DARK SKIES for September 2020:

T/W Sep.	1/2	none
W/T Sep.	2/3	none
T/F Sep.	3/4	none
F/S Sep.	4/5	none
S/S Sep.	5/6	9:06 p.m. - 9:21 p.m.
S/M Sep.	6/7	9:04 p.m. - 9:44 p.m.
M/T Sep.	7/8	9:01 p.m. - 10:09 p.m.
T/W Sep.	8/9	8:59 p.m. - 10:38 p.m.
W/T Sep.	9/10	8:57 p.m. - 11:12 p.m.
T/F Sep.	10/11	8:55 p.m. - 11:54 p.m.
F/S Sep.	11/12	8:53 p.m. - 12:44 a.m.
S/S Sep.	12/13	8:51 p.m. - 1:44 a.m.
S/M Sep.	13/14	8:49 p.m. - 2:52 a.m.
M/T Sep.	14/15	8:47 p.m. - 4:06 a.m.
T/W Sep.	**15/16**	**8:45 p.m. - 5:05 a.m.**
W/T Sep.	**16/17**	**8:43 p.m. - 5:06 a.m.**
T/F Sep.	**17/18**	**8:41 p.m. - 5:08 a.m.**
F/S Sep.	**18/19**	**8:39 p.m. - 5:09 a.m.**
S/S Sep.	19/20	8:41 p.m. - 5:10 a.m.
S/M Sep.	20/21	9:13 p.m. - 5:12 a.m.
M/T Sep.	21/22	9:49 p.m. - 5:13 a.m.
T/W Sep.	22/23	10:30 p.m. - 5:14 a.m.
W/T Sep.	23/24	11:19 p.m. - 5:15 a.m.
T/F Sep.	24/25	12:15 a.m. - 5:17 a.m.
F/S Sep.	25/26	1:16 a.m. - 5:18 a.m.
S/S Sep.	26/27	2:20 a.m. - 5:19 a.m.
S/M Sep.	27/28	3:24 a.m. - 5:20 a.m.
M/T Sep.	28/29	4:28 a.m. - 5:21 a.m.
T/W Sep.	29/30	none
W/T Sep.	30/1	none

Times listed are for Dodgeville, Wisconsin when
(1) Moon is below the horizon
(2) Sun is > 18° below the horizon
(astronomical twilight)

Please minimize your use of outdoor lighting during these times to give everyone the best possible view of the night sky.

Time Travel

conducted by David Oesper

Continued from last month...

Hunting for Comets and Planets*

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(Received 1991 November 4)

A simple way to calculate the occultation frequency is to look at the situation from the point of view of a distant star. Suppose that the star lies close to the ecliptic plane. Then it sees the Kuiper Belt as a thin edge-on disk with the Earth moving inside it. The dimensions of the disk are about 200 astronomical units or 3×10^{10} km from East to West and about 10 astronomical units or 15×10^{8} km from North to South. The area of the disk as seen from the star is 5×10^{19} km^2. If we consider a comet with diameter 1 km occulting the star as seen from the Earth, the shadow of the comet sweeps out a track 1 km wide on the Earth. The Earth is moving in its orbit at 30 km s^{-1}, much faster than the comets in the Belt. The rate at which the shadow sweeps out area on the Earth is 30 km^2 s^{-1}. Dividing the total area of the disk by the sweep-rate, we deduce that an average comet occults the star, as seen from any single point on the Earth, approximately once every 2×10^{18} s. If we adopt Kuiper's optimistic estimate of 10^{13} for the population of the disk, we find that the star is occulted once every 2×10^{5} s, or once every 2 days. If we set up a small telescope with automatic detecting equipment to watch 100 stars continuously, we might expect to see occultations at an average rate of two per hour. That would be frequent enough to make the search for occultations interesting. It might even be frequent enough to justify spending a modest amount of money on small telescopes dedicated to the job of searching.

How small does a star have to be to be eclipsed by a comet? The angular size of a 1 km comet in the Kuiper Belt is about 10^{-10} radians, roughly the same apparent size as the famous golf ball that one of our astronauts took with him to the Moon. Fortunately it turns out that there are plenty of stars with angular size as small as this. Nearby stars will not do. A star like Sirius or Alpha Centauri at a distance of a few parsecs is about a hundred times too fat, and a red giant star like Betelgeuse is even worse. To be eclipsed, a star similar to the Sun needs to be a few hundred parsecs away. This means that any star with the same colour as the Sun or bluer, and of visual magnitude 13 or fainter, will have angular size small enough for occultations to be seen. If we consider stars of magnitude 13, bright enough to be easily observed in a small telescope, there are several million of them in the sky. They are about ten times more abundant in the part of sky near to the plane of the Galaxy than they are at the galactic poles. Near the galactic plane there are about a hundred of them per square degree of sky. It would be easy to find places where a hundred suitable stars of magnitude 13 are available within the one-degree field of a small telescope. The best places to observe are the two places in the sky where the plane of the ecliptic (with the highest concentration of comets) intersects the plane of the Galaxy (with the highest concentration of stars). The planes intersect in the constellations Taurus and Sagittarius. In the northern hemisphere, Taurus is the place to observe in winter and Sagittarius is the place to observe in summer. These also happen to be places in the sky where there are many other interesting things to observe besides occultations.

* The text of the Milne Lecture, delivered 1991 October 24.

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To be continued next month...