

Calendars, clocks and the end of Irish Time

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2016: Calendar Year

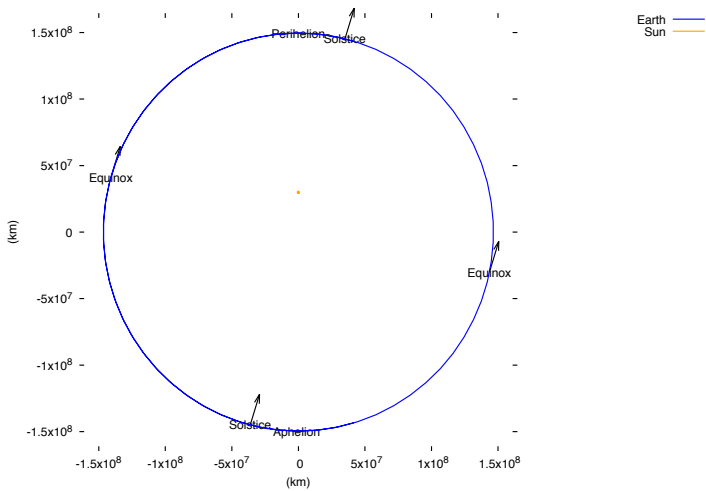
Seasons: Weather cycles, days lengthen and shorten.

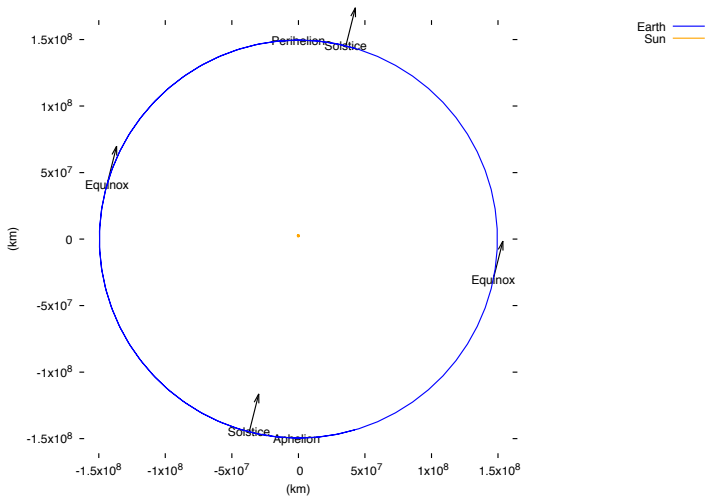
Aim of our calendar: Keep Equinoxes and Solstices at the right time of year, especially the vernal equinox.

Tricky: year isn't whole number of days (365.24219).

The time of year: angle between earth's axis and the line from the earth to the sun.

NB: seasons nothing to do with distance to sun. Earth is at its closest (Perihelion) about 2th January 2016.





Counting Years

Count years from the (supposed) year of Christ's birth.

Dionysius Exiguus (AD 523) produced new table of Easter Dates.

Herod died in 4BC, so Dionysius probably got it wrong.

BC dating came somewhat later, with the missing year zero.

Before that dates were counted since the founding of Rome.

1AD = 754AUC (ab urbe condita).



October: Calendar Month

Need bigger division of years than just days.

Moon's phases is next most obvious thing in the sky.

Months roughly to be in sync with the moon (29.5305889 days)?

Other calendars are better in this respect.

We've ended up with funny months.

Story says Romulus gave 10 months, a successor, Numa, added 2 more.

Julian Reform

Ianuarius	29	31	Quinctilis	31	31
Februarius	28	28/9	Sextis	29	31
Martius	31	31	September	29	30
Aprilis	29	30	October	31	31
Maius	31	31	November	29	30
Iunius	29	30	December	29	31

Old leap: Cut Feb at 23/24, *intercalarius* of 27 days, irregular.

New leap: Once in 4, double Feb 24.

Took 445 day year (46BC), and fumbling to get there (8AD).

(Astronomical events a useful retrospective!)

Aiming for 365.24219 day year.

When	Calendar	Length
????	Old Roman	$355 \pm \text{£££}$
45BC	Julian	365.25
1582AD	Gregorian	365.2425

Papal Bull of 24 Feb 1582: 4 Oct followed by 15 Oct.
Equinox back at 21 Mar.

Took a while to catch on: 1752 for us.

