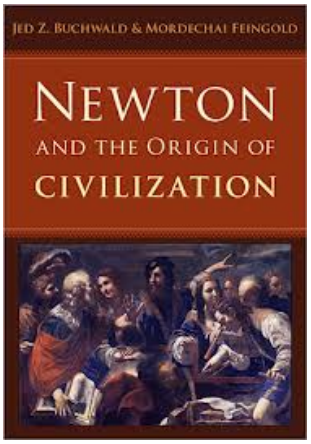
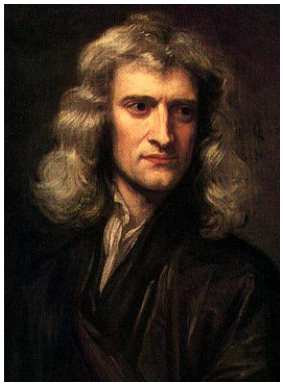
Newton and the origin of civilisation *Jed Z. Buchwald and Mordechai Feingold* Princeton University Press, 2013 (xvi+528 p.), hard cover, ISBN 978-069-115478-7, £ 34.95

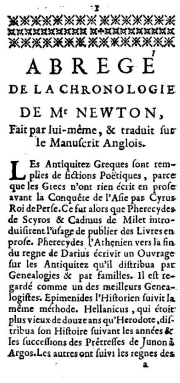


We all know Isaac Newton (1642-1727) as an all-round scientist, being a mathematician, engineer, physicist, astronomer, philosopher, alchemist, and theologian. His name is connected to many mathematical theorems, laws and algorithms. His *Philosophiæ Naturalis Principia Mathematica* (1687) laid the foundations of classical mechanics and is considered his masterpiece. In his *Opticks* (1704) he showed how white light can be decomposed into different colours with a prism and rebundled into white light with a lens. He was not only a developer of theories, he was also good at doing experiments and designed a telescope named after him. And this list can be continued for a while.

Mathematicians probably do not know so much about one of his lesser successes, namely his work on chronology. Although the principles and skills that he applied in this study originate from his early career, he got only fully involved in the time-line of early history at a later stage in life, but still, on and off, he has put effort in the topic during some 50 year. An *Abstract* of his notes circulated before his death. It was translated into French and published together with (anonymous) comments by Etienne Souciet as *Abrégé de la chronologie de M. le Chevalier Isaac Newton, fait par lui-même* (1725). The full notes were only published posthumously as *The Chronology of Ancient Kingdoms Amended* (1728). It starts with a letter to the Queen of England by John Conduitt (member of parliament and married to Newton's niece) followed by *A short chronicle* which is nothing but a list of dates and events ranging from 1125 BC to 331 BC. The rest consists of six chapters

- Chap. I. Of the Chronology of the First Ages of the Greeks.
- Chap. II. Of the Empire of Egypt.
- Chap. III. Of the Assyrian Empire.
- Chap. IV. Of the two Contemporary Empires of the Babylonians and Medes.
- Chap. V. A Description of the Temple of Solomon.
- Chap. VI. Of the Empire of the Persians.





ABREGÉ
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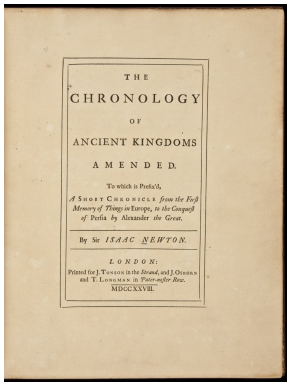
LEs Antiquitez Grecques sont remplies de fictions Poëtiques, parce que les Grecs n'ont rien écrit en prose avant la Conquête de l'Asie par Cyrus Roi de Perse. Ce fut alors que Pherecydes de Scyros & Cadmus de Milet introduisirent l'usage de publier des Livres en prose. Pherecydes l'Athenien vers la fin du regne de Darius écrivit un Ouvrage sur les Antiquitez qu'il distribua par Genealogies & par familles. Il est regardé comme un des meilleurs Genealogistes. Epimenides l'Historien suivit la même méthode. Hellanicus, qui étoit plus vieux de douze ans qu'Herodote, distribua son Histoire suivant les années & les successions des Prêtresses de Junon à Argos. Les autres ont suivi les regnes des



THE
CHRONOLOGY
OF
ANCIENT KINGDOMS
AMENDED.

