Tesla](https://en.wikipedia.org/wiki/Nikola_Tesla)

**11,858 HE – 11,947 HE:** MAX PLANK, German Physicist was the originator of quantum theory, which revolutionized human understanding of atomic and subatomic processes founding modern physics. MAX PLANK's discovery of energy quanta won him the Nobel Prize in Physics in **11,918 HE**.



MAX PLANK **11,933 HE**, photographer and location unknown.<sup>1780</sup>

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<sup>1780</sup> [https://en.wikipedia.org/wiki/Max\\_Planck](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."<sup>1781</sup>

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<sup>1781</sup> [https://en.wikipedia.org/wiki/Max\\_Planck](https://en.wikipedia.org/wiki/Max_Planck)





From left to right: W. NERNST, A. EINSTEIN, M. PLANCK, R.A. MILLIKAN & VON LAUE at a dinner given by von Laue in Berlin on 11 November **11,931 HE.**<sup>1782</sup>

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<sup>1782</sup> [https://en.wikipedia.org/wiki/Max\\_Planck](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.<sup>1783</sup>

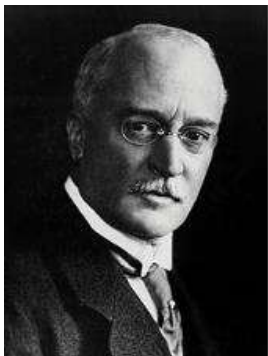
**11,858 HE– 11,913 HE: RUDOLF CHRISTIAN KARL DIESEL,**<sup>1784</sup> a German inventor and mechanical engineer, famous for the

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<sup>1783</sup> [https://en.wikipedia.org/wiki/Max\\_Planck\\_Society](https://en.wikipedia.org/wiki/Max_Planck_Society)

<sup>1784</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](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 **11,900 HE.**<sup>1785</sup>

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<sup>1785</sup> [https://en.wikipedia.org/wiki/Rudolf\\_Diesel](https://en.wikipedia.org/wiki/Rudolf_Diesel)



Drawing of RUDOLF DIESEL's, diesel engine, artist and location unknown.<sup>1786</sup>

**11,860 HE – 11,948 HE:** SIR D'ARCY WENTWORTH THOMPSON, CB FRS FRSE, Scottish biologist and mathematician who launched the field of Cell Biology.<sup>1787</sup>

⇒ **11,910 HE:** D'ARCY WENTWORTH THOMPSON published his translation of ARISTOTLE's *History of Animals*. THOMPSON had worked on the enormous task intermittently for many years. (It was not the first translation of the book into English, but the earlier attempts by Thomas Taylor (**11,809 HE**) and Richard Cresswell (**11,862 HE**) were inaccurate and criticized at the time as showing "not only an inadequate knowledge of Greek, but an extremely imperfect acquaintance with zoology".) THOMPSON'S version benefited from his

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<sup>1787</sup>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*.

[https://en.wikipedia.org/wiki/D'Arcy\\_Wentworth\\_Thompson](https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson)

excellent Greek, his expertise in zoology, his "full" knowledge of ARISTOTLE's biology, and his command of the English language, resulting in a fine translation, "correct, free and idiomatic".<sup>1788</sup>

- ⇒ **11,917 HE**: The modern field of cell biology began with the publication of SIR D'ARCY WENTWORTH THOMPSON's seminal book: *On Growth and Form*<sup>1789</sup> 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*

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<sup>1788</sup> Gill, Theo (11,911 HE). "*A New Translation of Aristotle's 'History of Animals'*". Science. 33 (854): 730–738. JSTOR 1637603 and

[https://en.wikipedia.org/wiki/D'Arcy\\_Wentworth\\_Thompson](https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson)

<sup>1789</sup> 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*

THOMPSON's description of the mathematical beauty of nature 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.<sup>1790</sup>

⇒ See some of D'ARCY WENTWORTH THOMPSON published around 300 articles and books during his career:<sup>1791</sup>

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<sup>1790</sup> [https://en.wikipedia.org/wiki/D'Arcy\\_Wentworth\\_Thompson](https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson)

<sup>1791</sup> [https://en.wikipedia.org/wiki/D'Arcy\\_Wentworth\\_Thompson](https://en.wikipedia.org/wiki/D'Arcy_Wentworth_Thompson)



D'ARCY WENTWORTH THOMPSON Dundee University,  
date unknown.<sup>1792</sup>

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<sup>1792</sup> Facebook Page for Historic Genius – BBC News



**11,862 HE – 11,945 HE: FLORENCE BASCOM**<sup>1793</sup> United States geologist was the first woman to receive a Ph.D. from Johns Hopkins University, after becoming the first woman to get her master's degree in geology. In **11,896 HE** BASCOM was the first woman to work for the United States Geological Survey. BASCOM published over 40 articles on genetic petrography, geomorphology (specifically the provenance of surficial deposits), and gravel.<sup>1794</sup>

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<sup>1793</sup> Wikipedia suggested

<sup>1794</sup> [https://en.wikipedia.org/wiki/Florence\\_Bascom](https://en.wikipedia.org/wiki/Florence_Bascom)



FLORENCE BASCOM, date, location, photographer unknown.<sup>1795</sup>

- ⇒ Named in honor of FLORENCE BASCOM: Bascom Crater on Venus; 6084 Bascom, an asteroid discovered in **11,985 HE**; Glacial Lake Bascom, a prehistoric, postglacial lake located in what is now northern Berkshire County, Massachusetts, formed when receding glacial ice acted as a dam and prevented drainage of the Hoosic River watershed.<sup>1796</sup>

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<sup>1795</sup> [https://en.wikipedia.org/wiki/Florence\\_Bascom](https://en.wikipedia.org/wiki/Florence_Bascom)

<sup>1796</sup> [https://en.wikipedia.org/wiki/Florence\\_Bascom](https://en.wikipedia.org/wiki/Florence_Bascom)

**11,863 HE – 11,941 HE:** ANNIE JUMP CANNON; United States physicist and astronomer. CANNON's cataloging work was instrumental in the development of contemporary stellar classification. With EDWARD C. PICKERING, CANNON is credited with the creation of the *Harvard Classification Scheme*, which was the first serious attempt to organize and classify stars based on their temperatures. She was nearly deaf throughout her career. CANNON was one of "Pickering's Women" because women were not allowed to use the actual telescope. Anna Draper, the widow of wealthy physician and amateur astronomer Henry Draper, set up a fund to support CANNON's work to examine the data, carry out astronomical calculations, and catalogue those telescoped photographs taken by men at night, during the day. CANNON started by examining the bright southern hemisphere stars. To these stars she applied a system: a division of stars into the spectral classes O, B, A, F, G, K, and M, and came up with the mnemonic of "Oh Be a Fine Girl, Kiss Me" as a way to remember

stellar classification. In **11,901 HE** ANNIE JUMP CANNON published her first catalog of stellar spectra.



ANNIE JUMP CANNON's in **11,922 HE**, photographer and location unknown<sup>1797</sup>

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<sup>1797</sup> [https://en.wikipedia.org/wiki/Annie\\_Jump\\_Cannon](https://en.wikipedia.org/wiki/Annie_Jump_Cannon)

**11,864 HE – 11,943 HE: GEORGE WASHINGTON CARVER,**  
United States botanist and inventor who actively promoted alternative crops to cotton, and methods to prevent soil depletion with crop rotation specifically alternating planting peanuts and sweet potatoes.<sup>1798</sup>

⇒ Apart from his work to improve the lives of farmers, **GEORGE WASHINGTON CARVER** was also a leader in promoting environmentalism.<sup>1799</sup>

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<sup>1798</sup> [https://en.wikipedia.org/wiki/George\\_Washington\\_Carver](https://en.wikipedia.org/wiki/George_Washington_Carver)

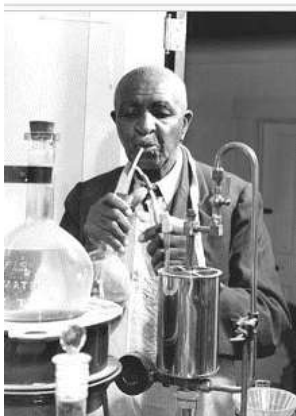
<sup>1799</sup> [https://en.wikipedia.org/wiki/George\\_Washington\\_Carver](https://en.wikipedia.org/wiki/George_Washington_Carver)



**11,906 HE:** GEORGE WASHINGTON CARVER, photograph taken by Frances Benjamin Johnston, location unknown.<sup>1800</sup>

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<sup>1800</sup> [https://en.wikipedia.org/wiki/George\\_Washington\\_Carver](https://en.wikipedia.org/wiki/George_Washington_Carver)



GEORGE WASHINGTON CARVER at work in his laboratory,  
date and photographer unknown.<sup>1801</sup>

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<sup>1801</sup> [https://en.wikipedia.org/wiki/George\\_Washington\\_Carver](https://en.wikipedia.org/wiki/George_Washington_Carver)



**11,952 HE:** Silver Commemorative GEORGE WASHINGTON CARVER, 50 cent coin.<sup>1802</sup>

⇒ GEORGE WASHINGTON CARVER received numerous honors for his work, including:

- **11,923 HE** Spingarn Medal of the NAACP. In an era of very high racial polarization, his fame reached beyond the black

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<sup>1802</sup> <https://www.ngccoin.com/coin-explorer/silver-commemoratives-pscid-71/1952-washington-carver-50c-ms-coinid-19434>



community. CARVER was widely recognized and praised in the white community for his many achievements and talents

- **11,928 HE:** honorary doctorate from Simpson College;
- **11,939 HE:** the Roosevelt Medal for Outstanding Contribution to Southern Agriculture;
- **11,940 HE,** CARVER established the George Washington Carver Foundation at the Tuskegee Institute;
- In **11,941 HE**, *Time* magazine dubbed Carver a "Black Leonardo";
- **11,941 HE:** The George Washington Carver Museum was dedicated at the Tuskegee Institute;
- **11,942 HE:** Henry Ford built a replica of Carver's birth cabin at the Henry Ford Museum and Greenfield Village in Dearborn as a tribute;
- **11,942 HE:** Ford dedicated a laboratory in Dearborn named after Carver;

- **11,943 HE**, Liberty ship SS George Washington Carver launched;
- **11,950 HE**, George Washington Carver State Park named;
- **11,951 HE-11,954 HE**: U.S. Mint features Carver on a 50 cents silver commemorative coin;
- **11,965 HE**, Ballistic missile submarine USS George Washington Carver (SSBN-656) launched;
- **11,969 HE**, Iowa State University constructs Carver Hall in honor of Carver– a graduate of the university;
- Circa **11,943 HE**: the US Congress designated January 5, the anniversary of his death, as George Washington Carver Recognition Day;
- **11,999 HE**: USDA names a portion of its Beltsville, Maryland campus the George Washington Carver Center;
- **12,007 HE**: the Missouri Botanical Gardens has a garden area named in his honor, with a commemorative statue and material about his work;

- Others:** Willowbrook Neighborhood Park in California was renamed George Washington Carver Park in his honor; Schools named for Carver include the George Washington Carver Elementary School in Los Angeles County, California, the George Washington Carver School of Arts and Science in Sacramento, California, and the Dr. George Washington Carver Elementary School, a Newark public school in Newark, New Jersey; Taxa named after him include: *Colletotrichum carveri* and *Metasphaeria carveri*, both named by Job Bicknell Ellis and Benjamin Matlack Everhart in **11,902 HE**; *Cercospora carveriana*, named by Pier Andrea Saccardo and Domenico Saccardo in **11,906 HE**; *Taphrina carveri* named by Anna Eliza Jenkins in **11,939 HE**; and *Pestalotia carveri*, named by E. F. Guba in **11,961 HE**.<sup>1803</sup>

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<sup>1803</sup> [https://en.wikipedia.org/wiki/George\\_Washington\\_Carver](https://en.wikipedia.org/wiki/George_Washington_Carver)

**11,866 HE – 11,943 HE:** HELEN BEATRIX POTTER, AKA BEATRIX POTTER, English Mycologist who proposed theory on how fungi reproduce,<sup>1804</sup> 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.<sup>1805</sup>

⇒ By the **11,890s HE** her scientific interests centered on mycology. First drawn to fungi because of their colors and evanescence in nature and her delight in painting them, her interest deepened after meeting Charles McIntosh, a revered

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<sup>1804</sup> <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

<sup>1805</sup> [https://en.wikipedia.org/wiki/Beatrix\\_Potter](https://en.wikipedia.org/wiki/Beatrix_Potter)

naturalist and amateur mycologist, during a summer holiday in Dunkeld in Perthshire in **11,892 HE**. Her work is only now being properly evaluated.

- ⇒ BEATRIX POTTER later gave her other mycological and scientific drawings to the Armit Museum and Library in Ambleside, where mycologists still refer to them to identify fungi. There is also a collection of her fungus paintings at the Perth Museum and Art Gallery in Perth, Scotland, donated by Charles McIntosh. In **11,967 HE**, the mycologist W.P.K. FINDLAY included many of POTTER'S beautifully accurate fungus drawings in his Wayside & Woodland Fungi, thereby fulfilling her desire to one day have her fungus drawings published in a book. In **11,997 HE**, the Linnean Society issued a posthumous apology to POTTER for the sexism displayed in its handling of her research.



Drawing by BEATRIX POTTER: reproductive system of the mushroom: *Hygrocybe coccinea*, **11,897 HE.**<sup>1806</sup>

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<sup>1806</sup> [https://en.wikipedia.org/wiki/Beatrix\\_Potter](https://en.wikipedia.org/wiki/Beatrix_Potter)



HELEN BEATRIX POTTER in **11,913 HE**, photographer and location unknown.<sup>1807</sup>

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<sup>1807</sup> [https://en.wikipedia.org/wiki/Beatrix\\_Potter](https://en.wikipedia.org/wiki/Beatrix_Potter)

- ⇒ As an Editor and illustrator of children's books, BEATRIX POTTER started by illustrating cards etc. and in **11,893 HE**, POTTER was on holiday at Eastwood in Dunkeld, Perthshire. She had run out of things to say to the son of her tutor, Noel, so she told him a story about "four little rabbits whose names were Flopsy, Mopsy, Cottontail and Peter". It became one of the most famous children's letters ever written and the basis of Potter's future career as a writer-artist-storyteller.<sup>1808</sup>
- ⇒ **11,902 HE:** *The Tale of Peter Rabbit* was published. BEATRIX POTTER published two or three books each year: 23 books in all.<sup>1809</sup>

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<sup>1808</sup> [https://en.wikipedia.org/wiki/Beatrix\\_Potter](https://en.wikipedia.org/wiki/Beatrix_Potter)

<sup>1809</sup> [https://en.wikipedia.org/wiki/Beatrix\\_Potter](https://en.wikipedia.org/wiki/Beatrix_Potter)



**11,867 HE – 11,923 HE:** CHARLES HENRY TURNER<sup>1810</sup> 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".<sup>1811</sup>

⇒ 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.<sup>1812</sup>

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<sup>1810</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>1811</sup> [https://en.wikipedia.org/wiki/Charles\\_Henry\\_Turner\\_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

<sup>1812</sup> [https://en.wikipedia.org/wiki/Charles\\_Henry\\_Turner\\_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))



**Circa 11,902 HE: CHARLES HENRY TURNER**, location and photographer unknown.<sup>1813</sup>

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<sup>1813</sup> [https://en.wikipedia.org/wiki/Charles\\_Henry\\_Turner\\_\(zoologist\)](https://en.wikipedia.org/wiki/Charles_Henry_Turner_(zoologist))

**11,867 HE – 11,934 HE:** MARIE SKLODOWSKA CURIE, Nobel prize winning Polish, French, physicist and chemist who conducted pioneering research on radioactivity.<sup>1814</sup>

- ⇒ 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

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<sup>1814</sup> [https://en.wikipedia.org/wiki/Marie\\_Curie](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, that were placed in her way because she was a woman.
- CURIE was known for her honesty and moderate life style. Having received a small scholarship in **11,893 HE**, she returned it in **11,897 HE** as soon as she began earning her keep.

- CURIE gave much of her first Nobel Prize money to friends, family, students, and research associates. In an unusual decision, she intentionally refrained from patenting the radium-isolation process, so that the scientific community could do research unhindered.
- CURIE insisted that monetary gifts and awards be given to the scientific institutions she was affiliated with rather than to her. MARIE CURIE and her husband PIERRE CURIE often refused awards and medals.
- ALBERT EINSTEIN reportedly remarked that she was probably the only person who could not be corrupted by fame.<sup>1815</sup>

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<sup>1815</sup> [https://en.wikipedia.org/wiki/Marie\\_Curie](https://en.wikipedia.org/wiki/Marie_Curie)



**Circa 11,920 HE**, photo of MARIE CURIE, location and photographer unknown.<sup>1816</sup>

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<sup>1816</sup> [https://en.wikipedia.org/wiki/Marie\\_Curie](https://en.wikipedia.org/wiki/Marie_Curie)



Photo of MARIE CURIE, date, location, and photographer unknown.<sup>1817</sup>



**11,935 HE MARIE CURIE** statue, facing the Radium Institute,  
Warsaw.<sup>1818</sup>

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<sup>1818</sup> [https://en.wikipedia.org/wiki/Marie\\_Curie](https://en.wikipedia.org/wiki/Marie_Curie)



- ⇒ **11,903 HE** MARIE CURIE was the first woman to win a Nobel Prize. **11,906 HE:** MARIE CURIE was the first woman to become a professor at the University of Paris. **11,922 HE,** MARIE CURIE became a member of the newly created International Committee on Intellectual Cooperation of the League of Nations. **11,995 HE** MARIE CURIE became the first woman to be entombed on her own merits in the Pantheon in Paris (note: she died in **11,934 HE**).
- ⇒ MARIE CURIE was the first person and only woman to win a Nobel Prize twice, and the only person to win twice in multiple sciences.<sup>1819</sup>

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<sup>1819</sup> [https://en.wikipedia.org/wiki/Marie\\_Curie](https://en.wikipedia.org/wiki/Marie_Curie)

**11,868 HE – 11,934 HE:** FRITZ HABER was a German chemist.

During World War II (**11,939 HE – 11,945 HE**) about 9,000,000 people were gassed to death using Zyklon-B, which was invented by Haber.<sup>1820</sup> 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.<sup>1821</sup>

⇒ **11,919 HE:** Years earlier, HABER received the Nobel Prize in Chemistry for his invention of the Haber–Bosch process. The conventional food production for half the world's current

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<sup>1820</sup> 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*

<sup>1821</sup> [https://en.wikipedia.org/wiki/Fritz\\_Haber](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*

population depends on this method for producing artificial nitrogen fertilizers: a method used in industry to synthesize ammonia from nitrogen gas and hydrogen gas.<sup>1822</sup> (Note: This Haber-Bosch process produces artificial nitrogen fertilizer which does not break down in nature as does naturally produced nitrogen fertilizer.<sup>1823</sup>) Haber was responding to events of **Circa 11,904 HE** (fifteen years earlier) when the British Association's president William Crookes had startled the world with his prophecy of global starvation due to the limits of agricultural production. The nitrogen fertilizer produced with the Haber–Bosch process helped the world avoid the predicted apocalypse — though the process also served the production of explosives used in the different kind of apocalypse, mentioned above. As of

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<sup>1822</sup> [https://en.wikipedia.org/wiki/Fritz\\_Haber](https://en.wikipedia.org/wiki/Fritz_Haber)

<sup>1823</sup> <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

**12,012 HE**, human activities produce more reactive nitrogen than natural processes, and around half the nitrogen found in the proteins and nucleic acids of the seven billion people alive today comes out of a Haber–Bosch plant.<sup>1824</sup>



**11,918 HE**: FRITZ HABER, location and photographer unknown.<sup>1825</sup>

⇒ **12,011 HE**: The Royal Society held a two-day meeting dealing with the current knowledge and uncertainties over the nitrogen

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<sup>1824</sup> <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

<sup>1825</sup> [https://en.wikipedia.org/wiki/Fritz\\_Haber](https://en.wikipedia.org/wiki/Fritz_Haber)

*cycle caused by use of artificial fertilizer developed by Haber and the Haber-Bosch process.* If the nitrogen budget surplus in soils is allowed to increase further due to use of reactive artificial nitrogen, the nitrogen budget will accumulate in surface and coastal waters, warns LEX BOWMAN from Utrecht University (Netherlands), and stimulate plant growth, decomposition and burial. Such eutrophication may have several negative consequences, such as loss of biodiversity, harmful algal blooms, including toxic ones, and hypoxia.<sup>1826</sup>

- 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

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<sup>1826</sup> <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

the future? And do we even know what we're doing to our planet by doubling its nitrogen throughput? Answers are still being researched.<sup>1827</sup>

**11,868 HE – 11,921 HE: HENRIETTA SWAN LEAVITT,**<sup>1828</sup> United States astronomer who discovered the relationship between luminosity and distance in measuring stellar distances which was used by **EDWIN HUBBLE** (See **11,889 HE -11,953 HE: EDWIN HUBBLE**) to determine our Universe is expanding.<sup>1829</sup>

⇒ Early **11,900's HE: HENRIETTA SWAN LEAVITT** began working as one of the women human "computers" at the Harvard College Observatory, (See: along with **11,863 HE – 11,941 HE: ANNIE JUMP CANNON**) hired by its director **EDWARD**

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<sup>1827</sup> <https://www.sciencedirect.com/science/article/pii/S0960982211014461>

<sup>1828</sup> <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

<sup>1829</sup> [https://en.wikipedia.org/wiki/Henrietta\\_Swan\\_Leavitt](https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt)

CHARLES PICKERING to measure and catalog the brightness of stars as they appeared in the observatory's photographic plate collection. (In the early **11,900s HE**, women were not allowed to operate telescopes.)<sup>1830</sup>

- ⇒ In **11,908 HE** HENRIETTA SWAN LEAVITT identified 1777 variable stars and published her results in the *Annals of the Astronomical Observatory of Harvard College*, noting that the brighter variables had the longer period.<sup>1831</sup> In another paper published in **11,912 HE** LEAVITT looked carefully at the relation between the periods and the brightness of a sample of 25 of the Cepheid variables (also now known as “Standard Candles”) in the Small Magellanic Cloud. This paper was communicated and signed by PICKERING, but the first sentence indicates that its contents "have been prepared by MISS

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<sup>1830</sup> [https://en.wikipedia.org/wiki/Henrietta\\_Swan\\_Leavitt](https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt)

<sup>1831</sup> [https://en.wikipedia.org/wiki/Henrietta\\_Swan\\_Leavitt](https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt)

LEAVITT". LEAVITT determined that, in her own words: "A straight line can be readily drawn among each of the two series of points corresponding to maxima and minima, thus showing that there is a simple relation between the brightness of the Cepheid variables and their periods."<sup>1832</sup>

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<sup>1832</sup> [https://en.wikipedia.org/wiki/Henrietta\\_Swan\\_Leavitt](https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt)





Photo is of HENRIETTA SWAN LEAVITT working at her desk in the Harvard College Observatory, Photographer and date unknown.<sup>1833</sup>

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<sup>1833</sup> [https://en.wikipedia.org/wiki/Henrietta\\_Swan\\_Leavitt](https://en.wikipedia.org/wiki/Henrietta_Swan_Leavitt)

**11,869 HE:** The United States First Transcontinental Railroad was completed.<sup>1834</sup>

- ⇒ The First Transcontinental Railroad (also called the Great Transcontinental Railroad, known originally as the "Pacific Railroad" and later as the "Overland Route") was a 1,912-mile (3,077 km) continuous railroad line constructed between **11,863 HE and 11,869 HE** that connected the existing eastern U.S. rail network at Omaha, Nebraska with the Pacific coast at the Oakland Long Wharf on San Francisco Bay.<sup>1835</sup>
- ⇒ 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

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<sup>1834</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1835</sup> [https://en.wikipedia.org/wiki/First\\_Transcontinental\\_Railroad](https://en.wikipedia.org/wiki/First_Transcontinental_Railroad)

Transcontinental Railroad across the United States connecting the Central Pacific and Union Pacific railroads.<sup>1836</sup>



**11,869 HE:** Photo *Driving of the Spike*, at Promontory Summit, near Ogden, Utah, United States.<sup>1837</sup>

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<sup>1836</sup> [https://en.wikipedia.org/wiki/Golden\\_spike](https://en.wikipedia.org/wiki/Golden_spike)

<sup>1837</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



The original "golden spike", on display at the Cantor Arts Museum at Stanford University.<sup>1838</sup>

**11,869 HE – 11,948 HE: JOHAN HJORT**, Norwegian fisheries scientist, marine zoologist, biologist and oceanographer.<sup>1839</sup> In **11,910 HE** JOHAN HJORT and SIR JOHN MURRAY and the Norwegian research ship Michael Sars departed Plymouth for a

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<sup>1838</sup> [https://en.wikipedia.org/wiki/Golden\\_spike](https://en.wikipedia.org/wiki/Golden_spike)

<sup>1839</sup> [https://en.wikipedia.org/wiki/Johan\\_Hjort](https://en.wikipedia.org/wiki/Johan_Hjort)

four-month expedition to take physical and biological observations at all depths between Europe and North America.<sup>1840</sup>

⇒ Named after JOHAN HJORT: The research vessel Johan Hjort. Three vessels have borne Hjort's name; the first was built in **11,922 HE**, the second in **11,932 HE**, and the third in **11,990 HE**; *Idioteuthis hjorti*, a whip-lash squid; *Balaenanemertes hjorti*, a ribbon worm; *Echinoclathria hjorti*, a sponge; *Prionoglossa hjortii*, a pelagic mollusk; *Saccopharynx hjorti*, a gulper eel; Hjort Massif, a mountain range in Antarctica; Hjort Ridge (“The Hjort Ridge, Trench, and Plateau comprise the southernmost portion of the Macquarie Ridge Complex (MRC), the Australian-Pacific plate boundary south of New Zealand”<sup>1841</sup>;

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<sup>1840</sup> [https://en.wikipedia.org/wiki/John\\_Murray\\_\(oceanographer\)](https://en.wikipedia.org/wiki/John_Murray_(oceanographer))

<sup>1841</sup> <https://repositories.lib.utexas.edu/handle/2152/775>

The Hjort maturity scale and Johan Hjorts vei ("Johan Hjort Street") in Bergen.



JOHAN HJORT, date, location, and photographer unknown.<sup>1842</sup>

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<sup>1842</sup> [https://en.wikipedia.org/wiki/Johan\\_Hjort](https://en.wikipedia.org/wiki/Johan_Hjort)

**11,869 HE – 11,970 HE:** ALICE HAMILTON, United States biochemist, and science all-star!<sup>1843</sup> 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.

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<sup>1843</sup> [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](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.<sup>1844</sup>

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<sup>1844</sup> [https://en.wikipedia.org/wiki/Alice\\_Hamilton](https://en.wikipedia.org/wiki/Alice_Hamilton)





Early photo of young ALICE HAMILTON, date, location and photographer unknown.<sup>1845</sup>

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<sup>1845</sup> [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](http://gizmodo.com/badass-historical-chemists-alice-hamilton-versus-absol-1746229941?utm_source=feedburner&utm_medium=feed&utm_campaign=Feed%3A+gizmodo%2Ffull+%28Gizmodo%29)

After **11,870 HE** Latin American governments encouraged further rail development through generous concessions that included government subsidies for construction.<sup>1846</sup>

- ⇒ **By 11,870 HE** railway line construction was underway, with Cuba leading with the most railway track in service (1,295 km), followed by Chile (797 km), Brazil (744 km), Argentina (732 km), Peru (669 km), and Mexico (417 km).<sup>1847</sup>
- ⇒ **By 11,900 HE:** Argentina (16,563 km), Brazil (15,316 km) and Mexico (13,615 km) were the leaders in length of track in service, and Peru, which had been an early leader in railway construction, had stagnated (1,790 km).<sup>1848</sup>

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<sup>1846</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1847</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1848</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

⇒ **In 11,909 HE:** In Mexico, growing nationalistic fervor led the government to bring the bulk of the nation's railroads under national control with a new government corporation, Ferrocarriles Nacionales de México (FNM), that exercised control of the main trunk rail lines through a majority of share ownership.<sup>1849</sup>

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<sup>1849</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



Undated photo is of a Mexican railway bridge, an example of engineering that overcame geographical barriers and allowed efficient movement of goods and people.<sup>1850</sup>

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<sup>1850</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,872 HE:** Japan developed its first railway line with technical and material assistance provided by several western nations such as Britain and the United States.<sup>1851</sup>

**11,873 HE – 11,932 HE:** ALBERTO SANTOS-DUMONT,<sup>1852</sup>  
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.<sup>1853</sup>

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<sup>1851</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1852</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](https://en.wikipedia.org/wiki/History_of_aviation)

<sup>1853</sup> [https://en.wikipedia.org/wiki/Alberto\\_Santos-Dumont](https://en.wikipedia.org/wiki/Alberto_Santos-Dumont)



**Circa 11,902 HE, ALBERTO SANTOS-DUMONT.** Location and photographer unknown.<sup>1854</sup>

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<sup>1854</sup> [https://en.wikipedia.org/wiki/Alberto\\_Santos-Dumont](https://en.wikipedia.org/wiki/Alberto_Santos-Dumont)



**11,901 HE: SANTOS-DUMONT'S "Number 6"** rounding the Eiffel Tower in the process of winning the Deutsch de la Meurthe Prize, photographer unknown.<sup>1855</sup>

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<sup>1855</sup> [https://en.wikipedia.org/wiki/Alberto\\_Santos-Dumont](https://en.wikipedia.org/wiki/Alberto_Santos-Dumont)

**11,874 HE – 11,937 HE:** GUGLIELMO MARCONI, Italian inventor and electrical engineer is known for his pioneering work on long-distance communications and for his development of Marconi's law and a radio telegraph system. MARCONI is often credited as the inventor of radio, and he shared the **11,909 HE** Nobel Prize in Physics with KARL FERDINAND BRAUN "in recognition of their contributions to the development of wireless telegraphy".<sup>1856</sup>

⇒ GUGLIELMO MARCONI was an entrepreneur, businessman, and founder of The Wireless Telegraph & Signal Company in the United Kingdom in **11,897 HE** (which became the Marconi Company). MARCONI succeeded in making a commercial success of radio by innovating and building on the work of previous experimenters and physicists. It is widely held that many of MARCONI's ideas were first developed by NIKOLA

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<sup>1856</sup> [https://en.wikipedia.org/wiki/Guglielmo\\_Marconi](https://en.wikipedia.org/wiki/Guglielmo_Marconi)



TESLA, but first published or patented by MARCONI. In **11,929 HE**, the King of Italy ennobled him as a Marchese (marquis).<sup>1857</sup>



GUGLIELMO MARCONI, date, location, and photographer unknown.<sup>1858</sup>

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<sup>1857</sup> [https://en.wikipedia.org/wiki/Guglielmo\\_Marconi](https://en.wikipedia.org/wiki/Guglielmo_Marconi)

<sup>1858</sup> [https://en.wikipedia.org/wiki/Guglielmo\\_Marconi](https://en.wikipedia.org/wiki/Guglielmo_Marconi)

**11,875 HE:** PAUL EMILE LECOQ DE BOISBAUDRAN, French chemist, using spectroscopy saw two violet lines never before seen and later isolated the “Star Stuff” Element Gallium, number 31.<sup>1859</sup>



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

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<sup>1859</sup> 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.<sup>1860</sup>

**11,776 HE - 11,870s HE:** In the United States, contraception had been legal. But in the **11,870s HE** the Comstock Act and various state Comstock laws outlawed the distribution of information about safe sex and contraception and the use of contraceptives.<sup>1861</sup>

⇒ **11,872 HE:** With the intent of making birth control a Federal Crime, Anthony Comstock, who was neither a doctor nor a scientist, set off for Washington with an anti-obscenity bill, including a ban on contraceptives, that he had drafted himself.<sup>1862</sup>

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<sup>1860</sup> <http://images-of-elements.com/gallium.php#a>

<sup>1861</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1862</sup> <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

- On March 3, **11,873 HE**, the US Congress passed the new law, later known as the Comstock Act. The statute defined contraceptives as obscene and illicit, making it a federal offense to disseminate birth control through the mail or across state lines.<sup>1863</sup>
- *Destruction of books*: Through his various campaigns, Anthony Comstock destroyed 15 tons of books, 284,000 pounds of plates for printing 'objectionable' books, and nearly 4,000,000 pictures.<sup>1864</sup> Comstock claimed that, "books are feeders for brothels."<sup>1865</sup> Comstock boasted that he was

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<sup>1863</sup> <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

<sup>1864</sup> Buchanan, Paul D, *The American Women's Rights Movement*, p. 75, and [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1865</sup> 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](https://en.wikipedia.org/wiki/History_of_birth_control)

responsible for 4,000 arrests,<sup>1866</sup> and claimed he drove fifteen persons to commit suicide in his "fight for the young".<sup>1867</sup>

⇒ Author / Compiler includes the previous and following entries as part of the ongoing thread of the scientific topics of population and birth control.

**11,877 HE:** In England, Annie Besant and Charles Bradlaugh were prosecuted for publishing the American physician and writer CHARLES KNOWLTON'S little book *Fruits of Philosophy: a treatise on the population question* AKA *The Fruits of Philosophy, or the Private Companion of Young Married People*.

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<sup>1866</sup> *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](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1867</sup> de Grazia, Edward, *Girls Lean Back Everywhere*, p. 5, and [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

- ⇒ The book which explained various methods of birth control, including a summary of what was then known about the physiology of conception, listed a number of methods to treat infertility and impotence, and explained a method of birth control KNOWELTON had developed: to wash out the vagina after intercourse with certain chemical solutions.<sup>1868</sup>
- ⇒ 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."<sup>1869 1870</sup>

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<sup>1868</sup> [https://en.wikipedia.org/wiki/Charles\\_Knowlton](https://en.wikipedia.org/wiki/Charles_Knowlton)

<sup>1869</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1870</sup> 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 **11,880s 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.<sup>1871 1872</sup>

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<sup>1871</sup> ^ Draznin, Yaffa Claire (12,001 HE). Victorian London's ***Middle-Class Housewife: What She Did All Day (#179). Contributions in Women's Studies.*** Westport, Connecticut: Greenwood Press. pp. 98–100. ISBN 0-313-31399-7, and [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1872</sup> <http://www.pbs.org/wgbh/americanexperience/features/pill-anthony-comstocks-chastity-laws/>

**11,878 HE – 11,968 HE: LISE MEITNER**<sup>1873 1874</sup> Austrian-Swedish physicist who worked on radioactivity and nuclear physics,<sup>1875</sup> was the first female member of the scientific class of the Austrian Academy of Sciences. In **11,939 HE** LISE MEITNER and OTTO HAHN led the small group of scientists who first discovered nuclear fission of uranium when it absorbed an extra neutron.

⇒ MEITNER's diploma bears the words: "For pioneering research in the naturally occurring radioactivities and extensive experimental studies leading to the discovery of fission."<sup>1876</sup>

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<sup>1873</sup> 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.

<sup>1874</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>1875</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)

<sup>1876</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)





LISE MEITNER in **11,946 HE**, location and photographer unknown<sup>1877</sup>

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<sup>1877</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)



OTTO HAHN, DR. HARTMANN, LISE MEITNER, WERNER HEISENBERG, THEODOR HEUSS in **11,958 HE**. Credit: Ullstein Bild, Getty Images.<sup>1878</sup>

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<sup>1878</sup> <https://blogs.scientificamerican.com/voices/honoring-a-pioneering-woman-in-physics/>



Nuclear fission experimental setup, reconstructed at the Deutsches Museum, Munich, photographer unknown.<sup>1879</sup>

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<sup>1879</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)



Statue of LISE MEITNER (sculptor: Anna Franziska Schwarzbach, **12,014 HE**), at Humboldt University in Berlin.<sup>1880</sup>

⇒ Since her **11,968 HE** death, she has received many naming honors: In **11,997 HE**, element 109 was named Meitnerium in her honor. MEITNER is the first and, so far, only non-

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<sup>1880</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)

mythological woman thus honored. (Curium was named after 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 **12,000 HE**, the European Physical Society established the biannual "Lise Meitner Prize" for excellent research in nuclear science. In **12,006 HE** the "Gothenburg Lise Meitner Award" was established by the University of Gothenburg in Sweden; it is awarded annually to a scientist who has made a breakthrough in physics. In **12,008 HE**, the chemical, biological, radiological, and nuclear defense school of the Austrian Armed Forces (NBC) established the Lise Meitner Award. In **12,010 HE**, a building at the Free University of Berlin was named the Hahn-Meitner Building; this was a renaming of a building previously known as the Otto Hahn Building. In **12,014 HE** the statue of LISE MEITNER was unveiled in the garden of the Humboldt University of Berlin next to similar statues of HERMANN VON

HELMHOLTZ and MAX PLANCK. A short residential street in Bramley, Hamshire, UK, her resting place, is named Meitner Close. Schools and streets were named after her in many cities in Austria and Germany. Since **12,015 HE** AlbaNova university centre in Stockholm has an annual LISE MEITNER Distinguished Lecture. In **12,017 HE**, the Advanced Research Projects Agency-Energy in the United States named a major nuclear energy research program in her honor.<sup>1881</sup>

**11,879 HE – 11,955 HE:** ALBERT EINSTEIN, Subject of the Kingdom of Württemberg during the German Empire: (**11,879 HE–11,896 HE**); Stateless: (**11,896 HE–11,901 HE**); Citizen of Switzerland (**11,901 HE–11,955 HE**); Austrian subject of the Austro-Hungarian Empire (**11,911 HE–11,912 HE**); Subject of the Kingdom of Prussia during the German Empire (**11,914 HE–**

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<sup>1881</sup> [https://en.wikipedia.org/wiki/Lise\\_Meitner](https://en.wikipedia.org/wiki/Lise_Meitner)

**11,918 HE**); German citizen of the Free State of Prussia; Weimar Republic, **11,918 HE–11,933 HE**; Citizen of the United States (**11,940 HE–11,955 HE**): Physicist and Philosopher.<sup>1882</sup>

⇒ After graduating in **11,900 HE**, ALBERT EINSTEIN spent almost two frustrating years searching for a teaching post. EINSTEIN acquired Swiss citizenship in February **11,901 HE** but was not conscripted into the military for medical reasons. With the help of Marcel Grossmann's father, he secured a job in Bern at the Federal Office for Intellectual Property, the patent office, as an assistant examiner – level III. EINSTEIN evaluated patent applications for a variety of devices including a gravel sorter and an electromechanical typewriter. In **11,903 HE** his position at the Swiss Patent Office became permanent, although he was passed over for promotion until he "fully mastered

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<sup>1882</sup> [https://en.wikipedia.org/wiki/Albert\\_Einstein](https://en.wikipedia.org/wiki/Albert_Einstein)

machine technology". *Eventually, much of EINSTEIN's work at 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.*<sup>1883</sup>

- ⇒ 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

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<sup>1883</sup> [https://en.wikipedia.org/wiki/Albert\\_Einstein](https://en.wikipedia.org/wiki/Albert_Einstein)



formula  $E = mc^2$ , which has been dubbed "the world's most famous equation".

