

What it takes to m

Iwan Williams talks about the process of defining a planet to suit everyone – and what happened to the various definitions in Prague.



When I was President of Division III of the IAU, I was charged with establishing what defines a planet, prompted by the discovery of Sedna. We set up a committee and discussed the problem by email for 18 months or so. It became clear that the committee was not coming round to a unanimous view. In the end the IAU decided that our role should be to present meaningful scientific definitions, with an indication of the level of support for each.

We had three definitions and they had one thing in common, and in common with the resolution that has now been adopted: they agreed that there are three different types of solar system body. There are the big planets that everyone recognizes as planets; there are the small rocky, funny-shaped bodies such as most asteroids; and the ones in the middle, including Pluto, Sedna and UB313. All of them also accept the division between the small irregular bodies and those large enough to have a rounded shape imposed by gravity. That's a clear scientific definition that everyone on the committee accepted, with a clear dividing line. The question then was, is there another line that divides round bodies like Pluto from round bodies like Earth?

First suggestion

The first recommendation from our committee was that there should be an arbitrary dividing line based on size. Anything with a radius greater than 1000km would be a planet, anything smaller would not. That view had the most support. The second most popular definition didn't take such a firm line – in fact it didn't propose a formal division at all. This view held that we can recognize a planet informally, without defining exactly what it is. So this recommendation proposed a new and equally informal category of trans-Neptunian planets, different from existing planets, having unusual orbits and so on,

but we know them when we see them. The third most popular suggestion – or, the least popular – was the dynamical definition. This said that a proper planet is the dominant body in its locality, it formed differently from other bodies locally, probably by gobbling up a few of them, and it perturbs the orbit of other bodies – a planet defined more by what it does than what it is.

We put these three recommendations forward to the IAU last year, and the Executive decided to establish a new and smaller Planet Definition Committee chaired by Owen Gingerich, to take things forward. I was on that committee, along with Richard Binzel, who presented the motion in Prague, André Brahic, Catherine Cesarsky, Dava Sobel and Junichi Watanabe. We met in Paris in June and came up with a compromise, moderately close to all the existing recommendations. This recognized the class of small, irregular, rocky things as “small solar system bodies” with a clear upper size boundary based on where gravity makes bodies round. We suggested that next group should be called “dwarf planets” and even came up with the name “Plutons” for them, to retain something of the special character of Pluto – which turned out to be very unpopular. At the top end, we wanted to leave it vague. So our proposal had three categories: classical planets, dwarf planets and small solar system bodies. This gave more planets than before, 12 at the time, of two different types, but distinct from the smaller, irregular bodies. An alternative proposal used almost the same words, but made dwarf planets a new category, distinct from planets, with the implication that there are eight planets, four dwarf planets (so far) and the small stuff.

In both these definitions, there are the three categories, so the argument was essentially about whether there are 8 or 12 planets. Everyone agreed that Pluto was not a planet in the sense that it used to be. The argument was over where to draw the big dividing line, between planets and dwarf planets, or between planets (including dwarf planets) and the rest.

Historically, anything orbiting the Sun was a planet, and anything smaller than Mercury a minor planet. As we discovered thousands of minor planets, the important distinction between small planets and chunks of rock was clear. Pluto became the problem. If we had taken the option of separating the small lumpy rocks from what we now call dwarf planets a few years ago, rather than trying to sort out Pluto at the same time, we might have had much less trouble. With hindsight, I think a lot of the problems stemmed

from the term Plutons. In fact, it's a pity that we ever came up with it. I think a lot of people were voting against the name rather than the actual proposals.

The view that eventually won the day in Prague was the resolution dividing the eight planets from the new categories of dwarf planets and minor solar system bodies, using the dynamic criterion that planets have “cleared their orbits”.

New opportunity

There's a lot to be positive about with the new definition. For a start, we have the opportunity to give a much more realistic picture of the solar system. The old picture of big planets and the rest, lumped together as minor planets, doesn't hold now we know so much more about the outer solar system. We can't stick Pluto and Sedna in with these lumpy little rocks, because they are not the same thing. An argument against this definition, and one that I slightly favour, is that it takes some of the excitement out of exploring the outer solar system. Although there's a lot to discover, we can be fairly sure that there is nothing bigger than Mercury out there. So there's now no chance at all for an amateur observer to find a new planet, which I think is sad.