To which is Prefix'd,
A Short Chronicle from the First Memory of Things in Europe, to the Conquest of Persia by Alexander the Great.

By Sir ISAAC NEWTON.

LONDON:
Printed for J. Tonson in the Strand, and J. Osborn and T. Longman in Pater-noster Row.
MDCCXXVIII.

I. Newton (ca 1689) Abrégé (1725) Chronology (1728) I. Newton (ca 1712)

In this book Newton revised the ancient history of the kingdoms mentioned in the chapters. He used all sources of ancient scriptures available, combined it with his knowledge of astronomy and tables and maps of observations to date the events in the past. The result was a contraction of history as it was commonly accepted in his days and it resulted in a vivid controversy among scientists pro and contra his findings. In their book, Buchwald and Feingold (B&F) scrutinize the archives to explain why, how, and when, Newton has come to his results. Newton has gone through all the literature available to him to find dates and references, but the authors of this book did as

well. It is as if they let the reader look inside the head of Newton. Every writing, letter, or public statement that has been made concerning this matter by Newton as well as by his opponents and his followers is analysed, explained, and continuously cited or quoted.

They start from the early beginnings to illustrate Newton's way of combining theory and experiments to arrive at a conclusion. In their first chapter they elaborate on the question of how far we can trust our senses. *Quaestiones quaedam philosophicae* is a set of notes by the young Newton where he contemplates on natural philosophy and the proper way to generate reliable knowledge. Every answer to a question should be subject to experiment, a motto that Newton has guided through his whole research career. As Newton reads the philosophers, B&F take the reader along from the hylomorphism of Aristotle, over scholastic cognition by Thomas Aquinas till the mechanical views of René Descartes. The astronomical observations by Newton, not only made him think about how to trust the sense of sight and the limitations of the eye, it also trained him as an experienced observer.

J. Hevelius

R. Hooke

C. Huygens

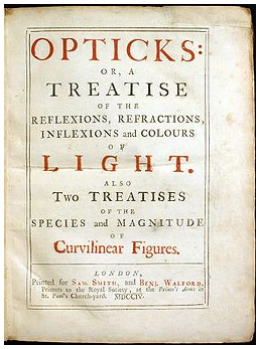
R. Boyle

The second chapter is about the controversy between Hevelius and Hooke. Johannes Hevelius (1611-1687) was an astronomer in Danzig who did his observations with "naked eye devices" while in Britain, Robert Hooke (1635-1703) was claiming that it was impossible to do observations properly if not by using telescopes with cross-hairs. Hooke uses members of the Royal Society to prove that human senses are untrustworthy, yet Hevelius's numbers were more accurate than expected because he did several observations and then selected the one assumed to be most accurate. This resulted in a public discussion. Similarly Christiaan Huygens (1629-1695) was convinced of this uncertainty of observations even if done with his (inevitably imperfect) instruments (clocks, telescopes), while Robert Boyle (1627-1691) was convinced that experiments cán produce reliable results. Newton also made several observations but his smart and in those days original idea was to take the average, and replace even the observation that was the most accurate with this average. This was unprecedented. P&G illustrate that although taking averages was applied in other publications, it was done for different purposes. They illustrate this idea in Newton's case with his experiments about the diffraction of light, published in his *Opticks*. It also shows Newton's way of thinking: he starts from an hypothesis (a model), then does experiments and let these, through computation, converge into a single number. This scientific approach he applied in all other situations as well.

In their chapter 3, B&F sketch erudition and chronology in 17th-century England. They show the evolution of chronology from Julius C. Scalinger (1484-1558), over Jean Bodin (1530-1596), François Béroalde de Verville (1556-1626) up to John Selden (1584-1654) and how technical chronology raised although eventually it lost importance in subsequent centuries. Of course the obvious clash between the study of laic documents and the infallibility of the Christian Bible was a constant source of severe discussion.