- ⇒ ALBERT EINSTEIN received the **11,921 HE** Nobel Prize in Physics “for his services to theoretical physics, and especially for his discovery of the law of the photoelectric effect,” a pivotal step in the development of quantum theory.<sup>1884</sup>
- ⇒ From **11,926 HE until 11,934 HE** EINSTEIN and his former student Leo Szilárd collaborated on ways to improve home non-electric refrigeration technology requiring only a heat source to operate. EINSTEIN used the experience he had gained during his years at the Swiss Patent Office to apply for valid patents for their inventions in several countries. The two were eventually

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<sup>1884</sup> [https://en.wikipedia.org/wiki/Albert\\_Einstein](https://en.wikipedia.org/wiki/Albert_Einstein)

granted 45 patents in their names for three different models.<sup>1885</sup>  
Scientists from Oxford are struggling to revive his invention  
today.<sup>1886</sup>

- ⇒ 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".<sup>1887</sup>

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<sup>1885</sup> [https://en.wikipedia.org/wiki/Einstein\\_refrigerator](https://en.wikipedia.org/wiki/Einstein_refrigerator)

<sup>1886</sup> <https://www.greenoptimistic.com/einstein-refrigerator/>

<sup>1887</sup> [https://en.wikipedia.org/wiki/Albert\\_Einstein](https://en.wikipedia.org/wiki/Albert_Einstein)

⇒ ALBERT EINSTEIN resolved the two differing opinions of ARISTOTLE and of ISAAC NEWTON to define time as we now know it.<sup>1888</sup>

- ARISTOTLE had concluded that time is measured by the changing of things. ARISTOTLE had concluded that if nothing changes, there is no time.<sup>1889</sup>
- NEWTON had concluded that there was a “separate true” time that passes independently of things and independently of change, accessible only by mathematical calculation.<sup>1890</sup>

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<sup>1888</sup> Carlo Rovelli's The Order of Time

<sup>1889</sup> Carlo Rovelli's *The Order of Time*

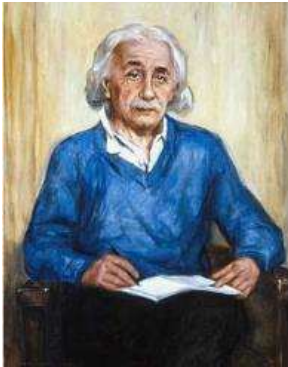
<sup>1890</sup> Carlo Rovelli's *The Order of Time*

- 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.<sup>1891</sup> Time varies depending on the observer's frame of reference. Someone moving faster than someone else will experience time passing at a different rate. Someone closer to a massive body (like our sun) will experience time differently than someone more distant from that massive body.<sup>1892</sup>

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<sup>1891</sup> [https://en.wikipedia.org/wiki/Absolute\\_space\\_and\\_time](https://en.wikipedia.org/wiki/Absolute_space_and_time)

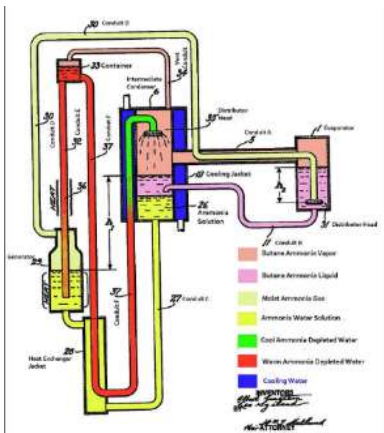
<sup>1892</sup> Carlo Rovelli's *The Order of Time*



ALBERT EINSTEIN / artist: Max Westfield / Oil on canvas,  
**11,944 HE**; National Portrait Gallery, Smithsonian Institution;  
gift of the artist.<sup>1893</sup>

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<sup>1893</sup> <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.<sup>1894</sup>

<sup>1894</sup> [https://en.wikipedia.org/wiki/Einstein\\_refrigerator](https://en.wikipedia.org/wiki/Einstein_refrigerator)

⇒ Awards and Honors Received by ALBERT EINSTEIN:

- **11,925 HE** the Royal Society awarded ALBERT EINSTEIN the Copley Medal. In **11,929 HE**, MAX PLANCK presented ALBERT EINSTEIN with the Max Planck medal of the German Physical Society in Berlin, for extraordinary achievements in theoretical physics. In **11,931 HE** EINSTEIN received the Prix Jules Janssen award. In **11,934 HE** ALBERT EINSTEIN gave the Josiah Willard Gibbs lecture. In **11,936 HE**, ALBERT EINSTEIN was awarded the Franklin Institute's Franklin Medal for his extensive work on relativity and the photo-electric effect. The International Union of Pure and Applied Physics named **12,005 HE** the "World Year of Physics" in commemoration of the 100th

anniversary of the publication of EINSTEIN's paper on Special Relativity.<sup>1895</sup>

⇒ 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

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<sup>1895</sup> [https://en.wikipedia.org/wiki/Einsteins\\_awards\\_and\\_honors](https://en.wikipedia.org/wiki/Einsteins_awards_and_honors)



Einstein seated with manuscript papers in hand. The statue, commissioned in **11,979 HE**, is located in a grove of trees at the southwest corner of the grounds of the National Academy of Sciences on Constitution Avenue. The chemical element 99, Einsteinium, was named for him in August **11,955 HE**, four months after Einstein's death. "2001 Einstein" is an inner main belt asteroid discovered on 5 March **11,973 HE**. In **11,999 HE**, Time magazine named ALBERT EINSTEIN the Person of the Century, ahead of Mahatma Gandhi and Franklin Roosevelt, among others. In the words of a biographer, "to the scientifically literate and the public at large, Einstein is synonymous with genius". Also in **11,999 HE**, an opinion poll of 100 leading physicists ranked ALBERT EINSTEIN the "greatest physicist ever". A Gallup poll recorded ALBERT EINSTEIN as the fourth most admired person of the 20th century in the U.S. In **11,990 HE**, ALBERT EINSTEIN's name was added to the Walhalla

temple, located in Donaustauf, Bavaria for "laudable and distinguished Germans". The United States Postal Service honored Einstein with a Prominent Americans series (**11,965 HE–11,978 HE**) 8¢ postage stamp. In **12,008 HE**, ALBERT EINSTEIN was inducted into the New Jersey Hall of Fame.<sup>1896</sup>

- ⇒ 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–

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<sup>1896</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](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).<sup>1897</sup>

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<sup>1897</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](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.<sup>1898</sup>
- ⇒ 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;

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<sup>1898</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](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.<sup>1899</sup>

⇒ 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,

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<sup>1899</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein)

Germany; Albert Einstein Street in Coimbra, Portugal; Einstein Street, Tel Aviv, Israel; Einstein Street, Haifa, Israel; Einstein St. in Norman, Oklahoma.<sup>1900</sup>

- ⇒ 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.<sup>1901</sup>
- ⇒ Other items named after ALBERT EINSTEIN: Bohr–Einstein debates, a series of epistemological challenges and responses by ALBERT EINSTEIN and NIELS BOHR; Russell–Einstein

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<sup>1900</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein)

<sup>1901</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein)

Manifesto, issued in **11,955 HE** by BERTRAND RUSSELL in the midst of the Cold War; Einstein–Szilárd letter, a letter sent to President Franklin Delano Roosevelt in August **11,939 HE**; Einstein Symposium, on the centennial of **11,905 HE** publication of the Special Theory of Relativity; Rebutia einsteinii, a cactus named after Einstein by its finder, Alberto Vojtěch Frič; Albert Einstein Institution, a non-profit organization studying methods of non-violent resistance; Albert Einstein German Academic Refugee 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.<sup>1902</sup>

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<sup>1902</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Albert\\_Einstein](https://en.wikipedia.org/wiki/List_of_things_named_after_Albert_Einstein)

**11,879 HE – 11,966 HE: MARGARET HIGGINS SANGER SLEE**  
**AKA MARGARET SANGER:** United States nurse, writer, social  
reformer.<sup>1903</sup>



**11,922 HE: MARGARET HIGGINS SANGER SLEE,** location  
and photographer unknown.<sup>1904</sup>

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<sup>1903</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>1904</sup> [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)



- ⇒ **11,916 HE:** SANGER opened a family planning and birth control clinic at 46 Amboy Street in the Brownsville neighborhood of Brooklyn, the first of its kind in the United States.<sup>1905</sup>
- ⇒ Books and pamphlets by MARGARET HIGGINS SANGER SLEE:
- In **11,911 HE or 11,912 HE:** *What Every Mother Should Know* - Originally based on a series of articles SANGER SLEE published in **11,911 HE** in the New York Call, which were, in turn, based on a set of lectures SANGER SLEE gave to groups of Socialist Party women in **11,910 HE –11,911**

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<sup>1905</sup> [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)

**HE.**<sup>1906</sup> Multiple editions were published through the **11,920s 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 **11,921 HE** edition, Michigan State University);

- **11,914 HE:** *Family Limitation* – Originally published as a 16-page pamphlet; also published in several later editions. (Online **11,917 HE** 6th edition, Michigan State University);
- **11,916 HE:** *What Every Girl Should Know* – Originally published by Max N. Maisel; 91 pages; also published in

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<sup>1906</sup> 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](https://en.wikipedia.org/wiki/Margaret_Sanger)

several later editions. (Online **11,922 HE** edition, Michigan State University);

- **11,916 HE:** *Fight for Birth Control*, New York (The Library of Congress);
- **11,917 HE:** *The Case for Birth Control: A Supplementary Brief and Statement of Facts* – published to provide information to the court in a legal proceeding. (Online at Internet Archive);
- **11,919 HE:** *Birth Control A Parent's Problem or Women's?"* The Birth Control Review;
- **11,920 HE:** *Woman and the New Race*, Truth Publishing, foreword by Havelock Ellis. Online (Harvard University);

Online (Project Gutenberg); Online (Internet Archive); Audio on Archive.org;

- **11,921 HE: Debate on Birth Control**, text of a debate between Sanger, Theodore Roosevelt, Winter Russell, George Bernard Shaw, Robert L. Wolf, and Emma Sargent Russell. Published as issue 208 of Little Blue Book series by Haldeman-Julius Co. Online (**11,921 HE**, Michigan State University);
- **11,922 HE: The Pivot of Civilization**, Brentanos. Online (**11,922 HE**, Project Gutenberg); Online (**11,922 HE**, Google Books);
- **11,928 HE: Motherhood in Bondage**, Brentanos. Online (Google Books);

- **11,931 HE:** *My Fight for Birth Control*, New York: Farrar & Rinehart;
- **11,938 HE:** *An Autobiography*. New York, NY: Cooper Square Press. ISBN 0-8154-1015-8;
- Periodicals by MARGARET HIGGINS SANGER SLEE: *The Woman Rebel* – Seven issues published monthly from March **11,914 HE** to August **11,914 HE**. SANGER SLEE was publisher and editor; *Birth Control Review* – Published monthly from February **11,917 HE** – **11,940 HE**. SANGER SLEE was Editor until **11,929 HE**; Not to be confused with *Birth Control News*, published by the London-based Society for Constructive Birth Control and Racial Progress.<sup>1907</sup>

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<sup>1907</sup> [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)

long lines of sleeping carriages and immense bodies by referring to former persons.

The reader will often help in this difficulty. There are many girls who have had no education and that will not be the case of the parents of the girl who may be called on the scene here a degraded and ignorant, from which it will be hard to rescue. Most depend upon the attitude of the girl, but even depends upon the attitude of the man toward the relation.

#### THE PRESERVE AND THE SPONGE

Another form of preservation is the primary one. 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 to 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 not to put the neck over, as the neck may not only be very small, but the neck may not be of place.



France

In my experience a well fitted primary form of the neck, method of putting on, and the use of the lower knowledge of women who have used it for years with the most satisfactory results. The middle is

12.



This page from SANGER'S *Family Limitation*, 11,917 HE edition, describes a cervical cap.<sup>1908</sup>

<sup>1908</sup> [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)

**11,879 HE:** “Star Stuff” Element Scandium discovered by LARS FREDRIK NILSON a Swedish chemist.<sup>1909</sup>



**LARS FREDRIK NILSON, 11,840 HE – 11,899 HE,**  
photographer and date unknown.<sup>1910</sup>

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<sup>1909</sup> [https://en.wikipedia.org/wiki/Lars\\_Fredrik\\_Nilson](https://en.wikipedia.org/wiki/Lars_Fredrik_Nilson)

<sup>1910</sup> [https://en.wikipedia.org/wiki/Lars\\_Fredrik\\_Nilson](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.<sup>1911</sup>

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<sup>1911</sup> <http://images-of-elements.com/scandium.php#a>

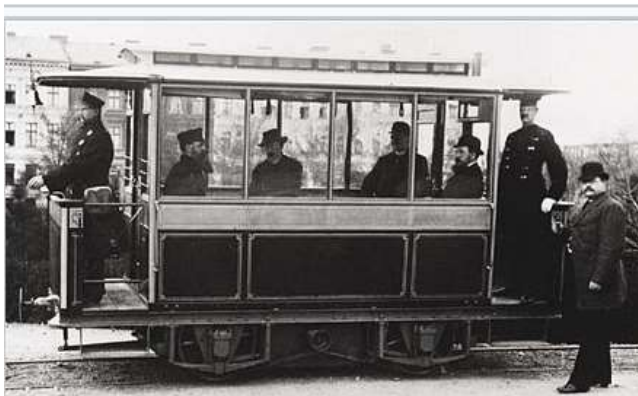


**11,881 HE:** Near Berlin, Lichterfelde, Germany: the world's first electric tram line, Gross-Lichterfelde Tramway, opened in Lichterfelde. It was built by Siemens.

- ⇒ The tram ran on 180 Volt DC, which was supplied by running rails. In **11,891 HE** the track was equipped with an overhead wire and the line was extended to Berlin-Lichterfelde West station.
- ⇒ The railway is still operational, thus making it the oldest operational electric railway in the world.<sup>1912</sup>

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<sup>1912</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



**11,882 HE:** Photo of a Lichterfelde tram, photographer unknown.<sup>1913</sup>

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<sup>1913</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



**12,012 HE:** photo of the current Lichterfelde tram.<sup>1914</sup>

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<sup>1914</sup> <https://www.bing.com/images/search?q=lichterfelde+tram>

**11,881 HE – 11,965 HE: SIR EDWARD BATTERSBY BAILEY,**  
English geologist, FRS, FRSE MC CB, LLD, and “cold water  
nutter” who discovered and defined how the land on Earth  
moves.<sup>1915</sup>



Sir EDWARD BATTERSBY BAILEY, photo by and at The  
Royal Society.<sup>1916</sup>

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<sup>1915</sup> BBC Men of Rock 2 of 3 12,010 HE BBC TV show “Moving Mountains”

<sup>1916</sup> Pictures.royalsociety.org bing search

**11,882 HE – 11,935 HE:** EMMY NOETHER, German and United States mathematician known for her landmark contributions to abstract algebra and theoretical physics.<sup>1917</sup>

⇒ 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.<sup>1918</sup>

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<sup>1917</sup> Podcast: Stuff You Missed in History Class

<sup>1918</sup> [https://en.wikipedia.org/wiki/Emmy\\_Noether](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.<sup>1919</sup> Tim James says EMMY NOETHER ranked up there with EINSTEIN and FEYNMAN.<sup>1920</sup>

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<sup>1919</sup> [https://en.wikipedia.org/wiki/Emmy\\_Noether](https://en.wikipedia.org/wiki/Emmy_Noether)

<sup>1920</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience



NOETHER in **11,930 HE**, location and photographer unknown.<sup>1921</sup>

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<sup>1921</sup> [https://en.wikipedia.org/wiki/Emmy\\_Noether](https://en.wikipedia.org/wiki/Emmy_Noether)



Young EMMY NOETHER, date, location and photographer unknown.<sup>1922</sup>

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<sup>1922</sup> [https://en.wikipedia.org/wiki/Emmy\\_Noether](https://en.wikipedia.org/wiki/Emmy_Noether)



⇒ List of things named after EMMY NOETHER: The crater Nöther on the far side of the Moon is named after her; the minor planet 7001 Noether is named for her; Google put a memorial doodle on Google's homepage in many countries on 23 March **12,015 HE** to celebrate her 133rd birthday; Noetherian, Noetherian group, Noetherian ring, Noetherian module, Noetherian space, Noetherian induction, Noetherian scheme, Noether normalization dilemma, Noether problem, Noether's theorem, Noether's second theorem, Lasker–Noether theorem, Skolem–Noether theorem, Brill–Noether theorem, Brauer–Noether theorem, and Albert–Brauer–Hasse–Noether theorem.<sup>1923</sup>

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<sup>1923</sup> [https://en.wikipedia.org/wiki/Emmy\\_Noether](https://en.wikipedia.org/wiki/Emmy_Noether)

**11,883 HE:** Near Vienna in Austria, the Mödling and Hinterbrühl Tram opened. It was the first tram line in the world in regular service powered from an overhead electric line.<sup>1924</sup>

**11,886 HE:** CLEMENS WINKLER, German chemist, discovered / isolated “Star Stuff” Element Germanium (15 years after DIMITRI MENDELEEV had predicted, in **11,871 HE**, the existence of the element and its properties).<sup>1925</sup>



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

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<sup>1924</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1925</sup> 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.<sup>1926</sup>

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<sup>1926</sup> <http://images-of-elements.com/germanium.php#a>



Photo of CLEMENS ALEXANDER WINKLER: **11,838 HE** – **11,904 HE**; date, location and photographer unknown.<sup>1927</sup>

**11,886 HE:** HENRI MOISSAN, France, chemist, discovered / isolated “Star Stuff” element Fluorine.<sup>1928</sup> MOISSAN was awarded the **11,906 HE** Nobel Prize in Chemistry and he was one of the

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<sup>1927</sup> [https://en.wikipedia.org/wiki/Clemens\\_Winkler](https://en.wikipedia.org/wiki/Clemens_Winkler)

<sup>1928</sup> [www.chemistryexplained.com/elements/C-K/Fluorine.html](http://www.chemistryexplained.com/elements/C-K/Fluorine.html)

original members of the International Atomic Weights Committee.<sup>1929</sup>



- 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 contact with water, it forms the very caustic hydrofluoric acid, HF.<sup>1930</sup>HENRI

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<sup>1929</sup> [https://en.wikipedia.org/wiki/Henri\\_Moissan](https://en.wikipedia.org/wiki/Henri_Moissan)

<sup>1930</sup> <http://images-of-elements.com/fluorine.php#a>

- MOISSAN collected Fluorine gas by passing an electric current through one of its compounds, hydrogen fluoride. Consumers are most familiar with fluorine's use in two products. Fluorine gas is used to make fluorides, compounds that were made part of toothpastes since the **11,950s HE**. Fluorides are effective in preventing tooth decay and are added to urban water supplies as well.<sup>1931</sup>
- The salts of the element Fluorine (fluorides), especially fluorite (calcium fluoride,  $\text{CaF}_2$ ), frequently occur in nature as minerals. Fluoride is needed for bones and teeth and supplementation with fluoride for the first time in history allowed humans to die with their own teeth in their mouths, but quickly becomes poisonous if the dose is too high.<sup>1932</sup>

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<sup>1931</sup> [www.chemistryexplained.com/elements/C-K/Fluorine.html](http://www.chemistryexplained.com/elements/C-K/Fluorine.html)

<sup>1932</sup> <http://images-of-elements.com/fluorine.php#a>



**11,852 HE – 11,907 HE:** HENRI MOISSAN, France, chemist, photographer and location unknown.<sup>1933</sup>

**11,886 HE:** Pears Transparent Soap was the world's first mass-market translucent soap. It was first produced and sold by Andrew Pears at a factory just off Oxford Street in London, England.<sup>1934</sup>

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<sup>1933</sup> [www.chemistryexplained.com/elements/C-K/Fluorine.html](http://www.chemistryexplained.com/elements/C-K/Fluorine.html)

<sup>1934</sup> [https://en.wikipedia.org/wiki/Pears\\_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))



**11,886 HE** advertisement for Pears soap<sup>1935</sup>

- ⇒ (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):

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<sup>1935</sup> [https://en.wikipedia.org/wiki/Pears\\_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))





- 11,884 HE:** The original Pears soap advertisement based on the fable “Washing the Blackamoor White,” published in the *Graphic for Christmas*.<sup>1936</sup>

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<sup>1936</sup> [https://en.wikipedia.org/wiki/Pears\\_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))



● **11,890s HE:** Advertisement for Pears soap promoting cleanliness as a justification for racist imperialism.<sup>1937</sup>

**11,887 HE:** The nation of Iran installed an approximately 20-km long railway between Tehran and Ray.<sup>1938</sup>

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<sup>1937</sup> [https://en.wikipedia.org/wiki/Pears\\_\(soap\)](https://en.wikipedia.org/wiki/Pears_(soap))

<sup>1938</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,887 HE:** H.N. WADSWORTH patented the first toothbrush in America. It was made of animal bone and swine hair.<sup>1939</sup>



H.N. WADSWORTH's toothbrush patent.<sup>1940</sup>

<sup>1939</sup> <https://www.padental.org/Online/Public/Children/Invention%20of%20Toothbrush.aspx>

<sup>1940</sup> <http://museumofeverydaylife.org/exhibitions-collections/previous-exhibitions/toothbrush-from-twig-to-bristle-in-all-its-expedient-beauty/a-visual-history-of-the-toothbrush>



**11,800's HE:** bone toothbrushes dug out of a garbage dump in Scotland, photographer and location unknown.<sup>1941</sup>

⇒ 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

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<sup>1941</sup> <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 **11,800's HE**.

**11,888 HE: ANDREAS FLOCKEN (11,845 HE – 11,913 HE)** was a German entrepreneur and inventor who created possibly the first real *passenger electric car* in the world called the Flocken Elektrowagen.<sup>1942</sup>

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<sup>1942</sup> [https://en.wikipedia.org/wiki/Andreas\\_Flocken](https://en.wikipedia.org/wiki/Andreas_Flocken)



**ANDREAS FLOCKEN, 11,910 HE**, photographer and location unknown.<sup>1943</sup>

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<sup>1943</sup> [https://en.wikipedia.org/wiki/Andreas\\_Flocken](https://en.wikipedia.org/wiki/Andreas_Flocken)



Reconstruction of Flocken Elektrowagen, (reconstruction, **12,011 HE**) photographer and location unknown.<sup>1944</sup>

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<sup>1944</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**11,888 HE:** Richmond, Virginia: US electric trolleys were pioneered on the Richmond Union Passenger Railway using equipment designed by FRANK J. SPRAGUE, "*The Father of Electric Traction*".<sup>1945</sup>



FRANK J. SPRAGUE, (11,857 HE – 11,934 HE) unknown photographer, date, location.<sup>1946</sup>

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<sup>1945</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>1946</sup> [https://en.wikipedia.org/wiki/Frank\\_J.\\_Sprague](https://en.wikipedia.org/wiki/Frank_J._Sprague)





**11,923 HE:** Drawing of the Richmond Theatrical District, with Perley Thomas streetcars.<sup>1947</sup>

**Circa 11,888 HE:** Author / Compiler includes the two famous paintings of the night skies, *because* as recently as when these paintings were created, although stars in the night sky could be

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<sup>1947</sup> [https://en.wikipedia.org/wiki/Richmond\\_Union\\_Passenger\\_Railway](https://en.wikipedia.org/wiki/Richmond_Union_Passenger_Railway)

enjoyed, used by travelers, and referred to in poetry, song, stories and art, *scientists and humanity still did not know what stars were!*<sup>1948</sup>



**11,888 HE:** Vincent van Gogh's painting “Starry Night over the Rhone”. Location: Musée d'Orsay.<sup>1949</sup>

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<sup>1948</sup> Neil de grass Tyson Youtube.com video

<sup>1949</sup> [https://en.wikipedia.org/wiki/The\\_Starry\\_Night](https://en.wikipedia.org/wiki/The_Starry_Night)



**11,889 HE:** Vincent van Gogh's painting 'Starry Night'  
Location: New York Museum of Modern Art.<sup>1950</sup>

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<sup>1950</sup> [https://en.wikipedia.org/wiki/The\\_Starry\\_Night](https://en.wikipedia.org/wiki/The_Starry_Night)

**11,888 HE – 11,993 HE:** INGE LEHMANN,<sup>1951</sup> Danish seismologist and geophysicist and the longest-lived woman scientist - having lived for over 104 years.<sup>1952</sup>

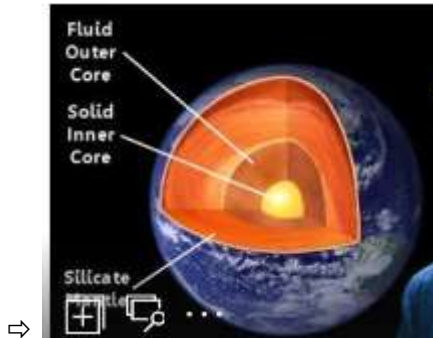
⇒ **11,936 HE:** INGE LEHMANN discovered that the Earth has a solid inner core surrounded by a molten outer core. (Before that, seismologists believed Earth's core to be a single molten sphere, being unable, however, to explain careful measurements of seismic waves from earthquakes, which were inconsistent with this idea.) LEHMANN analyzed the seismic wave measurements and concluded that Earth must have a solid inner core and a molten outer core to produce seismic waves that matched the

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<sup>1951</sup> Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

<sup>1952</sup> [https://en.wikipedia.org/wiki/Inge\\_Lehmann](https://en.wikipedia.org/wiki/Inge_Lehmann)

measurements. Other seismologists tested and then accepted LEHMANN'S explanation.<sup>1953</sup>



**11,936 HE:** drawing of INGE LEHMANN's discovery that the Earth has a solid inner core inside a molten outer core.<sup>1954</sup>

<sup>1953</sup> [https://en.wikipedia.org/wiki/Inge\\_Lehmann](https://en.wikipedia.org/wiki/Inge_Lehmann)

<sup>1954</sup> Famousscintists.org



**11,932 HE:** Photo of INGE LEHMANN, location unknown, photographer signed the photo.<sup>1955</sup>



**12,017 HE:** A new memorial dedicated to LEHMANN was installed on Frue Plads in Copenhagen. The monument is designed by Elisabeth Toubro.<sup>1956</sup>

- ⇒ INGE LEHMANN received many honors for her outstanding scientific achievements, among them: The asteroid 5632 *Ingelehmman* and **11,997 HE** the American Geophysical Union established the annual Inge Lehmann Medal to honor "outstanding contributions to the understanding of the structure,

composition, and dynamics of the Earth's mantle and core." In **12,015 HE** (which was the 100th anniversary of women's suffrage in Denmark) LEHMANN got, in recognition of her great struggle against the male-dominated research community that existed in Denmark in the **mid-11,900's HE**, a new beetle species named after her: *Globicornis (Hadrotoma) ingelehmannae*; In **12,015 HE**, on the 127th anniversary of her birth, Google dedicated its worldwide Google Doodle to her.<sup>1957</sup>

**11,889 HE -11,953 HE: EDWIN HUBBLE**, United States Astronomer, played a crucial role in establishing the field of extragalactic astronomy and because he was good at self-promotion is generally regarded as one of the most important observational cosmologists of the **11,900's HE**. EDWIN HUBBLE used the work of, among

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<sup>1957</sup> [https://en.wikipedia.org/wiki/Inge\\_Lehmann](https://en.wikipedia.org/wiki/Inge_Lehmann)



others, **HENRIETTA SWAN LEAVITT** (see **11,868 HE – 11,921 HE**) United States astronomer, who discovered the relationship between luminosity and distance in measuring stellar distances.<sup>1958</sup>

- ⇒ **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**

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<sup>1958</sup> <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

SLIPHER had provided the first evidence for this argument almost a decade before.<sup>1959</sup>

- **11,919 HE...** “when HUBBLE first put his head to the eyepiece, the number of galaxies that were known to us was exactly one: the Milky Way. Everything else was thought to be either part of the Milky Way itself or one of the many distant peripheral puffs of gas. HUBBLE quickly demonstrated how wrong that belief was.”<sup>1960</sup>

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<sup>1959</sup> [https://en.wikipedia.org/wiki/Edwin\\_Hubble](https://en.wikipedia.org/wiki/Edwin_Hubble)

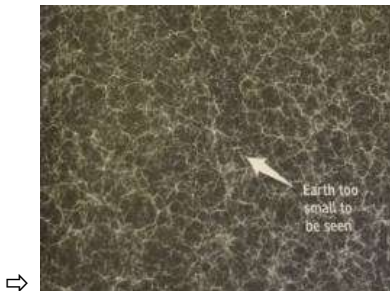
<sup>1960</sup> Bill Bryson: A Short History of Nearly Everything



EDWIN HUBBLE, date, location, and photographer unknown.<sup>1961</sup>

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<sup>1961</sup> [https://en.wikipedia.org/wiki/Edwin\\_Hubble](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.<sup>1962 1963</sup>

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<sup>1962</sup> <http://wwwmpa.mpa-garching.mpg.de/galform/virgo/millennium/>

<sup>1963</sup> SEAN CARROLL *The Big Picture: On the Origins of Life, Meaning, and the Universe Itself*

**11,889 HE – 11,964 HE:** Ms. ROGER ARLINER YOUNG,<sup>1964</sup> United States female scientist of zoology, biology, and marine biology. YOUNG was the first African-American woman to receive a doctorate degree in zoology.<sup>1965</sup>

⇒ **12,005 HE:** Ms. ROGER ARLINER YOUNG was recognized in a Congressional Resolution along with four other African-American women "who have broken through many barriers to achieve greatness in science." The others honored were RUTH ELLA MOORE ("who in **11,933 HE** became the first African-American woman to earn a Ph.D. in natural science from the Ohio State University"), EUPHEMIA LOFTON HAYNES ("who in **11,943 HE** became the first African-American woman to receive a Ph.D. in mathematics from the Catholic University of America"), SHIRLEY ANN JACKSON ("who in **11,973 HE**

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<sup>1964</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>1965</sup> [https://en.wikipedia.org/wiki/Roger\\_Arliner\\_Young](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.<sup>1966</sup>

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<sup>1966</sup> [https://en.wikipedia.org/wiki/Roger\\_Arliner\\_Young](https://en.wikipedia.org/wiki/Roger_Arliner_Young)



ROGER ARLINER YOUNG, photographer, date and location unknown.<sup>1967</sup>

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<sup>1967</sup> [https://en.wikipedia.org/wiki/Roger\\_Arliner\\_Young](https://en.wikipedia.org/wiki/Roger_Arliner_Young)

**11,890 HE – 11,965 HE:** PROF. ARTHUR HOLMES FRS, FRSE, LLD, British geologist pioneered the use of radiometric dating of minerals and Earth's age based on measurements of the relative abundance of uranium isotopes by ALFRED O. C. NIER. The general method is now known as the Holmes-Houterman model after FRITZ HOUTERMANS who published in the same year.<sup>1968</sup>

⇒ 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.<sup>1969 1970</sup>

⇒ 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

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<sup>1968</sup> BBC Men of Rock 2 of 3 12,010 HE BBC TV show "Moving Mountains"

<sup>1969</sup> [https://en.wikipedia.org/wiki/Arthur\\_Holmes](https://en.wikipedia.org/wiki/Arthur_Holmes)

<sup>1970</sup> BBC Men of Rock 2 of 3 12,010 HE BBC TV show "Moving Mountains"



problem with the theory lay in the mechanism of movement, and he proposed that Earth's mantle contained convection cells that dissipated radioactive heat and moved the crust at the surface.

⇒ ARTHUR HOLMES *Principles of Physical Geology* ended with a chapter on continental drift. Part of the model was the origin of the seafloor spreading concept.<sup>1971</sup>

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<sup>1971</sup> [https://en.wikipedia.org/wiki/Arthur\\_Holmes](https://en.wikipedia.org/wiki/Arthur_Holmes)



ARTHUR HOLMES around age 22; photographer and location unknown<sup>1972</sup>

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<sup>1972</sup> [https://en.wikipedia.org/wiki/Arthur\\_Holmes](https://en.wikipedia.org/wiki/Arthur_Holmes)



The tectonic plates of the world were mapped in the second half of the **11,900's HE.**<sup>1973</sup>

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<sup>1973</sup> [https://en.wikipedia.org/wiki/Plate\\_tectonics](https://en.wikipedia.org/wiki/Plate_tectonics)

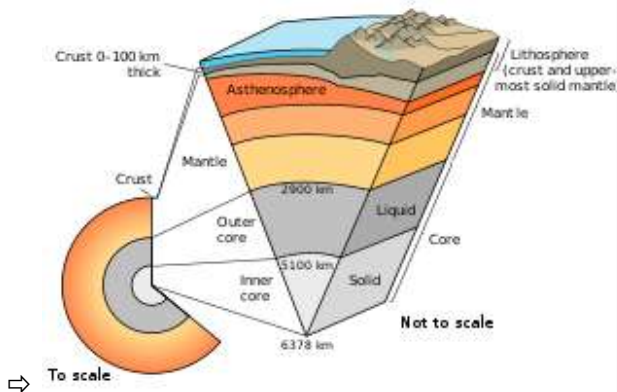
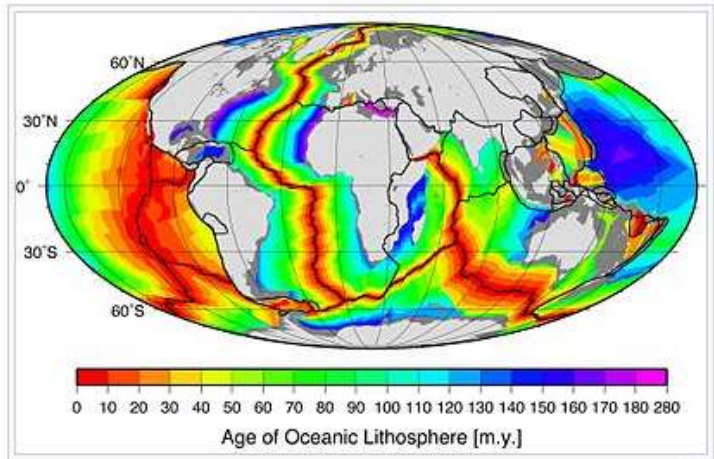


Diagram of the internal layering of the Earth showing the lithosphere above the asthenosphere (not to scale).<sup>1974</sup>

<sup>1974</sup> [https://en.wikipedia.org/wiki/Plate\\_tectonics](https://en.wikipedia.org/wiki/Plate_tectonics)



● Sea Floor spreading by continental drift.<sup>1975</sup>

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<sup>1975</sup> [https://en.wikipedia.org/wiki/Seafloor\\_spreading](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.<sup>1976</sup>


**Circa 11,890 HE:** Electric Automobiles come into use in the United States. The first Baker electric vehicle was a two-seater with a selling price of US \$850. One was sold to THOMAS EDISON as his first car. EDISON also designed the nickel-iron batteries used in some Baker electrics. These batteries have extremely long lives with some still in use early **12,000's HE.**<sup>1977</sup>

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<sup>1976</sup> [https://en.wikipedia.org/wiki/Arthur\\_Holmes](https://en.wikipedia.org/wiki/Arthur_Holmes)

<sup>1977</sup> [https://en.wikipedia.org/wiki/Baker\\_Motor\\_Vehicle](https://en.wikipedia.org/wiki/Baker_Motor_Vehicle)



1909 Baker Suburban Runabout 



1978

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<sup>1978</sup> [https://en.wikipedia.org/wiki/Baker\\_Motor\\_Vehicle](https://en.wikipedia.org/wiki/Baker_Motor_Vehicle)



Photo captures of ads for electric vehicles.<sup>1979</sup>

<sup>1979</sup> [https://en.wikipedia.org/wiki/Baker\\_Motor\\_Vehicle](https://en.wikipedia.org/wiki/Baker_Motor_Vehicle)



**11,893 HE – 11,916 HE:** ERNST MACH, Austrian physicist and philosopher who discovered the non-acoustic function of the inner ear which helps control human balance. One of his best-known ideas is the so-called "Mach principle," concerning the physical origin of inertia.

- ⇒ Most of MACH's initial studies in the field of experimental physics concentrated on the interference, diffraction, polarization and refraction of light in different media under external influences. From there followed important explorations in the field of supersonic fluid mechanics.
- The ratio of the speed of a fluid to the local speed of sound is now called the Mach number. It is a critical parameter in the

description of high-speed fluid movement in aerodynamics and hydrodynamics.<sup>1980</sup>

⇒ ERNST MACH also became well known for his philosophy developed in close interplay with his science. MACH defended a type of phenomenalism recognizing only sensations as real. This position seemed incompatible with the view of atoms and molecules as external, mind-independent things. He famously declared, after an **11,897 HE** lecture by Ludwig Boltzmann at the Imperial Academy of Science in Vienna: "I don't believe that atoms exist!"<sup>1981 1982 1983</sup>

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<sup>1980</sup> [https://en.wikipedia.org/wiki/Ernst\\_Mach](https://en.wikipedia.org/wiki/Ernst_Mach)

<sup>1981</sup> Yourgrau, P. (2005). A World Without Time: The Forgotten Legacy of Gödel and Einstein. Allen Lane

<sup>1982</sup> [https://en.wikipedia.org/wiki/Ernst\\_Mach](https://en.wikipedia.org/wiki/Ernst_Mach)

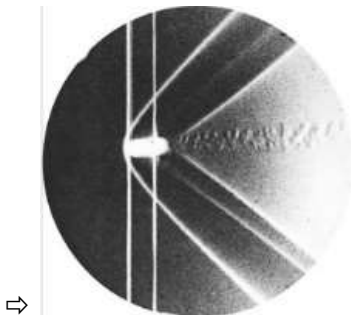
<sup>1983</sup> Max Tegmark, Our Mathematical Universe



ERNST MACH, date, photographer and location unknown.<sup>1984</sup>

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<sup>1984</sup> [https://en.wikipedia.org/wiki/Ernst\\_Mach](https://en.wikipedia.org/wiki/Ernst_Mach)



⇒ ERNST MACH'S work also focused on the Doppler effect in optics and acoustics.<sup>1985</sup> This historic **11,887 HE** shadowgraph is of a bow shockwave around a supersonic bullet.<sup>1986</sup>

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<sup>1985</sup> [https://en.wikipedia.org/wiki/Ernst\\_Mach](https://en.wikipedia.org/wiki/Ernst_Mach)

<sup>1986</sup> John D. Anderson, Jr. "Research in Supersonic Flight and the Breaking of the Sound Barrier -- Chapter 3". [history.nasa.gov](http://history.nasa.gov). p. 65.

**11,894 HE - 11,996 HE:** GEORGES LEMAÎTRE, Belgian priest – scholar; astronomer and professor of physics<sup>1987</sup> who proposed the theory of the expansion of the universe, which is widely misattributed to EDWIN HUBBLE.

⇒ GEORGES LEMAÎTRE was the first to derive what is now known as *Hubble's Law* and made the first estimation of what is now called the *Hubble Constant*, which LEMAÎTRE published in **11,927 HE**, two years before HUBBLE's article. LEMAÎTRE also proposed what became known as the *Big Bang* theory of the origin of the universe,<sup>1988</sup> (See another who gets credit for the term Big Bang: **11,915 HE – 12,001 HE** FRED HOYLE).

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<sup>1987</sup> Bill Bryson Short History of Nearly Everything ebook

<sup>1988</sup> Bill Bryson Short History of Nearly Everything ebook

LEMAÎTRE called the Big Bang his "hypothesis of the primeval atom" or the "Cosmic Egg".<sup>1989</sup>



LEMAÎTRE circa **11,933 HE**, photographer and location unknown.<sup>1990</sup>

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<sup>1989</sup> [https://en.wikipedia.org/wiki/Georges\\_Lemaitre](https://en.wikipedia.org/wiki/Georges_Lemaitre)

<sup>1990</sup> [https://en.wikipedia.org/wiki/Georges\\_Lemaitre](https://en.wikipedia.org/wiki/Georges_Lemaitre)

**11,894 HE:** “Star Stuff” element Argon is discovered by JOHN WILLIAM STRUTT (11,842 HE – 11,919 HE) and WILLIAM RAMSEY (11,852 HE – 11,916 HE).<sup>1991</sup>



The photo is of a vial of glowing ultrapure argon. Our air consists to 1% of “Star Stuff” Element Atomic Number 18, Argon, Ar.