Tables and Rules for the Moveable and Immoveable Feasts; together with the Days of Fasting and Abstinence throughout the whole Year.

Rules to know when the Moveable Feasts and Holy-days begin.

E After-day, on which the rest depend, is always the first Sunday after the Full Moon which happens upon or next after the twenty fifth Day of March; and if the Full Moon happens upon a Sunday, *Easter-day* is the Sunday after.

Advent Sunday is always the nearest Sunday to the Feast of S. Andrew, whether before or after.

<i>Septuagesima</i>	2	(Nint)	Week before <i>Easter</i>		<i>Agation Sunday</i>	} is {	5 Weeks	} after
<i>Sextagesima</i>	1	(Eight)			40 Days		<i>Easter</i>	
<i>Quinquagesima</i>	2	(Seven)			7 Weeks			
<i>Quadregesima</i>	3	(Six)			8 Weeks			

A Table of all the Feasts that are to be observed in the Church of England throughout the Year.

The Days of the Feasts of	ALL Sundays in the Year.	The Days of the Feasts of
	The Circumcision of our Lord JESUS CHRIST.	
	The Epiphany.	
	The Conversion of S. Paul.	
	The Purification of the Blessed Virgin.	
	S. Matthias the Apostle.	
	The Annunciation of the Blessed Virgin.	
	S. Mark the Evangelist.	
	S. Philip and S. James the Apostles.	
	The Ascension of our Lord JESUS CHRIST.	
S. Barnabas.	S. Peter the Apostle. S. James the Apostle. S. Bartholomew the Apostle. S. Matthew the Apostle. S. Michael and all Angels. S. Luke the Evangelist. S. Simon and S. Jude the Apostles. All Saints. S. Andrew the Apostle. S. Thomas the Apostle. The Nativity of our Lord. S. Stephen the Martyr. S. John the Evangelist. The Holy Innocents.	

The Nativity of S. John Baptist.

Monday and Tuesday in *Easter-week*.
Monday and Tuesday in *Whitsun-week*.

A Table

A Table of the Vigils, Fasts and Days of Abstinence, to be observed in the Year.

THE Even or Vigils before		The Even or Vigils before	
			The Nativity of our Lord.
			The Purification of the Blessed Virgin Mary.
			The Annunciation of the Blessed Virgin.
			<i>Easter-day</i> .
<i>Whitsun-day</i> .		<i>S. John Baptist.</i>	
<i>Pentecost</i> .		<i>S. Peter.</i>	
<i>S. Matthias.</i>		<i>S. James.</i>	
		<i>S. Bartholomew.</i>	
		<i>S. Matthew.</i>	
		<i>S. Simon and Jude.</i>	
		<i>S. Andrew.</i>	
		<i>S. Thomas.</i>	
		All Saints.	

Note, That if any of these Feast-days fall upon a Monday, then the Vigil or Fast-day shall be kept upon the Saturday, and not upon the Sunday next before it.

Days of Fasting or Abstinence.

- I. THE Fast Days of Lent.
- II. The Ember-days at the four Seasons, being the Wednesday, Friday and Saturday } after {
 - 1. the first Sunday in Lent.
 - 2. the Feast of Pentecost.
 - 3. September 14.
 - 4. December 13.
- III. The three Rogation-days, being the Monday, Tuesday and Wednesday before Holy Thursday, or the Ascension of our Lord.
- IV. All the Fridays in the Year, except *Christmas-day*.

Certain Solemn Days for which particular Services are appointed.

- I. THE fifth Day of November, being the Day kept in Memory of the Papists' Conspiracy.
- II. The thirtieth Day of January, being the Day kept in Memory of the Martyrdom of King Charles the First.
- III. The nine and twentieth Day of May, being the Day kept in Memory of the Birth and Return of King Charles the Second.

TABLE

Wednesday: Day of Week

7 day week is very old. Ptolemaic week by Romans and biblical week by Jews.

Portuguese	English	French	Planet
segunda-feira	Monday	lundi	Moon
terça-feira	Tuesday	mardi	Mars
quarta-feira	Wednesday	mercredi	Mercury
quinta-feira	Thursday	jeudi	Jupiter
sexta-feira	Friday	vendredi	Venus
sábado	Saturday	samedi	Saturn
domingo	Sunday	dimanche	(Sun)

Possibly longest unbroken tradition. Resisted French (10 day) and Communist (5 then 6 day) reform.

