Notes on Precession in Astronomy

Precession is the slow gyration of the Earth's spin axis, due to the gravitational pull of the Moon, Sun and planets on the unevenly distributed mass of the Earth. The Earth slowly wobbles, much as a top, or gyroscope, does when spun. This wobble is called the Earth's Precession.
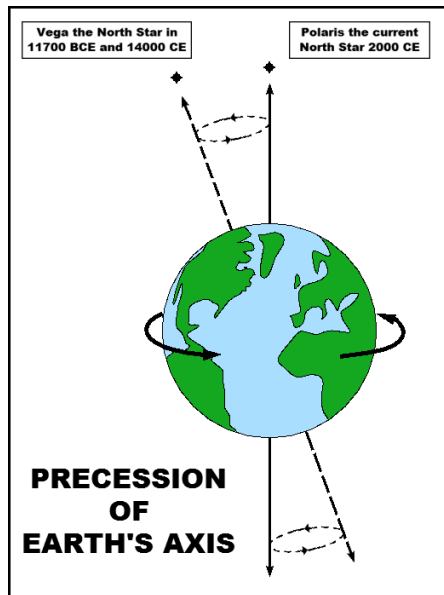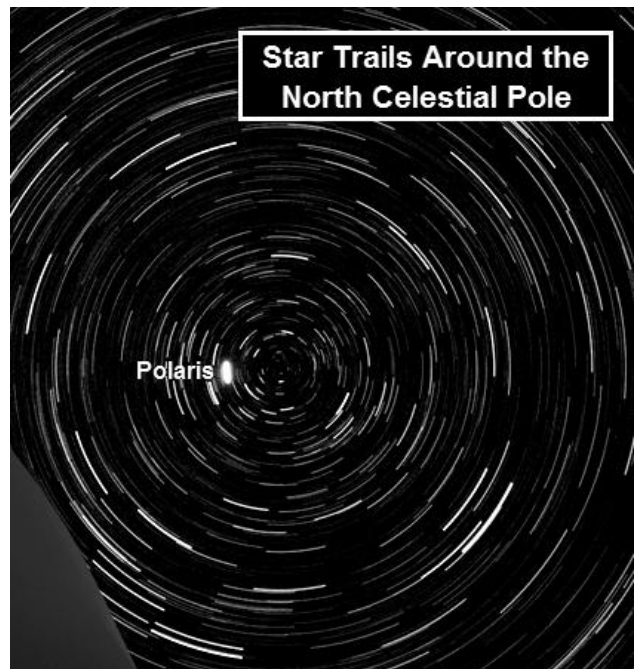
Precession of the Northern Pole Star

The star Polaris, which is currently close to the North Celestial Pole, appears to be stationary while other stars appear to rotate around it as the Earth turns daily on its axis [see Star Trail photograph.] However, the specific star that is the North Star varies over time because of the Earth's Precession.

Precession was first discovered by the Greek astronomer Hipparchus in about 150 BCE, and its resultant observational effect was well documented by the time of Claudius Ptolemy, who discussed it at length in his "Almagest" around 100 CE.

The Earth's Precession changes at a rate of about 50.287 arc seconds per year, eventually making an entire circle of 360° in 25,772 years. [Note: Each degree contains 360°, and each degree contains 3600 arc seconds.]

Because the Earth tilts on its axis at 23½° and slowly wobbles, while it is rotating and orbiting around the Sun, a line drawn through both poles will trace out a cone in the sky above each pole. Hence, the specific star that becomes the pole star will change over time. [See the progression of the North Celestial Pole against the sky in the map on page 2.]

Star Trails Around the North Celestial Pole

Polaris

Vega the North Star in 11700 BCE and 14000 CE

Polaris the current North Star 2000 CE

PRECESSION OF EARTH'S AXIS

Eventually, the bright star Vega, in the constellation Lyra, will become the North Star in about 11,700 years, as it was roughly 14,000 years ago. It will not be as close to the actual North Celestial Pole as Polaris is since it will never be more than 3.3° away. [Note in the Table, on page 2, that the only reasonably bright star to be closer to the Celestial Pole was Thuban about 5000 years ago.]
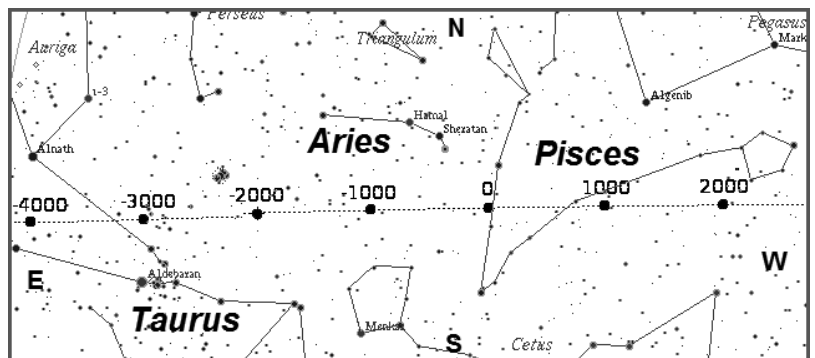
Precession of the Vernal Equinox through the Zodiacal Constellations