- Because of its abundance, Argon is the cheapest and most frequently used noble gas, which comes into operation when

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<sup>1991</sup><https://www.bing.com/search?q=what%20year%20was%20argon%20element%20discovered%3F&qsn&form=QBRE&sp=-1&pq=undefined&sc=0-39&sk=&cvid=5CC3DFB9A91445B192A739969CD88D16>

an inert atmosphere is needed.<sup>1992</sup> 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.<sup>1993</sup>

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<sup>1992</sup> <http://images-of-elements.com/argon.php#a>

<sup>1993</sup> <https://en.wikipedia.org/wiki/Argon>





⇒ JOHN WILLIAM STRUTT and WILLIAM RAMSAY, photographers, locations and dates unknown.<sup>1994</sup>

**11,895 HE:** The formal isolation / discovery of the “Star Stuff” element Helium was made in **11,895 HE** by two Swedish chemists, PER TEODOR CLEVE and NILS ABRAHAM LANGLET, who found helium emanating from the uranium ore cleveite.<sup>1995</sup>

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<sup>1994</sup>

<sup>1995</sup> <https://www.bing.com/search?q=who+discovered+argon+element&PC=U316&FORM=CHROMN>  
<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 **11,868 HE** by GEORGES RAYET, CAPTAIN C. T. HAIG, NORMAN R. POGSON, AND LIEUTENANT JOHN HERSCHEL, and was subsequently confirmed by French astronomer JULES JANSSEN.
- JULES JANSSEN is often jointly credited with detecting the element along with NORMAN LOCKYER. JULES JANSSEN recorded the “Star Stuff” Helium spectral line during the solar eclipse of **11,868 HE** while NORMAN LOCKYER observed it 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.<sup>1996</sup>



- 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. Nonetheless it has multiple applications, from making

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<sup>1996</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

balloons fly to cooling things to extremely low temperatures with liquid helium. Helium 4 nuclei are emitted at radioactive  $\alpha$ -decays.<sup>1997</sup>

**11,895 HE:** The first use of electrification on a main rail line was on a four-mile stretch of the Baltimore Belt Line of the Baltimore and Ohio Railroad (B&O) connecting the main portion of the B&O to the new line to New York through a series of tunnels around the edges of Baltimore's downtown.<sup>1998</sup>

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<sup>1997</sup> <http://images-of-elements.com/helium.php#a>

<sup>1998</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

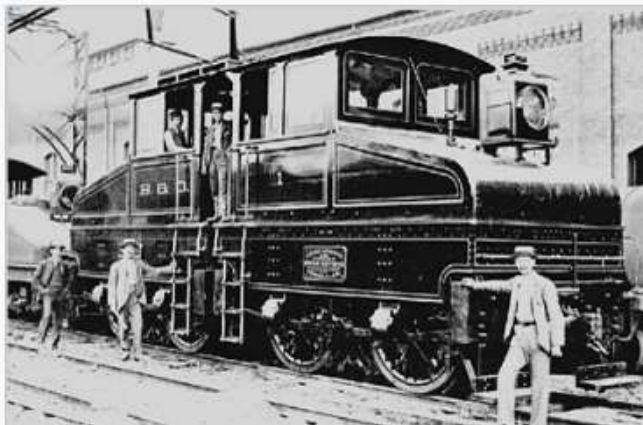


Photo is of 3 men with a Baltimore & Ohio electric engine, photographer and date unknown.<sup>1999</sup>

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<sup>1999</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,895 HE:** Electric car built by THOMAS PARKER.



PARKER's electric car. Photographer and location unknown<sup>2000</sup>

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<sup>2000</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**11,897 HE:** This tool was used in the construction of the Panama Canal.



C.L. Berger Transit, Boston, Mass. Patented in **11,897 HE**.<sup>2001</sup>

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<sup>2001</sup> This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.



More various circa **11,800 HE – 11,900 HE** engineer's tools.<sup>2002</sup>

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<sup>2002</sup> This photo is from the collection of Charlie T. Gunnels; used by permission of his daughter, Loretta Wallis.



**11,897 HE– 11,956 HE:** IRÈNE JOLIOT-CURIE, French scientist, the daughter of MARIE CURIE and PIERRE CURIE and the wife of FRÉDÉRIC JOLIOT-CURIE.<sup>2003</sup>

⇒ Jointly with her husband, IRÈNE JOLIOT-CURIE was awarded the Nobel Prize in Chemistry in **11,935 HE** for their discovery of artificial radioactivity. This made the CURIES the family with the most Nobel laureates to date.

- Both children of the Joliot-Curies, HÉLÈNE and PIERRE, are also esteemed scientists.<sup>2004</sup>

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<sup>2003</sup> <https://www.youtube.com/watch?v=dCeqyO53pqE> TimJamesScience

<sup>2004</sup> [https://en.wikipedia.org/wiki/Ir%C3%A8ne\\_Joliot-Curie](https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie)

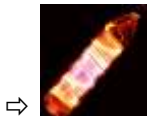


IRÈNE JOLIOT-CURIE, date, location, and photographer unknown<sup>2005</sup>

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<sup>2005</sup> [https://en.wikipedia.org/wiki/Ir%C3%A8ne\\_Joliot-Curie](https://en.wikipedia.org/wiki/Ir%C3%A8ne_Joliot-Curie)

**11,898 HE:** The “Star Stuff” element NEON was discovered as one of the three residual rare inert elements remaining in dry air, after nitrogen, oxygen, argon, and carbon dioxide were removed.<sup>2006</sup>  
Discovered by WILLIAM RAMSAY and MORRIS TRAVERS.<sup>2007</sup>



⇒ 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

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<sup>2006</sup> <https://en.wikipedia.org/wiki/Neon>

<sup>2007</sup> <https://en.wikipedia.org/wiki/Neon>

neon compound has been produced so far. It is mainly used for light sources, as it glows in a characteristic reddish-orange light.<sup>2008</sup>



WILLIAM RAMSAY, date, location, photographer unknown.<sup>2009</sup>

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<sup>2008</sup> <http://images-of-elements.com/neon.php#a>

<sup>2009</sup> <https://en.wikipedia.org/wiki/Neon>

**Circa 11,900 HE:** The population of the world was approximately 1,600,000,000 people.<sup>2010</sup>

**11,900 HE – 11,979 HE: CECILIA PAYNE-GAPOSCHKIN:** British United States Astronomer and Physicist was the first person to earn a PhD in astronomy from all-female Radcliffe College. PAYNE-GAPOSCHKIN proposed in her PhD thesis an explanation for the composition of stars in terms of the relative abundances of hydrogen and helium. She defined that the composition of the Sun was predominantly hydrogen and thus very different from that of the Earth. She was able to determine the paths of stellar evolution.<sup>2011</sup>

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<sup>2010</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>2011</sup> [https://en.wikipedia.org/wiki/Cecilia\\_Payne-Gaposchkin](https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin)



CECILIA PAYNE-GAPOSCHKIN, date, location, and photographer unknown.<sup>2012</sup>

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<sup>2012</sup> [https://en.wikipedia.org/wiki/Cecilia\\_Payne-Gaposchkin](https://en.wikipedia.org/wiki/Cecilia_Payne-Gaposchkin)

**11,901 HE – 11,954 HE:** ENRICO FERMI, born in Italy and later naturalized as a citizen of the United States. Physicist and the creator of the world's first nuclear reactor, the Chicago Pile-1.<sup>2013</sup>

⇒ Nobel Prize in Physics, **11,938 HE**. In **11,926 HE**, FERMI discovered the statistical laws, nowadays known as the *Fermi statistics* governing the particles subject to PAULI's exclusion principle (now referred to as fermions, in contrast with bosons which obey the Bose-Einstein statistics). In **11,927 HE**, Fermi was elected Professor of Theoretical Physics at the University of Rome (a post which he retained until **11,938 HE**, when he – immediately after the receipt of the Nobel Prize – emigrated to the United States, primarily to escape Mussolini's fascist dictatorship).<sup>2014</sup>

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<sup>2013</sup> [https://en.wikipedia.org/wiki/Enrico\\_Fermi](https://en.wikipedia.org/wiki/Enrico_Fermi)

<sup>2014</sup> <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>



Photo of ENRICO FERMI, location, date, photographer unknown.<sup>2015</sup>

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<sup>2015</sup> <https://www.nobelprize.org/prizes/physics/1938/fermi/biographical/>



**11,901 HE – 11-994 HE:** LINUS PAULING, United States chemist and biochemist,<sup>2016</sup> peace activist, editor, educator, and husband of United States human rights activist Ava Helen Pauling.<sup>2017</sup> LINUS PAULING published more than 1,200 papers and books, of which about 850 dealt with scientific topics. *New Scientist* called him one of the 20 greatest scientists of all time, and as of **12,000 HE** he was rated the 16th most important scientist in history.<sup>2018</sup>

⇒ LINUS PAULING was one of the founders of the fields of quantum chemistry and molecular biology.

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<sup>2016</sup> 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.*

<sup>2017</sup> [https://en.wikipedia.org/wiki/Linus\\_Pauling](https://en.wikipedia.org/wiki/Linus_Pauling)

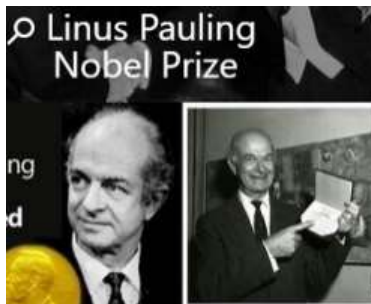
<sup>2018</sup> [https://en.wikipedia.org/wiki/Linus\\_Pauling](https://en.wikipedia.org/wiki/Linus_Pauling)

- ⇒ 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 **11,954 HE**. For his peace activism, he was awarded the Nobel Peace Prize in **11,962 HE**. He is one of only four individuals to have won more than one Nobel Prize (the

others being MARIE CURIE, JOHN BARDEEN, AND FREDERICK SANGER). Of these, he is the only person to have been awarded two unshared Nobel Prizes, and one of two people to be awarded Nobel Prizes in different fields, the other being MARIE CURIE.<sup>2019</sup>

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<sup>2019</sup> [https://en.wikipedia.org/wiki/Linus\\_Pauling](https://en.wikipedia.org/wiki/Linus_Pauling)



LINUS PAULING receiving the Nobel Prize, **11,954 HE**, Stockholm; photographer unknown.<sup>2020</sup>

**11,902 HE:** Italian railways were the first in the world to introduce electric traction for the entire length of a main line rather than just a short stretch. The 106 km *Valtellina line* was opened in **11,902**

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<sup>2020</sup> <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.



**11,901 HE:** Prototype of the Ganz AC electric locomotive in Valtellina, Italy.<sup>2021</sup>

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<sup>2021</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,902 HE – 11,992 HE: BARBARA MCCLINTOCK**<sup>2022</sup> United States Nobel Prize winning scientist and cytogeneticist.<sup>2023</sup>

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.<sup>2024</sup> During the **11,940s HE and 11,950s HE** BARBARA MCCLINTOCK discovered *transposition* and used it to demonstrate that genes are responsible for turning physical characteristics on and off. She developed theories to explain the suppression and expression of genetic information from one generation of maize plants to the next. Due to skepticism of

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<sup>2022</sup> <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

<sup>2023</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)

<sup>2024</sup> <https://en.wikipedia.org/wiki/Cytogenetics>

her research and its implications, she stopped publishing her data in **11,953 HE**.<sup>2025</sup>

⇒ MCCLINTOCK proposed the idea of genetic recombination in reproduction.<sup>2026</sup>

⇒ In **11,973 HE**, in reference to her decision 20 years earlier to stop publishing detailed accounts of her work, she wrote: *“Over the years I have found that it is difficult if not impossible to bring to consciousness of another person the nature of his tacit assumptions when, by some special experiences, I have been made aware of them. This became painfully evident to me in my attempts during [the **11,950s HE**] to convince geneticists that the action of genes had to be and was controlled. It is now equally painful to recognize the fixity of assumptions that many*

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<sup>2025</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)

<sup>2026</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

*persons hold on the nature of controlling elements in maize and the manners of their operation. One must await the right time for conceptual change.”*<sup>2027</sup>

⇒ **11,983 HE:** BARBARA MCCLINTOCK received the Nobel Prize for Physiology or Medicine.

- MCCLINTOCK was the first woman to win that prize unshared, and the first United States woman to win any unshared Nobel Prize.
- The Nobel Prize was given to her by the Nobel Foundation for discovering "*mobile genetic elements*"; this was more than

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<sup>2027</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)



30 years after she initially described the phenomenon of controlling elements.



BARBARA MCCLINTOCK shown in her laboratory, date and photographer unknown.<sup>2028</sup>

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<sup>2028</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](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.<sup>2029</sup>

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<sup>2029</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)



**11,983 HE** Photo of BARBARA MCCLINTOCK giving her Nobel Lecture.<sup>2030</sup>



Honors and Awards: In **11,947 HE**, BARBARA MCCLINTOCK received the Achievement Award from the

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<sup>2030</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)

American Association of University Women. She was elected a Fellow of the American Academy of Arts and Sciences in **11,959 HE**. In **11,967 HE**, MCCLINTOCK was awarded the Kimber Genetics Award; three years later, she was given the National Medal of Science by Richard Nixon in **11,970 HE**. She was the first woman to be awarded the National Medal of Science. Cold Spring Harbor named a building in her honor in **11,973 HE**. She received the Louis and Bert Freedman Foundation Award and the Lewis S. Rosensteil Award in **11,978 HE**. In **11,981 HE** she became the first recipient of the MacArthur Foundation Grant and was awarded the Albert Lasker Award for Basic Medical Research, the Wolf Prize in Medicine, and the Thomas Hunt Morgan Medal by the Genetics Society of America. In **11,982 HE** she was awarded the Louisa Gross Horwitz Prize from Columbia University for her research in the "evolution of genetic information and the control of its expression."

- ⇒ BARBARA MCCLINTOCK was compared to GREGOR MENDEL (see **11,822 HE – 11,884 HE**) in terms of her scientific career by the Swedish Academy of Sciences when she was awarded the Prize. She was elected a Foreign Member of the Royal Society (ForMemRS) in **11,989 HE**. MCCLINTOCK received the Benjamin Franklin Medal for Distinguished Achievement in the Sciences of the American Philosophical Society in **11,993 HE**. She was awarded 14 Honorary Doctor of Science degrees and an Honorary Doctor of Humane Letters. In **11,986 HE** she was inducted into the National Women's Hall of Fame.
- ⇒ During her final years, MCCLINTOCK led a more public life, especially after Evelyn Fox Keller's **11,983 HE** biography of her, *A Feeling for the Organism*, brought MCCLINTOCK's story to the public. She remained a regular presence in the Cold Spring Harbor community and gave talks on mobile genetic

elements and the history of genetics research for the benefit of junior scientists.

⇒ The McClintock Prize is named in her honor. Laureates of the award include DAVID BAULCOMBE, DETLEF WEIGEL ROBERT A. MARTIENSSEN, JEFFREY D. PALMER, AND SUSAN R. WESSLER.<sup>2031</sup>

**11,903 HE:** WILBER WRIGHT & ORVILLE WRIGHT, United States,<sup>2032</sup> at Kill Devil Hills on the Outer Banks of North Carolina,<sup>2033</sup> 4 miles south of Kitty Hawk, North Carolina, the

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<sup>2031</sup> [https://en.wikipedia.org/wiki/Barbara\\_McClintock](https://en.wikipedia.org/wiki/Barbara_McClintock)

<sup>2032</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

<sup>2033</sup> <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.<sup>2034</sup>

- 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.

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<sup>2034</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

- **GEORGE CAYLEY**, Englishman, **11,773 HE – 11,857 HE** focused his science on fixed wing shape.
- Later, **OTTO LILIENTHAL**, **11,848 HE – 11,896 HE**, put **CAYLEY'S** ideas into practice building gliders and gathering data that the **WRIGHTS** utilized to make their flying machines.
- There was also **ALBERTO SANTOS-DUMONT**, **11,873 HE – 11,932 HE**, Brazilian inventor and aviation pioneer.<sup>2035</sup>

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<sup>2035</sup> [https://en.wikipedia.org/wiki/History\\_of\\_aviation](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.<sup>2036</sup>

⇒ **11,867 HE – 11,912 HE: WILBER WRIGHT**, Editor, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.<sup>2037</sup>

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<sup>2036</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*

<sup>2037</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)



- WILBER WRIGHT, date, location and photographer unknown.<sup>2038</sup>

⇒ **11,871HE – 11,948HE:** ORVILLE WRIGHT, Printer/publisher, bicycle retailer/manufacturer, airplane inventor/manufacturer, pilot trainer.<sup>2039</sup>

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<sup>2038</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

<sup>2039</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)



• ORVILLE WRIGHT, date, location and photographer unknown<sup>2040</sup>

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<sup>2040</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)



**11,929 HE:** Above is a photograph of founding members of NACA (National Advisory Committee for Aeronautics) at

Committee meeting. ORVILLE WRIGHT served on NACA for 28 years.<sup>2041</sup>

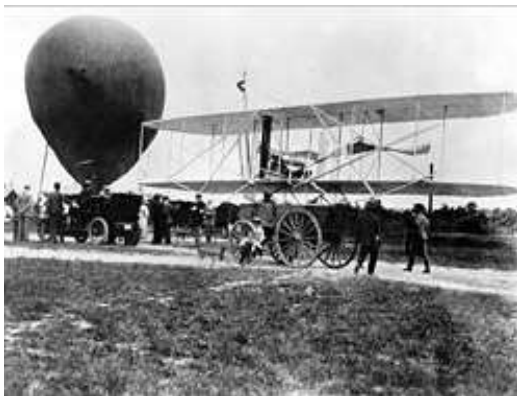


National Advisory Committee for Aeronautics (NACA) seal, with an image of the WRIGHT flier. NASA was created from the National Advisory Committee on Aeronautics in **11,958 HE**.<sup>2042</sup>

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<sup>2041</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

<sup>2042</sup> <https://wright.nasa.gov/orville.htm>



The Wright Military Flyer aboard a wagon in **11,908 HE**,  
photographer unknown.<sup>2043</sup>

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<sup>2043</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

- ⇒ It is notable that distinguished, accomplished, and recognized United States scientists of the time **WILLIAM HENRY PICKERING (11,858 HE – 11,938 HE)** and **SIMON NEWCOMB (11,835 HE – 11,909 HE)** both said flight by humans could not be a serious or practical proposition.<sup>2044</sup>
- ⇒ Also, Bishop Milton Wright, **(11,828 HE -11,917 HE)** United States Episcopalian Bishop and Father of **WILBUR WRIGHT** and **ORVILLE WRIGHT** said, “Men will never fly, because flying is reserved for angels.”<sup>2045</sup>

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<sup>2044</sup> RICHARD DAWKINS *Unweaving the Rainbow: Science, Delusion and the Appetite for Wonder*

<sup>2045</sup> *Asimov's Book of Science and Nature Quotations* (Blue Cliff Edition), edited by ISAAC ASIMOV and Jason A. Shulman, section 1.14

**11,903 HE – 11,972 HE:** LOUIS LEAKEY, British and Kenyan paleoanthropologist and archeologist.<sup>2046</sup> 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.<sup>2047</sup>

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<sup>2046</sup> [https://en.wikipedia.org/wiki/Wright\\_brothers](https://en.wikipedia.org/wiki/Wright_brothers)

<sup>2047</sup> [https://en.wikipedia.org/wiki/Louis\\_Leakey](https://en.wikipedia.org/wiki/Louis_Leakey)





LOUIS LEAKEY examining skulls from Olduvai Gorge, Tanzania, date, location, and photographer unknown<sup>2048</sup>

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<sup>2048</sup> [https://en.wikipedia.org/wiki/Human\\_evolution#First\\_fossils](https://en.wikipedia.org/wiki/Human_evolution#First_fossils)

**11,904 HE – 11,983 HE: JOSEPH EDWARD MAYER,**<sup>2049</sup> United States chemist who formulated the Mayer expansion in statistical field theory.<sup>2050</sup> It was through finding him that we learned of his **11,963 HE** Nobel Laureate Wife (See **11,906 HE – 11,972 HE: MARIA GOEPPERT MAYER**).



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<sup>2049</sup> 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*

<sup>2050</sup> [https://en.wikipedia.org/wiki/Joseph\\_Edward\\_Mayer](https://en.wikipedia.org/wiki/Joseph_Edward_Mayer)

**11,904 HE:** German electric car, with the chauffeur on top<sup>2051</sup>

**11,905 HE:**



Columbia Electric's (11,896 HE – 11,899 HE) "Victoria" electric

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<sup>2051</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

cab on Pennsylvania Ave., Washington D.C., seen from Lafayette Park in **11,905 HE**; photographer unknown.<sup>2052</sup>

**11,905 HE – 11,962 HE:** Dr. WILLIAM W. CARDOZO, United States Pediatrician published in **11,937 HE:** "*Immunologic Studies in Sickle Cell Anemia*" in the Archives of Internal Medicine; many of the findings are still valid today.<sup>2053</sup>

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<sup>2052</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

<sup>2053</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)



Dr. CARDOZO, artist, date and location unknown.<sup>2054</sup>

**11,905 HE – 11,989 HE: EMILIO SEGRÈ<sup>2055</sup>**, Italian born United States physicist and a **11,959 HE** shared Nobel Prize winner. SEGRÈ and others discovered the antiproton.

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<sup>2054</sup> <https://aaregistry.org/story/sickle-cell-pioneer-william-w-cardozo/>

<sup>2055</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)

- ⇒ **11,937 HE:** SEGRÈ discovered Technetium, which was *not* a Star Stuff Element. It was the first artificially synthesized element that does not occur in nature.
- ⇒ From **11,943 HE to 11,946 HE** SEGRÈ worked at the Los Alamos National Laboratory for the Manhattan Project. He helped discover the element Astatine and the isotope plutonium-239, which was used to make the nuclear bomb dropped on Nagasaki.
- ⇒ EMILIO SEGRÈ was also active as a photographer and took many photos documenting events and people in the history of modern 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.<sup>2056</sup>



EMILIO SEGRÈ, date, location and photographer unknown.<sup>2057</sup>

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<sup>2056</sup> [https://en.wikipedia.org/wiki/Emilio\\_Segrè](https://en.wikipedia.org/wiki/Emilio_Segrè)

<sup>2057</sup> [https://en.wikipedia.org/wiki/Emilio\\_Segrè](https://en.wikipedia.org/wiki/Emilio_Segrè)

**11,906 HE – 11,972 HE:** MARIA GOEPPERT MAYER<sup>2058</sup> 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.<sup>2059</sup> A graduate of the University of Göttingen, GOEPPERT MAYER wrote her doctoral thesis on the theory of possible two-photon absorption by atoms. At the time, the chances of experimentally verifying her thesis seemed remote, but the development of the laser permitted this verification.

⇒ MARIA GOEPPERT married JOSEPH EDWARD MAYER (See **11,904 HE – 11,983 HE**) and moved to the United States,

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<sup>2058</sup> 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*

<sup>2059</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)



where he was an associate professor at Johns Hopkins University. Strict rules against nepotism prevented Johns Hopkins University from taking her on as a faculty member, but she was given a job as an assistant.<sup>2060</sup>

- ⇒ **11,935 HE:** MARIA GOEPPERT MAYER published a landmark paper on double beta decay.<sup>2061</sup>
- ⇒ **11,937 HE:** MARIA GOEPPERT MAYER moved to Columbia University, where she was only offered an unpaid position.<sup>2062</sup>
- ⇒ **Circa 11,939 HE – 11,945 HE:** During World War II, MARIA GOEPPERT MAYER worked for the Manhattan Project at

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<sup>2060</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

<sup>2061</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

<sup>2062</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

Columbia on isotope separation, and with EDWARD TELLER at the Los Alamos Laboratory on the development of Teller's "Super" bomb.<sup>2063</sup>

- ⇒ **Circa 11,950 HE:** After the war, MARIA GOEPPERT MAYER became an unpaid associate professor of Physics at the University of Chicago and a senior physicist at the nearby Argonne National Laboratory. GOEPPERT MAYER developed the mathematical model for the structure of nuclear shells, for which she was awarded the Nobel Prize in Physics in **11,963 HE**, which she shared with J. HANS D. JENSEN and EUGENE WIGNER.<sup>2064</sup> GOEPPERT MAYER's model explained why certain numbers of nucleons in an atomic nucleus result in particularly stable configurations. These numbers are what

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<sup>2063</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

<sup>2064</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

EUGENE WIGNER called magic numbers: 2, 8, 20, 28, 50, 82, and 126.<sup>2065</sup>

⇒ ENRICO FERMI (SEE **11,901 HE – 11,954 HE**: ENRICO FERMI) provided a critical insight by asking GOEPPERT MAYER: "Is there any indication of spin orbit coupling?" She realized that this was indeed the case and described the idea as follows:

- *“Think of a room full of waltzers. Suppose they go round the room in circles, each circle enclosed within another. Then imagine that in each circle, you can fit twice as many dancers by having one pair go clockwise and another pair go counterclockwise. Then add one more variation; all the dancers are spinning twirling round and round like tops as*

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<sup>2065</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](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 **11,960 HE**, MARIA GOEPPERT MAYER was appointed full professor of physics at the University of California, San Diego.<sup>2066</sup>

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<sup>2066</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)



MARIA GOEPPERT MAYER, date, location and photographer unknown.<sup>2067</sup>

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<sup>2067</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)



**11,963 HE:** The year she was awarded her Nobel Prize in Physics. This photo is of MARIA GOEPPERT MAYER walking into the Nobel ceremony with King Gustaf VI Adolf of Sweden.<sup>2068</sup>

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<sup>2068</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](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 **12,011 HE**, she was included in the third issuance of the American Scientists collection of US postage stamps, along with MELVIN CALVIN, ASA GRAY, AND SEVERO OCHOA. Her papers are in the Geisel Library at the University of California, San Diego, and the university's physics department is housed in Mayer Hall, which is named after her and her husband, JOSEPH EDWARD MAYER.<sup>2069</sup>

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<sup>2069</sup> [https://en.wikipedia.org/wiki/Maria\\_Goeppert\\_Mayer](https://en.wikipedia.org/wiki/Maria_Goeppert_Mayer)

**11,906 HE – 11,992 HE: GRACE BREWSTER MURRAY HOPPER**  
was an American computer scientist who popularized the idea of machine-independent programming languages, which led to the development of COBOL (an acronym for COmmon Business-Oriented Language), an early high-level computer programming business language. She was also a Navy Rear Admiral.<sup>2070</sup>

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<sup>2070</sup> [https://en.wikipedia.org/wiki/Grace\\_Hopper](https://en.wikipedia.org/wiki/Grace_Hopper)





**11,984 HE:** Rear Admiral GRACE M. HOPPER.<sup>2071</sup>

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<sup>2071</sup> [https://en.wikipedia.org/wiki/Grace\\_Hopper](https://en.wikipedia.org/wiki/Grace_Hopper)



**11,978 HE:** GRACE HOPPER in a computer room in Washington DC. Photographed by Lynn Gilbert.<sup>2072</sup>

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<sup>2072</sup> [https://en.wikipedia.org/wiki/Grace\\_Hopper](https://en.wikipedia.org/wiki/Grace_Hopper)



**Circa 11,960 HE: GRACE HOPPER** (and three other unnamed people) at the UNIVAC I console. Photographer unknown.<sup>2073</sup>

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<sup>2073</sup> [https://en.wikipedia.org/wiki/Grace\\_Hopper](https://en.wikipedia.org/wiki/Grace_Hopper)

**11,907 HE– 11,964 HE:** RACHEL CARSON, United States marine biologist, author of *Silent Spring*, and conservationist.<sup>2074</sup>



**11,940 HE:** RACHEL CARSON (Fish & Wildlife Service employee photo).<sup>2075</sup>

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<sup>2074</sup> [https://en.wikipedia.org/wiki/Rachel\\_Carson](https://en.wikipedia.org/wiki/Rachel_Carson)

<sup>2075</sup> [https://en.wikipedia.org/wiki/Rachel\\_Carson](https://en.wikipedia.org/wiki/Rachel_Carson)



Statue of RACHEL CARSON at the Museo Rocsen, Nono, Argentina.<sup>2076</sup>

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<sup>2076</sup> [https://en.wikipedia.org/wiki/Rachel\\_Carson](https://en.wikipedia.org/wiki/Rachel_Carson)

**11,909 HE:** It was not until this year that Pure “Star Stuff” Element Boron was first *isolated and produced* by the United States chemist EZIEKIEL WEINTRAUB.<sup>2077</sup> However:

⇒ **Circa 11,350 HE** in “The Prologue” of Chaucer’s *Canterbury Tales* “Borax” is mentioned.<sup>2078</sup> The people of the time had an idea of how to use it... but did not know it was an element.

⇒ **In the early 11,800’s HE**, multiple scientists *recognized* the “Star Stuff” element Boron: SIR HUMPHRY DAVY BT, JOSEPH LOUIS GAY-LUSSAC, LOUIS JACQUES THENARD, and JONS JAKOB BERZELIUS.<sup>2079</sup>

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<sup>2077</sup> <https://en.wikipedia.org/wiki/Boron>

<sup>2078</sup> Dr. Paul Parsons and Gail Dixon book: The Periodic Table: A Visual Guide to the Elements

<sup>2079</sup> <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.<sup>2080</sup>

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<sup>2080</sup> <http://images-of-elements.com/boron.php#a>

**11,909 HE – 12,012 HE:** RITA LEVI-MONTALCINI, OMRI, OMCA, Italian. In **11,986 HE** she was awarded the Nobel Prize in Physiology or Medicine jointly with colleague STANLEY COHEN for the discovery of nerve growth factor (NGF). Although an atheist, this made LEVI-MONTALCINI the fourth Nobel Prize winner to come from Italy's small (less than 50,000 people) but very old Jewish community, after EMILIO SEGRÈ, SALVADOR LURIA (a university colleague and friend), and FRANCO MODIGLIANI.<sup>2081</sup>

⇒ RITA LEVI-MONTALCINI, Some Honors and Awards: In **11,966 HE**, she was elected a Fellow of the American Academy of Arts and Sciences. In **11,968 HE**, she became the tenth woman elected to the United States National Academy of Sciences. In **11,987 HE**, she received the National Medal of

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<sup>2081</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)



Science, the highest American scientific honor. In **11,991 HE**, she expressed her desire to formulate a Carta of Human Duties as necessary counterpart of the too much neglected Declaration of Human Rights. Her vision of came true with the issuing of the Trieste Declaration of Human Duties and the foundation in **11,993 HE** of the International Council of Human Duties (ICHD) at the University of Trieste. She was elected a Foreign Member of the Royal Society (ForMemRS) in **11,995 HE**. In **12,009 HE**, she received the Leonardo da Vinci Award from European Academy of Sciences. In **12,011 HE**, at the Sapienza University of Rome she received the PhD Honoris Caus from the McGill University, Canada. She was a founding member of Città della Scienza and Academician of Studium, Accademia di Casale e del Monferrato, Italy.

⇒ On 22 April **12,009 HE**, LEVI-MONTALCINI became the first Nobel laureate ever to reach the age of 100 and the event was

feted with a party at Rome's City Hall. At the time of her death, she was the oldest living Nobel laureate.<sup>2082</sup>



**12,009 HE** Photo of RITA LEVI-MONTALCINI. Location and photographer unknown.<sup>2083</sup>

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<sup>2082</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)

<sup>2083</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)

**11,909 HE:** RICHARD RICHTER, German, developed the first intrauterine birth control device made from silkworm gut which was further developed and marketed in Germany by Ernst Gräfenberg in the late **11,920s HE**.<sup>2084 2085</sup>

**11,910 HE – 12,008 HE:** DOROTHY JOHNSON VAUGHAN<sup>2086</sup>  
United States mathematician and human computer who worked for the National Advisory Committee for Aeronautics (NACA), and NASA,<sup>2087</sup> and became acting supervisor of the West Area Computers, the first African-American woman to supervise a

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<sup>2084</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

<sup>2085</sup> Fritz, Marc A.; Speroff, Leon (12,011 HE). *"Intrauterine contraception"*. Clinical gynecologic endocrinology and infertility (8th ed.). Philadelphia: Wolters Kluwer Health/Lippincott Williams & Wilkins. pp. 1095–1098. ISBN 978-0-7817-7968-5.

<sup>2086</sup> *Hidden Figures: The American Dream and the Untold Story of the Black Women Mathematicians Who Helped Win the Space Race.* by Margot Lee Shetterly

<sup>2087</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Vaughan](https://en.wikipedia.org/wiki/Dorothy_Vaughan)

group of staff composed entirely of African-American women mathematicians at NACA.<sup>2088</sup>



DOROTHY JOHNSON VAUGHAN date, location and photographer unknown.<sup>2089</sup>

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<sup>2088</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Vaughan](https://en.wikipedia.org/wiki/Dorothy_Vaughan)

<sup>2089</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Vaughan](https://en.wikipedia.org/wiki/Dorothy_Vaughan)

**11,910 HE – 11,997 HE:** JACQUES-YVES COUSTEAU, French naval officer, explorer, conservationist, filmmaker, innovator, scientist, photographer, editor, and researcher who studied the seas and life in the seas. During the **11,940s HE**, COUSTEAU is credited with improving the aqualung design which gave birth to the open-circuit scuba technology used today. In **11,950 HE**, COUSTEAU founded the French Oceanographic Campaigns (FOC), and leased a ship called *Calypso* from Thomas Loel Guinness for a symbolic one franc a year. COUSTEAU refitted the *Calypso* as a mobile laboratory for field research and as his principal vessel for diving and filming. He also carried out underwater archaeological excavations in the Mediterranean, in particular at Grand-Congloué (**11,952 HE**).<sup>2090</sup>

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<sup>2090</sup> [https://en.wikipedia.org/wiki/Jacques\\_Cousteau](https://en.wikipedia.org/wiki/Jacques_Cousteau)



COUSTEAU'S submarine near Oceanographic Museum in Monaco. Photographer and date unknown.<sup>2091</sup>

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<sup>2091</sup> [https://en.wikipedia.org/wiki/Jacques\\_Cousteau](https://en.wikipedia.org/wiki/Jacques_Cousteau)



JACQUES-YVES COUSTEAU in **11,972 HE**. Photographer and location unknown.<sup>2092</sup>

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<sup>2092</sup> [https://en.wikipedia.org/wiki/Jacques\\_Cousteau](https://en.wikipedia.org/wiki/Jacques_Cousteau)

# 11,910 HE– 11,994 HE: DOROTHY MARY CROWFOOT

HODGKIN OM FRS HonFRSC, British **11,964 HE** Nobel Prize winning chemist who invented / developed *Protein*

*Crystallography*: the technique which shines light at proteins to expose their 3-dimensional structure.<sup>2093</sup> (See **11,638 HE – 11,686**

**HE: NICHOLAS STENO**, Danish Geologist<sup>2094</sup> who developed crystallography.<sup>2095</sup>)

⇒ As of **12,016 HE** she remained the only British woman scientist to have been awarded a Nobel Prize in any of the three sciences it recognizes.<sup>2096</sup>

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<sup>2093</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>2094</sup> ISAAC ASIMOV: ASIMOV'S Chronology of Science and Discovery page 161

<sup>2095</sup> [https://en.wikipedia.org/wiki/Nicolas\\_Steno](https://en.wikipedia.org/wiki/Nicolas_Steno)

<sup>2096</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Hodgkin](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 **11,947 HE** and EMBO Membership in **11,970 HE**; The National Portrait Gallery, London lists 17 portraits of CROWFOOT HODGKIN. In **11,965 HE**: CROWFOOT HODGKIN was the second woman in 60 years, after Florence Nightingale, to be appointed to the Order of Merit by a king or queen. As of **12,016 HE** she was the first woman to receive the Copley Medal. She was elected a Foreign Honorary Member of the American Academy of Arts and Sciences and a foreign member of the USSR Academy of Sciences. The communist government of Bulgaria awarded her its Dimitrov Prize; In **11,983 HE** she received the Austrian Decoration for Science and Art. Asteroid 5422 was named "Hodgkin" in her honor.

⇒ Over the years British postage stamps have twice commemorated CROWFOOT HODGKIN.<sup>2097</sup>



⇒ Photo of DOROTHY MARY CROWFOOT HODGKIN, date, location and photographer unknown.<sup>2098</sup>

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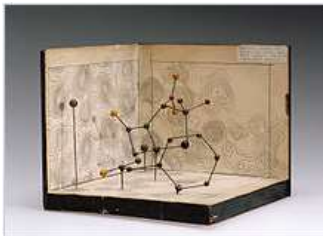
<sup>2097</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Hodgkin](https://en.wikipedia.org/wiki/Dorothy_Hodgkin)

<sup>2098</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Hodgkin](https://en.wikipedia.org/wiki/Dorothy_Hodgkin)



**Circa 11,945 HE:** Model of the structure of penicillin by

DOROTHY MARY CROWFOOT HODGKIN, photographer  
and location unknown.<sup>2099</sup>



**Circa 11,945 HE:** Molecular model of penicillin by DOROTHY  
MARY CROWFOOT HODGKIN, photographer and location  
unknown.<sup>2100</sup>

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<sup>2099</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Hodgkin](https://en.wikipedia.org/wiki/Dorothy_Hodgkin)

<sup>2100</sup> [https://en.wikipedia.org/wiki/Dorothy\\_Hodgkin](https://en.wikipedia.org/wiki/Dorothy_Hodgkin)

**11,912 HE – 11,997 HE:** CHIEN-SHIUNG WU<sup>2101</sup> was a Chinese-American experimental physicist who made significant contributions in the field of nuclear physics. Her nicknames include "the First Lady of Physics", "the Chinese Madame Curie", and the "Queen of Nuclear Research". She worked on the Manhattan Project, where she helped develop the process for separating uranium metal into uranium-235 and uranium-238 isotopes by gaseous diffusion. CHIEN-SHIUNG WU is best known for conducting the Wu experiment, which contradicted the hypothetical law of conservation of parity. This discovery resulted in her colleagues TSUNG-DAO LEE and CHEN-NING YANG winning the **11,957 HE** Nobel Prize in physics and earned WU the inaugural Wolf Prize in Physics in **11,978 HE**.<sup>2102</sup>

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<sup>2101</sup> 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*

<sup>2102</sup> [https://en.wikipedia.org/wiki/Chien-Shiung\\_Wu](https://en.wikipedia.org/wiki/Chien-Shiung_Wu)



**11,958 HE** Photo is of CHIEN-SHIUNG WU at Columbia University. Photographer unknown.<sup>2103</sup>

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<sup>2103</sup> [https://en.wikipedia.org/wiki/Chien-Shiung\\_Wu](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.<sup>2104</sup>

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<sup>2104</sup> [https://en.wikipedia.org/wiki/Chien-Shiung\\_Wu](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).<sup>2105</sup>

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<sup>2105</sup> [https://en.wikipedia.org/wiki/Chien-Shiung\\_Wu](https://en.wikipedia.org/wiki/Chien-Shiung_Wu)



**11,912 HE – 11,991 HE: SALVADOR LURIA**<sup>2106</sup> Italian microbiologist, later a naturalized United States citizen and a **11,969 HE** shared Nobel Laureate with MAX DELBRÜCK and ALFRED HERSHEY, for their discoveries on the replication mechanism and the genetic structure of viruses. LURIA also showed that bacterial resistance to viruses (phages) is genetically inherited.<sup>2107</sup>

⇒ **11,963 HE:** While on sabbatical to study at the Institut Pasteur in Paris, SALVADOR LURIA found that bacteriocins impair the function of cell membranes. After he returned to MIT, his lab discovered that bacteriocins achieve this impairment by forming holes in the cell membrane, allowing ions to flow through and destroy the electrochemical gradient of cells.

