

Time in the Bible

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1 Creation

In biblical times most cultures had a story about the creation; in the case of the Jews, Adam was thought to have been expelled from the Garden of Eden well before 5,000 BC (or well over 1,000 years earlier than Bishop Ussher (1658) calculated in the seventeenth century). These stories generally took it for granted that the creator and some materials pre-dated the Earth's creation. But when Aristotle, the Greek philosopher, argued that the universe was timeless, most scientists tended to agree with him and Christians, if they thought about it all, tended to believe that God had taken pre-existing material from the universe and used it to form the Earth.

This account was not overturned until the nineteen-sixties when the 'big bang' theory developed by the Belgian Catholic priest, Georges Lemaître (1927), came to be accepted. This had three consequences:

- the proposed date for creation was put back around 14 billion years;
- there was uncertainty about what might have existed before the creation of the universe;
- a creator of the universe became scientifically possible.

Before this, it had become clear that the universe is much bigger than anyone had thought in biblical times and the light year, or the distance light can travel in a year, had become the standard unit for measuring distances in the universe.

2 Years

As hunter gatherers and then as farmers, our ancestors found it helpful to understand the seasons of the year and they worked out that the moon takes just under 30 days to complete its cycle from new moon to new moon and a year contains roughly 360 days. In a purely lunar calendar, the months slip back slightly every year because twelve lunar months is less than a year; the only purely lunar calendar in use today is the Islamic calendar which is why Ramadan moves back slightly every year.

The Jews, like most cultures that adopted lunar calendars, developed a scheme which brought the lunar calendar back into alignment with the solar year, usually by adding an extra month every so often. A typical reference point would be the spring or autumn equinox when day length is the same as night length. If the lunar calendar was too far out of alignment with

the equinox, the extra month would be added. This is only possible if you are far enough away from the equator to notice the differences in day and night length; cultures closer to the equator tended to observe the position of Venus in order to make these adjustments.

The Jews worked out, possibly with the help of Babylonian mathematicians, a reasonably strict way of doing this which gives the Jewish calendar a nineteen year cycle. However, in Rome the decision was up to the priests and they became notorious for manipulating the calendar to postpone or bring forward elections. So Julius Caesar commissioned Sosigenes of Alexandria to draw on all that was known about the length of the year to create a new calendar which was first implemented in 45 BC. Though scientists at the time knew that the solar year was slightly shorter than 365.25 days, Sosigenes based his calendar, to be known as the Julian calendar, on 365.25 days.

Consequently, it gradually began to drift out of alignment, though not too seriously for most people's purposes, until it became clear that Easter was drifting away from the spring equinox which was the basis for the calculation of the passover in the Jewish calendar. After lengthy discussions, Pope Gregory proposed a number of changes in 1582 which were adopted in Catholic countries but rejected in most Protestant and Orthodox countries. However, they were gradually adopted, by England, Wales, Northern Ireland and the British Empire in 1752, until by 1930 pretty well all countries had adopted it though some localities still stick to the Julian calendar.

With the development of even more accurate measurements, it is clear that fluctuations in the time it takes for the Earth to orbit the Sun mean that, to keep our calendars in strict alignment with the solar year, we occasionally have to insert leap seconds into our calendars, the next one being due in June 2015. This is largely only a concern to those maintaining Internet servers or specialised scientific equipment which has to be aligned with UTC (or Coordinated Universal Time).

3 Hours, minutes and seconds

What we think of as mathematics developed independently in Egypt and Iraq at least 4,000 years ago; Egyptian mathematics was relatively simple, concerned with practical applications similar to those which you might find today in a cookery book explaining how to work out the quantities for different sizes of circular baking tin. Babylonian mathematics was far more sophisticated but, when the archaeologists excavating sites in the Middle East in the nineteenth century found lots of clay tablets with numbers on, they assumed that these were accounts and put them aside. Only in the second half of the twentieth century did they begin to translate these tablets and discover how sophisticated Babylonian mathematics was. Babylonians used sixty as their base, rather than the ten of the decimal system, probably because you can divide sixty by two, three, four, five, six, ten, twelve, fifteen, twenty and thirty, so making fractional calculations much simpler.

They divided the day into 24 hours each with 60 minutes each with 60 seconds and they used 360 degrees to divide up a circle probably because, with the solar year being just over 360 days, stars would appear at roughly the same angle on the same day each year. The Babylonian mathematician-astronomers were known as *magi* and their mathematical skills were easily enough to set and deal with conundrums such as you might find in a Sunday newspaper today but far ahead of anything else known in biblical times. Around 800 BC, a number of them became interested in whether there was any association between what they saw in the skies

and what happened on earth and out of this came astrology which in turn led the *magi* to visit Jesus after his birth. Astrology remained part of astronomy and mathematics until 1619 when a Halifax man, Sir Henry Savile, endowed the Savilian Chair of Astronomy at Oxford University and forbade the holders from practising astrology.

After Alexander the Great brought together the Greek and Babylonian cultures in his empire around 330 BC and established the first university and library in Alexandria, Greek mathematicians were quick to realise how sophisticated Babylonian mathematics was and took it over wholesale — which is why we still use the hours, minutes, seconds and degrees that the Babylonian *magi* invented.

4 Days

While we are now accustomed to marking the start of a day by reference to the middle of the night, which is twelve hours before midday when the sun is highest in the sky, in biblical times, as today in the Moslem and Jewish calendars, the start of a day was dusk the day before and the night was generally divided into four watches. Counting daylight hours started with dawn with the third hour being around nine in the morning, the sixth around midday and the ninth around three in the afternoon. So when, in the story of the labourers in the vineyard, the last group are hired at the eleventh hour (Mt 20:6), they are hired at around five in the afternoon and work until dusk.

5 Weeks

There have been wide variations between cultures in the length of the week from as few as four days to as many as ten, the length often determining the frequency of market day when people from the country came into the towns to sell their wares. The Romans inherited an eight day week from their Etruscan neighbours which was occasionally lengthened to nine to avoid clashes with religious festivals. According to the Old Testament, a seven day week was part of the Jewish religion but it is not clear whether it was systematically observed until the Jews began to be deported to Babylon in 597 BC and came across the Babylonian seven day week. The Emperor Constantine imposed a seven day week on the Roman Empire in 321 AD and this has become the *de facto* week across the world with the first day being the most important for Christians as Jesus rose on the first day of the week — counting the day from dusk the day before.

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