2003 Brouwer Award Winner - William Ward

William R. Ward (Southwest Research Institute) has made a truly remarkable number of fundamental, creative, and seminal contributions to a wide range of topics concerning the origin and evolution of planets and satellites.

Ward was the first to recognize that the obliquity of Mars undergoes large oscillations that are driven by secular variations in the orbit of Mars. These oscillations have profound implications for past variations of Martian climate. Over the years he has made a number of other insightful contributions concerning the evolution of the Martian obliquity. After the chaotic motion of the planets was discovered, he realized (with Rudy) that this might allow a secular spin-orbit resonance to be crossed and that even larger variations in obliquity might then occur. This work inspired later demonstrations that the obliquity of Mars undergoes large chaotic variations. Ward has made many other contributions to the obliquity dynamics of the planets and their satellites. He showed that the Moon has undergone large obliquity variations, he was the first to realize that the Earth's obliquity variations are small because of the large lunar contribution to the precession, and he showed that as the Moon continues to recede from the Earth, the Earth will encounter a secular spin-orbit resonance and undergo large obliquity variations.

Ward is particularly well-known for his many works modeling the dynamical interaction between planetary embryos, gaseous, and particle disks. In 1984 (with Hourigan), he derived the minimum mass that a planet must have in order to open a gap in an inviscid disk, and observed that once such a gap was opened, rapid tidal drift would terminate. To describe these two drift regimes, he later coined the terms Type I and Type II migration now adopted in the literature, where the former is relatively rapid when the planet has not opened a gap in the nebula, and the latter occurs on the viscous time scale of the disk after the planet becomes large enough to open a gap. In a 1986 paper, Ward examined the sources of asymmetry in disk-planet interaction in the pre-gap phase and concluded that in a Keplerian disk, exterior torques would dominate and the planet would migrate inward. Here the idea that there would be a systematic inward decay of satellites and/or planets due to their interaction with an accompanying disk was first established, and thus Ward predicted, well before the discovery of extrasolar planets in close orbits, that planets would spiral inward. These works are central to our understanding the ubiquity of "hot Jupiters" and the consequences for the survival of terrestrial type planets.

For his many contributions to the field of dynamics, including his fundamental contributions to our understanding of planetesimal formation, planetary obliquity variation, secular resonance sweeping, the origin of the Moon, lunar evolution and dynamics, planet-disk interactions, planet migration, and planetary formation dynamics, Bill Ward is truly deserving of the Division of Dynamical Astronomy's Brouwer Award.

by Jack Wisdom and Robin Canup