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<sup>2106</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)

<sup>2107</sup> [https://en.wikipedia.org/wiki/Salvador\\_Luria](https://en.wikipedia.org/wiki/Salvador_Luria)

- **SALVADOR LURIA** awards and recognitions: He was named a member of the National Academy of Sciences in **11,960 HE**. From **11,968 HE** to **11,969 HE**, he served as president of the American Society for Microbiology. In **11,969 HE**, he was awarded the Louisa Gross Horwitz Prize from Columbia University together with **MAX DELBRÜCK**. In the U.S. he won the **11,974 HE** National Book Award in Science for his popular science book *Life: The Unfinished Experiment* and received the National Medal of Science in **11,991 HE**.<sup>2108</sup>

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<sup>2108</sup> [https://en.wikipedia.org/wiki/Salvador\\_Luria](https://en.wikipedia.org/wiki/Salvador_Luria)



The photo is of SALVADOR LURIA, date, location and photographer unknown.<sup>2109</sup>

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<sup>2109</sup> [https://en.wikipedia.org/wiki/Salvador\\_Luria](https://en.wikipedia.org/wiki/Salvador_Luria)

**11,912 HE – 11,977 HE:** WERNHER MAGNUS MAXIMILIAN FREIHERR VON BRAUN<sup>2110</sup> German, and, later, United States aerospace engineer and space architect.

⇒ **11,942 HE:** VON BRAUN helped develop the Nazi V2 rocket (German, military, sub-orbital). **11,944 HE:** VON BRAUN claimed that he was aware of the treatment of prisoners in German concentration camps but felt helpless to change the situation, after former Buchenwald inmate Adam Cabala claimed that von Braun went to the concentration camp to pick slave laborers: “also the German scientists led by Prof. Wernher von Braun were aware of everything daily. As they went along the corridors, they saw the exhaustion of the inmates, their arduous work and their pain. Not one single time did Prof. Wernher von Braun protest against this cruelty during his

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<sup>2110</sup> 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.”<sup>2111</sup>

- ⇒ **11,945 HE**, The U.S. Secretary of State approved the transfer of VON BRAUN and his specialists to the United States; however, this was not announced to the public until later that year. VON BRAUN was among those scientists for whom the Joint Intelligence Objectives Agency (JIOA) arguably falsified employment histories and expunged Nazi memberships.<sup>2112</sup> Either the US got him or the Soviets, so this was the way the US got him.<sup>2113</sup> **11,952 HE - 11,956 HE**, VON BRAUN led the US

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<sup>2111</sup> [https://en.wikipedia.org/wiki/Wernher\\_von\\_Braun](https://en.wikipedia.org/wiki/Wernher_von_Braun)

<sup>2112</sup> [https://en.wikipedia.org/wiki/Wernher\\_von\\_Braun](https://en.wikipedia.org/wiki/Wernher_von_Braun)

<sup>2113</sup> Paul Premack clarified

Army's rocket development team resulting in the Redstone rocket. with the first high-precision inertial guidance system.

**11,958 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.<sup>2114</sup>

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<sup>2114</sup> [https://en.wikipedia.org/wiki/Wernher\\_von\\_Braun](https://en.wikipedia.org/wiki/Wernher_von_Braun)



**11,960 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.<sup>2115</sup>

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<sup>2115</sup> [https://en.wikipedia.org/wiki/Wernher\\_von\\_Braun](https://en.wikipedia.org/wiki/Wernher_von_Braun)

## 11,912 HE:



Detroit Electric vehicle advertisement, artist unknown.<sup>2116</sup>

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<sup>2116</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)



## 11,913 HE:

<sup>2117</sup>

The Ford Model T, created by the Ford Motor Company five years prior, became the first automobile to be mass-produced on a moving assembly line. By **11,927 HE**, Ford had produced over 15,000,000 Model T automobiles.<sup>2118</sup>

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<sup>2117</sup> [https://en.wikipedia.org/wiki/Ford\\_Model\\_T](https://en.wikipedia.org/wiki/Ford_Model_T)

<sup>2118</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

## 11,913 HE:



THOMAS EDISON and an electric car, photographer and location unknown.<sup>2119</sup>

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<sup>2119</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile)

**11,913 HE – 11,996 HE**, MARY LEAKEY; British and Kenyan paleoanthropologist. For much of her career MARY LEAKEY worked with her husband LOUIS LEAKEY at Olduvai Gorge, where they uncovered fossils of the earliest hominins, as well as the stone tools produced by them. MARY LEAKEY discovered the first fossilized *Proconsul* skull, an extinct ape now believed to be ancestral to humans. She also discovered the robust *Zinjanthropus* skull at Olduvai Gorge in Tanzania, eastern Africa. She developed a system for classifying the stone tools found at Olduvai Gorge. She discovered the Laetoli footprints, and at the Laetoli site she discovered hominin fossils that were more than 3.75 million years old. During her career, she discovered fifteen new species of other animals, and one new genus.<sup>2120</sup>

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<sup>2120</sup> [https://en.wikipedia.org/wiki/Mary\\_Leakey](https://en.wikipedia.org/wiki/Mary_Leakey)

Mary Leakey

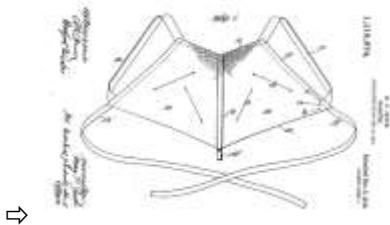


**11,977 HE MARY LEAKEY**, photographer unknown and location unknown.<sup>2121</sup>

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<sup>2121</sup> [https://en.wikipedia.org/wiki/Mary\\_Leakey](https://en.wikipedia.org/wiki/Mary_Leakey)

**11,914 HE: MARY P. JACOB** patents the first modern bra.<sup>2122</sup>



United States Patent for the first modern bra.<sup>2123</sup>

<sup>2122</sup> <https://www.youtube.com/watch?v=aqKm-tYHlwM>

<sup>2123</sup> <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=1,115,674.PN.%2526OS=PN/1,115,674%2526RS=PN/1,115,674>



### 11,914 HE:

Swiss & German co-production of world's first functional diesel-electric railcar. Location and photographer unknown.<sup>2124</sup>

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<sup>2124</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

**11,914 HE - 12,000 HE:** HEDY LAMARR<sup>2125</sup> born Hedwig Eva Maria Kiesler, Austrian-born United States inventor and film star.<sup>2126</sup> At the beginning of World War II, HEDY LAMARR and composer George Antheil developed a radio guidance system for Allied torpedoes which used spread spectrum and frequency hopping technology to defeat the threat of jamming by the Axis powers. It was publicly said that the US Navy did not adopt the technology until the **11,960s HE**, however there were unauthorized reports that the work helped the US win WWII. The principles of their work are arguably incorporated into Bluetooth technology, and are similar to methods used in legacy versions of CDMA and Wi-Fi.<sup>2127 2128</sup>

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<sup>2125</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>2126</sup> [https://en.wikipedia.org/wiki/Hedy\\_Lamarr](https://en.wikipedia.org/wiki/Hedy_Lamarr)

<sup>2127</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience

<sup>2128</sup> [https://en.wikipedia.org/wiki/Hedy\\_Lamarr](https://en.wikipedia.org/wiki/Hedy_Lamarr)



HEDY LAMARR, date, location, artist unknown.<sup>2129</sup>

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<sup>2129</sup> [https://en.wikipedia.org/wiki/Hedy\\_Lamarr](https://en.wikipedia.org/wiki/Hedy_Lamarr)



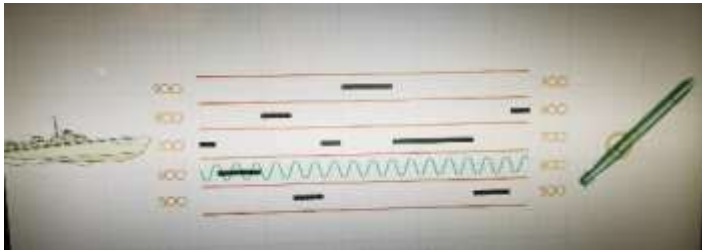


Illustration of Frequency Hopping technology invented by LAMARR.<sup>2130</sup>

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<sup>2130</sup> Netflix: Bombshell: The Hedy Lamarr Story

**Circa 11,915 HE:** According to CARL SAGAN, due to scientific advancements, human life expectancy rose to about 50 years. To put that into context: A) Around **39,000 BHE** human life expectancy in hunter-gather, pre-agricultural times was about 20-30 years; B) It took about 50,000 years to increase life expectancy by ten years to age 40 by about **11,870 HE**.

⇒ Due to increases in science-based health care, and the use of artificial, non-degrading, nitrogen to grow crops, it had taken only 45 years to gain another ten years of life expectancy. In the hundred years that followed, average life expectancy for females in the US reached 84 years of age, adding another 34 years of average longevity. (See above LOUIS PASTEUR and ROBERT TYNDALL and Fritz Haber.).<sup>2131</sup>

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<sup>2131</sup> CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

**11,915 HE - 11,958 HE:** NACA, United States National Advisory Committee for Aeronautics, a U.S. federal agency, founded to undertake, promote, and institutionalize aeronautical research. It was the foundation agency for NASA.<sup>2132</sup>

**Born 11,918 HE:** KATHERINE COLEMAN GOBLE JOHNSON, United States mathematician who for much of her life was employed by NACA and NASA and calculated the math for ALAN SHEPARD's historic rocket launch and splashdown.<sup>2133</sup> JOHNSON was cited as a pioneering example of African-American women in STEM.<sup>2134</sup>

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<sup>2132</sup> [https://en.wikipedia.org/wiki/National\\_Advisory\\_Committee\\_for\\_Aeronautics](https://en.wikipedia.org/wiki/National_Advisory_Committee_for_Aeronautics)

<sup>2133</sup> ***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.

<sup>2134</sup> [https://en.wikipedia.org/wiki/Katherine\\_Johnson](https://en.wikipedia.org/wiki/Katherine_Johnson)

- ⇒ At the **12,016 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 **12,016 HE**, JOHNSON was included in the list of "100 Women", BBC's list of 100 influential women worldwide. NASA stated, "Her calculations proved as critical to the success of the Apollo Moon landing program and the start of the Space Shuttle program, as they did to those first steps on the country's journey into space."



**KATHERINE COLEMAN GOBLE JOHNSON** at NASA in **11,966 HE**, photographer unknown.<sup>2135</sup>



**12,015 HE:** KATHERINE COLEMAN GOBLE JOHNSON being awarded the Presidential Medal of Freedom by President Obama.<sup>2136</sup> (Author / Compiler did not remove other face from the photo).

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<sup>2135</sup> [https://en.wikipedia.org/wiki/Katherine\\_Johnson](https://en.wikipedia.org/wiki/Katherine_Johnson)

<sup>2136</sup> [https://en.wikipedia.org/wiki/Katherine\\_Johnson](https://en.wikipedia.org/wiki/Katherine_Johnson)

**11,918 HE – 12,003 HE:** FRANCO MODIGLIANI<sup>2137</sup> was an Italian born United States economist and the recipient of the **11,985 HE** Nobel Prize in Economics "for his pioneering analyses of saving and of financial markets."<sup>2138</sup> MODIGLIANI, from the **11,950s HE**, is the originator of the life-cycle hypothesis, which attempts to explain the level of saving in the economy. In the hypothesis it is proposed that consumers aim for a stable level of consumption throughout their lifetime (for example by saving during their working years and then spending during their retirement).<sup>2139</sup>

⇒ Author / Compiler note: As of **12,019 HE**, people are often outliving their money. Evidently such a notion was inconceivable in as little time as the less than 40 years which have passed since MODIGLIANI was awarded the Nobel Prize

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<sup>2137</sup> [https://en.wikipedia.org/wiki/Rita\\_Levi-Montalcini](https://en.wikipedia.org/wiki/Rita_Levi-Montalcini)

<sup>2138</sup> [https://en.wikipedia.org/wiki/Franco\\_Modigliani](https://en.wikipedia.org/wiki/Franco_Modigliani)

<sup>2139</sup> [https://en.wikipedia.org/wiki/Franco\\_Modigliani](https://en.wikipedia.org/wiki/Franco_Modigliani)

in Economics for his pioneering analyses of saving and of financial markets.



**12,000** HE photo is of FRANCO MODIGLIANI, location and photographer unknown.<sup>2140</sup>

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<sup>2140</sup> [https://en.wikipedia.org/wiki/Franco\\_Modigliani](https://en.wikipedia.org/wiki/Franco_Modigliani)



**11,918 HE: KALMAN KANDO** (Hungarian engineer, **11,869 HE - 11,931 HE**) invented and developed the rotary phase converter, enabling electric locomotives to use three-phase motors while supplied electricity via a single overhead wire, carrying the simple industrial frequency (50 Hz) single phase AC of the high voltage national networks.<sup>2141</sup>



KALMAN KANDO, date, location, photographer unknown.<sup>2142</sup>

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<sup>2141</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)

<sup>2142</sup> [https://en.wikipedia.org/wiki/Kálmán\\_Kandó](https://en.wikipedia.org/wiki/Kálmán_Kandó)

**11,918 HE - 11,999 HE:** GERTRUDE BELLE ELION; United States, biochemist and pharmacologist who shared the **11,988 HE** Nobel Prize in Physiology or Medicine with GEORGE H. HITCHINGS AND SIR JAMES BLACK.<sup>2143</sup>

⇒ When she was 15, her grandfather died of cancer, instilling in her a desire to do all she could to try and cure the disease. She graduated from Hunter College in **11,937 HE** with a degree in chemistry and New York University (M.Sc.) in **11,941 HE**, while working as a high school teacher during day time. Her fifteen fellowship applications were turned down due to gender bias at the time, so she enrolled in a secretarial school, which lasted six weeks before she found a job. Unable to obtain a graduate research position, she worked as a food quality

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<sup>2143</sup> Stuff You Missed In History Class podcast: and [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)

supervisor at A&P supermarkets and other odd jobs while she did her science research.<sup>2144</sup>

- ⇒ 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.<sup>2145</sup> 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,

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<sup>2144</sup> [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)

<sup>2145</sup> Stuff You Missed In History Class podcast: and [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)

organ transplant rejection, as well as herpes (which was the first selective and effective drug of its kind).<sup>2146</sup> She invented treatments for gout, meningitis, septicemia, and bacterial infections of the urinary and respiratory tracts, and cancer treatment.<sup>2147</sup>

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<sup>2146</sup> [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)

<sup>2147</sup> Stuff You Missed In History Class podcast: and [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)



GERTRUDE BELLE ELION, photographer, date and location unknown.<sup>2148</sup>

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<sup>2148</sup> [https://en.wikipedia.org/wiki/Gertrude\\_B.\\_Elion](https://en.wikipedia.org/wiki/Gertrude_B._Elion)

**11,918 HE - 11,988 HE:** RICHARD FEYNMAN, United States, Theoretical Physicist. FEYNMAN is known for his clear presentation of ideas, methodical research, playfulness, work in the path integral formulation of quantum mechanics, the theory of quantum electrodynamics, and the physics of the superfluidity of supercooled liquid helium, as well as in particle physics for which he proposed the parton model.<sup>2149</sup>

⇒ In **11,965 HE:** For his contributions to the development of quantum electrodynamics, RICHARD FEYNMAN, jointly with JULIAN SCHWINGER and SIN-ITIRO TOMONAGA, received the Nobel Prize in Physics.<sup>2150</sup>

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<sup>2149</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

<sup>2150</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

- ⇒ FEYNMAN developed a widely used pictorial representation scheme for the mathematical expressions governing the behavior of subatomic particles, which later became known as Feynman diagrams.<sup>2151</sup>
- ⇒ During his lifetime, RICHARD FEYNMAN became one of the best-known scientists in the world. In an **11,999 HE** poll of 130 leading physicists worldwide by the British journal *Physics World*, FEYNMAN was ranked as one of the ten greatest physicists of all time.<sup>2152</sup> FEYNMAN was a keen popularizer of physics through both books and lectures.<sup>2153</sup>

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<sup>2151</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

<sup>2152</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

<sup>2153</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

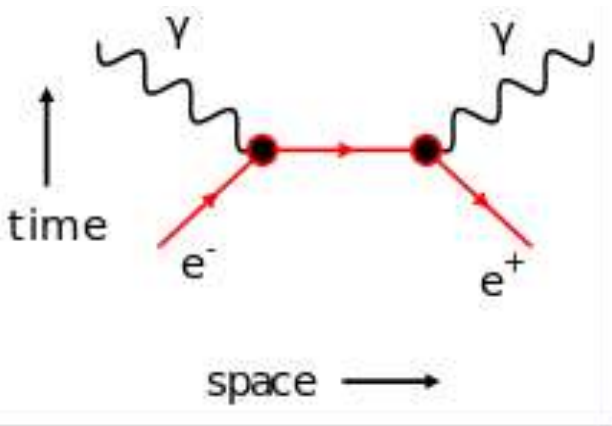


RICHARD FEYNMAN at the Robert Treat Paine Estate in Waltham, Massachusetts in **11,984 HE**.<sup>2154</sup>

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<sup>2154</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)





⇒

One example of a Feynman diagram. This example is of electron/positron annihilation<sup>2155</sup>

<sup>2155</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)



The Feynman section at the Caltech bookstore, date and photographer unknown.<sup>2156</sup>

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<sup>2156</sup> [https://en.wikipedia.org/wiki/Richard\\_Feynman](https://en.wikipedia.org/wiki/Richard_Feynman)

**11,919 HE – 12,013 HE:** Dr. JANE COOKE WRIGHT (also known as "Jane Jones" due to her marriage to anti-poverty attorney David Jones) was a pioneering cancer researcher and surgeon noted for her contributions to chemotherapy.<sup>2157</sup>

⇒ 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).<sup>2158</sup>

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<sup>2157</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>2158</sup> [https://en.wikipedia.org/wiki/Jane\\_C.\\_Wright](https://en.wikipedia.org/wiki/Jane_C._Wright)



Dr. JANE COOKE WRIGHT, date, location and photographer unknown<sup>2159</sup>

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<sup>2159</sup> [https://en.wikipedia.org/wiki/Jane\\_C.\\_Wright](https://en.wikipedia.org/wiki/Jane_C._Wright)

**11,920 HE – 11,958 HE: ROSALIND FRANKLIN<sup>2160</sup>** 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.<sup>2161</sup> 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.<sup>2162</sup>

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<sup>2160</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience and Benjamin and Kira Premack, White Elk Tamaskan 12,016 HE Scientists Litter

<sup>2161</sup> [https://en.wikipedia.org/wiki/Rosalind\\_Franklin](https://en.wikipedia.org/wiki/Rosalind_Franklin)

<sup>2162</sup> <https://www.youtube.com/watch?v=dCeQyO53pqE> TimJamesScience



ROSALIND FRANKLIN, photographer, location, and date  
unknown.<sup>2163</sup>

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<sup>2163</sup> [https://en.wikipedia.org/wiki/Rosalind\\_Franklin](https://en.wikipedia.org/wiki/Rosalind_Franklin)

**11,920 HE – 12,006 HE: MARIE THARP**, United States oceanographer and geologist.<sup>2164</sup>

- ⇒ Before the **11,950s HE**, little was known about the layout of the ocean floor. (SEE **11,869 HE – 11,948 HE: JOHAN HJORT**). Although THARP had a geology degree, she is also considered an oceanographer. Prior to THARP, the ocean floor had previously been envisioned as a flat plain of mud. THARP and BRUCE HEEZEN became part of a research project to map the topography – or layout – of the ocean floor.
- ⇒ However, women at this time were not allowed on boats. So, while THARP never physically got to voyage on the sea while working on the ocean floor mapping, she was a primary contributor to the success of the project. (See **11,863 HE –**

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<sup>2164</sup> <https://exploration.marinersmuseum.org/subject/marie-tharp/>

**11,941 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.

- ⇒ **11,953 HE:** MARIE THARP's observations led her to promote the theory of continental drift, or seafloor spreading – the idea that the continents move by spreading across the ocean bed. Continental drift had not been accepted as a theory. (See German meteorologist **11,880 HE – 11,930 HE:** ALFRED WEGENER) (Also See **11,890 HE – 11,965 HE** PROF. ARTHUR HOLMES, British geologist.) THARP noticed that several of the small



earthquakes occurring under the sea came from her proposed rift valley. However, the other scientists on the project continually rejected her findings.

- ⇒ **11,957 HE:** Based THARP's calculations, the first map of the North Atlantic Ocean was published.
- ⇒ **11,961 HE:** Based THARP's calculations, a map showing the South Atlantic Ocean floor was published.
- ⇒ **11,964 HE:** Based THARP's calculations, a map of the Indian ocean floor was published.
- ⇒ **11,977 HE:** THARP completed a full world's ocean map titled: ***The World Ocean Floor***. While completing her drawings, MARIE THARP's maps revealed 40,000 miles of an underwater ridge.<sup>2165</sup>

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<sup>2165</sup> <https://exploration.marinersmuseum.org/subject/marie-tharp/>



MARIE THARP. Photographer, location, and date unknown.<sup>2166</sup>

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<sup>2166</sup> <https://exploration.marinersmuseum.org/subject/marie-tharp/>



**11,922 HE – 11,995 HE:** CESARE EMILIANI, Italian-United States geologist, micropaleontologist, founder of paleoceanography and *Inventor of the Holocene Era calendar*. EMILIANI developed the timescale of marine isotope stages, which despite modifications remains in very wide use today.

- ⇒ 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.<sup>2168</sup>
- ⇒ 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

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<sup>2168</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

serving to test the hypotheses of seafloor spreading and plate tectonics.<sup>2169</sup> (Also see **11,452 HE– 11,519 HE: LEONARDO DA VINCI** and **11,830 HE-11,882 HE: SIR CHARLES WYVILLE THOMSON**, and **11,890 HE – 11,965 HE: PROF. ARTHUR HOLMES**, and **11,920 HE – 12,006 HE: MARIE THARP**.)

⇒ **CESARE EMILIANI** was honored by having the genus *Emiliana* erected as home for the taxon *huxleyi*, which had previously been assigned to *Coccolithus*. **EMILIANI** was further honored by receiving the Vega Medal of the Swedish Society for Anthropology and Geography (SSAG) (Swedish: Svenska Sällskapet for Antropologi och Geografi) in **11,983 HE**, and the Alexander Agassiz Medal of the U.S. National Academy of

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<sup>2169</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

Sciences in **11,989 HE** for his isotopic studies on Pleistocene and Holocene planktic foraminifera.<sup>2170</sup>

- ⇒ **Circa 11,993 HE:** In his later years, EMILIANI dedicated a great deal of time to promoting a calendar reform based on the Holocene Era (**HE**) calendar concept to eliminate the BC–AD chronology gap caused by the lack of a year 0.
- The Holocene Era (HE) – The word Holocene means *entirely recent* – and the calendar reform idea encompasses the growth and impacts of the human species worldwide, including its written history and the development of major civilizations.

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<sup>2170</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](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 Holocene Era.
- The *Anno Domini* / AD era has no year zero, with 1 BC followed immediately by AD 1, complicating the calculation of timespans further.<sup>2171</sup>
- The years BC are counted down when moving from past to future, making calculation of timespans difficult.<sup>2172</sup>

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<sup>2171</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

<sup>2172</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

- Also, it is difficult to follow the numbering of the centuries in the Anno Domini / AD calendar. For example: When referring to the fourth century AD/CE or the fourth century BC/BCE the timing is less definable than by using **10,400 HE or 9,601 BHE**.<sup>2173</sup> (See the included HE Year Converter Calculator.<sup>2174</sup>)
- HE places its beginning at **1 HE**, a rough approximation of the start of the current geologic epoch: the Holocene/Human Era.<sup>2175</sup>

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<sup>2173</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

<sup>2174</sup> By Paul Premack, JD, CELA

<sup>2175</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)





CESARE EMILIANI in the early **11,950s HE** while conducting pioneering research at the University of Chicago. (Photo: Archives of the Rosenstiel School of Marine and Atmospheric Science, University of Miami.)<sup>2176</sup>

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<sup>2176</sup> [https://en.wikipedia.org/wiki/Cesare\\_Emiliani](https://en.wikipedia.org/wiki/Cesare_Emiliani)

**11,922 HE - 11,999 HE:** MARIE VAN BRITTAN BROWN, United States Inventor of the home security system in **11,966 HE**.<sup>2177</sup>

⇒ Thirteen inventors who came along after BROWN have cited her patent, with the latest being in **12,013 HE**. Even now, over fifty years after her patent was granted, her invention is being used by smaller businesses and living facilities. Although the system was originally intended for domestic uses, many businesses began to adopt her system due to its effectiveness. For her invention MARIE VAN BRITTAN BROWN received an award from the National Science Committee.<sup>2178</sup>

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<sup>2177</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>2178</sup> [https://en.wikipedia.org/wiki/Marie\\_Van\\_Brittan\\_Brown](https://en.wikipedia.org/wiki/Marie_Van_Brittan_Brown)

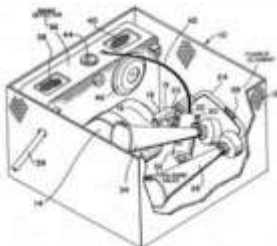


Photo is of MARIE VAN BRITTAN BROWN and part of the drawing for her Home Security System. Date, location and photographer and artist unknown.<sup>2179</sup>

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<sup>2179</sup> <https://www.bing.com/images/search> Greatest-Gadgets-Created-By-Black-Inventors-Home-Security-System



**11,966 HE:** one drawing from BROWN's U.S. Patent 3,482,037 for the first home security system.<sup>2180</sup>

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<sup>2180</sup> <https://patents.google.com/patent/US3482037>

**11,922 HE – 11,995 HE: CLAIR CAMERON (PAT) PATTERSON,** United States Geochemist<sup>2181</sup> 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.<sup>2182</sup>

⇒ Both he and his wife LORNA (LAURIE) PATTERSON as scientists were sent to work on the Manhattan Project.<sup>2183</sup> At Oak Ridge, they worked together at the uranium-235 electromagnetic

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<sup>2181</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2182</sup> [https://en.wikipedia.org/wiki/Clair\\_Cameron\\_Patterson](https://en.wikipedia.org/wiki/Clair_Cameron_Patterson)

<sup>2183</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

separation plant. This is where CLAIRE PATTERSON gained experience with the mass spectrometer.<sup>2184</sup>

- 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."<sup>2185</sup>

⇒ **11,956 HE:** CLAIR CAMERON PATTERSON developed the uranium–lead dating method into the lead–lead dating method.

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<sup>2184</sup> <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

<sup>2185</sup> <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

By using lead isotopic data from the Canyon Diablo meteorite, PATTERSON calculated an age for the Earth of 4.55 billion years; a figure far more accurate than those that existed at the time and one that has remained largely unchanged.<sup>2186</sup>

- ⇒ CLAIR CAMERON PATTERSON had first encountered lead contamination in the late **11,940s HE** as a graduate student at the University of Chicago.<sup>2187</sup>
- ⇒ 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

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<sup>2186</sup> [https://en.wikipedia.org/wiki/Clair\\_Cameron\\_Patterson](https://en.wikipedia.org/wiki/Clair_Cameron_Patterson)

<sup>2187</sup> [https://en.wikipedia.org/wiki/Clair\\_Cameron\\_Patterson](https://en.wikipedia.org/wiki/Clair_Cameron_Patterson)

fulfill the cell's vital needs. Lead also blocks neurotransmitters, the communication network between the cells. It interferes with the molecular receptors that are vital to memory and learning. This is especially damaging to children - but lead poisoning spares no one.<sup>2188</sup>

- ⇒ Starting about **11,900 HE**, the makers of leaded paint hired the fledgling advertising industry to persuade the consumer that lead was child-friendly. But lead production didn't really shift into high gear until the early **11,920's HE** when chemist Thomas Midgley and inventor Charles Kettering of General Motors found that tetraethyl lead could be marketed as an anti-knock additive to gasoline. It had once been considered for use as a poison gas by the U.S. war department. Unlike the lead in paint,

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<sup>2188</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7



tetraethyl lead was fat soluble. Half a cup of it on your skin could kill you.<sup>2189</sup>

- The manufacturers calculated that they could sell the poison, but some of the workers who processed lead in factories in Delaware and New Jersey were going insane, hallucinating, jumping out of windows. (The workers died screaming. See above: Circa **9,855 HE** – circa **10,529 HE**: Antiquity Roman Empire.)<sup>2190</sup>
- 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

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<sup>2189</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2190</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

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 evidence to suggest that lead posed any threat to the consumer.<sup>2191</sup>

- 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.<sup>2192</sup>

⇒ PATTERSON and everyone else at the time assumed the prevalence of lead in the environment occurred naturally.<sup>2193</sup> He set out to discover everything he could about how lead circulates

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<sup>2191</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2192</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2193</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

through the environment. On a grant from the American Petroleum Institute, PATTERSON carefully measured the concentrations of lead in deep and shallow seawater. PATTERSON found that his initial data made no sense.<sup>2194</sup>

- 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.<sup>2195</sup>

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<sup>2194</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2195</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- Knowing the quantity of lead in the shallow seas and the time needed to mix it into the deeper layers, PATTERSON was able to estimate the rate of lead contamination at the surface.<sup>2196</sup>
- 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.<sup>2197</sup>

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<sup>2196</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2197</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

- The U.S. government - the Army, the Navy, the atomic energy commission, the public health service, and the National Science Foundation supported PATTERSON's research on lead pollution.<sup>2198</sup>
- 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.<sup>2199</sup> It was a form of time

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<sup>2198</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2199</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

travel, to recover snow that had fallen three centuries ago, before the start of the Industrial Revolution.<sup>2200</sup>

- 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.<sup>2201</sup>
- PATTERSON published his findings in a major environmental health journal and sent copies to various government leaders, including Senator Edmund Muskie of Maine, the chairman of the senate subcommittee on air and water pollution. In **11,966 HE**, Muskie held hearings on the lead question. The first witness was Dr. Robert Kehoe,

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<sup>2200</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2201</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

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. 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%.<sup>2202</sup>

⇒ *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.*<sup>2203</sup>

⇒ PATTERSON, the man who figured out the age of the earth, was also responsible for one of the greatest public health victories of the 11,900s HE.<sup>2204</sup>

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<sup>2202</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2203</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7

<sup>2204</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 7





CLAIR CAMERON PATTERSON, date, location, photographer unknown.<sup>2205</sup>

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<sup>2205</sup> [https://en.wikipedia.org/wiki/Clair\\_Cameron\\_Patterson](https://en.wikipedia.org/wiki/Clair_Cameron_Patterson)



LORNA (LAURIE) MCCLEARY PATTERSON; United States, chemist. Photo **11,943 HE**, Graduation from Grinnell College.<sup>2206</sup>

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<sup>2206</sup> <http://calteches.library.caltech.edu/3906/1/DuckSoup.pdf>

**11,922 HE: NIELS HENRIK DAVID BOHR (11,885 HE – 11,962 HE)** Danish physicist, philosopher and a promoter of scientific research received the Nobel Prize in Physics. BOHR made foundational contributions to understanding atomic structure and quantum theory. He predicted the existence of a new zirconium-like element, which was named Hafnium, after the Latin name for Copenhagen, where it was discovered. Later, the element Bohrium was named after him.

⇒ During the **11,930s HE**, BOHR helped refugees from Nazism. After Denmark was occupied by the Germans, he had a famous meeting with HEISENBERG, who had become the head of the German nuclear weapon project. In September **11,943 HE**, word reached BOHR that he was about to be arrested by the Germans, and he fled to Sweden. From there, he was flown to Britain, where he joined the British Tube Alloys nuclear weapons project, and was part of the British mission to the Manhattan

Project. After the war, BOHR called for international cooperation on nuclear energy. He was involved with the establishment of CERN and the Research Establishment Risø of the Danish Atomic Energy Commission and became the first chairman of the Nordic Institute for Theoretical Physics in **11,957 HE.**<sup>2207</sup>

- ⇒ 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

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<sup>2207</sup> [https://en.wikipedia.org/wiki/Niels\\_Bohr](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.<sup>2208</sup>

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<sup>2208</sup> [https://en.wikipedia.org/wiki/List\\_of\\_things\\_named\\_after\\_Niels\\_Bohr](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 **11,920 HE**. (Date of photo and photographer unknown.)<sup>2209</sup>

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<sup>2209</sup> [https://en.wikipedia.org/wiki/Niels\\_Bohr](https://en.wikipedia.org/wiki/Niels_Bohr)



NIELS HENRIK DAVID BOHR, date, location and photographer unknown.<sup>2210</sup>

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<sup>2210</sup> [https://en.wikipedia.org/wiki/Niels\\_Bohr](https://en.wikipedia.org/wiki/Niels_Bohr)

**11,923 HE:** Star stuff element 72, Hafnium was discovered by DIRK COSTER, Dutch physicist and GEORG VON HEVESY Hungarian Chemist<sup>2211</sup> 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.<sup>2212</sup>



- 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.

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<sup>2211</sup> 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*

<sup>2212</sup> [https://en.wikipedia.org/wiki/Dirk\\_Coster](https://en.wikipedia.org/wiki/Dirk_Coster)



Therefore, they are hard to separate. The silvery, heavy Hafnium so far is used only for a few special technical applications. Hafnium carbide ( $\text{HfC}$ ) and tantalum hafnium carbide ( $\text{Ta}_4\text{HfC}_5$ ) are very hard and mechanically enduring, the latter the highest melting point of all materials at over  $4000^\circ\text{C}$ .<sup>2213</sup>

⇒ **11,885 HE – 11,966 HE: GEORG VON HEVESY**, who in **11,943 HE** received the Nobel Prize for Chemistry. He was a Fellow of the Royal Society<sup>2214</sup> and discovered that water takes 9 days to pass through the human body by consuming heavy water and measuring the output.<sup>2215</sup> HEVESY was also the first person to use a radioactive tracer, now widely used in medicine

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<sup>2213</sup> <http://images-of-elements.com/hafnium.php#a>

<sup>2214</sup> [https://en.wikipedia.org/wiki/George\\_de\\_Hevesy](https://en.wikipedia.org/wiki/George_de_Hevesy)

<sup>2215</sup> 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

(radiology). He was trying to separate lead from radium (later 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.<sup>2216</sup>

- Awards: **11,949 HE** HEVESY received the Copley Medal; **11,950 HE** HEVESY received the Faraday Lectureship Prize; **11,958 HE:** HEVESY received the Atoms for Peace Award.<sup>2217</sup>

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<sup>2216</sup> 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

<sup>2217</sup> [https://en.wikipedia.org/wiki/George\\_de\\_Hevesy](https://en.wikipedia.org/wiki/George_de_Hevesy)



- **11,943 HE:** GEORG VON HEVESY, photographer and location unknown.<sup>2218</sup>

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<sup>2218</sup> [https://en.wikipedia.org/wiki/George\\_de\\_Hevesy](https://en.wikipedia.org/wiki/George_de_Hevesy)

⇒ **11,889 HE – 11,950 HE:** DIRK COSTER, chemist, political activist, and anti-Nazi. In **11,938 HE**, COSTER traveled to Berlin to convince LISE MEITNER (See above) that she had to leave Germany to escape the persecution of the Jews. Together they went by train to Groningen. At the Dutch border, COSTER persuaded German immigration officers that MEITNER had permission to travel to the Netherlands. From there MEITNER went on to Sweden by way of Copenhagen. During the German occupation of Holland, COSTER also helped Jews hide from the Nazis and listened to the BBC on a daily basis using a bicycle-powered radio. COSTER died in Groningen.<sup>2219</sup>

- The asteroid 10445 Coster is named after DIRK COSTER.<sup>2220</sup>

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<sup>2219</sup> [https://en.wikipedia.org/wiki/Dirk\\_Coster](https://en.wikipedia.org/wiki/Dirk_Coster)

<sup>2220</sup> [https://en.wikipedia.org/wiki/Dirk\\_Coster](https://en.wikipedia.org/wiki/Dirk_Coster)



- DIRK COSTER, date, location and photographer unknown.<sup>2221</sup>

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<sup>2221</sup> [https://en.wikipedia.org/wiki/Dirk\\_Coster](https://en.wikipedia.org/wiki/Dirk_Coster)

**11,926 HE:** It was this year, less than 100 years ago, that NIKOLA TESLA, legendary scientist and inventor, during an interview for Collier magazine, described a piece of technology (what we now know as the smart phone) that would revolutionize the lives of its users. Here's the quote:

⇒ NIKOLA TESLA said: "When wireless is perfectly applied the whole earth will be converted into a huge brain, which in fact it is, all things being particles of a real and rhythmic whole. We shall be able to communicate with one another instantly, irrespective of distance. Not only this, but through television and telephony we shall see and hear one another as perfectly as though we were face to face, despite intervening distances of thousands of miles; and the instruments through which we shall be able to do this will be amazingly simple compared with our

present telephone. A man will be able to carry one in his vest pocket.”<sup>2222</sup>

**11,925 HE:** Dot Matrix printing was invented by RUDOLF HELL, Germany, who invented the Hellschreiber, an early facsimile-like dot matrix-based teletypewriter device, patented in **11,929 HE**.<sup>2223</sup>

**Born 11,927 HE:** JOAN FEYNMAN, United States Astrophysicist who decided to go into science when she read a graph by CECILIA PAYNE-GAPOSCHKIN (see above) and after being influenced by her brother RICHARD FEYNMAN (see above).<sup>2224</sup>

⇒ JOAN FEYNMAN studied the science behind climate change. Along with her colleague, and husband, ALEXANDER

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<sup>2222</sup> <https://www.thoughtco.com/history-of-smartphones-4096585>

<sup>2223</sup> [https://en.wikipedia.org/wiki/Dot\\_matrix\\_printing](https://en.wikipedia.org/wiki/Dot_matrix_printing)

<sup>2224</sup> [https://en.wikipedia.org/wiki/Joan\\_Feynman](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.<sup>2225</sup>
- ⇒ 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

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<sup>2225</sup> [https://en.wikipedia.org/wiki/Joan\\_Feynman](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.<sup>2226</sup>

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<sup>2226</sup> [https://en.wikipedia.org/wiki/Joan\\_Feynman](https://en.wikipedia.org/wiki/Joan_Feynman)



JOAN FEYNMAN, date, location, and photographer  
unknown.<sup>2227</sup>

**11,928 HE – 12,016 HE:** VERA COOPER RUBIN, United States astronomer who pioneered work on galaxy rotation rates. She uncovered the discrepancy between the predicted angular motion of galaxies and the observed motion, by studying galactic rotation curves. This phenomenon became known as the galaxy rotation problem. Although initially met with skepticism, RUBIN's results have been confirmed over the subsequent decades.<sup>2228</sup>

⇒ VERA COOPER RUBIN's attempts to explain the galaxy rotation problem led to the theory of dark matter.<sup>2229</sup>

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<sup>2227</sup> [https://en.wikipedia.org/wiki/Joan\\_Feynman](https://en.wikipedia.org/wiki/Joan_Feynman)

<sup>2228</sup> [https://en.wikipedia.org/wiki/Vera\\_Rubin](https://en.wikipedia.org/wiki/Vera_Rubin)

<sup>2229</sup> [https://en.wikipedia.org/wiki/Vera\\_Rubin](https://en.wikipedia.org/wiki/Vera_Rubin)



VERA COOPER RUBIN, date, location, and photographer unknown.<sup>2230</sup>

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<sup>2230</sup> [http://summer-astronomy-pc.wikispaces.com/file/view/vera\\_rubin.jpg/153326721/239x359/vera\\_rubin.jpg](http://summer-astronomy-pc.wikispaces.com/file/view/vera_rubin.jpg/153326721/239x359/vera_rubin.jpg)

**11,928 HE – 11,997 HE:** EUGENE SHOEMAKER, United States geologist and astronomer. SHOEMAKER became famous in **11,994** when, working with his wife CAROLYN S. SHOEMAKER and DAVID LEVY they discovered a comet destined to crash into Jupiter (**SEE 11,994**).<sup>2231</sup>

**11,928 HE:** Penicillin discovered.<sup>2232</sup>

⇒ The world's first antibiotic substance benzylpenicillin (Penicillin G) was discovered by Sir ALEXANDER FLEMING, Scottish Physician and Researcher.<sup>2233</sup>

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<sup>2231</sup> <https://www2.jpl.nasa.gov/sl9/sl9.html>

<sup>2232</sup> <https://www.biography.com/people/alexander-fleming-9296894>

<sup>2233</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)

⇒ In **11,945 HE** FLEMMING shared the Nobel Prize in Physiology or Medicine for the discovery and development of Penicillin with HOWARD FLOREY and ERNST BORIS CHAIN.<sup>2234</sup>

- Some of the legacies of SIR ALEXANDER FLEMING:  
**11,881 HE – 11,955 HE**, FRS FRSE FRCS: an International Historic Chemical Landmark plaque at the Alexander Fleming Laboratory Museum in London; at least three large Swedish magazines ranked penicillin as the most important discovery of the millennium; he was named in the BBC's list of the 100 Greatest Britons following a nationwide vote; a statue of Alexander Fleming stands outside the main bullring in Madrid, Plaza de Toros de Las Ventas. Flemingovo náměstí is a square named after FLEMING in the university

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<sup>2234</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)

area of the Dejvice community in Prague; A secondary school is named after him in Sofia, Bulgaria; In Athens, a square in the downtown district of Votanikos is named after FLEMING and bears his bust. There are also a number of Streets in greater Athens and other towns in Greece named after either FLEMING or his Greek second wife Amalia; In mid-**12,009 HE**, FLEMING was commemorated on a new series of banknotes issued by the Clydesdale Bank; his image appears on the new issue of £5 notes and FLEMING was voted third greatest Scot in an opinion poll conducted by STV, behind only Scotland's national poet Robert Burns and national hero William Wallace; an asteroid in the Asteroid Belt: 91006 Fleming, is named after FLEMING; Fleming station, on the Thessaloniki Metro system, takes its name from Fleming Street on which it is located, which in turn is named after him.





