can have upward of 100 million). Equally convenient, the slugs "have organized their 'brain' into half a dozen little brainlets called 'ganglia' which are located in some proximity to the parts of the body they control."

But could they learn? In the 1960s and '70s, Kandel and his colleagues showed that if you had patience, a Waterpik, and a cattle prod, you could "train" the slugs. They could get used to stimuli that were harmless, and, notably, they could be classically conditioned, meaning they could learn to associate one stimulus with another. Eerily, they still behaved the same way with "their intact brainlets carefully removed from their bodies and laid on a sheet of glass, . . . provided one didn't sever the various nerves that wired them up," Burnett says. Learning, Kandel and his colleagues discovered, happens through what scientists call "synaptic plasticity"—changes that occur in the connection between two neurons in response to stimuli.

Of course, that's putting it simply, but, like the slugs, sometimes simple things can help us understand something much more complicated.

SCIENCE & TECHNOLOGY

Brave New Worlds

THE SOURCE: "The Four Hundred Years of Planetary Science Since Galileo and Kepler" by Joseph A. Burns, in ***Nature***, July 29, 2010.

Scientists were stunned in 1979 when *Voyager 1* revealed Io, a moon of Jupiter long thought to be a dead chunk of rock, to have a number of active volcanoes spewing lava in spectacular plumes above its surface. Io is just one wonder among many uncovered in the last 50 years with the advent of the space age and its interplanetary probes, space-based telescopes, and other technological advances. But the pace and nature of the recent revelations about the solar system—and beyond—also underscore, says Joseph A. Burns, how "sluggish" the pace of discovery was during the 350-year period after Tuscan scientist Galileo Galilei first turned his "improved, but still primitive, telescope heavenward" in 1610.

Until humankind ventured into space, astronomy could advance only at the slow but steady pace of incremental improvements in telescopes, as scientists built larger viewers and improved lenses. Observers counted five moons of Saturn between 1655 and 1684, and added four more by the end of the 19th century. William Herschel's chance sighting of Uranus in 1781 vastly extended the perceived size of the solar system. From mathematical analysis of that giant planet's orbital fluctuations, others inferred the existence of Neptune (in 1846) and then Pluto (hailed as the ninth planet upon its discovery in 1930, though recently downgraded to a mere "dwarf planet"). But little was known about the chemical makeup of the planets, moons, comets, and asteroids that populate Earth's galactic neighborhood.

Despite the 1986 *Challenger* disaster and chronic funding difficulties, the National Aeronautics and Space Administration still managed a series of deep-space triumphs in the 1970s and '80s with the two *Voyager* missions and follow-up launches of *Galileo* to Jupiter (1989) and *Cassini-Huygens* to Saturn (1997). The latter mission disclosed Titan (one of Saturn's moons) to be "a remarkable world," Burns writes, complete with "globe-girdling, hydrocarbon sand dunes, apparent dendritic valley systems, and regional-scale methane lakes."

These space missions, says Burns, who teaches astronomy at Cornell University, also uncovered chaos's "determining role in the solar system's accumulation and evolution." Observing the random spin of Hyperion (one of Saturn's moons) and Mars's odd oblique orbit forced scientists to completely dispense with the notion of a "clocklike universe" that had persisted even up to the mid-20th century. And evidence of long-ago collisions between Earth and immense extraterrestrial objects, as well as the spectacular impact of the disintegrating remnants of the Shoemaker-Levy 9 comet with Jupiter, demonstrated that the universe, far from being a serene, unchanging realm, as observers had once believed, could transform in an instant.

What comes next? Burns applauds NASA's present strategy to "follow the water" in its search for extraterrestrial life. Could some form of life exist at the bottom of Martian river basins or emerge from frigid Titan's "rich organic environment"? The list of potentially habitable zones, both in and out of our solar system, has been lengthened in recent years, but, Burns concludes, "if extraterrestrial life is found, probably it will not be where or what scientists currently forecast."