Planetary Systems Proliferate

Several millennia ago, the Greeks coined the word "planet," or wanderer, to describe the five roving objects they saw chaotically traversing the sky. Today, our knowledge of these other worlds has accelerated beyond the solar system: The first extrasolar planet was reported in 1995, 20 more have since been spied around other stars, and the first multiple-planet system was detected earlier this year. Closer to home, planetary missions in the past decade have gathered more intimate knowledge of the moon, Venus, Mars, and Jupiter and its satellites. In this special issue, we focus on some key areas of rapid advancement in understanding planetary systems, from their formation and structure to their potential to support life.

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The News stories track developments in understanding planetary evolution, from the birth of a planet to its ability to support life. As Govert Schilling reports (p. 66), observations are gradually confirming the theory that planets coalesce from a swirling disk of gas and dust around young stars. Such planetary disks have been popping up everywhere, indicating that planetary systems are common in the universe and that the formation of our solar system was probably not a unique event. Focusing on the four inner or terrestrial planets of our system, Richard A. Kerr (p. 68) finds that modeling studies have given researchers a new respect for the role of chance in determining these planets' structure and composition, and therefore their ability to support life. Finally, Gretchen Vogel (p. 70) reports that astrobiologists are broadening their perspective, concluding that the "habitable zone," which is defined by the presence of water and energy and was once limited to the region inside the martian orbit, may now include exotic objects such as distant moons or even rogue planets lost between the stars.

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The Review articles examine two fast-paced areas of planetary science. Guillot (p. 72) discusses the structure and composition of giant planets, as revealed by recent observations of Jupiter, Saturn, Uranus, and Neptune, as well as high-pressure experiments to determine the properties of these planets' main component, hydrogen. This new understanding may help to distinguish planets from brown dwarfs and offers hints as to the interior structure of the giant extrasolar planets.

And as Showman and Malhotra explain (p. 77), the Galilean satellites provide a well-studied mini–planetary system that can be used to improve our understanding of larger systems. Galileo Galilei discovered the four largest moons of Jupiter—Io, Europa, Ganymede, and Callisto—in 1610, and during the last half of this decade, the Galileo spacecraft has explored this system, which probably formed from a disk of gas and dust around Jupiter. In a striking parallel with the larger solar system, the jovian system may have formed by chance, each world is unique, and Europa may harbor life. So, while observations venture beyond the solar system, the Galilean satellites provide a wealth of information about planetary processes and interactions close to home. –ELIZABETH CULOTTA AND LINDA ROWAN

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