A star by any other name

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He counts the number of the stars, to each He gives a name.
Psalm 147

Many of the great astronomers and astrologers of ancient and medieval times were Arabian and gave names to the stars in the sky in their own tongue. Since Arabic is a sister language to Hebrew, one finds that the name by which a star is labeled today often makes sense in Hebrew. Sometimes the connection is straightforward; for example, Rigel, the bright bluish-white star in the leg of Orion, (= *regel*, foot). Deneb, which can be seen in late summer, is the tail of the swan in the constellation Cygnus, (in Semetic languages, often the *d* and *z* can be transposed, so we have *zanav*, tail).

In the Big Dipper, the dim companion to bright Mizar is named Alcor. (In ancient times, this pair functioned as a kind of eye chart, since only those with keen vision can discern that there are indeed two stars). The original name was *Al Khiwwar* (= *chiver*, faint).

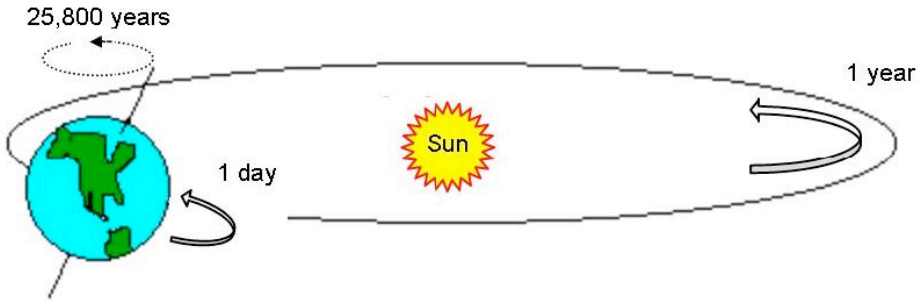
Sometimes the Hebrew link is more complex, as in the case of the red supergiant Betelgeuse – the shoulder of Orion. The Arabian astronomers called the three stars in Orion's belt the golden nuts or walnuts – *Al Jauza* (= *egoz*, nut or walnut). This later denoted the whole constellation of Orion. The beautiful yellow star at the shoulder/hand was called *Iad Al Jauza* – the hand (*yad* in Hebrew) of *Al Jauza*, and that evolved into our Betelgeuse.

One star whose Hebrew/Arabic etymology is blatant is a small star in the Little Dipper (one of the Guardians) called Kochab (= *kochav*, star). Not that Kochab is small in absolute terms, quite the contrary. It is actually an orange giant 190 times a luminous as the sun. Nonetheless, to earthbound viewers, it doesn't look particularly impressive. Why would this relatively insignificant star be given the distinction of having such an auspicious name - The Star? The answer has to do with a phenomenon called the Precession of the Equinoxes. Our earth spins around its axis completing one revolution every day. At the same time it orbits the sun and returns to the same position in space every year. The orientation of the earth spin, however, is not in the same plane as the orbit around the sun but rather our globe's rotation is tilted with respect to that plane by about 23 degrees. This is what accounts for the seasons. As the earth goes around the sun the axis retains the same orientation, so that sometimes the top half of the earth (north) is tilted towards the sun and sometimes the bottom, southern pole is tilted towards the sun. In December, the northern hemisphere is tilted away from the sun and that causes two things to happen. Firstly, the days are shorter due to the geometry of the earth's rotation around a tilted axis, and secondly, the steeper angle of the ground relative to the sun's radiation reduces the energy per unit area hitting the earth. All this leads to the cooler weather of winter. The opposite is true in the summer, and in the southern hemisphere.

The earth has another motion as well. In order to understand this motion, we can perform one of the few experiments in astrophysics that can be done in the home. Find a dreidel laying around since last Chanukah and spin it hard. The dreidel is pretty much motionless – except for the very fast spinning of a few revolutions per second. But after a few moments another motion begins with the handle of the driedel starting to wobble in a small circle.

This motion is much slower, maybe a few seconds for each full circle. The earth exhibits this type motion as well, which was first explained by Isaac Newton. Just like a dreidel which wobbles as it spins, the axis of the earth's rotation slowly wobbles as well, and completes a full cycle about every 26,000 years. If we looked at the sidereal year (meaning the year based on the position of the stars in the sky), then over the course of 25,800 years, the earth will have lost one full cycle of seasons – only 24,799 winters and

summers! Although the time scale for this effect sounds interminably long, the effects have been pronounced over the course of history. If left uncorrected, in half that time, 13,000 years or so, it could snow in New York in June.



