

# Scratch That One Off the List

By Jim Johnson



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While at Minnesota, Mr. Johnson worked in a small computer lab owned by the university mathematics department, and decided that computer programming was more in line with where he wanted to go with his career than staying in academia. He still plays with number theory from time to time, but makes his living doing computer programming for the Nebraska Department of Revenue.

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When I was a child in grade school, I learned a sentence that has stuck with me ever since: "My Very Enormous Mother Just Served Us Nine Pickles." Most of you probably learned this or some similar nine-word mnemonic to help you remember the names of the nine (as we then reckoned) planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and Pluto. Your Mother may have been "Very Elegant" or "Very Educated" or "Very Excellent" rather than "Very Enormous," and she may have Just Served Us "Nine Prunes" or "Nine Pizzas" instead of "Nine Pickles." But little did I suspect that some 40 years after I had learned the names of the planets back in a one-room schoolhouse up in the Nebraska Sandhills, Pluto would be scratched off the list of planets, nine planets would become eight, and "Nine Pickles" would have to be replaced with "Nachos," or "Noodles," or "Nothing."

In 2006, the International Astronomical Union (IAU), to the dismay of many, decided to define "planet" in a way that excludes Pluto. This paper looks at how the IAU came to that decision, what kind of reaction they received, and what has happened since then. It will also touch on what might happen in the future, and why those of you with a penchant for watching high-level intellectual fisticuffs might want to book a

flight to the next international gathering of astronomers. We will consider whose job it is to define what criteria determine planethood, and step into a minefield and talk about whether it really matters.

Let's begin in the middle. On August 24, 2006, the IAU General Assembly, meeting in Prague, considered several resolutions. Most were dealt with quickly and without much controversy, certainly without much attention from the international news media gathered outside the room. However, that was not the case with Resolution 5A.

Resolution 5A stated:

The IAU therefore resolves that planets and other bodies in our Solar System, except satellites, be defined into three distinct categories in the following way:

- (1) A "planet" is a celestial body that
  - (a) is in orbit around the Sun,
  - (b) has sufficient mass for its self-gravity to overcome rigid body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, and
  - (c) has cleared the neighbourhood around its orbit.
- (2) A "dwarf planet" is a celestial body that
  - (a) is in orbit around the Sun,
  - (b) has sufficient mass for its self-gravity to overcome rigid

body forces so that it assumes a hydrostatic equilibrium (nearly round) shape, (c) has **not** cleared the neighbourhood around its orbit, and

(d) is not a satellite.

(3) All other objects, except satellites, orbiting the Sun shall be referred to collectively as “Small Solar-System Bodies.”

In order to make the intent of the resolution absolutely clear, the authors of Resolution 5A inserted a footnote:

The **eight** planets are: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune.

A follow-up Resolution 5B, had it passed, would have watered down 5A by replacing the word “planet” in item (1) and its footnote with the phrase “classical planet,” effectively meaning that the term “planet” would apply to both items (1) and (2), and one would have to use the term “classical” if one wanted to specify just the eight large planets.

Resolution 5A was passed with about 90% of the vote. Resolution 5B was defeated. It garnered 91 votes from the 424 voting members present, but the number of opposing votes was so large that the assembly agreed that the vote had failed, and a count was not needed.

Following the votes on Resolutions 5A and 5B, the assembly passed Resolution 6A, clarifying that Pluto was to be a “dwarf planet” and recognizing it

as the first member of a class of trans-Neptunian objects. A separate Resolution, 6B, would have named this class of objects “plutonian objects”; that resolution narrowly failed.

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Following the vote, the IAU sent out a press release listing the eight planets, along with the first three dwarf planets: Pluto, Ceres, and a body which at the time was given the temporary name 2003 UB313; the latter was renamed Eris in September of 2006. Additionally, there were at that time a dozen objects on the IAU “dwarf planet watchlist,” some of which were expected to be named as dwarf planets in the months and years following the 2006 conference. As of June 25, 2018, the IAU recognizes five dwarf planets: Pluto, Ceres, Eris, Makemake and Haumea. In 2008 the IAU Executive Committee approved the term “plutoid” for dwarf planets whose semi-major axis is larger than that of Neptune. (Thus four of the five current dwarf planets are plutoids, the exception being Ceres, which is an asteroid.)

Having started in the middle, we now step back in time to the beginning. To understand the story of Pluto’s decline in astronomical standing, one should first look at its “birth”—that is, not the actual birth of the dwarf planet some billions of years ago, but the discovery of Pluto as a wandering object in the early part of the 20th century.

