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Research & Books

From the issue dated Novemb

Pluto or Bust

Scientists prepare to get up close and personal with the last (perhaps) plan

By RICHARD MONASTERSKY

If planets had personalities, Pluto would have developed an acute inferiority complex by now. The runt of the solar system's litter, Pluto was the last planet to be discovered, and it has never quite lived up to expectations. When astronomers first spotted the distant world in 1930, they figured that it was comparable to Earth in size, a view that held sway with only modifications until the 1960s.

Turns out Pluto is a mere pittance of a planet, smaller even than our moon. And way out on the frigid fringes of the solar system. At 3 billion miles from Earth, never attracted close-up inspection from one of our robotic envoys, which have all the other planets and a host of moons, comets, and asteroids, to boot.

Now, Pluto is about to enjoy its moment in the — albeit distant — Sun. Sometime in January or February, if all goes well, NASA will launch a probe that will traverse the solar system to rendezvous with the outermost planet. The project, called New Horizons, is not for those who like instant gratification. It will take between nine and a half years to reach Pluto, depending on which route the craft travels. But when the probe gets there, scientists will get their first good views of a world that has grown more enigmatic with each passing year.

In the lead-up to the mission, researchers have already sleuthed out new facts about Pluto and its neighborhood that upend long-cherished ideas about the solar system.

"Pluto is an even more interesting place to visit now," says Harold A. Weaver, the project scientist for the mission and a planetary scientist at the Johns Hopkins University's Applied Physics Laboratory, which is running the mission for NASA. Last month, for example, Mr. Weaver and his colleagues announced they had discovered two new moons of Pluto in images taken by the Hubble Space Telescope. These as-yet-unnamed satellites are considerably smaller than Charon, Pluto's main moon, with diameters about half the size of its parent planet.

"We're just very excited by the new results," says Mr. Weaver. "We can't wait to get up close to Pluto to see what's really there."

Until quite recently, astronomers thought that Pluto was one-of-a-kind, a loner that didn't fit in with either the gaseous giant planets — Jupiter, Saturn, Uranus, and Neptune — or the rocky inner planets, Mercury, Venus, Earth, and Mars. But in 1992, researchers started discovering other Plutolike, icy bodies out beyond the orbit of Neptune,

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region known as the Kuiper Belt.

Since then, astronomers have spotted a thousand of these distant Kuiper Belt objects. Last summer they even reported finding one bigger than Pluto — a discovery that raises questions about whether Pluto should still be considered a planet or whether the planet rules should be open to new additions. (See related article on this page.)

"I was taught in grade-school astronomy that Pluto is a misfit," says S. Alan Stern, leader of the New Horizons mission. "In fact, it's not. Earth is the misfit." We are outnumbered by all the frosty kin of Pluto that inhabit the outer edge of the solar system, says Mr. Stern, director of the department of space studies at the Southwest Research Institute in Boulder, Colo. As part of the new mission, researchers hope to steer the space probe past one or two small Kuiper Belt objects after passing by Pluto.

"We're going to a new portion of the solar system," says Mr. Weaver. All of the newfound objects in the Kuiper Belt constitute a third realm of our solar system category called icy dwarves. "This is the frontier of planetary science," he says.

Rocky Road to Launch

Even though the New Horizons mission has yet to leave the launch pad, it has already made an epic journey fraught with perils. Mr. Stern first started pushing for a NASA mission in the late 1980s, and NASA eventually signed on, putting the program under the control of its Jet Propulsion Laboratory, which is managed by the California Institute of Technology. That facility has run all missions to the outer planets to date. But in 2000, the lab doubled the price tag on the project, NASA halted the mission.

Planetary scientists and the public fought back, waging an unusual political campaign on behalf of Pluto. A high-school student from Pennsylvania established an online petition that attracted more than 10,000 signatures in support of the mission. The Planet Society, an advocacy group, sent thousands of postcards to Congress, some hand-delivered by the television personality Bill Nye, "the Science Guy."