- SIR ALEXANDER FLEMING: date, location, and photographer unknown.<sup>2235</sup>

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<sup>2235</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)



- Barcelona, Spain: to SIR ALEXANDER FLEMING (11,956 HE), by Catalan sculptor Josep Manuel Benedicto. Barcelona: jardins del Doctor Fleming.<sup>2236</sup>

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<sup>2236</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)



• Faroe Islands postage stamp commemorating FLEMING.<sup>2237</sup>

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<sup>2237</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)

⇒ **11,898 HE – 11,968 HE: HOWARD WALTER FLOREY,**<sup>2238</sup>  
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.”<sup>2239</sup>

- Some of FLOREY's honors and legacies: His portrait appeared on the Australian \$50 note for 22 years (**11,973 HE – 11,995 HE**), and the suburb of Florey in the Australian Capital Territory is named after him. The Florey Institute of Neuroscience and Mental Health, located at the University of Melbourne, Victoria, and the largest lecture theatre in the University of Adelaide's medical school are also named after him. The federal government of Australia renamed the Australian Student Prize, given to outstanding high-school leaders, the "Lord Florey Student Prize", in recognition of

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<sup>2238</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](https://en.wikipedia.org/wiki/Alexander_Fleming)

<sup>2239</sup> [https://en.wikipedia.org/wiki/Howard\\_Florey](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.<sup>2240</sup>

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<sup>2240</sup> [https://en.wikipedia.org/wiki/Howard\\_Florey](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).<sup>2241</sup>

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<sup>2241</sup> [https://en.wikipedia.org/wiki/Howard\\_Florey](https://en.wikipedia.org/wiki/Howard_Florey)



• Australian out of circulation \$50 note<sup>2242</sup>

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<sup>2242</sup> [https://en.wikipedia.org/wiki/Howard\\_Florey](https://en.wikipedia.org/wiki/Howard_Florey)



- Lord HOWARD WALTER FLOREY, date, location and photographer unknown.<sup>2243</sup>

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<sup>2243</sup> [https://en.wikipedia.org/wiki/Howard\\_Florey](https://en.wikipedia.org/wiki/Howard_Florey)



⇒ ERNST BORIS CHAIN (11,906 HE – 11,979 HE) German-born British biochemist and fellow by the Royal Society<sup>2244</sup> 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.

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<sup>2244</sup> [https://en.wikipedia.org/wiki/Alexander\\_Fleming](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.<sup>2245</sup>
- 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.<sup>2246</sup>

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<sup>2245</sup> <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>

<sup>2246</sup> <https://www.nobelprize.org/prizes/medicine/1945/chain/biographical/>



- ERNST BORIS CHAIN in **11,945 HE**, photographer and location unknown.<sup>2247</sup>

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<sup>2247</sup> [https://en.wikipedia.org/wiki/Ernst\\_Chain](https://en.wikipedia.org/wiki/Ernst_Chain)

**Born 11,929 HE:** PETER WARE HIGGS,<sup>2248</sup> CH FRS FRSE, is a British theoretical physicist, emeritus professor in the University of Edinburgh, and **12,013** Nobel Prize laureate in physics, for his work on the mass of subatomic particles.<sup>2249</sup>

- ⇒ **Circa 11,964 HE:** PETER HIGGS proposed that broken symmetry in electroweak theory could explain the origin of mass of elementary particles in general.<sup>2250</sup>
- ⇒ 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

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<sup>2248</sup> LAWRENCE M. KRAUSE The Greatest Story Ever Told: So Far

<sup>2249</sup> [https://en.wikipedia.org/wiki/Peter\\_Higgs](https://en.wikipedia.org/wiki/Peter_Higgs)

<sup>2250</sup> [https://en.wikipedia.org/wiki/Peter\\_Higgs](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.<sup>2251</sup>
- ⇒ See **11,212 HE** entry on discovery of the Higgs Boson at CERN.
- ⇒ HIGGS Honors and Awards: Hughes Medal (**11,981 HE**); FRS (**11,983 HE**); Rutherford Medal (**11,984 HE**); Dirac Medal (**11,997 HE**); Wolf Prize in Physics (**12,004 HE**); Sakurai Prize (**12,010 HE**); Nobel Prize in Physics (**12,013 HE**); Copley Medal (**12,015 HE**).<sup>2252</sup>

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<sup>2251</sup> <https://www.nobelprize.org/prizes/physics/2013/higgs/facts/>

<sup>2252</sup> [https://en.wikipedia.org/wiki/Peter\\_Higgs](https://en.wikipedia.org/wiki/Peter_Higgs)



PETER HIGGS, date, place, photographer unknown.<sup>2253</sup>

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<sup>2253</sup> [https://en.wikipedia.org/wiki/Peter\\_Higgs](https://en.wikipedia.org/wiki/Peter_Higgs)



PETER HIGGS; portrait by Lucinda Mackay hanging at James Clerk Maxwell Foundation.<sup>2254</sup>

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<sup>2254</sup> [https://en.wikipedia.org/wiki/Peter\\_Higgs](https://en.wikipedia.org/wiki/Peter_Higgs)

**Circa 11,930 HE:** MARGARET HIGGINS SANGER SLEE's second husband, Noah Slee became the first legal manufacturer of diaphragms for use as birth control in the United States.<sup>2255</sup>

**Born 11,930 HE:** TU YOUYOU<sup>2256</sup>, 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.<sup>2257</sup>

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<sup>2255</sup> *Margaret Sanger – 20th Century Hero*" (PDF). Planned Parenthood. p. 8. and [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)

<sup>2256</sup> Benjamin and Kira Premack, White Elk Tamaskan **12,016 HE** Scientists Litter

<sup>2257</sup> [https://en.wikipedia.org/wiki/Tu\\_Youyou](https://en.wikipedia.org/wiki/Tu_Youyou)



- ⇒ TU YOUYOU discovered *Artemisinin* (also known as *Qinghaosu*) and *Dihydroartemisinin*, used to treat malaria, a significant breakthrough in **11,900s HE** century tropical medicine, saving millions of lives in developing countries in South Asia, Africa, and South America.<sup>2258</sup>
- ⇒ Awards received by TU YOUYOU: **11,978 HE**, National Science Congress Prize, P.R. China; **11,979 HE**, National Inventor's Prize, P.R. China; **11,992 HE**, (One of the) Ten Science and Technology Achievements in China, State Science Commission, P.R. China; **11,997 HE**, (One of the) Ten Great Public Health Achievements in New China, P.R. China; **12,011 HE**, GlaxoSmithKline Outstanding Achievement Award in Life Science; **12,011 HE**, Lasker-DeBakey Clinical Medical Research Award; **12,011 HE**, Outstanding Contribution Award,

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<sup>2258</sup> [https://en.wikipedia.org/wiki/Tu\\_Youyou](https://en.wikipedia.org/wiki/Tu_Youyou)

China Academy of Chinese Medical Sciences; **12,012 HE**, (One of the Ten) National Outstanding Females, P.R. China; **12,015 HE**, Warren Alpert Foundation Prize (co-recipient); **12,015 HE**, Nobel Prize in Physiology or Medicine **12,015 HE** (co-recipient) for her discoveries concerning a novel therapy against Malaria, awarded one half of this prize; and William C. Campbell and Satoshi Ōmura jointly awarded another half for their discoveries concerning a novel therapy against infection with roundworm parasites; **12,016 HE**, Highest Science and Technology Award, China.<sup>2259</sup>

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<sup>2259</sup> [https://en.wikipedia.org/wiki/Tu\\_Youyou](https://en.wikipedia.org/wiki/Tu_Youyou)



Photo of TU YOUYOU. Photographer, location and date unknown.<sup>2260</sup>

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<sup>2260</sup> [https://en.wikipedia.org/wiki/Tu\\_Youyou](https://en.wikipedia.org/wiki/Tu_Youyou)

**11,931 HE – 11,942 HE:** Wind generator: The WIME D-30 in service in Balaklava, Yalta, USSR was a forerunner of modern horizontal-axis utility-scale wind generators.<sup>2261</sup>

**11,934 HE – 11,996 HE:** CARL SAGAN: United States astronomer, cosmologist, astrophysicist, astrobiologist, science educator.<sup>2262</sup> CARL SAGAN wrote many popular science books, such as *The Dragons of Eden*, *Broca's Brain*, and *Pale Blue Dot*; the book *Cosmos* was published to accompany the series he narrated and co-wrote the award-winning **11,980 HE** television series *Cosmos: A Personal Voyage* where he told said we were all made of “Star Stuff”. CARL SAGAN also wrote the science fiction novel

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<sup>2261</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

<sup>2262</sup> [https://en.wikipedia.org/wiki/Carl\\_Sagan](https://en.wikipedia.org/wiki/Carl_Sagan)

**Contact.** His papers, containing 595,000 items, are archived at The Library of Congress.<sup>2263</sup>

- ⇒ In **11,960 HE**, CARL SAGAN's PhD thesis included the first calculation of the runaway greenhouse effect on Venus. This was part of a career-long interest in the atmospheres of the planets, including our own.<sup>2264</sup>
- ⇒ In the original Cosmos series, in **11,980 HE**, CARL SAGAN warned "We are releasing vast quantities of carbon dioxide, increasing the greenhouse effect. It may not take much to destabilize the Earth's climate, to convert this heaven, our only home in the cosmos, into a kind of hell."<sup>2265</sup>

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<sup>2263</sup> [https://en.wikipedia.org/wiki/Carl\\_Sagan](https://en.wikipedia.org/wiki/Carl_Sagan)

<sup>2264</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 12

<sup>2265</sup> COSMOS, A Space Time Odyssey, by Ann Druyan Episode 12

- ⇒ SAGAN was a professor at New York's Cornell University. A young NEIL DEGRASSE TYSON was mentored by SAGAN and modelled his career in science education on SAGAN's example. TYSON hosted the **12,014 HE** remake of the TV series COSMOS. One of SAGAN's children, NICK SAGAN, is a writer who has among other credits, written several scripts for Star Trek: The Next Generation and Star Trek: Voyager.<sup>2266</sup>
- 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.<sup>2267</sup>

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<sup>2266</sup> [https://en.wikipedia.org/wiki/Carl\\_Sagan](https://en.wikipedia.org/wiki/Carl_Sagan)

<sup>2267</sup> ISAAC ASIMOV *In Joy Still Felt* The autobiography of ISAAC ASIMOV



**11,980 HE:** CARL SAGAN, photographer and location unknown.<sup>2268</sup>

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<sup>2268</sup> [https://en.wikipedia.org/wiki/Carl\\_Sagan](https://en.wikipedia.org/wiki/Carl_Sagan)

**11,939 HE – 11,942 HE:** The world's first electronic-digital computer was built at Iowa State University by DR. JOHN V. ATANASOFF and CLIFFORD BERRY.



The Atanasoff-Berry Computer, photographer, location and date unknown.<sup>2269</sup>

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<sup>2269</sup> <https://www.thoughtco.com/john-atanasoff-and-clifford-berry-inventors-4078350>





**11,903 HE – 11,995 HE:** DR. JOHN V. ATANASOFF was an American physicist and inventor, best known for being credited with inventing the first electronic digital computer.<sup>2270</sup>

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<sup>2270</sup> [https://en.wikipedia.org/wiki/John\\_Vincent\\_Atanasoff](https://en.wikipedia.org/wiki/John_Vincent_Atanasoff)

⇒ **11,918 HE – 11,963 HE: CLIFFORD EDWARD BERRY** helped JOHN VINCENT ATANASOFF create the first digital electronic computer.<sup>2271</sup> (No photo found.)

**Born 11,939 HE: GEORGE ROBERT CARRUTHERS,**<sup>2272</sup> United States inventor, physicist, and space scientist.<sup>2273</sup> 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.

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<sup>2271</sup> [https://en.wikipedia.org/wiki/Clifford\\_Berry](https://en.wikipedia.org/wiki/Clifford_Berry)

<sup>2272</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>2273</sup> [https://en.wikipedia.org/wiki/George\\_Robert\\_Carruthers](https://en.wikipedia.org/wiki/George_Robert_Carruthers)



Telescope developed by Dr. GEORGE CARRUTHERS on display at the National Air and Space Museum.<sup>2274</sup>

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<sup>2274</sup> [https://en.wikipedia.org/wiki/George\\_Robert\\_Carruthers](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.<sup>2275</sup>

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<sup>2275</sup> [https://en.wikipedia.org/wiki/George\\_Robert\\_Carruthers](https://en.wikipedia.org/wiki/George_Robert_Carruthers)

**Born 11,940 HE:** GEORGE EDWARD ALCORN, JR.,<sup>2276</sup> United States physicist and inventor who worked primarily for IBM and NASA who in **12,015 HE** was inducted into the National Inventors Hall of Fame.<sup>2277</sup>

⇒ List of U.S. Patents issued to ALCORN: #3,986,912 Process for controlling the wall inclination of a plasma etched via hole; #4,062,720, Process for forming ledge-free aluminum copper silicon conductor structure; #4,172,004, Method for forming dense dry etched multi-level metallurgy with non-overlapped vias; #4,201,800, Hardened photoresist master image mask process; #4,289,834, Dense dry etched multi-level metallurgy with non-overlapped vias; #4,472,728 Imaging X-ray spectrometer; #4,543,442, GaAs Schottky barrier photo-

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<sup>2276</sup> [https://en.wikipedia.org/wiki/List\\_of\\_African-American\\_inventors\\_and\\_scientists](https://en.wikipedia.org/wiki/List_of_African-American_inventors_and_scientists)

<sup>2277</sup> [https://en.wikipedia.org/wiki/George\\_Edward\\_Alcorn\\_Jr.](https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.)

responsive device and method of fabrication; and #4,618,380, Method of fabricating an imaging X-ray spectrometer.<sup>2278</sup>



Photo of GEORGE EDWARD ALCORN JR. Date, location and photographer, unknown.<sup>2279</sup>

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<sup>2278</sup> [https://en.wikipedia.org/wiki/George\\_Edward\\_Alcorn\\_Jr.](https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.)

<sup>2279</sup> [https://en.wikipedia.org/wiki/George\\_Edward\\_Alcorn\\_Jr.](https://en.wikipedia.org/wiki/George_Edward_Alcorn_Jr.)

In **11,941 HE**: The world's first megawatt-size wind turbine was connected to the local electrical distribution system on the mountain known as Grandpa's Knob in Castleton, Vermont, United States.



Photo is of the world's first megawatt-sized wind turbine near Grandpa's Knob Summit, Castleton, Vermont.<sup>2280</sup>

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<sup>2280</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

**Born 11,941 HE:** RICHARD DAWKINS, English ethologist, evolutionary biologist, author, and public figure. DAWKINS defined and labelled the concept of the “meme”. The meme first appeared in DAWKINS’s first book “*The Selfish Gene*” and was an attempt to understand why some behaviors, from an evolutionary perspective, seemed to make no sense but, somehow or other, were found to be very common in human societies.<sup>2281</sup>

**11,995 HE until 12,008 HE:** DAWKINS was emeritus fellow of New College, Oxford, and was the University of Oxford's Professor for Public Understanding of Science.<sup>2282</sup> 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

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<sup>2281</sup> <https://www.richarddawkins.net/2014/02/whats-in-a-meme>

<sup>2282</sup> [https://en.wikipedia.org/wiki/Richard\\_Dawkins](https://en.wikipedia.org/wiki/Richard_Dawkins)



highest and most aesthetically rewarding achievements of the human spirit.”<sup>2283</sup>



**12,010 HE: RICHARD DAWKINS** at Cooper Union, New York City, photographer unknown.<sup>2284</sup>

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<sup>2283</sup> <https://www.richarddawkins.net/>

<sup>2284</sup> [https://en.wikipedia.org/wiki/Richard\\_Dawkins](https://en.wikipedia.org/wiki/Richard_Dawkins)

**Born 11,942 HE: ROBERT DUANE BALLARD,**<sup>2285</sup> United States Explorer and Professor of Oceanography.<sup>2286</sup>

⇒ ROBERT DUANE BALLARD is most noted for his work in underwater archaeology, maritime archaeology, and the archeology of shipwrecks.<sup>2287</sup> **11,973 – 11,975 HE BALLARD** dived 9,000 feet (2,750 meters) in *Alvin* and in a French submersible to explore the Mid-Atlantic Ridge, an underwater mountain chain in the Atlantic Ocean.<sup>2288</sup> **11,977 HE and 11,979 HE BALLARD** was part of an expedition that uncovered thermal vents in the Galapagos Rift. The presence of plant and animal life within these deep-sea warm springs led to the

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<sup>2285</sup> Tiffany Premack, and Alien Deep documentary, Netflix.

<sup>2286</sup> [https://en.wikipedia.org/wiki/Robert\\_Ballard](https://en.wikipedia.org/wiki/Robert_Ballard)

<sup>2287</sup> [https://en.wikipecia.org/wiki/Robert\\_Ballard](https://en.wikipecia.org/wiki/Robert_Ballard)

<sup>2288</sup> <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

discovery of chemosynthesis, the chemical synthesis of food energy.<sup>2289</sup> **11,985 HE:** BALLARD's team located the wreck of the Titanic. BALLARD leads ocean exploration on E/V Nautilus. He is a powerful leader in responsible ocean treatment.<sup>2290</sup> **ROBERT DUANE BALLARD Awards and Honors:** **11,988 HE,** BALLARD was awarded an Honorary Degree (Doctor of Science) by the University of Bath; **11,990 HE,** he received the Academy of Achievement's Golden Plate Award; **11,994 HE** Kilby International Awards recipient; **11,996 HE** the U.S. Navy Memorial Foundation awarded Ballard its Lone Sailor Award for his naval service and his work on underwater archaeology; **12,002 HE** he received The Caird Medal of the National Maritime Museum; **12,003 HE** he was awarded The National Humanities Medal.

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<sup>2289</sup> <https://www.britannica.com/biography/Robert-Ballard-American-oceanographer>

<sup>2290</sup> Alien Deep documentary, Netflix.



ROBERT DUANE BALLARD, date, location, photographer unknown.<sup>2291</sup>

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<sup>2291</sup> [https://en.wikipedia.org/wiki/Robert\\_Ballard](https://en.wikipedia.org/wiki/Robert_Ballard)

**11,945 HE – 11,956 HE:** The first general– purpose digital computer, the Electronic Numerical Integrator and Computer (ENIAC).<sup>2292</sup> 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.<sup>2293</sup>

⇒ The team of design engineers assisting the development included ROBERT F. SHAW (function tables), JEFFREY CHUAN CHU

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<sup>2292</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2293</sup> <https://en.wikipedia.org/wiki/ENIAC>

(divider/square-rooter), THOMAS KITE SHARPLESS (master programmer), FRANK MURAL (master programmer), ARTHUR BURKS (multiplier), HARRY HUSKEY (reader/printer) and JACK DAVIS (accumulators). In **11,946 HE**, the researchers resigned from the University of Pennsylvania and formed the Eckert-Mauchly Computer Corporation.<sup>2294</sup>

⇒ **11,956 HE:** By the end of its operation, ENIAC contained 20,000 vacuum tubes, 7200 crystal diodes, 1500 relays, 70,000 resistors, 10,000 capacitors and approximately 5,000,000 hand-soldered joints. It weighed more than 30 short tons (27 t), was roughly  $2.4 \text{ m} \times 0.9 \text{ m} \times 30 \text{ m}$  (8 ft  $\times$  3 ft  $\times$  98 ft) in size,

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<sup>2294</sup> <https://en.wikipedia.org/wiki/ENIAC>

occupied  $167\text{m}^2$  (1,800 sq. ft) and consumed 150 kW of electricity.<sup>2295</sup>



ENIAC in BRL building 328. (U.S. Army photo).<sup>2296</sup>

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<sup>2295</sup> <https://en.wikipedia.org/wiki/ENIAC>

<sup>2296</sup> <https://en.wikipedia.org/wiki/ENIAC>



**11,946 HE** Photo is of ENIAC's 2 designers American physicist JOHN MAUCHLY (**11,907 HE – 11,980 HE**) and American engineer J. PRESPER ECKERT (**11,919 HE – 11,995 HE**) of the University of Pennsylvania, with Walter Cronkite.<sup>2297</sup>

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<sup>2297</sup> [https://en.wikipedia.org/wiki/John\\_Mauchly](https://en.wikipedia.org/wiki/John_Mauchly)







JOSEPH MONROE JACKSON III, date, location, and photographer unknown<sup>2300</sup>.

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<sup>2300</sup> Image from

<https://www.facebook.com/photo.php?fbid=10203579947792994&set=a.1186946627533&type=3&theater>

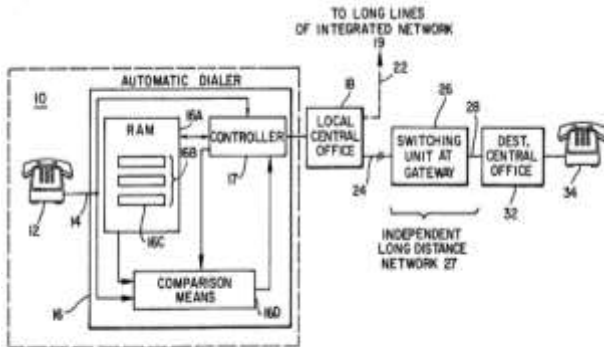


Fig. 1



Page 2 of JACKSON's Patent.<sup>2301</sup>

<sup>2301</sup>[pdfpiw.uspto.gov/.piw?PageNum=0&docid=04447676&IDKey=8EED3D54C92C%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-](http://pdfpiw.uspto.gov/.piw?PageNum=0&docid=04447676&IDKey=8EED3D54C92C%0D%0A&HomeUrl=http%3A%2F%2Fpatft.uspto.gov%2Fnetacgi%2Fnph-)

**11,950's HE:** The first birth control pills were developed by GREGORY PINCUS and JOHN ROCK with help from the Planned Parenthood Federation of America.<sup>2302</sup>



Photo is of GREGORY PINCUS, **(11,903 HE – 11,967 HE)**.

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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

<sup>2302</sup> [https://en.wikipedia.org/wiki/History\\_of\\_birth\\_control](https://en.wikipedia.org/wiki/History_of_birth_control)

American biologist and researcher. Location and photographer unknown.<sup>2303</sup>

⇒ Author / Compiler could find no photo of **JOHN ROCK (11,890 HE – 11,984 HE)**, American obstetrician and gynecologist.<sup>2304</sup>

**11,951 HE:** The first computer for commercial use was introduced to the public; the Universal Automatic Computer (UNIVAC).<sup>2305 2306</sup> **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

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<sup>2303</sup> [https://en.wikipedia.org/wiki/Gregory\\_Goodwin\\_Pincus](https://en.wikipedia.org/wiki/Gregory_Goodwin_Pincus)

<sup>2304</sup> [https://en.wikipedia.org/wiki/John\\_Rock\\_\(American\\_scientist\)](https://en.wikipedia.org/wiki/John_Rock_(American_scientist))

<sup>2305</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2306</sup> <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

to deal with the exploding U.S. population (the beginning of the famous baby boom). In April **11,946 HE**, a \$300,000 deposit was given to ECKERT and MAUCHLY for the research into a new computer called UNIVAC.<sup>2307</sup>

⇒ The fifth UNIVAC machine (built for the U.S. Atomic Energy Commission) was used by CBS to predict the result of the **11,952 HE** presidential election. With a sample of just 1% of the voting population it famously predicted an Eisenhower landslide while the conventional wisdom favored Stevenson. The CBS crew was so certain that UNIVAC was wrong they pretended it was not working. As the election continued and it became clear it was correct, the announcer admitted their sleight of hand and the machine became famous. The result was a greater public

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<sup>2307</sup> <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

awareness of computing technology, and from then on computerized predictions became part of election night broadcasts.<sup>2308</sup>



⇒ UNIVAC displayed at unknown location, photographer unknown.<sup>2309</sup>

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<sup>2308</sup> [https://en.wikipedia.org/wiki/UNIVAC\\_I](https://en.wikipedia.org/wiki/UNIVAC_I)

<sup>2309</sup> <https://www.thoughtco.com/the-history-of-the-univac-computer-1992590>

**11,953 HE:** East German Postal service uses electric vehicles to deliver mail.



East German electric vans of the Deutsche Post, photographer unknown.<sup>2310</sup>

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<sup>2310</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)



**Born 11,953 HE:** CAROLYN PORCO, United States, NASA planetary scientist known for her work in the exploration of the outer solar system, beginning with her imaging work on the *Voyager* missions to Jupiter, Saturn, Uranus, and Neptune. She led the imaging science team on the *Cassini* mission in orbit around Saturn and led the team when *Cassini* was de-orbited to burn up in Saturn's upper atmosphere. She is an expert on planetary rings and the Saturnian moon, Enceladus. *Cassini* data confirmed a prediction by PORCO and MARK MARLEY that acoustic oscillations within the body of Saturn are responsible for creating particular features in the rings of Saturn.<sup>2311</sup>

⇒ CAROLYN PORCO was founder of The Day the Earth Smiled and “Astronomers Without Borders” coordinated events

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<sup>2311</sup> [https://en.wikipedia.org/wiki/Carolyn\\_Porco](https://en.wikipedia.org/wiki/Carolyn_Porco)

internationally. NASA spearheaded a related event called 'Wave at Saturn' "to help acknowledge the historic interplanetary portrait as it was being taken."<sup>2312</sup> <sup>2313</sup>

- ⇒ 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.

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<sup>2312</sup> [https://en.wikipedia.org/wiki/The\\_Day\\_the\\_Earth\\_Smiled](https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled)

<sup>2313</sup> [https://en.wikipedia.org/wiki/Carolyn\\_Porco](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.”<sup>2314</sup>

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<sup>2314</sup> [https://en.wikipedia.org/wiki/Carolyn\\_Porco](https://en.wikipedia.org/wiki/Carolyn_Porco)



CAROLYN PORCO, date, location and photographer unknown.<sup>2315</sup>



July 19, **12,013 HE**: This image taken by *Cassini* is called “The

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<sup>2315</sup> [https://en.wikipedia.org/wiki/Carolyn\\_Porco](https://en.wikipedia.org/wiki/Carolyn_Porco)

Day the Earth Smiled.” Earth is a blue dot underneath the rings of Saturn.<sup>2316</sup>

**Born 11,953 HE: SIR ANDREW WILES**, British Mathematician, professor at Princeton University.<sup>2317</sup> In **19,995 HE WILES** published the correct proof to Fermat’s Last Theorem.<sup>2318</sup> Together, the two papers which contain the proof are 129 pages long, use standard constructions of modern algebraic geometry, such as the category of schemes and Iwasawa theory, and other techniques from the **11,900’s HE** not available to previous mathematicians<sup>2319</sup> such as GERMAIN or FERMAT. (See **11,776**

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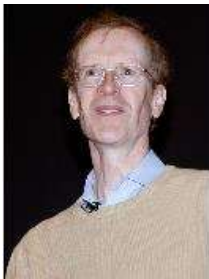
<sup>2316</sup> [https://en.wikipedia.org/wiki/The\\_Day\\_the\\_Earth\\_Smiled](https://en.wikipedia.org/wiki/The_Day_the_Earth_Smiled)

<sup>2317</sup> Liz Strachan *A Slice of Pi*

<sup>2318</sup> Liz Strachan *A Slice of Pi*

<sup>2319</sup> [https://en.wikipedia.org/wiki/Wiles\\_proof\\_of\\_Fermats\\_Last\\_Theorem](https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem)

**HE – 11,831 HE MARIE-SOPHIE GERMAIN and 11,607 HE – 11,665 HE: PIERRE DE FERMAT.)**



**12,005 HE SIR ANDREW WILES**, photographer and location unknown<sup>2320</sup>

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<sup>2320</sup> [https://en.wikipedia.org/wiki/Wiles\\_proof\\_of\\_Fermats\\_Last\\_Theorem](https://en.wikipedia.org/wiki/Wiles_proof_of_Fermats_Last_Theorem)

**Born 11,954 HE:** LAWRENCE M. KRAUSS is a United States-Canadian theoretical physicist, cosmologist, and founder of Arizona State University's Origins Project to investigate fundamental questions about the universe.<sup>2321</sup>

⇒ 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.<sup>2322</sup>

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<sup>2321</sup> [https://en.wikipedia.org/wiki/Lawrence\\_M.\\_Krauss](https://en.wikipedia.org/wiki/Lawrence_M._Krauss)

<sup>2322</sup> [https://en.wikipedia.org/wiki/Lawrence\\_M.\\_Krauss](https://en.wikipedia.org/wiki/Lawrence_M._Krauss)





LAWRENCE M. KRAUSS at Ghent University, 12,013 HE,  
photographer unknown.<sup>2323</sup>

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<sup>2323</sup> [https://en.wikipedia.org/wiki/Lawrence\\_M.\\_Krauss](https://en.wikipedia.org/wiki/Lawrence_M._Krauss)

Born **11,955 HE:** Dr. LUCILLE M. JONES, United States seismologist and public voice for earthquake science and earthquake safety in California. Dr. JONES said: “Earthquakes are inevitable, but disasters are not.”<sup>2324</sup>



Dr. LUCILLE M. JONES (photographer, location and date unknown.)<sup>2325</sup>

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<sup>2324</sup> [https://en.wikipedia.org/wiki/Lucy\\_Jones](https://en.wikipedia.org/wiki/Lucy_Jones)

<sup>2325</sup> Wikipedia suggested

**11,955 HE – 11,966 HE:** French wind turbine. The Station d'Etude de l'Energie du Vent at Nogent-le-Roi in France operated an experimental 800 KVA wind turbine.



**11,955 HE:** Photo is of the Experimental wind turbine at Nogent-le-Roi, France.<sup>2326</sup>

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<sup>2326</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

**Born 11,955 HE:** William Sanford Nye, popularly known as **BILL NYE THE SCIENCE GUY**, United States science communicator, television presenter, currently the CEO of the Planetary Society.

- ⇒ He has helped develop sundials for the Mars Exploration Rover missions and is a mechanical engineer.
- ⇒ He is best known as the host of the PBS and syndicated children's science show **BILL NYE THE SCIENCE GUY (11,993 HE–11,998 HE)**, the Netflix show *Bill Nye Saves the World* (**12,017 HE–present**), and for his many subsequent appearances in popular media as a science educator.<sup>2327</sup>

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<sup>2327</sup> [https://en.wikipedia.org/wiki/Bill\\_Nye](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.<sup>2328</sup>
- ⇒ 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.<sup>2329</sup>

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<sup>2328</sup> [https://en.wikipedia.org/wiki/Bill\\_Nye](https://en.wikipedia.org/wiki/Bill_Nye)

<sup>2329</sup> [https://en.wikipedia.org/wiki/Bill\\_Nye](https://en.wikipedia.org/wiki/Bill_Nye)



**12,016 HE** BILL NYE speaking to a group about Mars, photographer and location unknown.<sup>2330</sup>

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<sup>2330</sup> [https://en.wikipedia.org/wiki/Bill\\_Nye](https://en.wikipedia.org/wiki/Bill_Nye)

**Born 11,956 HE:** Dr. MAE CAROL JEMISON,<sup>2331</sup> United States, physician, engineer, astronaut, and the first African-American woman in space.<sup>2332</sup>

⇒ **11,993 HE:** Yes, Star Trek fans, Dr. MAE JEMISON appeared as Lieutenant Palmer in "Second Chances," an episode of the science fiction television series Star Trek: The Next Generation, earning her the distinction of being the first real-life astronaut to appear on Star Trek.<sup>2333</sup>

⇒ 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

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<sup>2331</sup> [https://en.wikipedia.org/wiki/Roger\\_Arliner\\_Young](https://en.wikipedia.org/wiki/Roger_Arliner_Young)

<sup>2332</sup> [https://en.wikipedia.org/wiki/Mae\\_Jemison](https://en.wikipedia.org/wiki/Mae_Jemison)

<sup>2333</sup> [https://en.wikipedia.org/wiki/Mae\\_Jemison](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.<sup>2334</sup>

⇒ 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,

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<sup>2334</sup> [https://en.wikipedia.org/wiki/Mae\\_Jemison](https://en.wikipedia.org/wiki/Mae_Jemison)



Michigan; Mae Jemison School, an elementary public school in Hazel Crest, Illinois; Jemison High School, Huntsville, Alabama.



**11,992 HE:** Dr. MAE JEMISON, photographer unknown.<sup>2335</sup>

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<sup>2335</sup> [https://en.wikipedia.org/wiki/Mae\\_Jemison](https://en.wikipedia.org/wiki/Mae_Jemison)



Dr. MAE JEMISON aboard the Spacelab Japan (SLJ) science module on the Earth-orbiting *Endeavour*, date unknown.<sup>2336</sup>

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<sup>2336</sup> [https://en.wikipedia.org/wiki/Mae\\_Jemison](https://en.wikipedia.org/wiki/Mae_Jemison)



Dr. MAE JEMISON with Nichelle Nichols on the set of Star Trek: The Next Generation. Photographer unknown.<sup>2337</sup>

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<sup>2337</sup> [https://memory-alpha.fandom.com/wiki/Mae\\_Jemison](https://memory-alpha.fandom.com/wiki/Mae_Jemison)

**11,957 HE:** The **B2FH Paper** was published and is a landmark paper on the origin of the chemical elements, published in Reviews of Modern Physics. Nicknamed after the initials of the Editors of the paper, MARGARET BURBIDGE, GEOFFREY BURBIDGE, WILLIAM A. FOWLER, and FRED HOYLE.

⇒ The actual title of the paper is "**Synthesis of the Elements in Stars**", but as the paper grew in influence it came to be referred to only as "B2FH". The B2FH group showed the famous result that all the elements (then known) except the very lightest, are produced by nuclear processes inside stars.<sup>2338</sup> *The B2FH group first advanced the idea of "nucleosynthesis" or fusion of lighter elements into heavier ones, which occurs during stars explosive*

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<sup>2338</sup> [https://en.wikipedia.org/wiki/B2FH\\_paper](https://en.wikipedia.org/wiki/B2FH_paper)

oxygen burning and silicon burning events. For this they received the Warner Prize in **11,959 HE**.<sup>2339 2340</sup>

- ⇒ **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

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<sup>2339</sup> [https://en.wikipedia.org/wiki/Margaret\\_Burbidge](https://en.wikipedia.org/wiki/Margaret_Burbidge)

<sup>2340</sup> [https://en.wikipedia.org/wiki/B2FH\\_paper](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.<sup>2341</sup>

- ⇒ **MARGARET BURBIDGE 11,919 HE – current**, British-born United States astrophysicist who was one of the first astrophysicists to measure the masses and rotation curves of galaxies and was one of the pioneers in the study of quasars. Among other positions held, she was Director of the Royal Greenwich Observatory, worked at Cavendish Laboratory in Cambridge, England, at Cal Tech, and was the first director of

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<sup>2341</sup> [https://en.wikipedia.org/wiki/Stellar\\_nucleosynthesis](https://en.wikipedia.org/wiki/Stellar_nucleosynthesis)

the Center for Astronomy and Space Sciences at the University of California at San Diego (UCSD).<sup>2342</sup>



• ELEANOR MARGARET PEACHEY BURBIDGE, date, location, and photographer unknown.<sup>2343</sup>

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<sup>2342</sup> [https://en.wikipedia.org/wiki/Margaret\\_Burbidge](https://en.wikipedia.org/wiki/Margaret_Burbidge)

<sup>2343</sup> [https://en.wikipedia.org/wiki/Margaret\\_Burbidge](https://en.wikipedia.org/wiki/Margaret_Burbidge)

⇒ GEOFFREY RONALD BURBIDGE: **11,925 HE – 12,010 HE**:  
English astronomy professor and theoretical astrophysicist.

- He worked at the Mount Wilson Observatory and Palomar Observatory and was the Director of Kitt Peak National Observatory from **11,978 HE** to **11,984 HE**.<sup>2344</sup>



- GEOFFREY RONALD BURBIDGE, date, location, and photographer unknown<sup>2345</sup>

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<sup>2344</sup> [https://en.wikipedia.org/wiki/Geoffrey\\_Burbidge](https://en.wikipedia.org/wiki/Geoffrey_Burbidge)

<sup>2345</sup> Image search from datuopinion.com



⇒ **11,911 HE – 11,995 HE: WILLIAM ALFRED FOWLER**, United States Scientist. In **11,983 HE** FOWLER was awarded the Nobel Prize in Physics.<sup>2346</sup>

- 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

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<sup>2346</sup> [https://en.wikipedia.org/wiki/William\\_Alfred\\_Fowler](https://en.wikipedia.org/wiki/William_Alfred_Fowler)

Mark Twain Society, and elected to the Society of American Baseball Research.<sup>2347</sup>



- WILLIAM ALFRED FOWLER, date and location unknown.<sup>2348</sup>

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<sup>2347</sup> <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>

<sup>2348</sup> [https://en.wikipedia.org/wiki/William\\_Alfred\\_Fowler](https://en.wikipedia.org/wiki/William_Alfred_Fowler)

⇒ **11,915 HE – 12,001 HE**: FRED HOYLE, British Astronomer who sarcastically coined the term the “Big Bang.” (See the other scientist who got credit for the term “Big Bang” **11,894 HE - 11,996 HE**: GEORGES LEMAÎTRE). HOYLE promoted the idea of panspermia as the origin of life on Earth.<sup>2349</sup>

- 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.....”<sup>2350</sup>

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<sup>2349</sup> [https://en.wikipedia.org/wiki/Fred\\_Hoyle](https://en.wikipedia.org/wiki/Fred_Hoyle)

<sup>2350</sup> <https://www.nobelprize.org/prizes/physics/1983/fowler/biographical/>

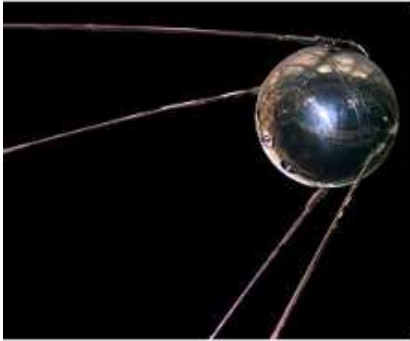


SIR FRED HOYLE. Location, date and photographer unknown.<sup>2351</sup>

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<sup>2351</sup> [https://en.wikipedia.org/wiki/Fred\\_Hoyle](https://en.wikipedia.org/wiki/Fred_Hoyle)

**11,957 HE:** The Soviets launched two orbital spacecraft, *Sputnik 1* and *Sputnik 2*.<sup>2352</sup>



A replica of Soviet *Sputnik 1* at the Smithsonian.<sup>2353</sup>

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<sup>2352</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2353</sup> [https://en.wikipedia.org/wiki/Sputnik\\_1](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.<sup>2354</sup>

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<sup>2354</sup> [https://en.wikipedia.org/wiki/Sputnik\\_1](https://en.wikipedia.org/wiki/Sputnik_1)



Model of *Sputnik 2* at the Polytechnic Museum in Moscow.<sup>2355</sup>  
*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.<sup>2356</sup>

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<sup>2355</sup> [https://en.wikipedia.org/wiki/Sputnik\\_2](https://en.wikipedia.org/wiki/Sputnik_2)

<sup>2356</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

**Born 11,958 HE:** your humble Author / Compiler and her Techno-Manager, too.

**11,958 HE:** *Explorer 1*, United States first successful launch of a US Satellite.<sup>2357</sup>



Photo is of WILLIAM HAYWARD PICKERING, JAMES VAN ALLEN, and WERNHER VON BRAUN displaying a full-

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<sup>2357</sup> <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.<sup>2358</sup>

**Born 11,958 HE:** NEIL DEGRASSE TYSON, United States, astrophysicist, cosmologist, author, and science communicator.

⇒ **11,996 HE - present,** NEIL deGRASSE TYSON has been the Frederick P. Rose Director of the Hayden Planetarium at the Rose Center for Earth and Space in New York City.<sup>2359</sup>

⇒ TYSON served on a **12,001 HE** government commission on the future of the U.S. aerospace industry, and on the **12,004 HE** Moon, Mars and Beyond commission.