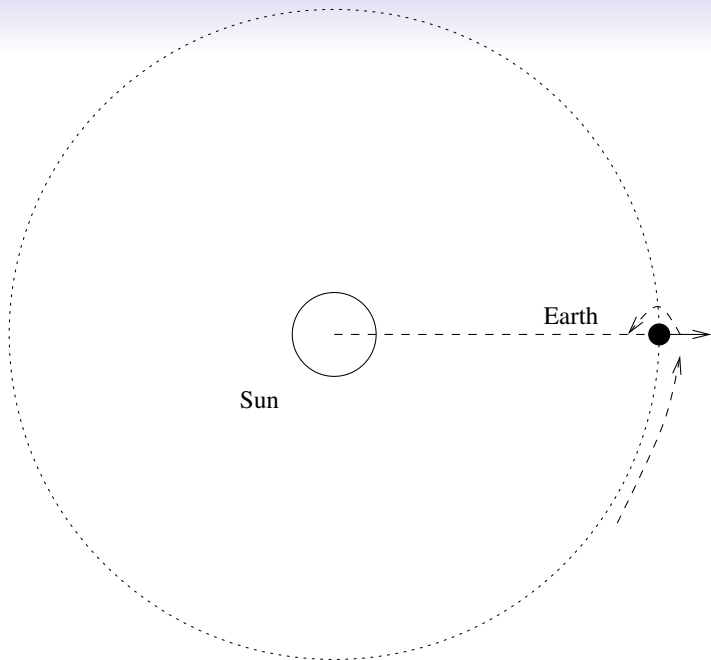
Days

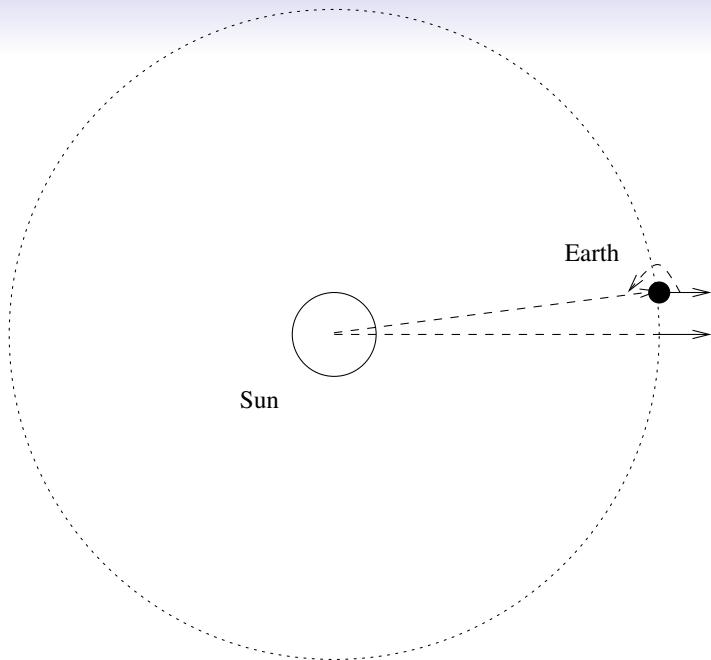
Obviously, it gets dark and bright once per day!

Different cultures start days at: sunset, sunrise, midnight, midday,
...

Must be something to do with Earth going around.

Solar vs. sidereal days.





Hours

Arbitrary divisions of a day. They arise by dividing things into 12.

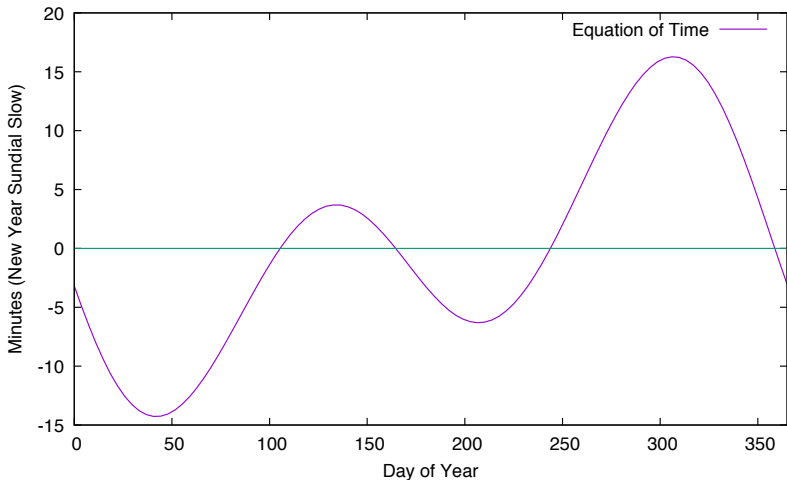
Were very uneven. Gradually fixed (14C).

