Pluto, Apollo, and the Case for Space Exploration. K.S. Schindler, Lowell Observatory, 1400 W. Mars Hill Rd., Flagstaff, AZ 86001, kevin@lowell.edu.

As we look back four years since New Horizons captivated the world with its revelations of Pluto, we also celebrate the 50th anniversary of humankind's first steps on the Moon and the 89th anniversary of Clyde Tombaugh's discovery of Pluto. Such reflections offer the opportunity to review successes and lessons learned from the past while planning for the future.

The Apollo Moon landings, for instance, offers a classic example of sequential, multi-stage exploration of the Moon, including naked eye observations, telescopic observations, flyby missions, orbiting missions, unmanned landers, and manned landers. The earliest of these observations involved ancient sky watchers simply looking up and noticing differences in the Moon's shading, a handful of large surface features, and its orbital motion. By the 1600's many of the craters, rilles, and other diminutive surface features could be seen thanks to the advent of the telescope for celestial viewing. Three and a half centuries later, the United States and Soviet Union began sending a variety of unmanned spacecraft that collectively flew by, orbited, and landed on the Moon. These led up to the manned landings from Apollo 11 in 1969 through Apollo 17 in 1972. Each level of exploration revealed previously unknown characteristics of the Moon. Perhaps most significantly, thanks to the manned missions that saw astronauts collect rocks and return them to Earth, scientists finally determined a highly plausible scenario for the Moon's formation.

As for Pluto, if we want to really understand and properly characterize its features, we are still in the early stages of exploration. Pluto is not visible to the unaided eye so was not observed until Clyde Tombaugh detected it in 1930. That means scientists have only been able to study it for less than a century, compared to four centuries of lunar studies through telescopes. Some of this disparity is equalized by the fact that technology has advanced so quickly in the 20th century, allowing scientists to speed up the process of learning. Still, for the first several decades after Pluto's discovery its characteristics remained little-understood. Scientists estimated basic parameters such as its orbit and mass, but physically it remained from our perspective little more than a dot in the sky, a celestial needle in the haystack. The Hubble Space Telescope allowed for the creation of crude albedo maps of Pluto's surface, but not until the New Horizons flyby and its mesmerizing images and scientific results did scientists really start to get an idea of how dynamic a world it is. Yet, how much of Pluto will we know if the exploration ends there? We may well compare that to our knowledge of the Moon had we never sent orbiters or landers there. If we are to comprehensively characterize Pluto, and, by extension, any other planetary body, we must continue the quest for knowledge with continued multi-stage exploration.