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<sup>2358</sup> [https://en.wikipedia.org/wiki/Explorer\\_1](https://en.wikipedia.org/wiki/Explorer_1)

<sup>2359</sup> [https://en.wikipedia.org/wiki/Neil\\_deGrasse\\_Tyson](https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson)

- ⇒ **12,004 HE:** TYSON was awarded the NASA Distinguished Public Service Medal. The U.S. National Academy of Sciences awarded Tyson the Public Welfare Medal in **12,015 HE** for his "extraordinary role in exciting the public about the wonders of science".<sup>2360</sup>
- ⇒ **12,014 HE:** NEIL deGRASSE TYSON hosted the television series Cosmos: A Spacetime Odyssey, a successor to CARL SAGAN'S **11,980 HE** series Cosmos: A Personal Voyage.<sup>2361</sup>

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<sup>2360</sup> [https://en.wikipedia.org/wiki/Neil\\_deGrasse\\_Tyson](https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson)

<sup>2361</sup> [https://en.wikipedia.org/wiki/Neil\\_deGrasse\\_Tyson](https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson)

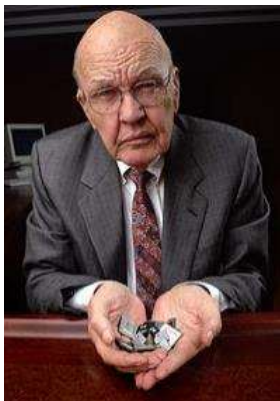


**12,009 HE NEIL deGRASSE TYSON**, photographer and location unknown<sup>2362</sup>

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<sup>2362</sup> [https://en.wikipedia.org/wiki/Neil\\_deGrasse\\_Tyson](https://en.wikipedia.org/wiki/Neil_deGrasse_Tyson)

**11,958 HE:** Patent of integrated circuit at Texas Instruments.<sup>2363</sup>



**12,000 HE:** JACK KILBY (11,923 HE – 12,005 HE) was a United States electrical engineer who was awarded the Nobel

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<sup>2363</sup> [https://en.wikipedia.org/wiki/Jack\\_Kilby](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."<sup>2364</sup>

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<sup>2364</sup> [https://en.wikipedia.org/wiki/Jack\\_Kilby](https://en.wikipedia.org/wiki/Jack_Kilby)



**11,958 HE: JACK KILBY'S** original integrated circuit, photographer and location unknown.<sup>2365</sup>

- ⇒ 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

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<sup>2365</sup> [https://en.wikipedia.org/wiki/Jack\\_Kilby](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.<sup>2366</sup>

## **11,959 HE – 11,960 HE:**

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<sup>2366</sup> [https://en.wikipedia.org/wiki/Jack\\_Kilby](https://en.wikipedia.org/wiki/Jack_Kilby)



The Henney Kilowatt was an electric car introduced in the US for two years.<sup>2367</sup>

**Born circa 11,960 HE: SUE O'CONNOR,**<sup>2368</sup> Australian  
Anthropologist Archeologist and Distinguished Professor in the

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<sup>2367</sup> [https://en.wikipedia.org/wiki/Henney\\_Kilowatt](https://en.wikipedia.org/wiki/Henney_Kilowatt)

<sup>2368</sup> [http://archive.archaeology.org/1203/trenches/jermalalai\\_cave\\_east\\_timor\\_fish\\_hooks.html](http://archive.archaeology.org/1203/trenches/jermalalai_cave_east_timor_fish_hooks.html)



School of Culture, History & Language at the University of New England (Australia).

- ⇒ O'CONNOR's research focuses primarily on the evidence of Pleistocene settlement and early human migration in the Indo-Pacific region.
- ⇒ Awards received by O'CONNOR: Australian Research Council QEII Fellowship; Rhys Jones Medal for Outstanding Contribution to Australian Archaeology; Australian Research Council Laureate Fellowship.<sup>2369</sup>
- ⇒ In **12,017 HE** O'CONNOR's research team recovered the world's oldest fish hooks from an ancient burial site in Indonesia. Five circular, rotating hooks, probably used for deep-sea fishing, were

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<sup>2369</sup> [https://en.wikipedia.org/wiki/Sue\\_O'Connor](https://en.wikipedia.org/wiki/Sue_O'Connor)

found under the chin and around the jaws of an adult female skeleton buried 12,000 years ago. (See also **circa 11,000 BHE – 4,000 BHE**: Jerimalai cave site in East Timor.)



SUE O'CONNOR, photographer, date and location unknown.<sup>2370</sup>

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<sup>2370</sup> <https://www.australianarchaeologicalassociation.com.au/awards/rhys-jones-medal/sue-oconnor/>

**11,961 HE: YURI GARGARIN, Soviet Union, is the first human to orbit earth.**<sup>2371</sup>



**YURI GAGARIN (11,934 HE – 11,968 HE) in Helsinki, photographer unknown.**<sup>2372</sup>

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<sup>2371</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2372</sup> [https://en.wikipedia.org/wiki/Yuri\\_Gagarin](https://en.wikipedia.org/wiki/Yuri_Gagarin)

**11,961 HE:** ALAN SHEPPARD, United States, first US Astronaut to be launched into space. SHEPPARD'S flight entered outer space, but his capsule re-entered the atmosphere without circumnavigating the globe.<sup>2373</sup> Hence, his flight tends to be treated as though it was less historic than John Glenn's later orbital flight for the United States.



Ten years later in **11,971 HE:** This Photo is of ALAN

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<sup>2373</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>

SHEPPARD on the moon. SHEPPARD was the only Mercury astronaut to become a moon walker.<sup>2374</sup>



Photo is of American Astronaut ALAN SHEPPARD (**11,923 HE – 11,998 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.<sup>2375</sup>

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<sup>2374</sup> [https://en.wikipedia.org/wiki/Alan\\_Shepard](https://en.wikipedia.org/wiki/Alan_Shepard)

<sup>2375</sup> [https://en.wikipedia.org/wiki/Alan\\_Shepard](https://en.wikipedia.org/wiki/Alan_Shepard)

**Circa 11,961 HE:** United States, “Mercury 13”: Women aviation pilots who were on their way to being astronauts, but whom President Johnson, Congress, and John Glenn stopped because they were women.<sup>2376</sup>

⇒ 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.<sup>2377</sup>

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<sup>2376</sup>

<https://www.npr.org/templates/story/story.php?storyId=4770249&storyid=4770249?storyId=4770249&storyid=4770249>

<sup>2377</sup> [https://en.wikipedia.org/wiki/Mercury\\_13](https://en.wikipedia.org/wiki/Mercury_13)

**11,962 HE:** United States, Bell Laboratories *Telstar 1* – first commercial communications satellite launched.<sup>2378</sup>



Photo is of a Model of a *Telstar* satellite, on display at Conservatoire national des arts et métiers.<sup>2379</sup>

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<sup>2378</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2379</sup> <https://en.wikipedia.org/wiki/Telstar>



Photo is of a 177 ft. horn antenna at AT&T's satellite ground station in Andover, Maine, built to communicate with *Telstar*. (A similar but smaller Bell Labs antenna was used by PENZIAS and WILSON in **11,964 HE** to discover the Cosmic Microwave Background).<sup>2380</sup>

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<sup>2380</sup> <https://en.wikipedia.org/wiki/Telstar>



**11,963 HE:** VALENTINA TERESHKOVA, Soviet engineer, first woman in space.



**11,963 HE** photo of VALENTINA TERESHKOVA.<sup>2381</sup>

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<sup>2381</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<https://www.npr.org/templates/story/story.php?storyId=4770249&storyid=4770249?storyId=4770249&storyid=4770249>

**11,964 HE;** ARNO ALLAN PENZIAS, German Physicist who with ROBERT WOODROW WILSON, United States Physicist, discover the Cosmic Microwave Background.<sup>2382 2383</sup>



ARNO ALLAN PENZIAS (right), German Physicist with

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<sup>2382</sup> [https://en.wikipedia.org/wiki/Robert\\_Woodrow\\_Wilson](https://en.wikipedia.org/wiki/Robert_Woodrow_Wilson)

<sup>2383</sup> [https://en.wikipedia.org/wiki/Arno\\_Allan\\_Penzias](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.<sup>2384</sup>

**11,964 HE:** The first electrified high-speed rail *Tōkaidō Shinkansen* was introduced between Tokyo and Osaka in Japan. Since then, high-speed rail transport functioning at speeds up to and above 300 km/h has been built in Japan, Spain, France, Germany, Italy, the People's Republic of China, Taiwan (Republic of China), the United Kingdom, South Korea, Scandinavia, Belgium, and the Netherlands.<sup>2385</sup>

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<sup>2384</sup> [https://en.wikipedia.org/wiki/Arno\\_Allan\\_Penzias](https://en.wikipedia.org/wiki/Arno_Allan_Penzias)

<sup>2385</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



**11,964 HE:** Photo is of a *0-Series Shinkansen*, which triggered the intercity train travel boom.<sup>2386</sup>

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<sup>2386</sup> [https://en.wikipedia.org/wiki/History\\_of\\_rail\\_transport](https://en.wikipedia.org/wiki/History_of_rail_transport)



**12,016 HE: Shinkansen in Osaka.**<sup>2387</sup>

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<sup>2387</sup> Image: Premack family photo

**11,965 HE:** ALEXI LEONOV, Soviet Cosmonaut – first spacewalker.  
Three months later, United States Astronaut ED WHITE did a  
spacewalk.<sup>2388</sup>



Photo of ALEXI LEONOV is from **11,974 HE.**<sup>2389</sup>

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<sup>2388</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2389</sup> [https://en.wikipedia.org/wiki/Alexey\\_Leonov](https://en.wikipedia.org/wiki/Alexey_Leonov)



Photo of ED WHITE is from **11,966 HE**.<sup>2390</sup>

**11,966 HE:** Television premier of Star Trek.<sup>2391</sup>

**Born 11,966 HE:** SEAN MICHAEL CARROLL is a cosmologist and physics professor specializing in dark energy and general

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<sup>2390</sup> [https://en.wikipedia.org/wiki/Ed\\_White\\_\(astronaut\)](https://en.wikipedia.org/wiki/Ed_White_(astronaut))

<sup>2391</sup> Paul Premack, personal witness to event.

relativity. CARROLL research papers include models of, and experimental constraints on, violations of Lorentz invariance; the appearance of closed time-like curves in general relativity; varieties of topological defects in field theory; and cosmological dynamics of extra spacetime dimensions. In recent years he has written extensively on models of dark energy and its interactions with ordinary matter and dark matter, as well as modifications of general relativity in cosmology.

- ⇒ CARROLL has also worked on the arrow of time problem. He and JENNIFER CHEN posit that the Big Bang is not a unique occurrence, but rather one of many cosmic inflation events resulting from quantum fluctuations of vacuum energy. They claim that the universe is infinitely old, but never reaches thermodynamic equilibrium as entropy increases continuously without limit due to the decreasing matter and energy density attributable to recurrent cosmic inflation. They assert that the



universe is "statistically time-symmetric" insofar as it contains equal progressions of time "both forward and backward."



Twitter.com Photo of SEAN M. CARROLL, date, location and photographer unknown.<sup>2392</sup>

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<sup>2392</sup> [https://en.wikipedia.org/wiki/Sean\\_M.\\_Carroll](https://en.wikipedia.org/wiki/Sean_M._Carroll)

<https://www.bing.com/images/search?q=image%20sean%20m%20carroll&id=56979022668C2A97142571DBFE5DF6BD2DD74357&FORM=IQFRBA>

**Born 11,967 HE:** MAX TEGMARK is a Swedish - United States physicist and cosmologist whose research has focused on combining theoretical work with new measurements to place constraints on cosmological models and their free parameters. He has over 200 publications. He has developed data analysis tools based on information theory and applied them to cosmic microwave background experiments such as COBE, QMAP, and WMAP, and to galaxy redshift surveys such as the Las Campanas Redshift Survey, the 2dF Survey, and the Sloan Digital Sky Survey.<sup>2393</sup> With DANIEL EISENSTEIN and WAYNE HU, TEGMARK introduced the idea of using baryon acoustic oscillations as a standard ruler. With ANGELICA DE OLIVEIRA-COSTA and ANDREW HAMILTON, he discovered the anomalous multipole alignment in the WMAP data sometimes referred to as the "axis of evil". With ANTHONY AGUIRRE, he

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<sup>2393</sup> [https://en.wikipedia.org/wiki/Max\\_Tegmark](https://en.wikipedia.org/wiki/Max_Tegmark)

developed the cosmological interpretation of quantum mechanics. TEGMARK has also formulated the "Ultimate Ensemble theory of everything", whose only postulate is that "all structures that exist mathematically exist also physically".<sup>2394</sup>



Photo of MAX TEGMARK, photographer, date, location unknown.<sup>2395</sup>

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<sup>2394</sup> [https://en.wikipedia.org/wiki/Max\\_Tegmark](https://en.wikipedia.org/wiki/Max_Tegmark)

<sup>2395</sup> [https://en.wikipedia.org/wiki/Max\\_Tegmark](https://en.wikipedia.org/wiki/Max_Tegmark)

**11,968 HE:** Seiko Epson, Japan, EP-101, the world's first miniprinter, is launched.<sup>2396</sup>



Photo of the world's first miniprinter. Dimensions and photographer unknown.<sup>2397</sup>

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<sup>2396</sup> <https://epson.com/company-history>

<sup>2397</sup> <https://epson.com/company-history>

**11,968 HE: ROBERT NORTON NOYCE**, United States, founded Intel.<sup>2398</sup>



Photo is of **ROBERT NORTON NOYCE (11,927 HE – 11,990 HE)** in front of the Intel SC1 building in Santa Clara in **11,970 HE**. Nicknamed “the Mayor of Silicon Valley,” **ROBERT NORTON NOYCE**, along with **JACK KILBY**, are credited with

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<sup>2398</sup> [https://en.wikipedia.org/wiki/Robert\\_Noyce](https://en.wikipedia.org/wiki/Robert_Noyce)

the realization of the first integrated circuit or microchip that fueled the personal computer revolution and gave Silicon Valley its name.<sup>2399</sup>

- ⇒ ROBERT NORTON NOYCE was granted 15 patents: U.S. Patent 2,875,141 Method and apparatus for forming semiconductor structures; U.S. Patent 2,929,753 Transistor structure and method; U.S. Patent 2,959,681 Semiconductor scanning device; U.S. Patent 2,968,750 Transistor structure and method of making the same; U.S. Patent 2,971,139 Semiconductor switching device; U.S. Patent 2,981,877 Semiconductor Device and Lead Structure; U.S. Patent 3,010,033 Field effect transistor; U.S. Patent 3,098,160 Field controlled avalanche semiconductive device,; U.S. Patent 3,108,359 Method for fabricating transistors; U.S. Patent

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<sup>2399</sup> [https://en.wikipedia.org/wiki/Robert\\_Noyce](https://en.wikipedia.org/wiki/Robert_Noyce)

3,111,590 Transistor structure controlled by an avalanche barrier; U.S. Patent 3,140,206 Method of making a transistor structure (coinventor WILLIAM SHOCKLEY); U.S. Patent 3,150,299 Semiconductor circuit complex having isolation means; U.S. Patent 3,183,129 Method of forming a semiconductor; U.S. Patent 3,199,002 Solid state circuit with crossing leads; U.S. Patent 3,325,787 Trainable system.<sup>2400</sup>

**Born 11,968 HE:** PROFESSOR BRIAN COX, English physicist who serves as professor of particle physics in the School of Physics and Astronomy at the University of Manchester.<sup>2401</sup> 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

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<sup>2400</sup> [https://en.wikipedia.org/wiki/Robert\\_Noyce](https://en.wikipedia.org/wiki/Robert_Noyce)

<sup>2401</sup> [https://en.wikipedia.org/wiki/Brian\\_Cox\\_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

Solenoid (CMS) experiment by installing additional, smaller detectors at a distance of 420 meters from the interaction points of the main experiments.<sup>2402</sup>

⇒ 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).

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<sup>2402</sup> [https://en.wikipedia.org/wiki/Brian\\_Cox\\_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))



- COX won Best Presenter and Best Science/Natural History programme by the Royal Television Society for Wonders of the Universe. COX won twice at the Broadcasting Press Guild Awards for “Best Performer” in a non-acting role, while Wonders of the Solar System was named best documentary series of **12,010 HE**.
- He was awarded the Institute of Physics President's medal by Sir Patrick Stewart, following which he gave a speech on the value of education in science and the need to invest more in future generations of scientists.
- COX also was awarded the Michael Faraday Prize of the Royal Society "for his excellent work in science

communication". He was elected a Fellow of the Royal Society (FRS) in **12,016 HE**.<sup>2403</sup>



PROFESSOR BRIAN COX at the Royal Society admissions day in London, **12,016 HE**.<sup>2404</sup>

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<sup>2403</sup> [https://en.wikipedia.org/wiki/Brian\\_Cox\\_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

<sup>2404</sup> [https://en.wikipedia.org/wiki/Brian\\_Cox\\_\(physicist\)](https://en.wikipedia.org/wiki/Brian_Cox_(physicist))

**11,968 HE:** The first computer mouse was sold (but not widely adopted until **11,980s HE**).<sup>2405</sup>

⇒ **11,968 HE:** The GUI (graphical user interface) was actually the baby of DOUGLASS ENGELBART (**11,925 HE – 12,013 HE**) who demonstrated in **11,968 HE** an operating system with a mouse pointer being inspired by an essay written in **11,945 HE** (Author / Compiler wonders by whom?) about making a computer more interactive.<sup>2406</sup>

- 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

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<sup>2405</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2406</sup> SciShow 5-2-12,016HE youtube.com Video: The Truth About 10 Famous Inventions  
<https://www.youtube.com/watch?v=g-KuigAQFp4>

for business use. Microsoft understood the GUI was the thing that would allow a user to interface with their computer using windows rather than typing lines of commands into prompts. Microsoft made the GUI suitable for business.<sup>2407</sup>

- He is best known for his work on founding the field of human–computer interaction, particularly while at his Augmentation Research Center Lab in SRI International, which resulted in creation of the computer mouse, and the development of hypertext, networked computers, and precursors to graphical user interfaces. These were demonstrated at The Mother of All Demos in **11,968 HE**. “Engelbart's Law”, the observation that the intrinsic rate of human performance is exponential, is named after him.

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<sup>2407</sup> SciShow 5-2-12,016HE youtube.com Video: *The Truth About 10 Famous Inventions*  
<https://www.youtube.com/watch?v=g-KuigAQFp4>



DOUGLAS CARL ENGELBART. Date, location and photographer unknown.<sup>2408</sup>

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<sup>2408</sup> [https://en.wikipedia.org/wiki/Douglas\\_Engelbart](https://en.wikipedia.org/wiki/Douglas_Engelbart)



ENGELBART'S prototype of a computer mouse, as designed by Bill English from ENGELBART'S sketches.<sup>2409</sup>

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<sup>2409</sup> Edwards, Benj (2008-12-09). "*The computer mouse turns 40*". Macworld. and [https://en.wikipedia.org/wiki/Douglas\\_Engelbart](https://en.wikipedia.org/wiki/Douglas_Engelbart)

**11,969 HE:** First United States (NASA) moon landing, Apollo 11.<sup>2410</sup>



*Eagle*, the Lunar Module ascent stage of Apollo 11, in orbit above the Moon. Earth is visible in the distance.<sup>2411</sup>

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<sup>2410</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2411</sup> [https://en.wikipedia.org/wiki/Apollo\\_Lunar\\_Module](https://en.wikipedia.org/wiki/Apollo_Lunar_Module)

**11,969 HE:** ARPANET, the forerunner to the modern internet.<sup>2412</sup> 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.<sup>2413</sup>

**11,970 HE:** DRAM memory introduced by Intel.<sup>2414</sup> 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.<sup>2415</sup>

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<sup>2412</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2413</sup> <https://en.wikipedia.org/wiki/ARPANET>

<sup>2414</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2415</sup> [https://en.wikipedia.org/wiki/Dynamic\\_random-access\\_memory](https://en.wikipedia.org/wiki/Dynamic_random-access_memory)



Starting **11,970s HE**: More advancements in Birth Control. Medication abortion is a type of non-surgical abortion. An oral preparation for medical abortion is commonly referred to as an abortion pill.<sup>2416</sup>

⇒ **11,980 HE**: Mifepristone, also known as RU-486, is a medication typically used in combination with misoprostol, is more than 95% effective during the first 50 days of pregnancy. It is also effective in the second trimester of pregnancy. It is taken by mouth.

- Mifepristone (RU-486) is on the World Health Organization's List of Essential Medicines and is one of the most effective and safe medicines needed in a health system.
- **11,987 HE**: Mifepristone became available France.
- **12,000 HE**: Mifepristone became available the United States.

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<sup>2416</sup> [https://en.wikipedia.org/wiki/Medical\\_abortion](https://en.wikipedia.org/wiki/Medical_abortion)

- **12,017 HE:** Mifepristone became available in Canada.<sup>2417</sup>

**11,970 HE:** United States *Apollo 13* and Soviet *Luna 16* (the first automatic spacecraft to return soil samples of the moon). The Soviet probe *Lunokhod 1* landed on the moon. Soviet *Venera 7* landed on Venus.<sup>2418</sup>

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<sup>2417</sup> <https://en.wikipedia.org/wiki/Mifepristone>

<sup>2418</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>



The Soviet *Luna 16*, location and date unknown.<sup>2419</sup>



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<sup>2419</sup> [https://en.wikipedia.org/wiki/Luna\\_16](https://en.wikipedia.org/wiki/Luna_16)



Launch of NASA Apollo 13, photographer unknown.<sup>2420</sup>

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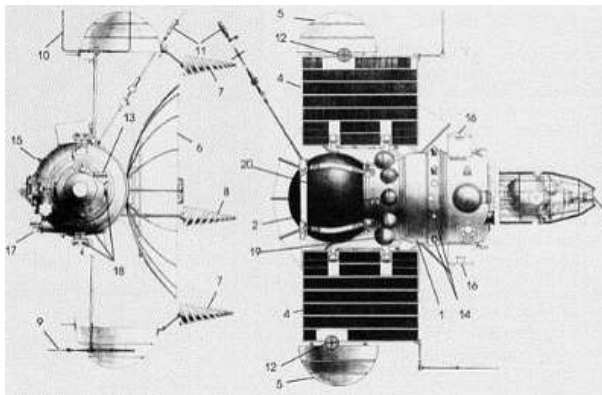
<sup>2420</sup> Jpeg NASA.gov



The Soviet *Lunokhod 1*, location and date unknown<sup>2421</sup>

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<sup>2421</sup> [https://en.wikipedia.org/wiki/Lunokhod\\_1](https://en.wikipedia.org/wiki/Lunokhod_1)



The Soviet *Venera 7* was the first space probe to transmit data from another planet back to Earth<sup>2422</sup>

<sup>2422</sup> [https://en.wikipedia.org/wiki/Venera\\_7](https://en.wikipedia.org/wiki/Venera_7)

**11,971 HE:** Email invented. The first computer program is written to send email messages between servers via the ARPANET. To achieve this, RAY TOMLINSON used the @ sign to separate the user name from the name of their machine, a scheme which has been used in email addresses ever since.<sup>2423</sup>

⇒ 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

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<sup>2423</sup> <http://www.computerhistory.org/timeline/computers/>

complete revolution, fundamentally changing the way people communicate".<sup>2424 2425</sup>



**12,004 HE** photo of RAY TOMLINSON (**11,941 HE – 12,016 HE**), photographer and location unknown.<sup>2426</sup>

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<sup>2424</sup> [https://en.wikipedia.org/wiki/Ray\\_Tomlinson](https://en.wikipedia.org/wiki/Ray_Tomlinson)

<sup>2425</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2426</sup> [https://en.wikipedia.org/wiki/Ray\\_Tomlinson](https://en.wikipedia.org/wiki/Ray_Tomlinson)



**Circa 11,971 HE – circa 11,979 HE:** GARY STARKWEATHER, United States engineer and inventor, who worked in Xerox's product development department, had the idea in **11,969 HE** of using a laser beam to "draw" an image of what was to be copied directly onto the copier drum. The *laser printer* was born and they were introduced for the office and then home markets in subsequent years by IBM, Canon, Xerox, Apple, Hewlett-Packard and many others. Over the decades, quality and speed have increased as price has fallen, and the once cutting-edge printing devices are now ubiquitous.<sup>2427</sup>

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<sup>2427</sup> [https://en.wikipedia.org/wiki/Laser\\_printing](https://en.wikipedia.org/wiki/Laser_printing)



**12,009 HE** Photo of GARY STARKWEATHER (Born **11,938 HE**).<sup>2428</sup>

**11,971 HE – 11,972 HE:** Electric cars received the unique distinction of becoming the first manned vehicles to drive on the Moon. The

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<sup>2428</sup> [https://en.wikipedia.org/wiki/Gary\\_Starkweather](https://en.wikipedia.org/wiki/Gary_Starkweather)

first Moon electric car was the *Lunar Rover*, which was first deployed during the *Apollo 15* mission. The "moon buggy" was developed by Boeing and GM subsidiary Delco Electronics.<sup>2429</sup>



**11,971 HE:** The U.S. Apollo *Lunar Rover* from *Apollo 15* on the Moon.<sup>2430</sup>

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<sup>2429</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

<sup>2430</sup> [https://en.wikipedia.org/wiki/Lunar\\_Roving\\_Vehicle](https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle)



**11,972 HE:** JOHN YOUNG works at the *Lunar Rover* on *Apollo 16*.<sup>2431</sup>

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<sup>2431</sup> [https://en.wikipedia.org/wiki/Lunar\\_Roving\\_Vehicle](https://en.wikipedia.org/wiki/Lunar_Roving_Vehicle)

**11,971 HE:** Soviet space station *Salyut 1* was launched. United States *Mariner 9* probe became the first craft to orbit another world - Mars.<sup>2432</sup>



Photo of *Salyut 1* as seen from *Soyuz 1*.<sup>2433</sup>

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<sup>2432</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2433</sup> [https://en.wikipedia.org/wiki/Salyut\\_1](https://en.wikipedia.org/wiki/Salyut_1)

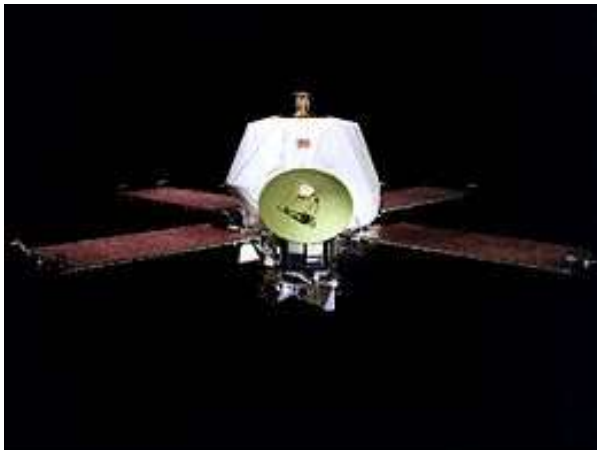
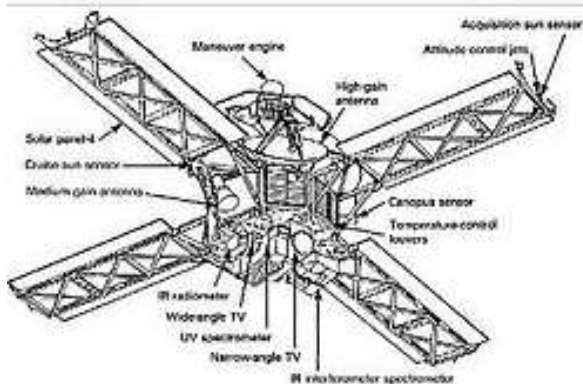


Photo of *Mariner 9*. Unknown location, photographer.<sup>2434</sup>

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<sup>2434</sup> <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.<sup>2435</sup>

<sup>2435</sup> [https://en.wikipedia.org/wiki/Mariner\\_9](https://en.wikipedia.org/wiki/Mariner_9)

**11,972 HE:** United States Astronauts EUGENE CERNAN and HARRISON "JACK" SCHMITT became the last men to walk on the moon, to date.<sup>2436</sup>



**11,971 HE** Photo is of US Astronaut EUGENE CERNAN (11,934 HE - 12,017 HE.<sup>2437</sup>)

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<sup>2436</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2437</sup> [https://en.wikipedia.org/wiki/Gene\\_Cernan](https://en.wikipedia.org/wiki/Gene_Cernan)





**11,971 HE** Photo is of US Astronaut HARRISON SCHMITT (born **11,935 HE**)<sup>2438</sup>.

**11,972 HE:** NASA *Pioneer 10* is launched to Jupiter.<sup>2439</sup>

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<sup>2438</sup> [https://en.wikipedia.org/wiki/Harrison\\_Schmitt](https://en.wikipedia.org/wiki/Harrison_Schmitt)

<sup>2439</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>



*Pioneer 10* in the final stages of construction.<sup>2440</sup>

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<sup>2440</sup> [https://en.wikipedia.org/wiki/Pioneer\\_10](https://en.wikipedia.org/wiki/Pioneer_10)

**11,973 HE:** United States *Skylab* is launched on board the modified *Saturn V* rocket. The space station is made from the upper stage of the *Saturn V* rocket.<sup>2441</sup>

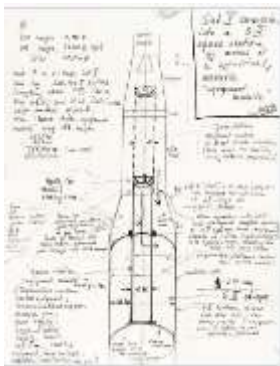


Image of *Skylab* in Earth orbit. Unknown photographer or date.<sup>2442</sup>

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<sup>2441</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2442</sup> [www.washingtonpost.com](http://www.washingtonpost.com) image of Skylab



**11,964 HE: WERNHER VON BRAUN (SEE 11,912 HE – 11,977 HE)** sketch of a Space Station based on conversion of a Saturn V stage.<sup>2443</sup>

<sup>2443</sup> <https://en.wikipedia.org/wiki/Skylab>

**11,975 HE:** The Nobel Prize in Physics was awarded jointly to AAGE NIELS BOHR (yes, reader, he was a son of NIELS BOHR definer of the atom see **11,922 HE**), BEN ROY MOTTELSON AND LEO JAMES RAINWATER "for the discovery of the connection between collective motion and particle motion in atomic nuclei and the development of the theory of the structure of the atomic nucleus based on this connection."<sup>2444</sup>

**11,975 HE:** Microsoft founded by BILL GATES III and PAUL ALLEN.<sup>2445</sup> Microsoft's first operating system was a version of Unix called Xenix, released in **11,980 HE**. Microsoft's first wildly successful operating system was MS-DOS, which Microsoft wrote for IBM in **11,981 HE** and was based on Tim Paterson's QDOS. In the deal of the century, BILL GATES only *licensed* MS-DOS to

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<sup>2444</sup> <https://www.nobelprize.org/prizes/physics/1975/summary/>

<sup>2445</sup> <https://www.thoughtco.com/microsoft-history-of-a-computing-giant-1991140>

IBM. By retaining the rights to the software, BILL GATES made a fortune for Microsoft and Microsoft became a major software vendor.<sup>2446</sup>

⇒ **11,985 HE – present HE:** Windows 95, Windows XP, Xbox, Microsoft Azure, Windows Vista, Windows 7, Microsoft stores, Windows 8, Xbox One, Outlook.com, Surface devices, Windows 10, Windows 10 Mobile, Microsoft Edge, and HoloLens.<sup>2447</sup>

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<sup>2446</sup> [https://en.wikipedia.org/wiki/History\\_of\\_Microsoft](https://en.wikipedia.org/wiki/History_of_Microsoft)

<sup>2447</sup> [https://en.wikipedia.org/wiki/History\\_of\\_Microsoft](https://en.wikipedia.org/wiki/History_of_Microsoft)



**12,018 HE:** BILL GATES III (born **11,955 HE**) at the United States Department of Health and Human Services.<sup>2448</sup> GATES has written two books: **11,995 HE:** *The Road Ahead*, written with Microsoft executive Nathan Myhrvold and journalist Peter

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<sup>2448</sup> [https://en.wikipedia.org/wiki/Bill\\_Gates](https://en.wikipedia.org/wiki/Bill_Gates)

Rinearson. It summarized the implications of the personal computing revolution and described a future profoundly changed by the arrival of a global information superhighway. **11,999 HE:** *Business @ the Speed of Thought* discusses how business and technology are integrated and shows how digital infrastructures and information networks can help get an edge on the competition.<sup>2449</sup>

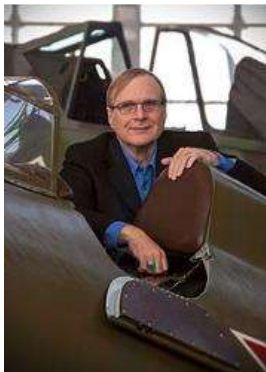
- **12,000 HE:** Bill & Melinda Gates Foundation is said to be the largest private foundation in the United States. The primary aims of the foundation are to enhance healthcare, to reduce extreme poverty, to expand educational opportunities, and to provide access to information technology.<sup>2450</sup>

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<sup>2449</sup> [https://en.wikipedia.org/wiki/Bill\\_Gates](https://en.wikipedia.org/wiki/Bill_Gates)

<sup>2450</sup> [https://en.wikipedia.org/wiki/Bill\\_and\\_Melinda\\_Gates\\_Foundation](https://en.wikipedia.org/wiki/Bill_and_Melinda_Gates_Foundation)





**12,013 HE:** photo of PAUL ALLEN (**11,953 HE – 12,018 HE**) at Flying Heritage Collection.<sup>2451</sup> ALLEN is the founder of Vulcan Inc, Allen Institute for Brain Science, Institute for

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<sup>2451</sup> [https://en.wikipedia.org/wiki/Paul\\_Allen](https://en.wikipedia.org/wiki/Paul_Allen)

Artificial Intelligence, Institute for Cell Science, and Stratolaunch Systems.<sup>2452</sup>

⇒ 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.

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<sup>2452</sup> [https://en.wikipedia.org/wiki/Paul\\_Allen](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.<sup>2453</sup>

**11,975 HE:** US-Soviet space craft rendezvous and dock.<sup>2454</sup>



Photo is of US-Soviet space craft rendezvous and dock, photographer unknown.<sup>2455</sup>

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<sup>2453</sup> [https://en.wikipedia.org/wiki/Paul\\_Allen](https://en.wikipedia.org/wiki/Paul_Allen)

<sup>2454</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2455</sup> Getty images

**11,976 HE:** NASA's space shuttle *Enterprise* rolled out of the Palmdale manufacturing facilities and was greeted by NASA officials and cast members from the Star Trek television series.

⇒ The *Enterprise* was used in atmospheric testing of the *Shuttle* and did not go to space.

⇒ *Enterprise* was transferred to the Intrepid Sea, Air & Space Museum in New York City, where it has been on display since **12,012 HE.**<sup>2456</sup>

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<sup>2456</sup> [https://www.nasa.gov/multimedia/imagegallery/image\\_feature\\_1204.html](https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html)



Enterprise with NASA Administrator Fletcher, and Star Trek cast members.<sup>2457</sup>

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<sup>2457</sup> [https://www.nasa.gov/multimedia/imagegallery/image\\_feature\\_1204.html](https://www.nasa.gov/multimedia/imagegallery/image_feature_1204.html)

**11,976 HE:** Both: 1) Apple Computer was founded by STEVE JOBS and STEVE WOZNIAK along with administrative supervisor Ronald Wayne, whose participation in the new venture was short lived, and 2) STEVE WOZNIAK'S Apple 1 computer was released.<sup>2458</sup>



Photo is of an original **11,976 HE** Apple 1 Computer in a briefcase, from the Sydney Powerhouse Museum collection.<sup>2459</sup>

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<sup>2458</sup> [https://en.wikipedia.org/wiki/Steve\\_Wozniak](https://en.wikipedia.org/wiki/Steve_Wozniak)

<sup>2459</sup> <http://www.computerhistory.org/timeline/computers/>



**12,017 HE:** Photo of STEVE WOZNIAK (Born **11,950 HE**)  
United States inventor, electronics engineer, programmer,  
philanthropist, and technology entrepreneur.<sup>2460</sup>

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<sup>2460</sup> [https://en.wikipedia.org/wiki/Steve\\_Wozniak](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.<sup>2461</sup>
- WOZNIAK alone designed the hardware, circuit board designs, and operating system for the Apple I. WOZNIAK originally offered the design to HP while working there but was denied by the company on five different occasions. JOBS instead had the idea to sell the Apple I with WOZNIAK as a fully assembled printed circuit board. WOZNIAK, at first skeptical, was later convinced by JOBS that even if they were not successful, they could at least say to their grandkids they had had their own company. Together they sold some of their possessions (such as WOZNIAK's HP scientific calculator and JOB'S Volkswagen van) raised \$1,300 and assembled the

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<sup>2461</sup> [https://en.wikipedia.org/wiki/Steve\\_Wozniak](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.<sup>2462 2463</sup>

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<sup>2462</sup> [https://en.wikipedia.org/wiki/Steve\\_Wozniak](https://en.wikipedia.org/wiki/Steve_Wozniak)

<sup>2463</sup> 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](https://en.wikipedia.org/wiki/Steve_Wozniak)

<sup>^</sup> "Apple co-founder offered first computer design to HP 5 times". [appleinsider.com](http://appleinsider.com).