Came to us via monastery and Roman army.

In 7C, lots of subdivisions, by middle ages we have *minutae primae* and *minutae secundae*.

Apparent vs. Mean Time

In 1792, move from apparent time to mean time.



Irish Legal time

Problem with midnight — it depends where you live.

In 1858, case law chooses local time.

In 1880, legislation fixes GMT in England, DMT in Ireland.



Dunsink Observatory

Usher: 25m7–48s (1787).

Brinkley: 25m22s (1832).

Romney-Robinson: 25m21s (1838).

Elliott-(Ray-Drury-

Malone): 25m21.02s (2017).

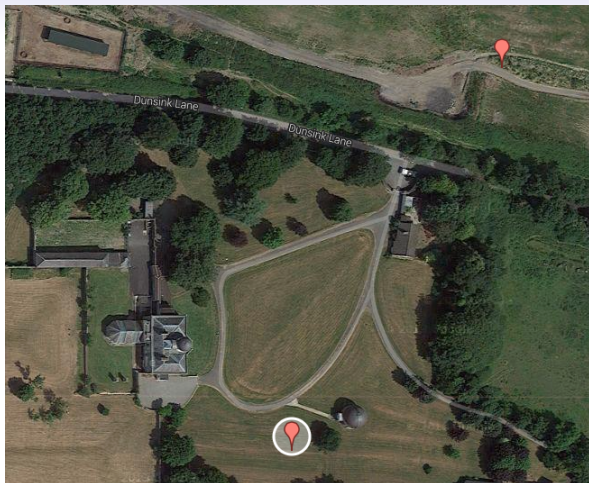


Image: Google Maps

$6^{\circ}20.3', 53^{\circ}23.2'$ vs $6^{\circ}20.2', 53^{\circ}23.3'$

1916

The Meridian Conference (1884): Greenwich as prime meridian.
By 1911, even France has moved to GMT.

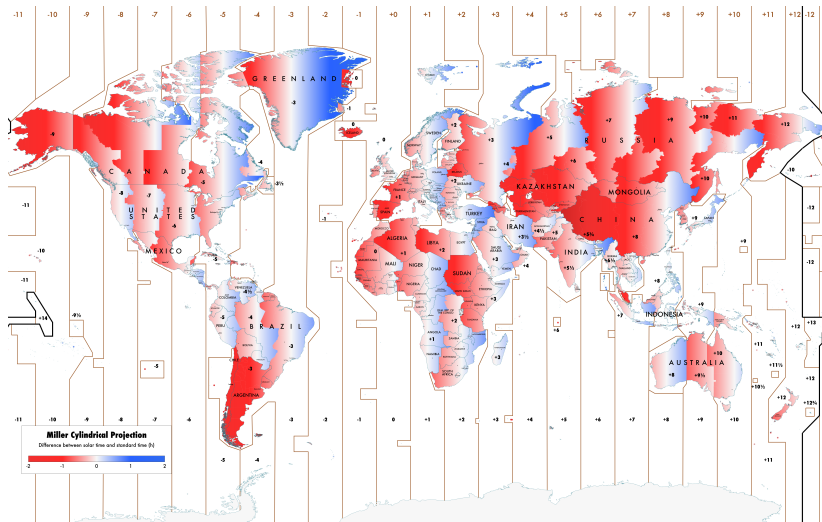
31 Mar	Germany adopts Summer Time.
24–29 April	Easter Rising.
10 May	Summer time bill read.
14 May	John Lonsdale: unification efforts.
17 May	Summer time act gets royal ascent.
21 May	Clocks put forward at 2am.
1 Aug	Uniform Time bill (Herbert Samuel), concerns (John Dillon).
4 Aug	Dublin Mercantile Association support
7 Aug	Edward Carlson comments in Parliament.
12 Aug	Dublin corpo supports bill.
17 Aug	Deal on Dublin Bill mentioned in Parliament.
23 Aug	Uniform Time Bill gets royal ascent.
Sep	Planning train/mail/boat/clocks/...
1 Oct	Irish clocks put back 35 min at 3am.