The outcry overturned the mission's cancellation. To resurrect the project, NASA took the unusual step of allowing other institutions besides the Jet Propulsion Laboratory to bid on it — a relatively new business model at the time. Mr. Stern teamed up with Johns Hopkins, and they won the contract for the mission, which will cost an estimated \$450 million. (By comparison, the budget for the ongoing rover mission on Mars was \$280 million for the first three months of exploration, which has been exceeded several times.) Hopkins's Applied Physics Lab manages the project for NASA. It will build the spacecraft and will provide mission control.

The Bush administration threatened several times to cut money needed for the mission, but Congress regularly stepped in to support it. Then this summer, as the launch neared, the Department of Energy threw up another roadblock. The department told NASA that, because of a production problem, it would not be able to provide the radioactive fuel needed to power the probe on its long journey. In the end, though, the Energy Department came up with enough fuel for the duration of the mission.

The exact arrival date at Pluto depends heavily on when the spacecraft launches

off in January, it will swing past Jupiter, whose gravitational pull gives the probe a 10 percent boost in speed, enough to reach Pluto by 2015. If the launch is delayed to February, the probe will fly a straighter but slower course to Pluto, taking an additional three and a half years or so.

After that long journey will come a scientific frenzy. Because the New Horizons will zoom past Pluto at 31,000 miles per hour, it won't have long to perform its science. The probe can't carry enough fuel to go into orbit around the planet, so researchers get one short shot at capturing information about Pluto and its three known moons.

Iceworld

They have a lot to learn about the planet. At this point, only a few facts are known. The surface is thought to be largely frozen nitrogen with scattered dark patches that are some sort of carbon-rich dust. The density of the planet is high enough that it may be made largely of rock, with various ices making up about a third of its bulk. For an atmosphere, made of nitrogen, with some methane and carbon monoxide, but the atmosphere is disappearing fast. The planet is currently in the part of its orbit that takes it away from the Sun, and as it cools down, many of the compounds in the atmosphere are freezing and falling as frost onto the surface.

NASA selected seven instruments for the New Horizons mission to the planet, its moons, and their neighborhood:

- A high-resolution camera that can spot features as small as a football field.
- A camera that can map the planet and its moons in visible and infrared light, providing information about the material that covers their surfaces.
- A spectrometer that senses ultraviolet light for studying Pluto's atmosphere.
- A device that detects charged particles near Pluto, which will help probe the planet's magnetic shield. (It will also determine how quickly gas molecules in Pluto's atmosphere are leaking into space.)
- An instrument for sensing neutral particles leaving the planet's atmosphere.
- Radio electronics that will investigate Pluto's atmosphere as well as measure the mass of the planet, its moons, and Kuiper Belt objects.
- A dust catcher for studying interplanetary dust particles all along the route to Pluto and beyond.

The dust instrument is unique because it was designed, built, and tested by students under the guidance of Mihály Horányi, a professor of physics at the University of Colorado at Boulder. This is the first time that a student-built instrument will fly on a planetary mission.

Mr. Horányi says the project started small, with one undergraduate student thinking about how to build an inexpensive dust collector. Participation in the effort must grow from there.

"One student turned into 2, 3, 10, 20. It spread mostly by word of mouth," he says. The challenge is to hand over the knowledge from one group of students to the next,

graduate or complete their postgraduate degrees.

Dust sounds insignificant compared with objects that are the size of planets, even a pipsqueak body like Pluto. But dust is the progenitor of everything in the solar system. The planets all evolved out of a disk of dust that orbited the Sun billions of years ago.

The New Horizons mission will give researchers their first information about interplanetary dust beyond the orbit of Uranus, says Mr. Horányi. Researchers had predicted there should be clumpings of dust associated with the outer planets, but they have never been seen. If the student-made instrument can find them, says Mr. Horányi, "then we can take that knowledge and use it to identify the presence of small protoplanetary disks" around other stars.

