DISCUSSION CONCLUDING AAS 11-667

Mark Storz asked if any studies had been performed to see if global mass transport (ice melt, erosion, *etc*.) might change the Earth's moment of inertia enough to explain the decreasing trend in the number of leap seconds. Wolfgang Dick replied that his discussions with Peter Brosche suggested that the effect seems mainly due to core-mantle coupling inside the Earth. Specifically the core and the mantle may rotate slightly differently, with the mantle experiencing more variation due to tidal effects caused by gravitational interaction with the Moon and Sun. The coupling between the mantle and the core has a regulating effect on the mantle such that whenever the mantle slows down, contact with the core will spin the mantle back up.

McCarthy said that rotational deceleration due to tides is computable, but the theory is different than what is observed. The difference between theory and observation has been attributed to an acceleration caused by rising sea levels and deglaciation; the Earth speeds up as it becomes rounder. Storz asked if mass transport had been analyzed sufficiently to support the theory, and McCarthy replied that "the theory matches the observations fairly closely." Steve Allen noted that, among the fifteen web sites of the IERS, some point to research in geophysical fluids where specialist studies can be reviewed.

Neil deGrasse Tyson concurred with Dick's observations that there is a public appetite for leap seconds. Public interest is "very high; they love it, they love talking about it, they love trying to understand it. The explanation involves the Moon, things they've heard about, words they've used before." Based on his life experience, Tyson "agreed emphatically" that the topic makes for "quite an entrée" into the domain of solar-system dynamics. Dick added that he uses leap seconds to explain the work of the BKG to visiting students. Particularly, it is the only effect that an ordinary person can observe themselves, because a precise watch will reveal the one-second difference in the time of day the next morning after a leap second.

Steve Malys asked how observed trends in Earth rotation might be related to the fact that the *SI* second was based on some average duration of the mean solar second from the 19th century. McCarthy said that if we were to define the *SI* second relative to Earth rotation now, we wouldn't have the issue of leap seconds but the issue would instead exist a century from now. This is because there is a deceleration that accumulates as a parabola. Seago added that McCarthy's statements were accurate but only over very long time periods. He said that if the trend were truly parabolic we would have experienced more and more leap seconds over time but fewer and fewer have been needed since their introduction in 1972. Over the scale of human lifetimes so-called *decadal fluctuations* tend to dominate the underlying long-term trend. As evidence, Seago noted that length of day was not increasing in the plots presented by Dick. Dick added that if the second had been redefined in 1972 then the origin of such plots would shift to that epoch.

George Kaplan affirmed the thrust behind Malys question: we have adopted a conventional rotation rate of the Earth based on 19th century observations, but there is "a lot of slop" in how the definition of today's *SI* second came about. The *ephemeris second* was defined in terms of the tropical year of 1900 as defined by Newcomb's theory of the solar system. Markowitz calibrated the atomic second to the ephemeris second that was uncertain to about one part in 10^9. Kaplan concluded that the conventional value that we put in our formulae for Earth rotation may be somewhat arbitrary.