In 1906 a wealthy Boston businessman named Percival Lowell was looking around for something to do. Lowell did some math and decided that the orbits of Uranus and Neptune were being displaced by some object. He designated this object “Planet X” and began searching for it. He searched for ten years until his death in 1916, but was never able to detect a planet. A decade later, Clyde Tombaugh took up the search. He looked around the neighborhood of Lowell’s “Planet X,” and in 1930 he discovered the object that we now know as Pluto.

The story of “Planet X” is not the scientific triumph it appears, though. As astronomers learned more about this new “planet,” they figured out that Pluto was too small and too far away to have an appreciable effect on the orbits of Uranus and Neptune. Furthermore, in 1993 an astronomer redid the math using more current estimates of the sizes and orbital parameters of Uranus and Neptune, and he found that Lowell’s conclusion had been wrong in the first place; there was actually no indication of an orbit-perturbing “Planet X.” Pluto’s discovery was a total

fluke; Tombaugh just happened to be looking in the right place at the right time.

So Pluto got started on the wrong foot. If it had been classified on its discovery as an asteroid-type object, then it would have been on the large side of known asteroids, but given that it started its life being considered a planet it was puny, and getting smaller as more accurate measurements came in. And it gets worse. As telescopes improved in the 1970s and 1980s, people kept finding more objects of comparable size out near Pluto. It was becoming clear that Pluto was quite different from the inner planets, and people were finding more and more Pluto-like objects out past Neptune in the region now known as the Kuiper Belt.

In the year 2000, the new Rose Center for Earth and Space opened at New York City's Hayden Planetarium. A "Scales of the Universe" walkway at the Center highlighted two different families of planets: the four giant Jovian planets in one section, and the four smaller terrestrial planets in another section. Pluto didn't fit into either grouping, and was quietly omitted from the walkway. Quiet, that is, until about a year later in January 2001, when the New York Times got wind of it and published a front-page article with the headline "Pluto's Not a Planet? Only in New York." The Rose Center's director, Neil DeGrasse Tyson, says of that day that his voice mail filled, his email in-box overflowed, and his life would never be the same again. For an entertaining look at some of the reactions, both positive and

negative, read Tyson's book *The Pluto Files: The Rise and Fall of America's Favorite Planet*.

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Then, in early January 2005, a few astronomers at Palomar Observatory, led by Mike Brown from Cal Tech, were analyzing pictures that they had taken a couple of years earlier, and they discovered an object which they determined was moving very slowly around the sun. On closer investigation, they determined that its mass was bigger than Pluto's mass. At this point it appears that Pluto has a slightly larger diameter, but nonetheless the new object is close enough in size that it has been described as "Pluto's Twin." The object was tentatively named 2003 UB313, 2003 being the year that the photographs were taken. Information about the position and size of the object was forwarded to the IAU, which as one of its duties "serves as the internationally recognized authority for assigning designations to celestial bodies and surface features on them."

Faced with a decision about how to classify 2003 UB313 (later named Eris after the Greek god of warfare and strife), the IAU did what all wise organizations do: it passed the decision on to a committee. Eighteen months and several different committees later, the IAU passed the eight-planet resolution at their 2006 General Assembly in Prague.

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So now, we're back to where this paper began, in 2006. Was there any public reaction to the decision to drop Pluto from the list of planets? Did we the public decide to leave such questions to the astronomers and get on with our own lives?

As the reader perhaps knows, public debate was vigorous and continues today. For some time to come, the question of Pluto will no doubt spark discussions every time there is a high-profile meeting of astronomers.

In the immediate aftermath of the decision, the stereotype of the scientist as a dispassionate, unemotional observer was dramatically put to the test. Mike Brown, the discoverer of the new "dwarf planet," commented that if the "anything round" resolution had been passed, then—even though he would have been flattered to have discovered what would have been the 12th planet—the situation would have been a "mess." He counts 53 objects that would have to be considered planets under that definition. On the other hand, Alan Stern, the

leader of NASA's New Horizons mission to Pluto, commented regarding the resolution that he was "embarrassed for astronomy" and said that the IAU decision "stinks, for technical reasons." Stern believes that neither Earth nor Jupiter fits the new definition of planet, Earth because there are a lot of Near-Earth Objects in its orbit, and Jupiter because some asteroids cross its orbit.

Reaction from other segments of the community came in swiftly as well. School children wrote anguished letters to astronomers. Songwriters wrote songs. Cartoonists drew pictures. Newspapers published human interest stories. Astrologers worried that their horoscopes might be affected. Comedians and late-night talk show hosts found fodder for entertainment. The state of New Mexico, home of Pluto's discoverer Clyde Tombaugh, passed a resolution declaring that Pluto is a planet whenever it crosses the skies over New Mexico.