Over Too Soon

Barring any disaster, the project is bound to be a winner with the public, which has demonstrated its affinity for the smallest planet through the intense lobbying effort that helped save the mission. But scientists not connected with the project wonder if it's a bit of a letdown to travel so far and spend so little time at the prime destination.

"We've gotten used to these really amazing spacecraft missions," to Mars, Jupiter, Saturn, says Michael E. Brown, a professor of planetary astronomy at Caltech. "This mission is going to be really anticlimactic, that this thing is going to fly by and take a couple of pictures," he says. "You almost feel that we're back in the old days of space science. But there's no other way of doing it."

David Jewitt, a professor of astronomy at the University of Hawaii-Manoa, says it's a kind of a strange mission, where not much happens for most of the time and then you have a burst of activity at the end. "Mr. Jewitt, who discovered the first Kuiper belt object in 1992, says it would be ideal to go out and spend some time exploring these objects, but the current propulsion systems used by NASA do not allow for such extended missions.

Although the New Horizons mission is supposed to visit one or two small Kuiper belt objects after passing Pluto, nobody has yet found suitable candidates to visit. "We agree it would be nice to do those other objects, but it will be quite difficult to find them," he says.

Despite those concerns, Mr. Jewitt has high hopes. "It's exciting because it's a new mission," he says. "It's going to go a long way and go to a place we haven't been before. I think it's going to be a spectacular success."

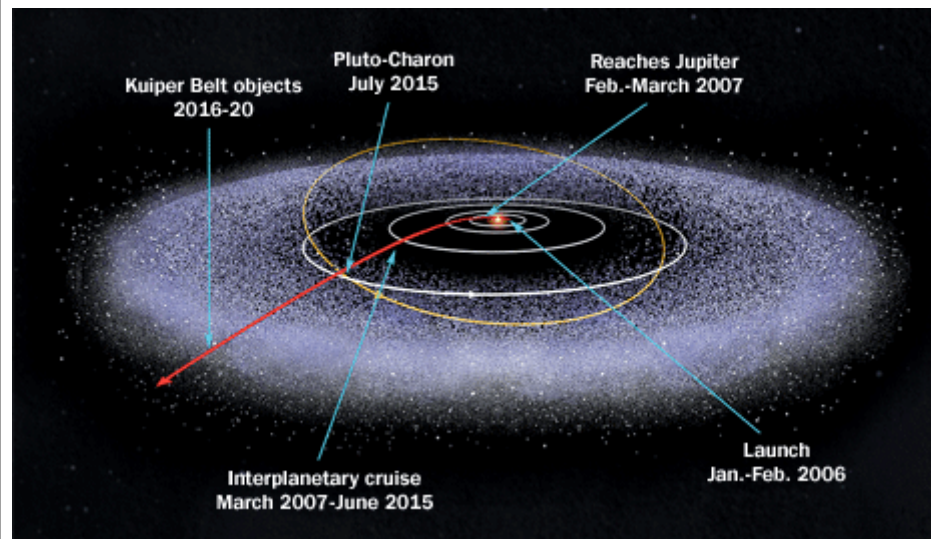
Project members do dispute the notion that the Pluto encounter will be over as soon as it starts. "The quantity of the information we return and the quality of that information will be substantial," says Fran Bagenal, a professor of astrophysical and planetary science at the University of Colorado at Boulder, who has been working with Mr. Stern on the mission since 1989. When the craft gets within three months of its arrival date at Pluto, she says, it will be taking images better than the Hubble Space Telescope, she says.

"It's the first step," says Hopkins's Mr. Weaver. Nobody knows what Pluto and

Kuiper Belt objects look like up close. "We're going to try to do the best we can what we have available," he says. "And that's pretty damn good."

TO PLUTO AND BEYOND

Early next year NASA will launch a mission to explore Pluto and the Kuiper Belt, the outer solar system, shown as a white ring. One possible route for the space probe would swing past Jupiter in 2007 and then pass within 6,000 miles of Pluto in a few years later it might encounter one or two small objects in the Kuiper Belt.



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