The next chapter describes Newton's vision on idolatry and prophesies. For example, at some

point he predicted the end of the world to happen in 2694. He came to that conclusion because he



Newton's Opticks


J.C. Scalinger


J. Bodin


J. Selden

situated the fall of Jerusalem in AD 69, to which he added 1290 and 1335, numbers that he found in a prophecy of Daniel. He scribbled this calculation on the back of an envelope. His *Observations upon the Prophecies of Daniel, and the Apocalypse of St. John* were also published posthumously. However, do not start worrying yet, this date for the apocalypse is just one possibility. He did compute several other dates. Newton saw these prophecies as symbols that should be linked to events, to which he then aligned his astronomical computations. Concerning idolatry, Newton was convinced that the gods from mythology were in fact sublimations of kings, and hence that mythology actually described ancient history. He even linked Egyptian myths with the kingdoms of Noah and his sons. The latter populated the world after the deluge and this history was transformed into Greek mythology. He even morphed these events into the description found in Genesis. He did not believe that the earth was created from chaos.

In chapter 5, the topics are the calculations by Newton and others about the world population after the deluge and the discussion about the deluge being a local rather than a world-wide event. Some of the models were completely ridiculous, assigning high fertility to the Jews, resulting in populations before and after the deluge that are multiples of the current world population.


OBSERVATIONS
UPON THE
PROPHECIES
OF
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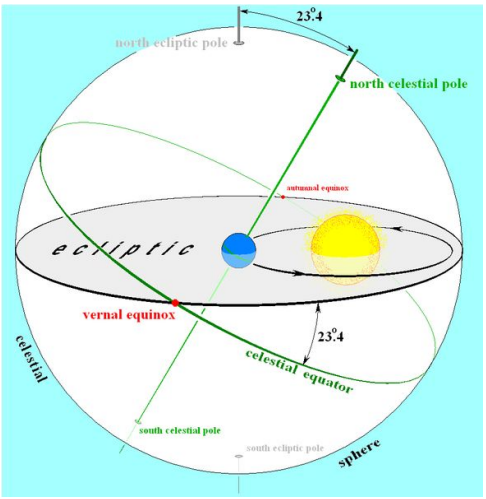
AND THE
APOCALYPSE
OF
St. JOHN.
In Two Parts.
By Sir ISAAC NEWTON.
LONDON,
Printed by J. Darby and T. Browne in Bartholomew-Close.
MDCCXXXIII.

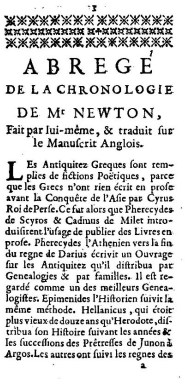
This discussion about population dynamics led Newton to reduce the number of people living in ancient history which consequently forced him to compress ancient history, a conclusion that is described in the next chapter. In the book *Daniel* of the Old Testament, 4 kingdoms are mentioned: Babylon, Persia, Greece and Rome. So Newton was wondering what had happened to Egypt and Assyria. His view on the dynamics was that after the deluge, the population was sparse, but with growing population, towns were formed, these needed a judge or some authority, and these cities eventually formed kingdoms that were enlarged by conquest or merging. He claimed that it was only in the time of Moses that the first city-kingdoms emerged. Assyria's capital Ninive, two centuries after the deluge was still a small city. Egypt in Moses' time was a collection of smaller kingdoms. The historical events he places very late in history. Solomon's death was 980 BC, the Argonauts 42 years later. He disavowed that the four ages of men under the reign of Noah and his successors Ham, Chus, and Nimrod. He claimed these did not happen in succession, but in parallel. He identifies them with Egyptian pharaohs Amosis, Ammon, Sesostris and Orus, the first three corresponding to Saturn, Jupiter and Mars.