Legal Time Since

1923	Western-European Time
1941–5	No double Summer Time
1947	No double Summer Time
1968	Standard Summer Time (GMT+1)
1971	Changed mind.
1986	Order giving effect to EEC directive
2001	2000/84/EU directive currently in force (from 2002 last Sun in March/October)

In this Act the expression 'West-European time' means Greenwich mean time.

Local Mean Time vs. Civil Time



[http://blog.poormansmath.net/
the-time-it-takes-to-change-the-time/](http://blog.poormansmath.net/the-time-it-takes-to-change-the-time/)

Seconds: Universal Time

All in terms of GMT. There's a problem...

... GMT is dead!

Universal Time is calculated from sidereal time (now ERA) using a formula like this:

$$86636.55536790872 + 0.000005098097 T \\ + 0.000000000509 T^2$$

(A day is usually 86400 long).

Atomic Seconds

International Atomic Time has been available since 1955 (officially since 1972). Uses SI second.

second: In the International System of Units (SI), the time interval equal to 9,192,631,770 periods of the radiation corresponding to the transition between the two hyperfine levels of the ground state of the cesium-133 atom.

How did they pick 9,192,631,770?

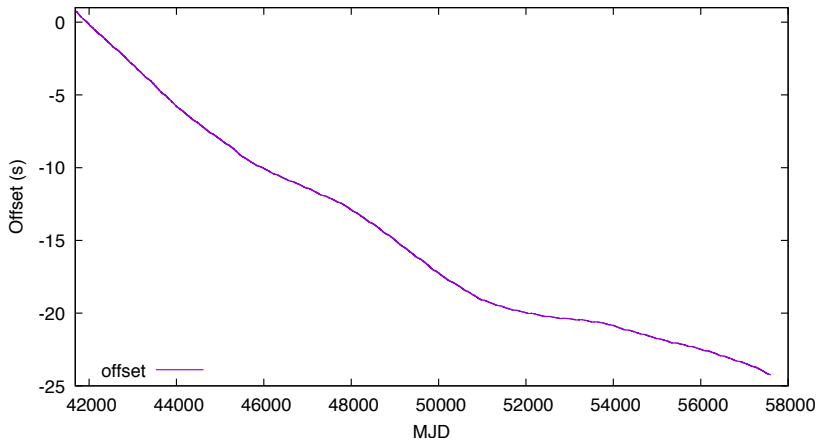
Used ET, based on Newcomb's measurements from 1750–1892.

Tidal forces (1.7ms/d/c) mean UT and SI seconds are different (by 2.5ms).

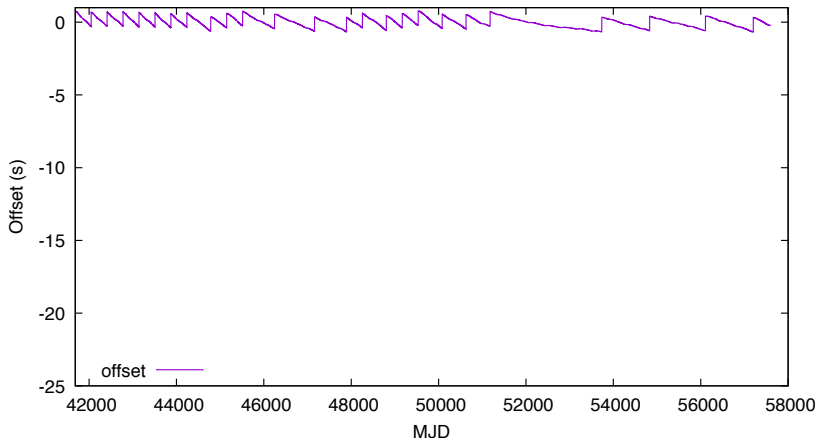
Coordinated Universal Time is a compromise. It ticks once per SI second, in sync with TAI.

If UTC is more than one second from UT1 then UTC is adjusted.

TAI UT1 offset, Feb 73 to Oct 16



UTC UT1 offset, Feb 73 to Oct 16



Pros and Cons

- Keeps UTC in sync with mean day.
 - Preserves legal status-quo.
 - Needed by astronomers and navigators.
-
- Subtracting dates is hard or impossible.
 - Makes software more complex.
 - Misapplication could be dangerous.

Particularly tricky for computers.

Debating since about 1999 — WRC-15 punted until WRC-23.

Enjoy your extra second on December 31!