Because the Earth's precession occurs in the opposite direction to the Earth's orbit, the Ecliptic, and the Celestial Equator move in opposite directions. So, as the Sun moves westward through the constellations, the precession moves eastward. The Vernal Equinox is presently located in the constellation of Pisces.
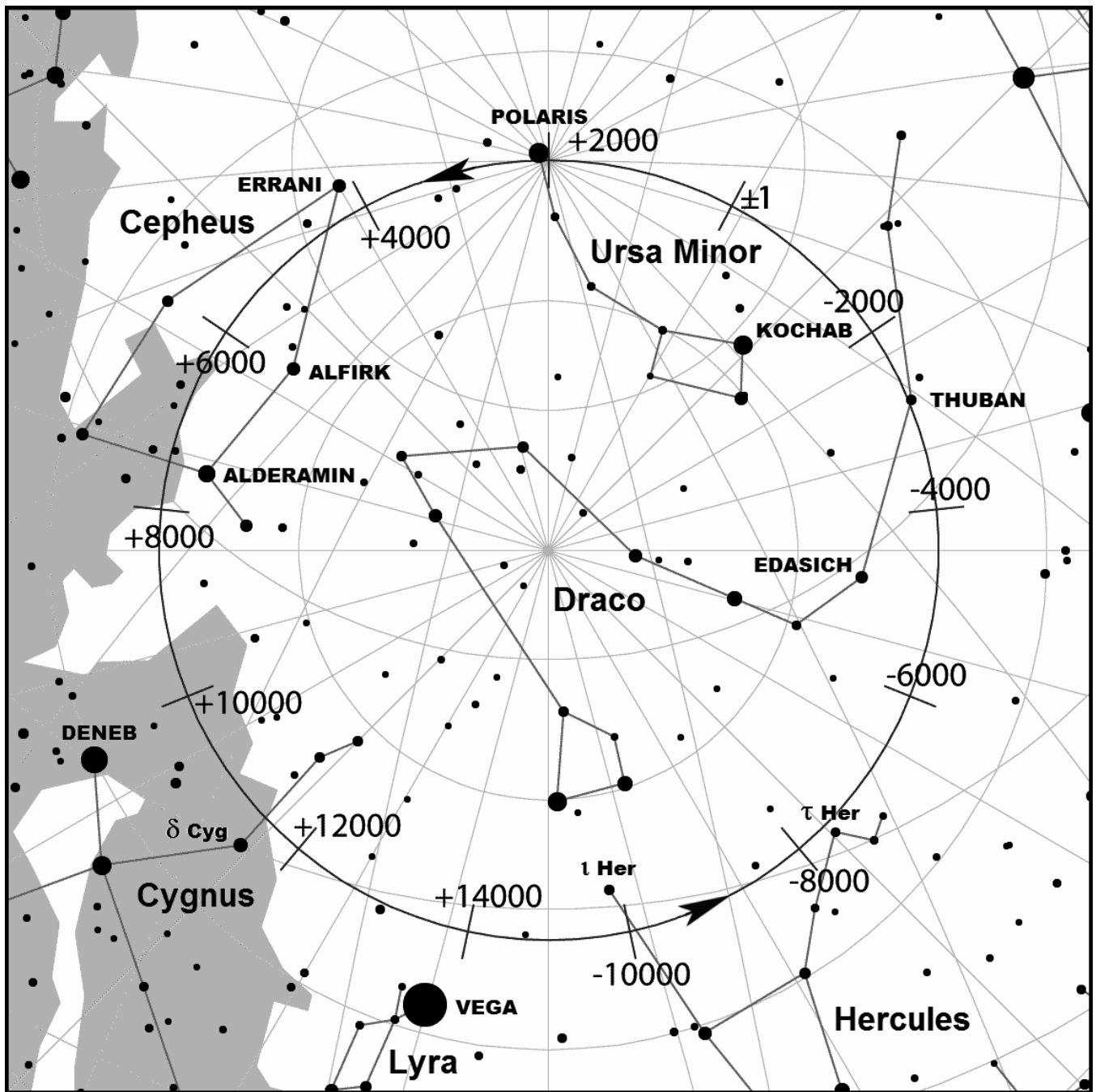
In 3000 BCE, when Thuban was the pole star, the Vernal Equinox was already well situated in the constellation Taurus. Between about 2000 BCE and 100 BCE, the Vernal Equinox resided in Aries. By the time of Claudius Ptolemy, 100 CE, it moved into the constellation of Pisces where it will

reside for several hundred years until it slowly migrates into the constellation Aquarius.

[Note: Due to differing methods over history that constellation sizes, as well as boundaries have been determined, and defined, as well as calendar changes, these dates should only be taken as a rough approximation. Depending upon the source, they may vary as much as +/- a couple hundred years.]

Westward shift of the Vernal Equinox through the Zodiacal Constellations - Wikipedia

Wikipedia modified by BDM

Table of Northern Pole Stars

Year	Star	Star Designation	Constellation	Magnitude	Dist. From North	Notes
-11700	Vega	α Lyr	Lyra	0.03	3.3°	
-10000	-	τ Her	Hercules	3.89	1.6°	Europe/Asia: Early Civilations
-5500	-	ι Her	Hercules	3.80	0.4°	
-5000	Edasich	ι Dra	Draco	3.29	2.8°	Agriculture/Technology
-3000	Thuban	α Dra	Draco	3.65	0.1°	1st Egyptian Dynasty/Early Mayan
-1000	Kochab	β Umi	Ursa Minor	2.08	4.2°	Anaasází Ancient Puebloans
2000	Polaris	α Umi	Ursa Minor	2.02	0.3°	Current Civilization
4000	Errani	γ Cep	Cepheus	3.21	1.3°	
6000	Alfirk	β Cep	Cepheus	3.23	2.9°	
7500	Alderamin	α Cep	Cepheus	2.45	1.5°	
10000	Deneb	α Cyg	Cygnus	1.25	4.2°	
11500	-	δ Cyg	Cygnus	2.87	1.4°	
14000	Vega	α Lyr	Lyra	0.03	3.3°	One Cycle = 25,772 years

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