The wobble of the earth's axis leads to another phenomenon, besides the drift of seasons. Imagine the earth's axis like a giant finger pointing out into the vast reaches of space. The star closest to that point in the sky (called the North Celestial Pole) will have particular significance, as it will appear stationary to us while all the other stars in the sky seem to revolve around it. This is the North Star and Polaris currently holds that title. But because of precession, the finger of the earth's axis moves around the sky like a vast game of eenie-meenie-miney-moe choosing a different pole star over the eons. In about 5,000 years the star at the king's right arm in the constellation Cepheus, Alderamin (= *yamin*, right) will be the North Star and in about 11,000 years it will be brilliant Vega, which the Assyrians called Dayan-Same (= *dayan shamayim*, the Judge of Heaven). That brings us back to our original star, Kochab. Around 3000 years ago the giant finger of the earth's axis pointed fairly close to Kochab and for some time it was the most important star in the sky, the North Star, which explains its illustrious appellation.

The shift in the seasons was not just an astronomical curiosity; indeed, it caused much grief in religious circles. In 385, the Council of Nicea had specified that Easter was to be celebrated after the vernal equinox (the astronomical definition of Spring, when the duration of the day is identical to that of the night). But due to the fact that the Julian calendar did not take the precession into account, by 1563, Easter was coming out too early. Pope Gregory XIII made a number of changes in the calendar to bring it up to speed with the most current astronomical notions, and in order to rectify the situation regarding Easter, Gregory decided to do away with 10 days. By Papal decree, Thursday, October 4, 1582 (Julian) was followed immediately by Friday, October 15, 1582 (Gregorian).

The Jewish calendar was not really affected by Pope Gregory's adjustment. One slight consequence of the correction has to do with the day when the Jews outside of Israel begin their petition for rain (*v'ten tal u'matar*) in the daily *Amidah*. This prayer is set to commence "sixty days into the [fall] season" (Ta'anit 10a). Autumn begins around September 23rd, so 60 days later should be November 22nd. Yet, in modern times, the prayer for rain starts on December 4th. Sources from before Gregory's 10 day deletion, however, do indeed give the date as November 22nd. For example, about thirty years before Gregory's decree the Bet Yosef (Orach Hayyim 117) quotes Rabbi David Abudirahim (1340) as having said *tal u'matar* on the night of November 22nd. One might ask: why not just count 60 days from the current equinox and recite the prayer then? But alas, the legal tradition adopted the 3rd century Shmuel's calculations regarding the onset of fall, and that is identical to those of Julius Ceaser – 365 and a quarter days exactly from autumn to autumn.

The Jewish calendar is actually a hybrid lunar/solar based system. The months follow the lunar cycle with each one beginning when the first sliver of the new moon is observed (*Rosh Chodesh*). One month is about 29 and a half days, which means a year of twelve months comprises 354 days. However, since

holidays are not only linked to the monthly date, but also have a seasonal character, (Passover, for example, is not only the 15th of Nissan, but also the festival of Spring), an additional month may be added to keep the holidays in sync with the seasons. In ancient times the leap month was not fixed according to any mathematical calculation, but rather was determined according to astronomical observations and other parochial considerations such as that year's particular agricultural/climatic conditions. Later on, the calendar rules became standardized and a cycle of 19 years including 7 leap years was adopted. The Jewish calendar makes no corrections for the precession of the equinoxes and is therefore racing ahead of the tropical year by about 1 day every 200 years, and so Passover is creeping slowly into summer. Jewish legal authorities have been aware of the drift of the calendar for some time, and so Ibn Ezra states in his 12th century commentary to Exodus 12;2 that Shmuel's calendar is only an approximation, "for today there exists a discrepancy between the genuine equinox and his [Shmuel's] equinox of about 9 days." The typical proposal for an ultimate solution to this problem maintains that the ideal situation in Jewish law is actually not to have a fixed calendar, but rather to determine leap years ad hoc. The day will come when the great Sanhedrin court of judges convening in Jerusalem will once again regulate the calendar, and they will take into account this and all other relevant considerations.

When that happens, the Star of David will truly shine brightly, and Jews in the Diaspora may once again begin reciting *tal u'matar* in November. (*Matar,* Hebrew for rain, by the way, is the name of the star in the right knee of the winged horse in the constellation Pegasus!)

For further reading:

- Still, in my opinion, the best introductory book to star watching is *The Stars* by H.A. Rey (more famous for his *Curious George* character).
- http://www.judaic.org/halakhot/talumatar.html
- http://www.greenheart.com/billh/gregory.html
- *Torah and Science*, Judah Landa, Ktav, 1991