**12,010 HE:** photo at the Worldwide Developers Conference of STEVE JOBS (11,955 HE – 12,011 HE).<sup>2464</sup>

- Some facts on STEVE JOBS: His declassified FBI report states that he used marijuana and LSD while he was in college, and once told a reporter that taking LSD was "one of the two or three most important things" he had done in his life. He considered taking up monastic residence at Eihei-ji in

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<sup>2464</sup> [https://en.wikipedia.org/wiki/Steve\\_Jobs](https://en.wikipedia.org/wiki/Steve_Jobs)

Japan and maintained a lifelong appreciation for Zen. JOBS would later say that people around him who did not share his countercultural roots could not fully relate to his thinking. JOBS denied paternity of his DNA tested daughter, Lisa Brennan (eventually he recognized paternity), and was worth over \$1 million in **11,978 HE** when he was just 23 years old. This grew to over \$250 million by the time he was 25, according to estimates.<sup>2465</sup>

**11,977 HE:** *Voyager 1 and 2* are launched. They reach the edge of the solar system in **12,018 HE**.<sup>2466</sup>

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<sup>2465</sup> [https://en.wikipedia.org/wiki/Steve\\_Jobs](https://en.wikipedia.org/wiki/Steve_Jobs)

<sup>2466</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

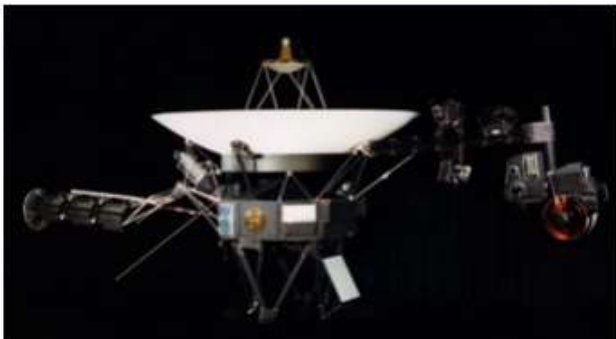
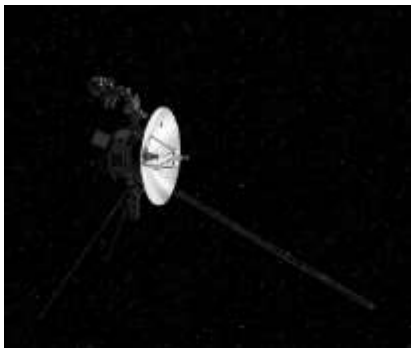


Image of *Voyager 1*. Location and artist unknown.<sup>2467</sup>

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<sup>2467</sup> <https://voyager.jpl.nasa.gov/>



Artist's concept of the *Voyager 2* spacecraft in space. Credit: NASA.<sup>2468</sup>

⇒ After completing its primary mission with the flyby of Saturn on November 12, **11,980 HE**, *Voyager 1* became the third of five

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<sup>2468</sup> <https://solarsystem.nasa.gov/missions/voyager-2/in-depth/>

artificial objects to achieve the escape velocity that will allow them to leave the Solar System. On August 25, **12,012 HE**, *Voyager 1* became the first spacecraft to cross the heliopause and enter the interstellar medium. Having operated for 41 years, 1 month and 20 days as of October 25, **12,018 HE**, the spacecraft still communicates with the Deep Space Network to receive routine commands and return data. At a distance of 142.31 astronomical units (21.289 billion kilometers; 13.229 billion miles) from the Sun as of June 4, **12,018 HE**, it is the most distant human-built object from Earth. The probe's objectives included flybys of Jupiter, Saturn, and Saturn's largest moon, Titan. While the spacecraft's course could have been altered to include a Pluto encounter by forgoing the Titan flyby, exploration of Titan (which was known to have a substantial atmosphere) took priority. It studied the weather, magnetic fields

and rings of the two planets and was the first probe to provide detailed images of their moons.<sup>2469</sup>



**Circa 11,979 HE:** Screen Snips of 8 of the many photos of Jupiter and area taken by *Voyager 2*.<sup>2470</sup>

<sup>2469</sup> [https://en.wikipedia.org/wiki/Voyager\\_1](https://en.wikipedia.org/wiki/Voyager_1)

<sup>2470</sup> [https://en.wikipedia.org/wiki/Voyager\\_2](https://en.wikipedia.org/wiki/Voyager_2)



⇒ **12,270 HE:** *Voyager* famously and fictionally returns to our Solar System in the film *Star Trek: The Motion Picture* (released in **11,979 HE**).<sup>2471</sup>

**11,979 HE:** Visicalc is the first commercial software widely adopted.<sup>2472</sup>

**11,979 HE:** WordStar is first commercial word processor.<sup>2473</sup>

**11,980 HE:** Atari gaming console introduced.<sup>2474</sup>

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<sup>2471</sup> Paul Premack

<sup>2472</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2473</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2474</sup> <http://www.computerhistory.org/timeline/computers/>



The third version of the Atari Video Computer System sold from **11,980 HE** to **11,982 HE**.<sup>2475</sup>

**11,980 HE:** MS-DOS operating system first introduced.<sup>2476</sup>

**Circa 11,980 HE:** Daisy wheel and Dot matrix printers introduced.



⇒ Photo is of The Royal LetterMaster, a daisy-wheel printer<sup>2477</sup>

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<sup>2475</sup> <https://en.wikipedia.org/wiki/Atari>

<sup>2476</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2477</sup> [https://en.wikipedia.org/wiki/Daisy\\_wheel\\_printing](https://en.wikipedia.org/wiki/Daisy_wheel_printing)



Photo is of the **11,980 HE** MX-80 Epson Dot matrix printer<sup>2478</sup>

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<sup>2478</sup> <https://epson.com/company-history>

**11,981 HE:** IBM 5150 PC with IBM 5151 monitor introduced.<sup>2479</sup>



Photo is of the IBM PC, location, photographer unknown.<sup>2480</sup>

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<sup>2479</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2480</sup> <http://www.computerhistory.org/timeline/computers/>

**11,981 HE:** RICHARD FEYNMAN introduces the idea for quantum computing.<sup>2481</sup>

**11,981 HE:** A new era in space flight began on April 12, **11,981 HE**, when Space Shuttle *Columbia*, or STS-1, launched from NASA's Kennedy Space Center in Florida. Astronaut JOHN YOUNG, a veteran of four previous spaceflights including a walk on the moon in **11,972 HE**, commanded the mission. Navy test pilot Bob Crippen piloted the mission and would go on to command three future shuttle missions. The shuttle was humankind's first re-usable spacecraft.<sup>2482</sup>

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<sup>2481</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2482</sup> [https://www.nasa.gov/multimedia/imagegallery/image\\_feature\\_2488.html](https://www.nasa.gov/multimedia/imagegallery/image_feature_2488.html)



**11,981 HE:** Launch of STS-1, Space Shuttle *Columbia*,  
photographer unknown.<sup>2483</sup>

**11,981 HE:** The NASA/DOE 7.5-megawatt Mod-2 three turbine cluster in Goodnoe Hills, Washington, United States.<sup>2484</sup>



Image of the NASA/DOE 7.5-megawatt Mod-2 three turbine cluster.

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<sup>2483</sup> [https://www.nasa.gov/mission\\_pages/shuttle/sts1/index.html](https://www.nasa.gov/mission_pages/shuttle/sts1/index.html)

<sup>2484</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)



**11,981 HE:** The Canadarm remote manipulator system was delivered to NASA. In all, five Canadarms — Nos. 201, 202, 301, 302, and 303 — were built and delivered to NASA.



**11,996 HE:** Canadarm during Space Shuttle mission STS-72.<sup>2485</sup>

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<sup>2485</sup> <https://en.wikipedia.org/wiki/Canadarm>

**11,981 HE:** *Voyager 2* reached Saturn and began transmitting images.<sup>2486</sup> **11,986 HE:** images arrive from Uranus, and in **11,989 HE** images arrive from Neptune.



**Circa 11,981 HE:** 8 of the many photos of Saturn and area taken by *Voyager 2*.<sup>2487</sup>

<sup>2486</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2487</sup> [https://en.wikipedia.org/wiki/Voyager\\_2](https://en.wikipedia.org/wiki/Voyager_2)

**Built between 11,983 HE and 11,998 HE:** The Large Hadron Collider (LHC), built underground, crosses the border between Switzerland and France at four points, with most of it in France. It is the world's largest and most powerful particle collider and the largest machine in the world. It was built by the European Organization for Nuclear Research (CERN) between in collaboration with over 10,000 scientists and hundreds of universities and laboratories, as well as more than 100 countries.<sup>2488</sup>

⇒ On 4 July **12,012 HE:** At the LHC, both CERN ATLAS and CERN CMS experiments teams announced they had independently made the same discovery of the HIGGS Boson. Using the combined analysis of two interaction types (known as 'channels'), both experiments independently reached a result implying that the probability of getting at least as strong a result

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<sup>2488</sup> [https://en.wikipedia.org/wiki/Large\\_Hadron\\_Collider](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 **12,011 HE** or early **12,012 HE**, meaning they did not discuss their results with each other, providing additional certainty that any common finding was genuine validation of a particle. This level of evidence, confirmed independently by two separate teams and experiments, meets the formal level of proof required to announce a confirmed discovery.<sup>2489</sup>

- ⇒ **12,015 HE**: The LHC's experimental work since restarting in **12,015 HE** has included probing the Higgs field and boson to a greater level of detail and confirming whether or not less common predictions were correct. In particular, exploration since **12,015 HE** has provided strong evidence of the predicted direct decay into fermions such as pairs of bottom quarks (3.6

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<sup>2489</sup> [https://en.wikipedia.org/wiki/Higgs\\_boson](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".<sup>2490</sup>

⇒ **12,017 HE**: The Large Hadron Collider has continued to produce findings that confirm the **12,013 HE** understanding of the Higgs field and particle. CERN confirmed that all measurements still agree with the predictions of the Standard

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<sup>2490</sup> [https://en.wikipedia.org/wiki/Higgs\\_boson](https://en.wikipedia.org/wiki/Higgs_boson)

Model and called the discovered particle simply "the Higgs boson".<sup>2491</sup>

⇒ **12,018 HE:** Both the ATLAS and CMS experiments at CERN reported observing the Higgs boson decay into a pair of bottom quarks, which makes up approximately 60% of all of its decays.<sup>2492</sup>

**11,983 HE:** Nintendo introduced their first gaming console outside Japan.<sup>2493</sup>

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<sup>2491</sup> [https://en.wikipedia.org/wiki/Higgs\\_boson](https://en.wikipedia.org/wiki/Higgs_boson)

<sup>2492</sup> [https://en.wikipedia.org/wiki/Higgs\\_boson](https://en.wikipedia.org/wiki/Higgs_boson)

<sup>2493</sup> <http://www.computerhistory.org/timeline/computers/>



⇒ The Nintendo Entertainment System.<sup>2494</sup>

**11,983 HE:** GUION BLUFORD (Born **11,942 HE**) is the first United States African-American astronaut in space.<sup>2495</sup>

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<sup>2494</sup> [https://en.wikipedia.org/wiki/Nintendo\\_video\\_game\\_consoles](https://en.wikipedia.org/wiki/Nintendo_video_game_consoles)

<sup>2495</sup> [https://en.wikipedia.org/wiki/Guion\\_Bluford](https://en.wikipedia.org/wiki/Guion_Bluford)



Photo of GUION BLUFORD, photographer unknown.<sup>2496</sup>

**11,983 HE: SALLY RIDE (11,951 HE – 12,012 HE)**<sup>2497</sup> is the first United States female astronaut in space.

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<sup>2496</sup> [https://en.wikipedia.org/wiki/Guion\\_Bluford](https://en.wikipedia.org/wiki/Guion_Bluford)

<sup>2497</sup> [https://en.wikipedia.org/wiki/Sally\\_Ride](https://en.wikipedia.org/wiki/Sally_Ride)





Photo of SALLY RIDE on Challenger's mid-deck during STS-7; photographer unknown.<sup>2498</sup>

**11,984 HE:** KATHRYN SULLIVAN (born **11,951 HE**<sup>2499</sup>) is the first United States woman to do a spacewalk.

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<sup>2498</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2499</sup> [https://en.wikipedia.org/wiki/Kathryn\\_D.\\_Sullivan](https://en.wikipedia.org/wiki/Kathryn_D._Sullivan)



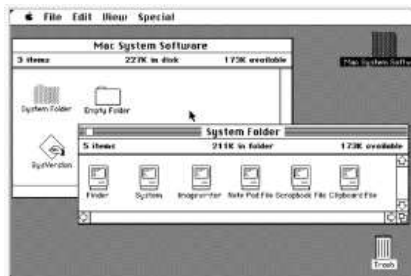
Photo of KATHRYN SULLIVAN; photographer unknown.<sup>2500</sup>

**11,984 HE:** Apple's Macintosh introduced the GUI (graphical user interface).<sup>2501</sup>

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<sup>2500</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2501</sup> <http://www.computerhistory.org/timeline/computers/>



The Mac GUI was the first commercially successful product to use a multi-panel window interface.<sup>2502</sup>

**11,985 HE:** Microsoft Windows 1.01 including GUI introduced.<sup>2503</sup>

<sup>2502</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_graphical\\_user\\_interface#Xerox\\_PARC](https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC)

<sup>2503</sup> <http://www.computerhistory.org/timeline/computers/>

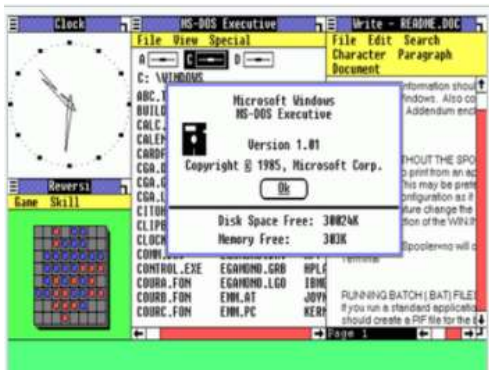


Photo is a screen snip of Windows 1.01.<sup>2504</sup>

**11,986 HE – 12,001 HE:** Soviet space station *Mir*.

<sup>2504</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_graphical\\_user\\_interface#Xerox\\_PARC](https://en.wikipedia.org/wiki/History_of_the_graphical_user_interface#Xerox_PARC)



**11,998 HE:** Soviet Union (and later Russia's) space station *Mir* seen from Space Shuttle *Endeavour* during STS-89.<sup>2505</sup>

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<sup>2505</sup> <https://en.wikipedia.org/wiki/Mir>

**11,988 HE:** The International Dark Sky Association was formed. 100 years after Vincent Van Gogh painted “Starry Night over the Rhone” in **11,888 HE**, almost 400 years to the date to the beginning of the Industrial Revolution which began around **11,589 HE**, light pollution was stealing the views of our night skies. Scientists DAVID CRAWFORD, professional astronomer and TIM HUNTER, physician / amateur astronomer incorporated The International Dark Sky Association.<sup>2506 2507</sup>

⇒ The mission of the IDA is "to preserve and protect the night time environment and our heritage of dark skies through quality outdoor lighting." Light pollution is the result of outdoor lighting

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<sup>2506</sup> <http://darksky.org>

<sup>2507</sup> Author / Compiler worked with DAVID CRAWFORD and many concerned Texans to enact the woefully inadequate Texas Dark Sky law, circa **11,996 HE– 12,000 HE**, sponsored by then Texas Congressman Pete Gallegos, which was a compromise- only legislating responsible shielded lighting on Texas roads, highways and parking lots. The law did not touch architecture, landscaping, etc.

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.<sup>2508</sup>

⇒ 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.<sup>2509</sup>

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<sup>2508</sup> <http://darksky.org>

<sup>2509</sup>



DAVID CRAWFORD, photographer and date unknown.<sup>2510</sup>

⇒ For more about dark skies, visit [www.darksky.org](http://www.darksky.org) or visit [www.mcdonaldobservatory.com/darkskies](http://www.mcdonaldobservatory.com/darkskies).<sup>2511</sup>

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<sup>2510</sup> [bing.com/images/search?idaquebec.org](http://bing.com/images/search?idaquebec.org)

<sup>2511</sup> Little flashlights were distributed at the Star Parties at both McDonald Observatory and Kitt Peak Observatory. Everyone saw better at night with the red light instead of the white light. Further research determined amber lights on the outside of buildings or in outdoor fixtures are 1) Not a Political Statement 2) Not a sexual announcement 3) Yes quite effective for humans and other living creatures 4) Yes a protection of nature 5) Yes a protection of Health 6) Yes a security measure 7) Yes better for human, as well as other creatures eyes to see at night.



**11,989 HE:** World Wide Web, invented by TIM BERNERS-LEE,<sup>2512</sup> also known as TimBL, an English engineer and computer scientist.<sup>2513</sup>

⇒ **11,991 HE:** The first website was built and put online on for the first time at CERN. Despite this being an international organization hosted by Switzerland, the office that BERNERS-LEE used was just across the border in France.<sup>2514</sup>

- 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,

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<sup>2512</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2513</sup> [https://en.wikipedia.org/wiki/Tim\\_Berners-Lee](https://en.wikipedia.org/wiki/Tim_Berners-Lee)

<sup>2514</sup> <http://www.computerhistory.org/timeline/computers/>

changes were made daily to the information available on the page as the WWW project developed.<sup>2515</sup>

- **11,992 HE:** BERNERS-LEE introduced the first web browser.<sup>2516</sup>
- BERNERS-LEE is one of the pioneer voices in favour of net neutrality and has expressed the view that ISPs should supply "connectivity with no strings attached" and should neither control nor monitor the browsing activities of customers without their expressed consent.<sup>2517</sup>

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<sup>2515</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2516</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2517</sup> [https://en.wikipedia.org/wiki/Tim\\_Berners-Lee](https://en.wikipedia.org/wiki/Tim_Berners-Lee)



**12,015 HE** Photo is of SIR TIMOTHY JOHN BERNERS-LEE  
OM KBE FRS FREng FRSA FBCS (born **11,955 HE**).<sup>2518</sup>

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<sup>2518</sup> [https://en.wikipedia.org/wiki/Tim\\_Berners-Lee](https://en.wikipedia.org/wiki/Tim_Berners-Lee)

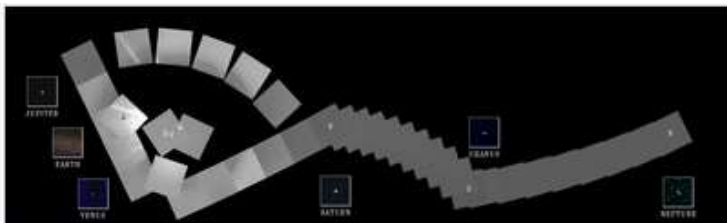
**11,990 HE:** Two of the many photos taken by *Voyager 1*:



**11,990 HE:** Photo is *The Pale Blue Dot* photo, taken by *Voyager 1*. Seen from about 6 billion kilometers, Earth appears as a tiny dot (the blueish-white speck approximately halfway down the brown band to the right) within the darkness of deep space.<sup>2519</sup>

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<sup>2519</sup> [https://en.wikipedia.org/wiki/Pale\\_Blue\\_Dot](https://en.wikipedia.org/wiki/Pale_Blue_Dot)



**11,990 HE:** The Family Portrait of our Solar System from *Voyager 1*.<sup>2520</sup>

**1,990 HE:** TOYOHIRO AKIYAMA (born **11,942 HE**) was the first Japanese astronaut and was on the Soviet Union space ship *Soyuz TM-11*.

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<sup>2520</sup> [https://en.wikipedia.org/wiki/Voyager\\_1](https://en.wikipedia.org/wiki/Voyager_1)



Photo is of TOYOHIRO AKIYAMA.<sup>2521</sup>

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<sup>2521</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Japanese\\_astronauts](https://en.wikipedia.org/wiki/List_of_Japanese_astronauts)

**11,990 HE:** The *Magellan* spacecraft began mapping the surface of Venus using radar equipment. The Space Shuttle *Discovery* deployed the *Hubble Space Telescope*.<sup>2522</sup>



Photo is of *Magellan* being fixed into position inside the payload bay of shuttle *Atlantis* prior to launch.<sup>2523</sup>

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<sup>2522</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2523</sup> [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.<sup>2524</sup>

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<sup>2524</sup> [https://en.wikipedia.org/wiki/Hubble\\_Space\\_Telescope](https://en.wikipedia.org/wiki/Hubble_Space_Telescope)



**11,992 HE:** MAMORU MOHRI, Japan. Scientist who flew on the *Endeavour STS-47*.



Photo is of MAMORU MOHRI.<sup>2525</sup>

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<sup>2525</sup> [https://en.wikipedia.org/wiki/List\\_of\\_Japanese\\_astronauts](https://en.wikipedia.org/wiki/List_of_Japanese_astronauts)

**11,994 HE:** Dr. CHIAKI MUKAI (born **11,952 HE**) is a Japanese doctor and JAXA astronaut.

⇒ Dr. CHIAKI MUKAI was the first Japanese woman in space and was the first Japanese citizen to have two spaceflights. Both were Space Shuttle missions:

- Her first was STS-65 aboard Space Shuttle *Columbia* in July **11,994 HE**, which was a Spacelab mission.
- Her second spaceflight was STS-95 aboard Space Shuttle *Discovery* in **11,998 HE**. In total Dr. CHIAKI MUKAI has spent 23 days in space.<sup>2526</sup>

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<sup>2526</sup> [https://en.wikipedia.org/wiki/Chiaki\\_Mukai](https://en.wikipedia.org/wiki/Chiaki_Mukai)



Photo of Dr. CHIAKI MUKAI.<sup>2527</sup>

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<sup>2527</sup> [https://en.wikipedia.org/wiki/Chiaki\\_Mukai](https://en.wikipedia.org/wiki/Chiaki_Mukai)

**11,993 HE:** Epson reaches its 5-year goal to be CFC free.



2528

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<sup>2528</sup> <https://epson.com/company-history>

**11,994 HE:** Sony introduced the PlayStation.<sup>2529</sup>



⇒ Photo of the Original PlayStation, photographer unknown.<sup>2530</sup>

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<sup>2529</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2530</sup> <https://en.wikipedia.org/wiki/PlayStation>

**11,994 HE – current:** Gravitational Wave observatories. Until this time, electromagnetic radiation and particles (visible light, radio waves, x-rays, neutrinos, etc.) have been used to observe the universe. Gravitational waves are disruptions in spacetime itself, a new and different science exposing a wealth of discoveries. As EINSTEIN described in his General Theory of Relativity, “Gravitational waves spread at the speed of light, filling the universe.” The waves are always created when mass violently accelerates, like when pair of black holes orbit each other. Though EINSTEIN was convinced it would never be possible to measure Gravitational Waves, these new observatories can, as gravitational waves pass Earth, measure fluctuations thousands of times smaller than an atomic nucleus.<sup>2531</sup>

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<sup>2531</sup> <https://www.nobelprize.org/prizes/physics/2017/press-release/>

- ⇒ The Laser Interferometer Gravitational-Wave Observatory (*LIGO*) Hanford, WA, USA and Livingston, LA, USA is a large-scale physics experiment and astronomical observatory to detect cosmic gravitational waves and to develop gravitational-wave observations.



• The *LIGO* Livingston control room as it was during *LIGO*'s first observing run in **12,001 HE**. The initial *LIGO* observatories were funded by the National Science

Foundation (NSF) and were conceived, built, and are operated by Caltech and MIT.<sup>2532</sup>

- ⇒ 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.

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<sup>2532</sup> <https://en.wikipedia.org/wiki/LIGO>





- EGO is the European Gravitational Observatory *VIRGO*, photographer unknown.<sup>2533</sup>

⇒ **12,015 HE – 12,017 HE:** The *LIGO* and *VIRGO* collaboration announced they had made the first observation of gravitational waves, originating from a pair of merging black holes. *LIGO* instruments detected two more confirmed, and one potential,

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<sup>2533</sup> <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.<sup>2534</sup>

⇒ **12,017 HE:** the Nobel Prize in Physics was awarded to RAINER WEISS, KIP THORNE, and BARRY C. BARISH "for decisive contributions to the *LIGO* detector and for the observation of gravitational waves."<sup>2535</sup>

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<sup>2534</sup> [https://en.wikipedia.org/wiki/Gravitational\\_wave](https://en.wikipedia.org/wiki/Gravitational_wave)

<sup>2535</sup> <https://en.wikipedia.org/wiki/LIGO>



- RAINER WEISS, born **11,932 HE**, is a United States physicist, contributor in gravitational physics and

astrophysics. He invented the laser interferometric technique which is the basic operation of *LIGO*.<sup>2536</sup>

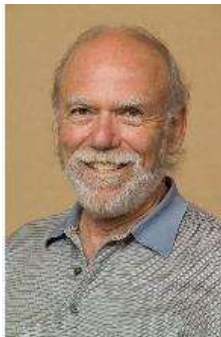


- **KIP THORNE:** born **11,940 HE** is a United States theoretical

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<sup>2536</sup> [https://en.wikipedia.org/wiki/Rainer\\_Weiss](https://en.wikipedia.org/wiki/Rainer_Weiss)

physicist and Nobel laureate, known for his contributions in gravitational physics and astrophysics. He continues to do scientific research and scientific consulting.<sup>2537</sup>



- **BARRY CLARK BARISH** born **11,936** **HE** is a United

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<sup>2537</sup> [https://en.wikipedia.org/wiki/Kip\\_Thorne](https://en.wikipedia.org/wiki/Kip_Thorne)

States experimental physicist and Nobel Laureate. He is a leading expert on gravitational waves, and is Linde Professor of Physics, emeritus at California Institute of Technology.<sup>2538</sup>

⇒ Circa **12,017 HE: SAMAYA NISSANKE**, Dutch Astrophysicist from Radboud University and<sup>2539</sup> **SHEILA ROWAN**, Scottish Astrophysicist from University of Glasgow<sup>2540</sup> 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

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<sup>2538</sup> [https://en.wikipedia.org/wiki/Barry\\_Barish](https://en.wikipedia.org/wiki/Barry_Barish)

<sup>2539</sup> <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>

<sup>2540</sup> [https://en.wikipedia.org/wiki/Sheila\\_Rowan\\_\(physicist\)](https://en.wikipedia.org/wiki/Sheila_Rowan_(physicist))

MAXWELL's equations" and "We can observe the universe in a totally different way now through ripples in the fabric of spacetime itself! It enables us to test Einstein's General Relativity Theory for the first time. For theoretical astrophysicists like us, the most exciting part is only just beginning"<sup>2541</sup> and "The night skies are incredibly dynamic and time-varying - and some of these transient sources shine brightly in both gravitational and electromagnetic radiation."<sup>2542</sup>

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<sup>2541</sup> Podcast: BBC Science Hour October 21, 12,017 HE

<sup>2542</sup> <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>



- SAMAYA NISSANKE, date, location, photographer unknown.<sup>2543</sup>

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<sup>2543</sup> <https://www.ru.nl/english/research/radboud/top-research-areas/astrophysics/more-info/samaya-nissanke-gravitational-wave-specialist/>



**11,994 HE:** First direct observation of a comet impacting Jupiter.



⇒

NASA/JPL composite image of fragments from comet SHOEMAKER-LEVY colliding with Jupiter. (See **11,928 HE**, EUGENE SHOEMAKER).<sup>2544</sup>

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<sup>2544</sup> <https://www2.jpl.nasa.gov/sl9/sl9.html>

**11,995 HE:** United States Astronaut Eileen Collins (born **11,956 HE**) became the first female Space Shuttle *Pilot*.<sup>2545</sup>



Photo of American Astronaut Eileen Collins with President

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<sup>2545</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

William Jefferson Clinton, location: The White House. (Hillary Clinton was also present<sup>2546</sup>, but we could not find a photo including all their faces). [See **11,999 HE** when Collins became first female Shuttle *Commander*.]

**11,995 HE: CHRIS AUSTIN HADFIELD**<sup>2547</sup> OC OOnt MSC CD (born **11,959 HE**) - First Canadian in Space.

⇒ **12,001 HE: CHRIS HADFIELD** became the first Canadian to walk in space and helped to install the Canadarm2.<sup>2548</sup>

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<sup>2546</sup> Netflix documentary “Mercury 13”

<sup>2547</sup> Multiple Great Youtube.com videos

<sup>2548</sup> [https://en.wikipedia.org/wiki/Chris\\_Hadfield](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.*<sup>2549</sup>



⇒ CHRIS AUSTIN HADFIELD, date unknown.<sup>2550</sup>

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<sup>2549</sup> [https://www.amazon.com/dp/0316253014/ref=cm\\_sw\\_r\\_cp\\_ep\\_dp\\_sCcFBb7FNTE7S](https://www.amazon.com/dp/0316253014/ref=cm_sw_r_cp_ep_dp_sCcFBb7FNTE7S)

<sup>2550</sup> [https://en.wikipedia.org/wiki/Chris\\_Hadfield](https://en.wikipedia.org/wiki/Chris_Hadfield)

**11,996 HE – 11,999 HE:** General Motors introduces the EV1.



One of the cars introduced due to the California Air Resources Board mandate, the EV1 had a range of 260 km (160 miles) with NiMH batteries. It was available initially to residents of the cities of Los Angeles, California, and Phoenix and Tucson, Arizona, and only for lease. Through forced repossession and destruction of the majority of EV1s, the GM electric car program

was forcibly ended.<sup>2551</sup> GM did not get back into electric car production until introduction of the Bolt, its first 100% electric vehicle, in **12,016 HE**. The **12.006 HE** documentary “*Who Killed the Electric Car*” decried GM’s decision to take the EV1 away from its adoring drivers.<sup>2552</sup>

**11,996 HE:** A Presidential Decision Directive was issued and later passed into law that transferred the "ownership" of the GPS system to an Interagency GPS Executive Board (IGEB), with representatives from the DOD, the U.S. Department of Transportation, and other government agencies. This transfer was done primarily to make sure GPS could be used effectively for both civil and military user needs.<sup>2553</sup>

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<sup>2551</sup> [wikipedia.org/wiki/General\\_Motors\\_EV1](http://wikipedia.org/wiki/General_Motors_EV1)

<sup>2552</sup> <http://whokilledtheelectriccar.com>

<sup>2553</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>

**11,996 HE:** The Author / Compiler and family wanted an electric car and the EV1 was not available in Texas, so we bought a VOLVO 950 and KEN BANCROFT converted it from an internal combustion engine vehicle to an electric car for us. We called it the Pioneer.<sup>2554</sup>



<sup>2554</sup> Author / Compiler family photos

**11,996 HE:** *James Webb Space Telescope* is authorized.<sup>2555</sup>

- ⇒ **11,996 HE - today:** NASA, ESA and CSA have collaborated on the telescope. ESA's participation in construction and launch was approved by its members in **12,003 HE**, and an agreement was signed between ESA and NASA in **12,007 HE**.
- ⇒ In exchange for full partnership, representation, and access to the observatory for its astronomers, ESA is providing the NIRSpec instrument, the Optical Bench Assembly of the MIRI instrument, an Ariane 5 ECA launcher, and manpower to support operations. The CSA will provide the Fine Guidance Sensor and the Near-Infrared Imager Slitless Spectrograph plus manpower to support operations.<sup>2556</sup>

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<sup>2555</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2556</sup> [https://en.wikipedia.org/wiki/James\\_Webb\\_Space\\_Telescope](https://en.wikipedia.org/wiki/James_Webb_Space_Telescope)



⇒ Countries Participating with the *James Webb Space Telescope*:

-  Austria;  Belgium;  Canada;  Czech Republic;  Denmark;  Finland;  France;  Germany;  Greece;  Ireland;  Italy;  Luxembourg;  Netherlands;  Norway;  Portugal;  Spain;  Sweden;  Switzerland;  United Kingdom;  United States.<sup>2557</sup>

⇒ **12,021 HE:** *James Webb Space Telescope* planned launch date.<sup>2558</sup>

<sup>2557</sup> [https://en.wikipedia.org/wiki/James\\_Webb\\_Space\\_Telescope](https://en.wikipedia.org/wiki/James_Webb_Space_Telescope)

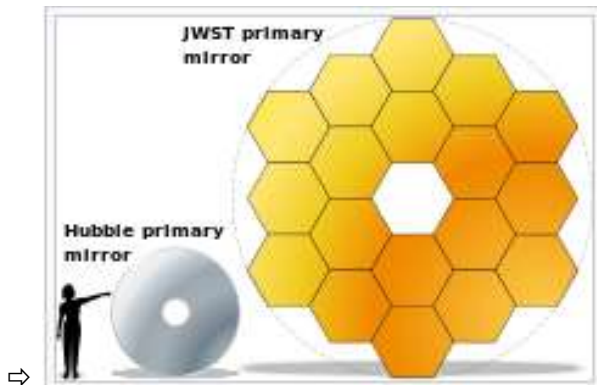
<sup>2558</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>



**12,016 HE:** *James Webb Space Telescope* main mirror assembled at Goddard Space Flight Center. Primary mirror segments are made of star-stuff elements beryllium and gold.<sup>2559</sup>

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<sup>2559</sup> [https://en.wikipedia.org/wiki/James\\_Webb\\_Space\\_Telescope](https://en.wikipedia.org/wiki/James_Webb_Space_Telescope)



*James Webb Space Telescope* primary mirror: Comparison with *Hubble Space Telescope* primary mirror.<sup>2560</sup>

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<sup>2560</sup> [https://en.wikipedia.org/wiki/James\\_Webb\\_Space\\_Telescope](https://en.wikipedia.org/wiki/James_Webb_Space_Telescope)

**11,996 HE:** Palm pilot introduced.<sup>2561</sup> 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.<sup>2562</sup>

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<sup>2561</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2562</sup> [https://en.wikipedia.org/wiki/Palm\\_\(PDA\)#PalmPilot1000\\_and\\_5000\\_\(1996\)](https://en.wikipedia.org/wiki/Palm_(PDA)#PalmPilot1000_and_5000_(1996))

**11,996 HE:** *Mars Pathfinder*, the United States robotic spacecraft base station with the wheeled robotic rover *Sojourner*, is launched. In **11,997 HE** the *Mars Pathfinder* arrived on Mars and began transmitting images.<sup>2563</sup>



**11,995 HE:** The *Pathfinder* air bags are tested.<sup>2564</sup>

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<sup>2563</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2564</sup> [https://en.wikipedia.org/wiki/Mars\\_Pathfinder](https://en.wikipedia.org/wiki/Mars_Pathfinder)



**11,996 HE:** *Pathfinder* and *Sojourner* at JPL being 'folded' into their launch positions.<sup>2565</sup>

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<sup>2565</sup> [https://en.wikipedia.org/wiki/Mars\\_Pathfinder](https://en.wikipedia.org/wiki/Mars_Pathfinder)



Photo is of **11,997 HE** close-up of the Mars sky at sunset, by Mars *Pathfinder*.<sup>2566</sup> (Author / Compiler note: See how much

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<sup>2566</sup> [https://en.wikipedia.org/wiki/Mars\\_Pathfinder](https://en.wikipedia.org/wiki/Mars_Pathfinder)

smaller our sun looks in this photo than in sunsets we view from Earth?<sup>2567</sup>)



*Sojourner* rover on Mars on sol 22.<sup>2568</sup> (Author / Compiler note: “Sol 22” means the 22nd day on Mars).<sup>2569</sup>

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<sup>2567</sup> <https://www.universetoday.com/14822/how-far-is-mars-from-the-sun/>

<sup>2568</sup> [https://en.wikipedia.org/wiki/Mars\\_Pathfinder](https://en.wikipedia.org/wiki/Mars_Pathfinder)

<sup>2569</sup> Paul Premack



**11,997 HE:** Toyota introduced the first mass produced Hybrid Electric Vehicle: the Prius. While other cars on the road were getting mpg ratings in the teens, Prius' range was about 50 mpg.<sup>2570</sup>



Prius Generation 1.<sup>2571</sup>

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<sup>2570</sup> <http://www.cars-directory.net/history/toyota/prius/>

<sup>2571</sup> [www.bing.com/images/search?q=1997+Toyota+Prius&FORM=RESTAB](http://www.bing.com/images/search?q=1997+Toyota+Prius&FORM=RESTAB)

**11,997 HE:** Human Lifespan, according to CARL SAGAN<sup>2572</sup>:

- **Circa 39,000 BHE:** In hunter gather, pre-agricultural times, the human life expectancy was about 20-30 years.
- **Circa 11,870 HE:** more than 50,000 years later, due to scientific advancement, human lifespan rose to about 40 years. (See LOUIS PASTEUR and ROBERT TYNDALL).
- **Circa 11,915 HE:** (circa 45 years later) Due to further scientific advancement, human age expectancy rose to about 50 years.

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<sup>2572</sup> CARL SAGAN The Demon-Haunted World; Science as a Candle in the Dark p.10

- **Circa 11,930 HE:** (Just 15 years later) Due to further scientific advancement human lifespan expectancy rose to about 60 years of age.
- **Circa 11,955 HE:** (Just 25 years later) Due to further scientific advancement human lifespan expectancy rose to about 70 years of age.
- **Circa 11,997 HE:** (Just 42 years later) Due to further scientific advancement human lifespan rose to about 80 years of age for males, 84 years of age for females.

