

The Case Against Defining “Planet”

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Editor’s Introduction

In August 2006, the International Astronomical Union (the organization that acts like the United Nations for astronomy) voted to change the category to which some of the smaller worlds in our solar system are assigned. Pluto and Eris (a slightly larger world that orbits the Sun even further out than Pluto) were now to be called dwarf planets, and not planets. As most of our readers will have heard, this decision generated a considerable amount of public controversy, fanned by the media, who always enjoy stories about demotions. But astronomers who worked with planets, and educators who taught about them, also had questions about the new designation. (More information about the controversy can be found in the sources below.)

More recently, the IAU introduced the new term, *plutoid*, for dwarf planets in our solar system beyond Neptune, setting off further strong reactions. We thought it would be interesting to inaugurate the ASP’s new Astronomy Beat feature by asking two noted planetary astronomers who have a strong association with our Society to take us behind the scenes of the controversy and give us their reactions. Below, former ASP President and Director of NASA’s Lunar Science Institute, David Morrison, gives us the background and his views on how the controversy might be settled. In two weeks, we will hear from ASP Board Member Mark Sykes, a strong critic of the IAU decision, on how all this affects one of his favorite objects, Ceres, the first asteroid/minor planet/dwarf planet discovered.

Two years ago, the International Astronomical Union (IAU) adopted a new definition of the word “planet” that effectively expelled Pluto from of the list of planets in our solar system, leaving us with eight (Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune). At the same time, astronomers are finding hundreds of objects orbiting other stars and are calling these planets as well. So how many planets are there: 8, or 9, or hundreds? Last month the IAU went further and defined a new class of small planets as “plutoids”, an ugly word that is unlikely to be adopted among astronomers, let alone the general public. What is going on here?

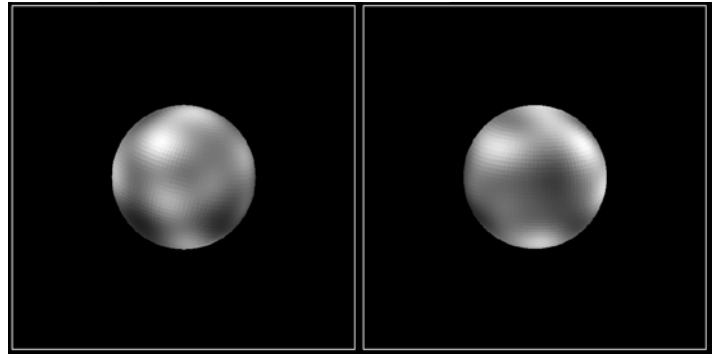


Artistic rendering of the solar system showing only eight planets
NASA/JPL

Over history, the word planet has had a variety of meanings, reflecting our growing understanding of the solar system. Before Copernicus, the term was used for any celestial “wanderer” that moved against the background of “fixed” stars — a meaning for planet that is still used today by many astrologers. There were seven wanderers visible to ancient observers: the Sun, the Moon, Mercury, Venus, Mars, Jupiter and Saturn.

After the work of Copernicus and Galileo, the new heliocentric cosmology redefined planets as large objects — worlds — that orbited the Sun. This definition dropped the Sun and Moon and added Earth, for a total of six planets. As new worlds were discovered, they were added to the list: Uranus in 1781, Ceres in 1801, and Neptune in 1846. As soon as astronomers realized that Ceres was small (diameter about 1000 km) and only one of several small worlds in the asteroid belt, it was demoted, leaving 8 planets.

When Pluto was discovered in 1930, it was thought to



A map of the two sides of Pluto created from Hubble Space Telescope observations
Alan Stern (Southwest Research Institute), Marc Buie (Lowell Observatory),
NASA and ESA



Clyde Tombaugh discovered Pluto at the Lowell Observatory in 1930
Lowell Observatory Archives

be a large object, much more massive than the Earth, so it was added to make the nine planets that we were all taught in school. This scheme began to unravel, however, when Pluto was found to be smaller than the Moon (in the 1980s), the first planets around other stars (exoplanets) were discovered (in the 1990s), and other members of the outer solar system were found that were as large as Pluto, such as Eris (in the 2000s).

While the IAU has a Working Group for approving the names of new objects or features in the solar system, it is unusual for an official scientific society such as the IAU to redefine a commonly used word such as “planet”. The word is already widely understood, and only a relative handful of astronomers and planetary scientists want or need a precise definition. I believe that the most important issue for scientists and public alike should be the classification of exoplanets, not the reclassification of objects in the solar system. Within the solar system, there is a long tradition of defining and using subclasses of planets, such as giant planets, terrestrial planets, and minor planets, just as astronomers refer to dwarf galaxies as a subclass of galaxies or giant stars as a subclass of stars.