The three sources Newton used to come to this drastic abbreviation of history are described in Chapter 7: the *Persika* by Ctesias of Cnidus (5th century BC) for the Persian history, the *Aegyptiaca* by Manetho (3rd century BC) for the history of Egypt and the *Marmor Parum* (ca 264 BC) for the Greek. However words should be linked to observations. And so he did. Newton developed a way to date events by locating colures at certain positions in the zodiac. On the helical sphere on which the stars evolve around the earth, the colures are great circles (not on the figure) through the celestial poles which align with the earth poles (inclined axis). One goes through the equinoxes, and the

other, orthogonal to it goes through the solstices. The zodiac is found along the celestial equator, orthogonal to the two colures. The ecliptic (horizontal circle) has an inclination of 23°4 with respect to the equator. The equator, the eclipse and the equinoctial colure intersect in the vernal and autumnal equinoxes. The position of the equinoxes in the zodiac shifts over the ages because of precession of the earth. It is this shift that allowed Newton to transform astronomical observations in the scriptures to dates. Therefore he had to rely on images with precise constellations of the stars. These were provided by publications of Hevelius and of John Flamsteed (1646-1719).



In the following 3 chapters, B&F discuss the publication of Newton's results on chronology and the flaming discussions it launched among scientists. First Newton made an abstract for Princes Caroline (1713-1757) who lent it to Abbé Conti (1677-1749) who was the intermediary in the Newton-Leibniz calculus controversy. The latter made a copy and that was translated to French and published in Paris as the *Abrégé* with comments anonymously added by Etienne Souciet (1713-1757), but without Newton's consent. This version of the story and variations of it are investigated by the authors. Other preliminary knowledge was shown by John Senex (1678-1740) who started producing globes on which Newton's colures appeared. With the posthumous publication of the full notes, and the translation of the *Abrégé* into English *Sir Isaac Newton's Chronology: Abridged by Himself. To which are Added, Some Observations on the Chronology of Sir Isaac Newton* (1728), the war over the topic broke loose.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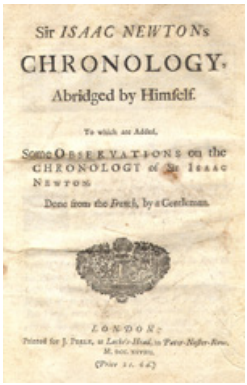
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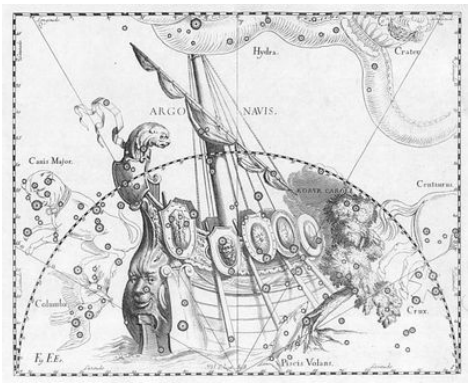
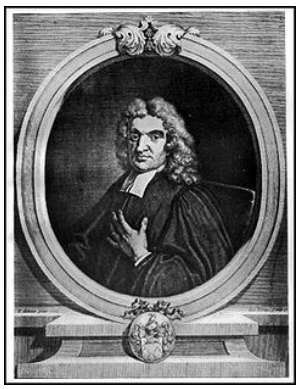




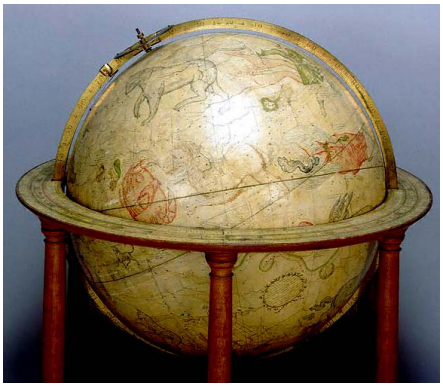
Abrégé | Abridged | Argo Navis constellation of stars by Hevelius | J. Flamsteed

William Whiston (1667-1752) was one of the opponents in England. He had read the original, but his publications were not very coherent and sometimes he wanted to use Newton's arguments for his own benefit, which brought him into contradictions for which he was attacked by other opponents of Newton's chronology. In France Nicolas Fréret (1688-1749) took over from Souciet and, although less of a mathematician, nevertheless contested Newton's calculations. Edmond Halley (1656-1742) and Louis Jouard de La Nauze (1696-1773) on the other hand joined the discussion in defense of Newton in England and France respectively. B&F describe the controversy in two full chapters and gradually move on to the next one in which is described how eventually the conflict and in general the interest in technical chronology as it was in those days faded away in the subsequent decades.