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So, does it really matter whether the list of planets includes Pluto?

One should note that this is not really a scientific question; it's more of a philosophical question, somewhere on the borderline between science and theology. The IAU couches their definition of planet in scientific terminology, and the "everything round" definition, when written out in the language of the committee that proposed it, also uses scientific terms, but to those of us sitting on the sidelines

it sounds like people in both cases are trying to shoehorn a scientific answer in to a cultural question. If you surveyed average people on the street and asked whether Pluto is a planet, you would probably spark quite a few heated discussions. But if instead you read the two scientific definitions and ask which is better, you'd no doubt wind up with blank stares and a lot of Undecideds.

It may also be a political question. I can imagine a feisty politician trying to make hay by sitting down at 3:00 in the morning and tweeting out an opinion on whether Pluto is a planet.

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Astronomer Alan Stern has said that he thinks it is awful to show pictures of scientists voting, because it leaves the impression that science is arbitrary and political, an impression that plays into the prejudices of those who claim that global warming and climate change are not real, or that evolution is just an idea. Stern thinks voting on scientific issues makes *all* of science look arbitrary. We should take a closer look at whether it is appropriate for scientists to be seen

voting on scientific issues, because that may be a big part of what is going on with the public reaction to the vote.

Earlier in this paper, we glanced at the stereotype of the scientist as a disinterested observer, and that disinterestedness is what we expect of our scientists. We tend to think of science almost as a religion, that is, as an absolute. We think there is one single Truth out there; scientists discover that Truth; they proclaim that Truth to the rest of us, and all people everywhere are supposed to accept that Truth forever after, never to be challenged. Back in grade school, when the teacher told me that Pluto was the ninth planet out from the sun, that supposedly established that fact forever in my mind, and in lots of other minds in lots of other classrooms; woe to anyone who would ever deny it.

But that is not the way that the scientific method works. Scientists are people; they come at problems with different points of view and different experiences. They are going to have disagreements, and sometimes they are going to find problems with established science. They may find a new way, or they may decide that the old way was better after all. Or maybe they will decide that one definition works better for one type of scientist and a different way for another type of scientist. I would prefer to see more scientists discussing issues, rather than fewer.

If I am only organizing things in my own mind, and not worrying about communicating to others, it does not really matter whether I think

of Pluto as a planet. The problem comes in trying to communicate with other people. If my definition disagrees with someone else's, we have a communication gap. And in the case of the list of the planets, the people on the front lines of this communication are the millions of grade school science teachers who are trying to interest their students in looking beyond our own planet farther out into the solar system.

In March 2017, a group of planetary scientists led by Kirby Runyon of Johns Hopkins University proposed a new definition of planet at the Lunar and Planetary Science XLVIII conference. This definition would concentrate on the intrinsic geophysical properties of the object and would pointedly *not* look at extrinsic orbital properties such as whether the object has cleared out its orbit. The authors of the paper state that their definition would yield at least 110 known planets, and they acknowledge that this is too many to expect school students to memorize, but they say that students should not be trying to memorize them all anyway. They suggest that a student might want to memorize a few planets of interest, and then just accept the fact that there are lots of other planets out there. The authors compare it to the 88 official constellations that are recognized by the IAU, or the 94 naturally occurring elements, saying that in those cases most people are content to learn only a few rather than memorizing a whole list.

On paper that makes sense; students shouldn't just memorize

a list. However, it doesn't jibe very well with how education is done in most real-life grade school classrooms. Given a list of 50 or 100 "planets" and asked to teach about them, the first thing a teacher would probably do is to give their students the whole list, maybe follow up with a quiz to see how many names the students can remember. And many of these objects don't yet have readily readable names anyway; until they become someone's topic of interest, they're given names like "2003 UB313." A list like that is not a great way to capture a third grader's attention. One hundred planets are too many to deal with effectively, given the time constraints of a grade school science teacher.

Or a teacher might try whittling down the list to a more manageable size of "worthy" planets. If we decide that "worthiness" is the way to go, then for consistency across schools, someone needs to define which planets are "worthy." An obvious choice would be the IAU, which does that anyway. However, we Americans tend to be reluctant to let outside international groups tell us what to teach our kids. Given a reason to step in, some national committee of science teachers might take on the job of defining the list of "worthy" planets, and some competing committee would come up with a different list, and consistency would go down the tubes. Grade schools would once again become the target of meaningless controversy.

Until the controversy is settled, just remember:

"My Very Energetic Mother

Just Served Us ... Nachos."

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