It is increasingly recognized that Pluto (and Eris) are in a different class from the 8 “major planets”, which leads logically to the acceptance of a class of “dwarf planets” (a term that is consistent with common astronomical nomenclature). The many newly discovered objects in the outer solar system (often called trans-Neptunian objects or TNOs) are of increasing interest to scientists, especially the largest members of this group. We would probably not be having this debate if the IAU had accepted the recommendation of its own advisory panel that a “dwarf planet” is a kind of planet,

just like a “giant planet”. In that case, Pluto and other large TNOs would be planets still, just dwarf planets (like dwarf stars or dwarf galaxies).

Unfortunately, a popular revolt among some of the astronomers at the IAU General Assembly in Prague (very few of them planetary scientists) led to a vote that a dwarf planet was not a planet (against all normal usage). The debate was further complicated when dynamicists — astronomer who study orbits — insisted that the definition of a planet be based on its ability to “gravitationally clear its region” of other small objects. Only a handful of astronomers really understand what this means – for example, since Jupiter shares its orbit with thousands of large “Trojan” asteroids, does this imply that Jupiter is no longer a planet?

To be useful, the definition of a planet needs to work for exoplanets as well solar system planets. In addition, any definition needs to be based on observable quantities. Aside from the obvious requirement that a planet orbits a star, the simplest criterion is mass, as a proxy for ability to sustain fusion reactions at the upper end and “roundness” or hydrostatic equilibrium at the lower end. Within the class of planets, we can have many (and changing) subsets: giant planets, terrestrial planets, dwarf planets, super-Earths, ice dwarfs, hot Jupiters, etc. These flexible classes don’t need the IAU to define them. In deference to centuries of usage, we should also not redefine “satellite”, or claim that some satellites are really planets, or that Ceres is a planet rather than an asteroid.

I recommend that the IAU overrule the vote at Prague that a dwarf planet is not a planet (and have written so to the President of the IAU). Even if you consider the decision in Prague to have been a valid democratic vote, you can’t establish an untruth by vote. The new term “plutoid” should also be dropped. Then the IAU could incorporate the terminology used for exoplanets at the upper mass limit (about 12 Jupiter masses) and by planetary scientists for the lower mass limit (about 0.001 Earth masses). The requirement that any definition be based on observable quantities eliminates the bickering over complicated dynamics-based definitions. From this point the communities of scientists involved can use subclasses like giant planet or dwarf planet, or educators can group Pluto and Eris with the traditional planets, without interference from

the IAU. We can surely tolerate multiple meanings of planet, just as with most other words.

About the Author

David Morrison is a planetary astronomer, as well known for his lucid public explanations and writings about astronomy, as for his research on the smaller bodies in our solar system. He is a former member of the IAU Working Group for Planetary System Nomenclature, and still serves on two of the IAU task forces on naming solar system objects and features. He is perhaps best known for his leadership in defining the threat of, and calling government and public attention to, Earth-threatening asteroids. Morrison was also one of the founders of the new interdisciplinary science of astrobiology and the Director of Astrobiology and Space Research at NASA’s Ames Research Center. Currently, NASA has asked him to serve as the interim director of the new Lunar Science Institute, headquartered at Ames. He is author or coauthor of ten textbooks and popular books on astronomy, including the text *Voyages through the Universe*, and the Scientific American Library volume *Exploring Planetary Worlds*. He was President of the ASP from 1983 to 1985 and received the Society’s Klumpke-Roberts Award for a lifetime of contributions to popularizing astronomy in 1993.



Resources for Further Information:

The IAU Gazetteer of Planetary Nomenclature (with explanations of the rules of naming worlds and features in our solar system):

<http://planetarynames.wr.usgs.gov/index.html>

The 2006 IAU Press Release on the new definition of dwarf planet and the status of Pluto:

http://www.iau.org/public_press/news/release/iau0603/

The 2008 IAU News Release on the new term “Plutoid”:

http://www.iau.org/public_press/news/release/iau0804/

A Roundtable with Scientists and Educators on the Dwarf Planet Issue:

<http://aer.noao.edu/cgi-bin/article.pl?id=207> (see Appendix 2 of this page for many other resources).

Pluto: The Discovery of a Planet (a nice retelling of how Pluto was found at the Planetary Society website):

<http://www.planetary.org/explore/topics/pluto/plutodiscovery0.html> ♦

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