In several appendices B&F give a useful list of technical definitions, and conventions and they describe Newton's method of calculation and they comment on extracts from Newton's notes for the *Chronology* and the calculations in there, how he places the colures. For example appendix D explains how colures can be placed on the original star globe. First, a star is chosen that lies (almost) on the colure. Then the position of that star is looked up in Hevelius or in is a catalog

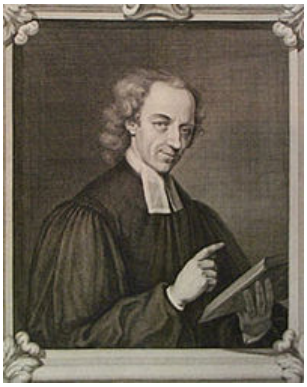
originating from Flamsteed. These give the coordinates of the star in the zodiac in 1690. Taking the precession into account allows to find the original date. The computations are relatively simple for the solstitial colure, but for the equinoctial colure, if the star is not on the ecliptic, it is a bit more complex.

Princes Caroline



Senex globe

Abbé Conti

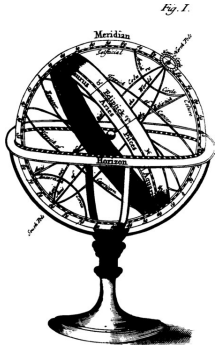


W. Whiston

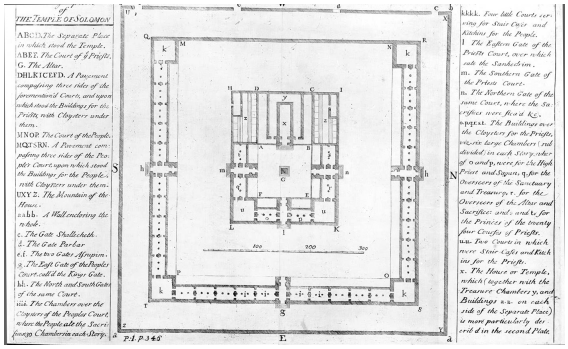
Appendix E explains how Newton obtained two confirmations for his dates: one for Hesiod and one for Thales. He gives no hints on how he does it in the *Chronology*, but much can be learned from his notes which is again illustrated by B&F.

An extensive list of references and a dexterous index complete this extensive and in depth study.

Telescope designed by Newton



Globe used by Newton



The temple of Solomon as it was published in the *Chrononogy*

Many of the historical works by Newton can be found at the site of the Newton project (`www.newtonproject.sussex.ac.uk`), or at the project Gutenberg (`www.gutenberg.org`). Although not essential, it will certainly be helpful if the reader is familiar with the Old Testament, or possibly other old scriptures, with ancient history, and with Greek mythology. If you are not so familiar, you may need a lot of looking up in wikipedia or elsewhere about who-is-who and where-is-where in ancient history.

With this book Buchwald and Feingold have provided the specialists with an overwhelming source of information. But anyone interested in history, i.e., ancient history but also the history of the 17th century and the evolution of ideas in between, will love the overwhelming stream of detailed information. The reader might otherwise be interested in the biography of Newton or just the methods and approaches used by a genius. Although this is a long review, it mentions only a tiny bit of everything that has been discussed in this book. The style and vocabulary used is not the simplest, but nevertheless it reads fluently. The only problem may be that in a novel there are usually not more than a handful of main characters. Here the reader may have a hard time to keep all the players, their motives, and the changing versions of events and results apart.

Adhemar Bultheel