Countdown

A History of Space Flight

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Richard Snow and Fred Allen at *American Heritage;* and Scott DeGarmo at *Science Digest.*

While researching those articles, as well as the present book, a number of people have been kind enough to grant interviews:

Air Force: Colonel Edward Hall, Jack Neufeld, General Bernard Schriever, Charles Terhune

Douglas Aircraft: C. J. Dorrenbacher, Jim Gunkel, Bob Johnson

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that of Syrtis in 1954. Instead, these seemed to result from nothing more than windblown dust. Indeed, because the winds would distribute organic compounds widely, and because such organics exist in meteorites and survive their impacts with the surface, it appeared that solar ultraviolet destroyed these compounds as they arrived. Mars not only lacked organics; it was actively hostile to their existence.

While NASA-Langley was proceeding with Viking, JPL was seeking new worlds to conquer, and had found a new way to reach them. NASA by then was using the nation's most powerful rocket, the Titan III-Centaur. It had launched Viking and had the thrust to reach Jupiter as well as the outer planets. But these missions would take a long time: sixteen years to Uranus, thirty to Neptune. In the words of Homer Stewart, the head of JPL's advanced-planning office, "The management problems in organizing and carrying out a direct 30-year mission to Neptune (sheer boredom on the part of the participants) look great enough to deter even the most determined explorer."

The new approach relied on the fact that when a spacecraft flew past a planet, the planet's gravity, combined with its motion around the sun, could deflect the probe in its trajectory and give it extra energy. When Mariner 4 had flown past Mars, for instance, it had picked up over three thousand feet per second in velocity. Jupiter could do even more, for it was the largest of the planets. It could add the boost of an extra rocket stage, entirely for free, and could reduce the flight time to Neptune to as little as eight years.

There was more. When the JPL analyst Gary Flandro undertook studies of such Jupiter-assisted missions, he found that the outer planets were about to enter a rare alignment. A single spacecraft could fly past all the major ones—Jupiter, Saturn, Uranus, and Neptune—in only nine years! Each planetary encounter could add energy, speeding the spacecraft to the next. Furthermore, the launch dates—only a dozen years in the future—were just right: far enough ahead to allow for careful planning and preparation and close enough to be well worth pursuing. Astrologers had long declared that planetary alignments control the affairs of individual people, and this one would certainly influence the future of JPL. The opportunity was too good to pass up.

Flandro's work had begun in 1965. Further studies followed, and with his customary expansiveness, Pickering proposed a venture that would build a flotilla of craft, two to follow the course of Jupiter-Saturn-Pluto and two others for Jupiter-Uranus-Neptune. However, while the celestial portents were propitious, the budgetary ones were not, for this $750-million plan came to the fore just as NASA was in the throes of the post-Apollo cuts in its appropriations. Pickering had to settle for two spacecraft rather than four, and to aim no farther than Saturn. The new program took the name Voyager.

Nonetheless, NASA came up with two supporting projects. One grew out of a low-key partnership between its Ames Research Center and the firm TRW, which had continued the Pioneer missions of the late 1950s. Pioneer 6 through Pioneer 9 had probed interplanetary space; now Pioneers 10 and 11 would reach for Jupiter. Moreover, Pioneer 11 gained the task of using the gravity-assist technique to fly onward to Saturn. The missions, which flew in 1972 and 1973, served as pathfinders. Jupiter in particular had a powerful magnetic field, trapping a zone of intense radiation that could damage a spacecraft's instruments. Saturn's rings carried enormous numbers of small solid bodies that could destroy a probe that came too close.

For both Pioneer 11 and the Voyagers, the successful use of gravity assist would require careful aim during the Jupiter encounter, for this planet had to act as a slingshot, shooting the spacecraft onward to Saturn with high accuracy. To gain experience, JPL carried out a practice run with a separate mission, Mariner 10. It used Venus to fling it toward Mercury; indeed, its post-Venus orbit allowed it to fly past Mercury three times, with cameras and other instruments alert.

Mercury, the closest planet to the sun, had shown even fewer details than Mars in astronomers' telescopes. Mariner 10 photographed much of it in sharp crispness, disclosing a heavily cratered world that closely resembled the moon. The images also gave evidence of the enormous violence of the impacts that had formed its features. One such collision had formed a great basin called Caloris. On the other side of Mercury, at Caloris's antipode, lay a curious patch of jumbled terrain. Donald Gault, a NASA scientist, proposed that the impact had produced intense seismic waves that converged onto this antipode, throwing up the jumble in an earthquake that shook the entire planet.

As Voyager approached launch, it earned a reprieve. The first spacecraft would indeed fly only to Jupiter and Saturn. But NASA officials decided that the second might fly past Saturn to Uranus and Neptune. So it was that these spacecraft rode their Titan III-Centaurs, in August and September 1977, as they set forth on expeditions as ambitious and potentially fruitful as any we will see in our lifetimes. Their high launch velocities took them past the orbit of the moon in less than twelve hours, as they covered a distance that for the Apollo astronauts required days. And while they traversed the far greater distance of half a billion miles that measured the way to Jupiter, three California scientists—Stan Peale, Pat Cassen, and Ray Reynolds—proceeded with their own preparations.