**11,998 HE:** FRED (11,911 HE– 12,002 HE) AND NORAH RODEN URQUART (11,918 HE – 12,009 HE) were presented with Canada's highest civilian award, the Order of Canada. FRED URQUART was a Canadian PhD zoologist who studied the migration of Monarch Butterflies, *Danaus plexippus* L. Together

they identified the migration routes and discovered that the migration spans multiple generations of Monarch butterflies. After many years of searching and with the help of CATALINA TRAIL and KEN BRUGGER, the URQUHARTS found the location in Mexico where the butterflies spend their winter, far away from their summer residence areas in Canada and the United States.<sup>2573</sup>



Poster for the 3D IMAX Film documentary film with Mike Slee

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<sup>2573</sup> [https://en.wikipedia.org/wiki/Fred\\_Urquhart](https://en.wikipedia.org/wiki/Fred_Urquhart)

as director took 5 years from funding to release in **12,012 HE**.<sup>2574</sup>

**11,998 HE:** Google is founded.<sup>2575</sup> Google was officially launched by LARRY PAGE, United States computer scientist and Internet entrepreneur, and SERGEY BRIN, United States computer scientist and internet entrepreneur.<sup>2576</sup>

⇒ PAGE is an investor in Tesla Motors. He has invested in renewable energy technology, and with the help of Google.org, Google's philanthropic arm, promotes the adoption of plug-in hybrid electric cars, and other alternative energy investments. He is also a strategic backer in the Opener startup which is

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<sup>2574</sup> [https://en.wikipedia.org/wiki/Flight\\_of\\_the\\_Butterflies](https://en.wikipedia.org/wiki/Flight_of_the_Butterflies)

<sup>2575</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2576</sup> [https://en.wikipedia.org/wiki/History\\_of\\_Google](https://en.wikipedia.org/wiki/History_of_Google)

developing aerial vehicles for consumer travel. PAGE also helped to set up Singularity University, a transhumanist think-tank. Google funds scholarships at Singularity University.<sup>2577</sup>



- Photo is of LARRY PAGE (**Born 11,971 HE**) speaking at the European Parliament in **12,009 HE**.<sup>2578</sup>

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<sup>2577</sup> [https://en.wikipedia.org/wiki/Larry\\_Page](https://en.wikipedia.org/wiki/Larry_Page)

<sup>2578</sup> [https://en.wikipedia.org/wiki/Larry\\_Page](https://en.wikipedia.org/wiki/Larry_Page)

⇒ *The Economist* referred to SERGEY BRIN as an "Enlightenment Man" and as someone who believes that "knowledge is always good, and certainly always better than ignorance," a philosophy that is summed up by Google's mission statement: "Organize the world's information and make it universally accessible and useful."<sup>2579</sup> BRIN is a supporter of lab-grown meat and kite-energy systems. BRIN is an investor in Tesla Motors. In **12,005 HE** BRIN was nominated to be one of the World Economic Forum's "Young Global Leaders". BRIN was involved in the Google driverless car project and attended the signing of the California Driverless Vehicle Bill.<sup>2580</sup>

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<sup>2579</sup> [https://en.wikipedia.org/wiki/Sergey\\_Brin](https://en.wikipedia.org/wiki/Sergey_Brin)

<sup>2580</sup> [https://en.wikipedia.org/wiki/Sergey\\_Brin](https://en.wikipedia.org/wiki/Sergey_Brin)



**12,008 HE** Photo is of SERGEY BRIN (Born: **11,973 HE**)  
Photographer and location unknown.<sup>2581</sup>

**11,998 HE:** First Modules of *The International Space Station* are  
launched.<sup>2582</sup>

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<sup>2581</sup> [https://en.wikipedia.org/wiki/Sergey\\_Brin](https://en.wikipedia.org/wiki/Sergey_Brin)

<sup>2582</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>



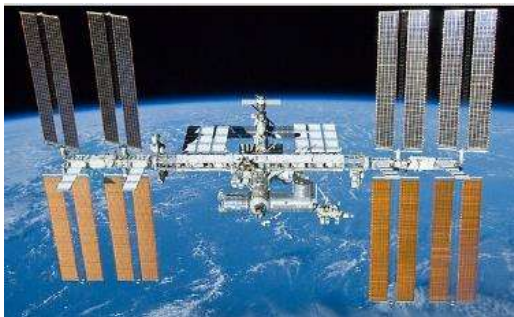


Photo is of *The International Space Station* on 23 May **12,010 HE** as seen from the departing Space Shuttle *Atlantis* during STS-132.<sup>2583</sup>

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<sup>2583</sup> [https://en.wikipedia.org/wiki/International\\_Space\\_Station](https://en.wikipedia.org/wiki/International_Space_Station)

⇒ The International Space Station programme is a joint project among five participating space agencies<sup>2584</sup> (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.<sup>2585</sup>
- **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

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<sup>2584</sup> [https://en.wikipedia.org/wiki/International\\_Space\\_Station](https://en.wikipedia.org/wiki/International_Space_Station)

<sup>2585</sup> [https://en.wikipedia.org/wiki/Canadian\\_Space\\_Agency](https://en.wikipedia.org/wiki/Canadian_Space_Agency)

of space. Established in **11,975 HE** and headquartered in Paris, France, ESA has a worldwide staff of about 2,000 people.<sup>2586</sup>

- **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.<sup>2587</sup>
- **NASA, United States.**<sup>2588</sup> As of **12,018, HE**, the United States portion of ISS is funded through **12,025 HE**.<sup>2589</sup>

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<sup>2586</sup> [https://en.wikipedia.org/wiki/European\\_Space\\_Agency](https://en.wikipedia.org/wiki/European_Space_Agency)

<sup>2587</sup> <https://en.wikipedia.org/wiki/JAXA>

<sup>2588</sup> [https://www.nasa.gov/offices/ogc/about/space\\_act1.html](https://www.nasa.gov/offices/ogc/about/space_act1.html)

<sup>2589</sup> [https://en.wikipedia.org/wiki/Assembly\\_of\\_the\\_International\\_Space\\_Station](https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station)

- **Roscosmos:** The Russian Roscosmos State Corporation for Space Activities responsible for the space flight and cosmonautics program for the Russian Federation.<sup>2590</sup>  
Roscosmos has endorsed the continued operation of ISS through **12,024 HE** but has proposed using elements of the Russian Orbital Segment to construct a new Russian space station to be called OPSEK.<sup>2591</sup>
- In addition to the *Canadarm*,<sup>2592</sup> 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

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<sup>2590</sup> <https://en.wikipedia.org/wiki/Roscosmos>

<sup>2591</sup> [https://en.wikipedia.org/wiki/Assembly\\_of\\_the\\_International\\_Space\\_Station](https://en.wikipedia.org/wiki/Assembly_of_the_International_Space_Station)

<sup>2592</sup> [https://en.wikipedia.org/wiki/Mobile\\_Servicing\\_System#Canadarm2](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.<sup>2593</sup>

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<sup>2593</sup> [https://en.wikipedia.org/wiki/Assembly\\_of\\_the\\_International\\_Space\\_Station](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.<sup>2594</sup>

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<sup>2594</sup> <https://www.youtube.com/watch?v=6YOz9Pxnzho>, Veritasium Interview

**11,999 HE:** EILEEN COLLINS, United States, became the first female Shuttle *Commander*.<sup>2595 2596</sup>



Mission Commander EILEEN COLLINS and STS-114 crew on their way to the launch pad.<sup>2597</sup>

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<sup>2595</sup> Netflix documentary “Mercury 13”

<sup>2596</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2597</sup> [https://en.wikipedia.org/wiki/Eileen\\_Collins](https://en.wikipedia.org/wiki/Eileen_Collins)



Image is of Eileen Collins speaking at the 2016 Republican National Convention<sup>2598</sup>

- Author / Compiler note: I have been trying to keep politics and religion out of this Holocene Era Timeline of Science. But the research and photo for the above entry shocked and baffled me when I discovered the information. Privacy in private life is good with me. However, Collins has a public

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<sup>2598</sup> [https://en.wikipedia.org/wiki/Eileen\\_Collins](https://en.wikipedia.org/wiki/Eileen_Collins)



life and got to where she is, as an employee of the public tax payer, because she stood on the shoulders of women who came before her.

- Some of the women on whose shoulders she stood were giants: women who historically were starved, who were jailed, who were humiliated, who were denied the vote and denied educations,<sup>2599</sup> women denied right to their own children, women denied the right to own land, denied salary because of their sex,<sup>2600</sup> or women denied jobs in their field because of their sex,<sup>2601</sup> or women denied rights to her own

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<sup>2599</sup> <https://www.youtube.com/watch?v=dCe9yO53pqE> TimJamesScience

<sup>2600</sup> 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*

<sup>2601</sup> Stuff You Missed In History Class podcast: <https://www.missedinhistory.com/podcasts/three-astonishing-belles.htm>

body,<sup>2602</sup> or women who fought to get Collins the right to vote and to even be educated, or to be in the military of the United States,<sup>2603</sup> or to be a pilot in the USA military like United States “Mercury 13,”<sup>2604</sup> 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

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<sup>2602</sup> [https://en.wikipedia.org/wiki/Margaret\\_Sanger](https://en.wikipedia.org/wiki/Margaret_Sanger)

<sup>2603</sup> [https://en.wikipedia.org/wiki/Grace\\_Hopper](https://en.wikipedia.org/wiki/Grace_Hopper)

<sup>2604</sup> [https://en.wikipedia.org/wiki/Mercury\\_13](https://en.wikipedia.org/wiki/Mercury_13)

Collins stood for and represented. In my mind Collins stood on the shoulders of giants and then, well, peed on their heads.

- I could have just deleted Collins (and to be honest, I wanted to delete her name) from this timeline like the Texas Board of Education has done to Hillary Clinton when they specifically excluded Secretary Clinton in the Texas **12,018 HE** school books. But I did not.
- What COLLINS did professionally was monumental. It is too bad Collins, in her private life, didn't help forward the women's effort when it was her turn.

**11,999 HE:** Chandra X-ray Observatory telescope is launched.<sup>2605</sup>

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<sup>2605</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>



Labeled diagram of CXO<sup>2606</sup>

<sup>2606</sup> [https://en.wikipedia.org/wiki/Chandra\\_X-ray\\_Observatory](https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory)

⇒ The data gathered by *Chandra* has greatly advanced the field of X-ray astronomy. Here are some examples of discoveries supported by observations from *Chandra*:

- The first light image, of supernova remnant Cassiopeia A, gave astronomers their first glimpse of the compact object at the center of the remnant, probably a neutron star or black hole. (Pavlov, et al., **12,000 HE**);
- In the Crab Nebula, another supernova remnant, *Chandra* showed a never-before-seen ring around the central pulsar and jets that had only been partially seen by earlier telescopes. (Weisskopf, et al., **12,000 HE**);
- The first X-ray emission was seen from the supermassive black hole, Sagittarius A, at the center of the Milky Way. (Baganoff, et al., **12,001 HE**);

- The X-ray shadow of Titan was seen when it transited the Crab Nebula; X-ray emissions from materials falling from a protoplanetary disc into a star. (Kastner, et al., **12,004 HE**);
- On January 5, **12,015 HE**, NASA reported that *CXO* observed an X-ray flare 400 times brighter than usual, a record-breaker, from Sagittarius A, a supermassive black hole in the center of the Milky Way galaxy;
- In September **12,016 HE**, it was announced that *Chandra* had detected X-ray emissions from Pluto, the first detection of X-rays from a Kuiper belt object. *Chandra* had made the observations in **12,014 HE** and **12,015 HE**, supporting the

*New Horizons* spacecraft for its July **12,015 HE** encounter.<sup>2607</sup>

**12,000 HE:** Humanity survived Y2K (also called Year 2000 bug or Millennium bug) a problem in the coding of computerized systems that was projected to create havoc in computers and computer networks around the world at the beginning of the year **12,000 HE**. (in metric measurements K stands for thousand). After more than a year of international alarm, feverish preparations, and programming corrections, few major failures occurred in the transition from December 31, **11,999 HE**, to January 1, **12,000 HE**.<sup>2608</sup>

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<sup>2607</sup> [https://en.wikipedia.org/wiki/Chandra\\_X-ray\\_Observatory](https://en.wikipedia.org/wiki/Chandra_X-ray_Observatory)

<sup>2608</sup> <https://www.britannica.com/technology/Y2K-bug>

**Circa 12,000 HE:** The population of the world was approximately 6,145,000,000 people.<sup>2609</sup>

**12,000 HE:** Microsoft Windows mobile (pocket PC) introduced.<sup>2610</sup>



Photo is of The Windows Mobile Device Center in Windows Vista, photographer unknown.<sup>2611</sup>

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<sup>2609</sup> <http://www.worldometers.info/world-population/world-population-by-year/>

<sup>2610</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2611</sup> [https://en.wikipedia.org/wiki/Windows\\_Mobile\\_Device\\_Center](https://en.wikipedia.org/wiki/Windows_Mobile_Device_Center)



**12,001 HE:** Wikipedia is established<sup>2612</sup> by JIMMY WALES and LARRY SANGER and quickly became a global project in multiple languages inspiring a wide range of online reference projects. In **12,018 HE**, it was the world's fifth-most-visited website.<sup>2613</sup>

⇒ JIMMY WALES, United States, but who as of **12,012 HE** lives in England, is a former co-chair of the World Economic Forum on the Middle East and a former board member of Socialtext. WALES is a member of the Berkman Center for Internet & Society at Harvard Law School, the advisory board of the MIT Center for Collective Intelligence, the board of directors at Creative Commons and Hunch.com. In **12,006 HE**, WALES was listed in the "Scientists & Thinkers" section of the TIME 100 and number 12 in Forbes "The Web Celebs 25". **12,013 HE**, WALES was awarded the UNESCO Niels Bohr Medal in

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<sup>2612</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2613</sup> [https://en.wikipedia.org/wiki/History\\_of\\_Wikipedia](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.<sup>2614</sup>

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<sup>2614</sup> [https://en.wikipedia.org/wiki/Jimmy\\_Wales](https://en.wikipedia.org/wiki/Jimmy_Wales)



**12,016 HE: JIMMY WALES** at the Wikimania conference,  
photographer unknown.<sup>2615</sup>

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<sup>2615</sup> [https://en.wikipedia.org/wiki/Jimmy\\_Wales](https://en.wikipedia.org/wiki/Jimmy_Wales)



**12,006 HE:** photo of LARRY SANGER (Born **11,968 HE**) (photographer and location unknown).<sup>2616</sup> In **12,002 HE** SANGER left Wikipedia and has since been critical of the project.<sup>2617</sup>

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<sup>2616</sup> [https://en.wikipedia.org/wiki/Larry\\_Sanger](https://en.wikipedia.org/wiki/Larry_Sanger)

<sup>2617</sup> [https://en.wikipedia.org/wiki/Larry\\_Sanger](https://en.wikipedia.org/wiki/Larry_Sanger)

**12,001 HE:** *NEAR (Near Earth Asteroid Rendezvous) Shoemaker* lands on asteroid Eros.<sup>2618</sup> The mission is named after EUGENE SHOEMAKER who died in an automobile accident in **11,997 HE.**<sup>2619</sup>

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<sup>2618</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2619</sup> <https://www2.jpl.nasa.gov/sl9/news81.html>

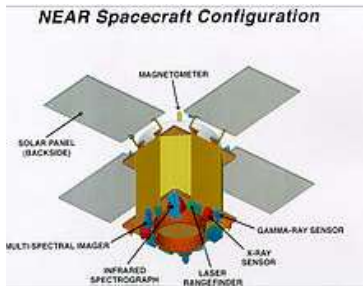


Diagram showing location of *NEAR* science instruments.<sup>2620</sup>

- ⇒ The primary scientific objective of *NEAR Shoemaker* was to return data on the bulk properties, composition, mineralogy, morphology, internal mass distribution, and magnetic field of Eros. This data will be used to help understand the characteristics of asteroids in general, their relationship to

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<sup>2620</sup> [https://en.wikipedia.org/wiki/NEAR\\_Shoemaker](https://en.wikipedia.org/wiki/NEAR_Shoemaker)

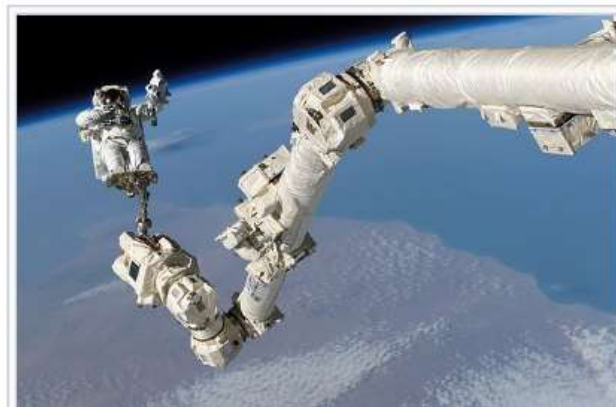
meteoroids and comets, and the conditions in the early Solar System.<sup>2621</sup>

**12,001 HE:** Canadarm 2 is launched to the ISS.<sup>2622</sup> The Mobile Servicing System (MSS), also known as Canadarm2, is a robotic system on board the International Space Station (ISS).

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<sup>2621</sup> [https://en.wikipedia.org/wiki/NEAR\\_Shoemaker](https://en.wikipedia.org/wiki/NEAR_Shoemaker)

<sup>2622</sup> [https://en.wikipedia.org/wiki/Mobile\\_Servicing\\_System](https://en.wikipedia.org/wiki/Mobile_Servicing_System)



The photo is of Astronaut STEPHEN K. ROBINSON anchored to the end of Canadarm2 during STS-114, **12,005 HE.**<sup>2623</sup>

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<sup>2623</sup> [https://en.wikipedia.org/wiki/Mobile\\_Servicing\\_System](https://en.wikipedia.org/wiki/Mobile_Servicing_System)



## 12,002 HE:

<sup>2624</sup>

After public protests by EV1 drivers' groups upset by the repossession of their electric cars, Toyota offered the last 328 RAV4-EVs for sale to the public during six months in **12,002 HE** and continues to support the several hundred Toyota RAV4-EVs in the hands of the general public and in fleet usage.<sup>2625</sup>

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<sup>2624</sup> <https://www.bing.com/images/search?q=image+toyota+rav4->

<sup>2625</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**12,002 HE:** SpaceX was founded by entrepreneur ELON MUSK.

Space Exploration Technologies Corp., doing business as SpaceX, is a private United States aerospace manufacturer and space transportation services company headquartered in Hawthorne, California with the goal of reducing space transportation costs and enabling the colonization of Mars.<sup>2626</sup>

⇒ ELON MUSK holds South African, Canadian, and U.S. citizenship and is the founder, CEO, and lead designer of SpaceX; co-founder, CEO, and product architect of Tesla, Inc.; co-founder and CEO of Neuralink; and co-founder of PayPal. Born and raised in Pretoria, South Africa, MUSK moved to Canada when he was 17 to attend Queen's University. He transferred to the University of Pennsylvania two years later, where he received an economics degree from the Wharton

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<sup>2626</sup> <https://en.wikipedia.org/wiki/SpaceX>

School and a degree in physics from the College of Arts and Sciences. He began a Ph.D. in applied physics and material sciences at Stanford University in **11,995 HE** but dropped out after two days to pursue an entrepreneurial career. **12,017 HE:** Tesla sent hundreds of Powerwall battery systems that can be paired with solar panels to the devastated island of Puerto Rico in an effort to restore electric power.<sup>2627</sup>

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<sup>2627</sup> <http://fortune.com/2017/09/28/tesla-battery-puerto-rico-power/>



ELON MUSK in **12,015 HE**. Photographer and location unknown.<sup>2628</sup>

**12,003 HE:**

⇒ *Spirit* and *Opportunity* Mars rovers;

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<sup>2628</sup> [https://en.wikipedia.org/wiki/Elon\\_Musk](https://en.wikipedia.org/wiki/Elon_Musk)

- ⇒ February 1: the Space Shuttle *Columbia* broke up on re-entry into the Earth's atmosphere;
- ⇒ August 25: NASA launched the largest-diameter infrared telescope ever in space, *the Spitzer Space Telescope*;
- ⇒ September 21: NASA's Galileo mission ended a 14-year exploration of the solar system's largest planet and its moons with the spacecraft crashing by design into Jupiter at 108,000 mph.<sup>2629</sup>

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<sup>2629</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>



- *Opportunity*, also known as MER-B (*Mars Exploration Rover – B*) or *MER-1*, is a robotic rover active on Mars since **12,004 HE**. Photographer and location unknown, but clearly a lab on Earth not on Mars.<sup>2630</sup>

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<sup>2630</sup> [https://en.wikipedia.org/wiki/Opportunity\\_\(rover\)](https://en.wikipedia.org/wiki/Opportunity_(rover))

## 12,004 HE -12,017 HE: *Cassini-Huygens* missions to Saturn and Titan.<sup>2631</sup>

- ⇒ The *Cassini-Huygens* mission commonly called *Cassini*, was a collaboration between NASA, the European Space Agency (ESA), and the Italian Space Agency (ASI) to send a probe to study the planet Saturn and its system, including its rings and natural satellites. (See **11,953 HE: CAROLYN PORCO**)
- *Cassini* was the fourth space probe to visit Saturn and the first to enter its orbit. The craft were named after astronomers GIOVANNI CASSINI (See **11,625 HE – 11,712 HE:**) and CHRISTIAAN HUYGENS. (See **11,629 HE – 11,695 HE**).

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<sup>2631</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>

- 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.
- *Cassini's* original mission was planned to last for four years, from June **12,004 HE** to May **12,008 HE**. The mission was extended for another two years until September **12,010 HE**, branded the *Cassini Equinox Mission*. The mission was extended a second and final time with the *Cassini Solstice Mission*, lasting another seven years until September 15,



**12,017 HE**, on which date *Cassini* was de-orbited to burn up in Saturn's upper atmosphere.<sup>2632</sup>

**12,005 HE - current:** SpaceX announced plans to pursue a human-rated commercial space program. SpaceX's *Dragon* is a conventional blunt-cone ballistic capsule which is capable of carrying cargo or up to seven astronauts into orbit and beyond. In **12,012 HE**, *Dragon* became the first commercial spacecraft to deliver cargo to the International Space Station and has since been conducting regular resupply services to the ISS.<sup>2633</sup>

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<sup>2632</sup> <https://en.wikipedia.org/wiki/Cassini-Huygens>

<sup>2633</sup> <https://en.wikipedia.org/wiki/SpaceX>



Image is of the *Dragon* spacecraft approaching the ISS (photographer, and date unknown).<sup>2634</sup>

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<sup>2634</sup> <https://en.wikipedia.org/wiki/SpaceX>



Photo is of the *Dragon* is berthed to the ISS by Canadarm2, date and photographer unknown.<sup>2635</sup>

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<sup>2635</sup> <https://en.wikipedia.org/wiki/SpaceX>

**12,006 HE:** The Cloud concept is established, evolving user's data storage and computing online.<sup>2636</sup>

⇒ 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.<sup>2637</sup>

**12,007 HE: Earth Hour** began. Sydney, Australia started Earth Hour as a symbolic lights-out event where all lights were turned off to see the night sky and to save funds.

⇒ The following year, people and places around the world started voluntarily turning off their lights. EARTH HOUR is now the

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<sup>2636</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2637</sup> [https://en.wikipedia.org/wiki/Cloud\\_storage](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.<sup>2638</sup>

⇒ 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.<sup>2639</sup>

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<sup>2638</sup> <https://www.earthhour.org/what-is-earth-hour>

<sup>2639</sup> <https://www.earthhour.org/celebrate-the-hour>

**12,007 HE:** The first Kindle book reader is released<sup>2640</sup>



Image is of a first generation Kindle Paperwhite.<sup>2641</sup>

**12,007 HE:** The Apple iPhone first released.<sup>2642</sup>



iPhone OS 1 running on a first generation iPhone.<sup>2643</sup>

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<sup>2640</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2641</sup> [https://en.wikipedia.org/wiki/Amazon\\_Kindle](https://en.wikipedia.org/wiki/Amazon_Kindle)

<sup>2642</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2643</sup> [https://en.wikipedia.org/wiki/IPhone\\_OS\\_1](https://en.wikipedia.org/wiki/IPhone_OS_1)

**12,008 HE:** Android operating system is first released.<sup>2644</sup> Android is continually developed by Google and the Open Handset Alliance, and it has seen a number of updates to its base operating system since the initial release.

⇒ Android code names are confectionery-themed and have been in alphabetical order since **12,009 HE's** Android 1.5 Cupcake. The most recent version of Android is Android 9 Pie, which was released in August **12,018 HE**.<sup>2645</sup>

**12,008 HE – 12,012 HE:** The Tesla Roadster is a battery electric vehicle (BEV) sports car that was produced in California, USA. It was the first highway legal serial production all-electric car to use lithium-ion battery cells and the first production all-electric car to travel more than 320 kilometers (200 mi) per charge. Elon Musk's

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<sup>2644</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2645</sup> [https://en.wikipedia.org/wiki/Android\\_version\\_history](https://en.wikipedia.org/wiki/Android_version_history)



vehicle is also the first production car to be launched into orbit and beyond, carried by a Falcon Heavy rocket in a test flight launched on February 6, **12,018 HE**.<sup>2646</sup> As of November **12.018 HE** the Roadster was nearing the orbit of Mars.

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<sup>2646</sup> [https://en.wikipedia.org/wiki/Tesla\\_Roadster\\_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))



The **12,008 HE** Tesla Electric Roadster...on Earth.  
Photographer unknown.<sup>2647</sup>

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<sup>2647</sup> [https://en.wikipedia.org/wiki/Tesla\\_Roadster\\_\(2008\)](https://en.wikipedia.org/wiki/Tesla_Roadster_(2008))



**12,018 HE** photo of the Tesla **12,008 HE** Roadster... in space.<sup>2648</sup>

**Circa 12,009 HE:** In the North Sea off Norway, offshore wind power began to expand beyond fixed-bottom, shallow-water turbines. The

world's first operational deep-water large-capacity floating wind turbine, *Hywind*, became operational.<sup>2649</sup>



**12,009 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.<sup>2650</sup>

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<sup>2648</sup>

<https://www.bing.com/images/search?q=images+of+tesla+roadster+in+space&qpv=images+of+tesla+roadster+in+space&FORM=IGRE>

<sup>2649</sup> [https://en.wikipedia.org/wiki/History\\_of\\_wind\\_power#Early\\_Middle\\_Ages](https://en.wikipedia.org/wiki/History_of_wind_power#Early_Middle_Ages)

<sup>2650</sup> [https://en.wikipedia.org/wiki/Floating\\_wind\\_turbine](https://en.wikipedia.org/wiki/Floating_wind_turbine)

**Circa 12,009 HE:** Biologists began to move away from the latin binomial naming system and began to label species by their genetic code chromosomal DNA bar codes.<sup>2651</sup>

⇒ Goodbye “Homo Sapiens” / “The Knowing Ape”

⇒ Hello “TCATCGGTCATTGG”.<sup>2652</sup>

- Author / Compiler Note: “???!!!”

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<sup>2651</sup> 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*

<sup>2652</sup> SAM KEAN *The Disappearing Spoon: And Other True Tales of Madness, Love, and the History of the World from the Periodic Table of the Elements*

**12,010 HE – 12,018 HE:**



First generation Nissan electric LEAF sold in Japan, United States, Australia, Canada and 17 European countries.<sup>2653</sup>

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<sup>2653</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

## 12,010 HE: Private Sector SpaceX first commercial launch.<sup>2654</sup>



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

<sup>2654</sup> <https://www.archives.gov/research/alic/reference/space-timeline.html>

of Falcon 9 v1.2 (Full Thrust), two versions of Falcon 9 Block 5, and Falcon Heavy.<sup>2655</sup>

**12,011 HE:** The United States *Space Shuttle Program* is decommissioned.<sup>2656</sup> After this date, NASA relies entirely on Russia's *Sputnik* to transport astronauts to the ISS. Private United States contractors, like the SpaceX *Dragon* spacecraft, should become active in transferring crew members sometime after **12,018 HE.**<sup>2657</sup>

**12,011 HE:** The Apple iPad is released<sup>2658</sup>

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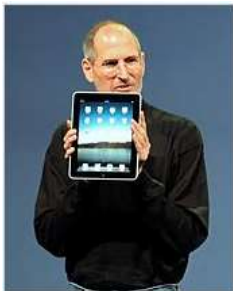
<sup>2655</sup> <https://en.wikipedia.org/wiki/SpaceX>

<sup>2656</sup> <https://www.archives.gov/research/aic/reference/space-timeline.html>

<sup>2657</sup> <https://en.wikipedia.org/wiki/SpaceX>

<sup>2658</sup> <http://www.computerhistory.org/timeline/computers/>





STEVE JOBS, Apple's then CEO, introducing the iPad.<sup>2659</sup> 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...”<sup>2660</sup>

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<sup>2659</sup> <https://en.wikipedia.org/wiki/iPad>

<sup>2660</sup> <https://en.wikipedia.org/wiki/iPad>

**12,012 HE:** This date is about 34 years since launch of *Voyager 1*,<sup>2661</sup> 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.<sup>2662</sup>

⇒ Travelling at about 17 kilometers per second (11 mi/s) *Voyager 1* has the fastest heliocentric recession speed of any spacecraft.<sup>2663</sup>

⇒ 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.

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<sup>2661</sup>[https://en.wikipedia.org/wiki/Voyager\\_1](https://en.wikipedia.org/wiki/Voyager_1)

<sup>2662</sup><https://www.archives.gov/research/alic/reference/space-timeline.html>

<sup>2663</sup>[https://en.wikipedia.org/wiki/Voyager\\_1](https://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.<sup>2664</sup>

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<sup>2664</sup> [https://en.wikipedia.org/wiki/Voyager\\_1](https://en.wikipedia.org/wiki/Voyager_1)

**12,012 HE:**



Global sales of the Renault electric Zoe, released in **12,012 HE**, achieved the 50,000-unit milestone in **12,016 HE**.<sup>2665</sup>

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<sup>2665</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_automobile](https://en.wikipedia.org/wiki/History_of_the_automobile) or  
[https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**12,012 HE:**



**TESLA** Model S fully electric, long range driving vehicle began deliveries, photographer unknown.<sup>2666</sup>

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<sup>2666</sup> [https://en.wikipedia.org/wiki/Tesla,\\_Inc.](https://en.wikipedia.org/wiki/Tesla,_Inc.)

## 12,013 HE:



Retail deliveries of the BMW electric i3 began in Europe in **12,013 HE**. The electric i3 ranked as the third bestselling all-electric car in **12,014 HE**. The range of the vehicle is about 80 miles. An optional internal combustion engine can be added, which uses gasoline to generate electricity and extends the range of the vehicle to about 150 miles.<sup>2667</sup> Photographer unknown.

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<sup>2667</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**12,014 HE:** Solar Roadways Incorporated (founded in **12,006 HE**), United States company based in Sandpoint, Idaho started a crowdfunding campaign at Indiegogo to raise money so they could develop their idea for solar powered road panels to bring a smart highway into production.

- The campaign raised \$2.2 million and became Indiegogo's most popular campaign ever in terms of the number of backers it attracted.<sup>2668</sup>

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<sup>2668</sup> [https://en.wikipedia.org/wiki/Solar\\_Roadways](https://en.wikipedia.org/wiki/Solar_Roadways)



Solar Roadway founders Julie Brusaw and SCOTT BRUSAW<sup>2669</sup> with solar road panel prototypes in Idaho, USA.<sup>2670</sup> Photographer and date unknown.

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<sup>2669</sup> <http://solarroadways.com/About/Team>

<sup>2670</sup> [https://en.wikipedia.org/wiki/Solar\\_Roadways](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 Roadways<sup>2671</sup>

<sup>2671</sup> <http://www.solarroadways.com/>

**12,015 HE:** United States probe *New Horizons* passed Pluto.<sup>2672</sup>



*New Horizons* at Kennedy Space Center, **12,005 HE.**<sup>2673</sup>

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<sup>2672</sup> <https://www.archives.gov/research/alice/reference/space-timeline.html>

<sup>2673</sup> [https://en.wikipedia.org/wiki/New\\_Horizons](https://en.wikipedia.org/wiki/New_Horizons)

**12,015 HE:** JEDIDAH C. ISLER, United States Observational Astrophysicist, first Black Woman to Graduate from Yale with a PhD in Astrophysics.<sup>2674</sup> 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.<sup>2675</sup>

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<sup>2674</sup> *TED Fellows Talks*. <https://youtu.be/XzZJuEDQ1a0>

<sup>2675</sup> <http://jedidahislerphd.com/research-interest/>

**12,015 HE:**



2676

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<sup>2676</sup> <https://www.bing.com/search?q=image+tesla+model+x&PC=U316&FORM=CHROMN>

**12,015 HE:** The Tesla Model X, a full-size electric crossover SUV, started deliveries.<sup>2677</sup>

**12,016 HE:**



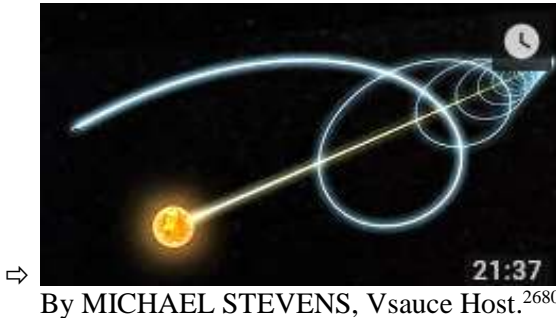
The first Chevrolet Bolt EVs were delivered to customers in the San Francisco Bay Area in **12,016 HE**.<sup>2678</sup>

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<sup>2677</sup> [https://en.wikipedia.org/wiki/Tesla,\\_Inc.](https://en.wikipedia.org/wiki/Tesla,_Inc.)

<sup>2678</sup> [https://en.wikipedia.org/wiki/History\\_of\\_the\\_electric\\_vehicle](https://en.wikipedia.org/wiki/History_of_the_electric_vehicle)

**12,016 HE:** Youtube.com video “How Earth Moves” including further calendar explanations.<sup>2679</sup>



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<sup>2679</sup> <https://www.youtube.com/watch?v=IJhgZBn-LHg>

<sup>2680</sup> <https://www.youtube.com/watch?v=IJhgZBn-LHg>

**12,016 HE:** MIT scientists build the first 5-atom quantum computer<sup>2681</sup> with the potential to crack the security of traditional encryption schemes.<sup>2682</sup>

**12,017 HE:**



<sup>2683</sup>

Official launch and delivery started of the TESLA Model 3- mid-size (US) / compact executive (EU) luxury all-electric four-door sedan.<sup>2684</sup>

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<sup>2681</sup> <http://www.computerhistory.org/timeline/computers/>

<sup>2682</sup> [https://en.wikipedia.org/wiki/Timeline\\_of\\_computing\\_2010-19](https://en.wikipedia.org/wiki/Timeline_of_computing_2010-19) and "*MIT's new 5-atom quantum computer could make today's encryption obsolete*".

<sup>2683</sup> <https://www.bing.com/search?q=image+tesla+model+3&pc=MOZI&form=MOZLBR>

<sup>2684</sup> [https://en.wikipedia.org/wiki/Tesla\\_Model\\_3](https://en.wikipedia.org/wiki/Tesla_Model_3)

12,018 HE:



Second generation Nissan electric LEAF introduced.<sup>2685</sup>

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<sup>2685</sup> <https://www.nissanusa.com/leaf>



## 12,018 HE: Methods of Birth Control.<sup>2686</sup>

- 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

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<sup>2686</sup> <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

**12,018 HE:** Updating CARL SAGAN's numbers on population - Most Populous Countries & Numbers, based on United Nations

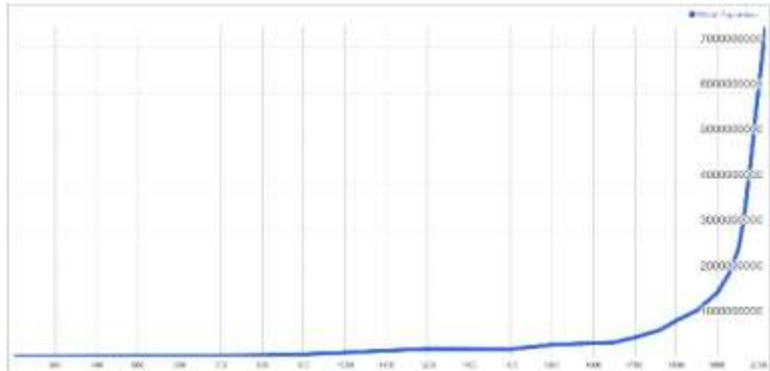
Estimates, comparing to the **11,950 HE** populations. (Information retrieved October 22 - 24 **12,018 HE**.)<sup>2687 2688</sup>

Thailand:	69,228,466 people, not one of the most populous nations in <b>11,950 HE</b>
Iran:	82,271,115 people, not one of the most populous nations in <b>11,950 HE</b>
Turkey:	82,271,851 people, increase from 21,408,401 people in <b>11,950 HE</b>
Germany:	82,349,181 people, increase from 69,966,243 people in <b>11,950 HE</b>
Congo:	84,781,426 people, founded: <b>11,960 HE</b>
Viet Nam:	96,779,230 people, increase from 24,809,906 people in <b>11,950 HE</b>
Egypt:	99,918,032 people, not one of the most populous nations in <b>11,950 HE</b>
Philippines:	106,989,899 people not one of the most populous nations in <b>11,950 HE</b>
Ethiopia:	108,292,163 people, not one of the most populous nations in <b>11,950 HE</b>
Japan:	127,092,269 people, increase from 82,802,084 people in <b>11,950 HE</b>
Mexico:	131,240,346 people, increase from 28,012,561 people in <b>11,950 HE</b>
Russia:	143,964,709 people, increase from 102,798,657 people in <b>11,950 HE</b>
Bangladesh:	166,882,594 people, increase from 37,894,681 people in <b>11,950 HE</b>
Nigeria:	197,336,063 people, increase from 37,859,744 people in <b>11,950 HE</b>
Pakistan:	201,942,393 people, increase from 37,542,376 people in <b>11,950 HE</b>
Brazil:	211,349,257 people, increase from 53,974,729 people in <b>11,950 HE</b>

<sup>2687</sup> <https://www.worldometers.info/world-population/>

<sup>2688</sup> <http://www.worldometers.info/population/most-populous-countries/#past>

Indonesia: 267,643,638 people, increase from 69,543,316 people in **11,950 HE**  
 USA: 327,470,395 people, increase from 158,804,395 people in **11,950 HE**  
 India: 1,358,548,924 people, increase from 376,325,200 people in **11,950 HE**  
 China: 1,416,743,377 people, increase from 554,419,275 people in **11,950 HE**



- ⇒ World population of humans is increasing dramatically, expected to reach approximately 11 billion before it stabilizes (barring disaster).<sup>2689</sup>

As of **12,018 HE**: China has Electric High-speed trains and rail (HSR). HSR in China is the country's network of passenger-dedicated railways designed for speeds of 250–350 km/h (155–217 mph).

- ⇒ China's HSR is the world's longest high-speed railway network and is also the most extensively used. It reaches 27,000 km (17,000 mi) in total length.<sup>2690</sup>

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<sup>2689</sup> <https://www.worldometers.info/world-population/>

<sup>2690</sup> [https://en.wikipedia.org/wiki/High-speed\\_rail\\_in\\_China](https://en.wikipedia.org/wiki/High-speed_rail_in_China)



China's Electric Railway network map.<sup>2691</sup>

<sup>2691</sup> [https://en.wikipedia.org/wiki/High-speed\\_rail\\_in\\_China](https://en.wikipedia.org/wiki/High-speed_rail_in_China)



Shanghai Maglev Train connecting the Pudong Airport with the city. Photographer unknown.<sup>2692</sup>

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<sup>2692</sup> [https://en.wikipedia.org/wiki/High-speed\\_rail\\_in\\_China](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.<sup>2693</sup>

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<sup>2693</sup> [https://en.wikipedia.org/wiki/High-speed\\_rail\\_in\\_China](https://en.wikipedia.org/wiki/High-speed_rail_in_China)





Chinese designed CRH380AL train at Shanghai Hongqiao Railway Station. Photographer unknown.<sup>2694</sup>

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<sup>2694</sup> [https://en.wikipedia.org/wiki/High-speed\\_rail\\_in\\_China](https://en.wikipedia.org/wiki/High-speed_rail_in_China)

**12,018 HE:** In May, NASA launched the international effort *InSight*, a mission to land a stationary science probe near the equator on Mars. The probe landed successfully on November 26, **12,018 HE.**<sup>2695</sup>

⇒ *InSight's* objectives are to place a seismometer called SEIS produced by the French space agency CNES, and to measure heat transfer with a heat probe called HP3 produced by the German space agency DLR in order to study the planet's early geological evolution. This could bring new understanding of the Solar System's terrestrial planets — Mercury, Venus, Earth, Mars — and Earth's Moon. By reusing technology from the Mars *Phoenix* lander, which successfully landed on Mars in **12,008 HE**, the cost and risk were reduced.<sup>2696</sup>

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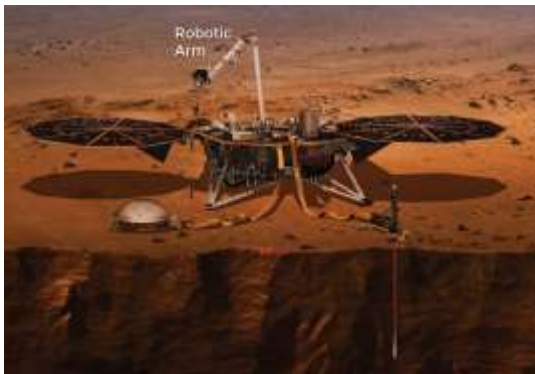
<sup>2695</sup> <https://mars.nasa.gov/insight/>

<sup>2696</sup> <https://en.wikipedia.org/wiki/InSight>

⇒ Major 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)
- 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)<sup>2697</sup>



Artist's Rendering of *InSight* on Mars, credit JPL.<sup>2698</sup>

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<sup>2697</sup> <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

<sup>2698</sup> <https://mars.nasa.gov/insight/spacecraft/about-the-lander/>

**12,019 HE to the Future:** We must end this ebook here. The Word file is soo big! Author / Compiler hopes, because it makes sense for all humanity, that people on their own, use the free BC/AD to HE conversion calculator so that EMILIANI's Holocene Era (**HE**) calendar system becomes the standard worldwide calendaring system.

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# About the HE Calendar and Formatting

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

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

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

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



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

About the confusion of using the standard calendar now in use: John Cleese said of his early experience teaching history before his Monty Python days, “I still got confused how dates with 16 on the front could occur in the 17<sup>th</sup> century. That’s about as basic as history gets.”<sup>2699</sup>

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<sup>2699</sup> Autobiography of John Cleese, ***So, Anyway...***, 12,015 HE

## Author / Compiler's Note

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

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

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

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

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

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

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*I dedicate this book*

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

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

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

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## About the Author / Compiler



Wife, Mom, Daughter, Law Office Business Manager, **11,990 HE** White House Honoree, Artist, Freedoms Foundation of Valley Forge Honoree, homeowner, EV driver, Recycling enthusiast, Starry Skies / Dark Skies enthusiast, Certified Laughter Yoga Leader, Ballroom dancer, Struggling author, friend to a few, acquaintance to a few more, SA Life Sunday Woman Honoree, sewing enthusiast, retired teacher for Junior Achievement – Favorite classes taught: “Enterprise in Action” and “Personal

Economics”, and more!.....