I suppose it was inevitable that the press were a lot more interested in the numbers of planets than what we actually said. They reported our initial proposal as giving the solar system 12 planets, not nine, and then it was all about Pluto being demoted. Somehow, in all the mess, we lost the very exciting fact that we have a new class of bodies in the solar system, one that we knew nothing about even 10 years ago. ●

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The resolutions as agreed at

A “planet” is defined as a celestial body that:

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

This means that the solar system consists of eight planets: Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus and Neptune. A new distinct class of objects called “dwarf planets” was also decided. It was agreed that “planets” and “dwarf planets” are two distinct classes of objects.

Make a planet

What lay behind the decision to reclassify Pluto as a “dwarf planet” at August’s IAU General Assembly in Prague?

Jocelyn Bell Burnell talks about her role in negotiating agreement on Resolutions 5A and 6A at the General Assembly of the IAU. The definition of a planet and the place for Pluto provoked strong opinions – and a near riot!



BOTH PICS: IAU/LAUS-HOLM

It was a surprising role for me, and one that I didn’t expect to assume. The IAU has a Resolutions Committee that formally presents resolutions to the meeting and ensures that they are drafted properly, with good English, which is especially important on an international body. I’ve been on the Resolutions Committee for three years, since the last General Assembly in Sydney, so I knew I would have some involvement, but I didn’t know beforehand that Pluto would come up in quite such a big way. When I got to Prague, I discovered that the draft resolution on Pluto’s place among the planets and minor planets of the solar system was not at all acceptable to the body of IAU members – so much so that it provoked a near-riot! I was wheeled in to chair sessions aimed at revising and presenting the resolution in such a way as to be acceptable to most members. I was to be a disinterested facilitator amid the decidedly fractious body of astronomers.

The problems arose from the first draft resolution, which included Pluto and several recently discovered bodies beyond Neptune as planets. Pluto is the big problem here; I think that the typical IAU member did not want to see it remaining

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as a planet. There was also dissatisfaction from the IAU membership with the definition of a planet presented in that draft. Mediation was quite a large part of my job, getting agreement and cooperation between interested parties. Some of the difficulties arose from the fact that the IAU Executive, aware of public and media interest, kept the resolution very quiet before the meeting in Prague, and then passed it to the press before discussing with the membership. At the plenary session where we started the debate, many members with particular interests in the issue said that they had not been consulted and felt slighted.

Hard work

I felt that I spent those 10 days working towards a better resolution and a better definition of a planet. There are so many ways to approach this problem: a planet should have sufficient mass to overcome hydrostatic forces and make a round body, without allowing all rounded bodies to be planets; a planet should be the dominant body in its orbit; it should perturb the orbits of other bodies, and so on... there are just so many ways to cut the cake and we had to find a definition that was consistent as well as acceptable to most people. We presented the resolution for a vote in the session we had aimed for, and got agreement, after 10 days of hard work that felt like shooting rapids between lots of rocks and hard places. It’s not a perfect definition and we’re still working on aspects of it – such as the names for these categories of bodies, and what to do about “binary planets” – but I think we’ve made the

cut pretty well.

One of the things that prompted the need for a better definition of a planet, and highlighted the difficulty with Pluto’s position, was the recent discoveries of more and more trans-Neptunian objects, thanks to new telescopes. Take UB313 for example. This is the body informally known as Xena, that’s pushing at the boundaries of existing definitions. If Pluto is a planet, then Xena certainly is and we can expect to find many more comparable bodies out there. As we get more new telescopes such as Pan-STARRS looking for these big trans-Neptunian objects, we’re going to find a growing population.

There were issues that we had to set on one side during the meeting in Prague, in the interest of getting the basic definition agreed without it all getting too messy and complicated. We had to be realistic about what we might achieve. For example, we had originally wanted to establish a general definition of a planet, both inside and outside the solar system, but had to withdraw from considering planets outside the solar system. I now chair the Resolutions Committee, so I suspect I’ll be busy with a resolution about them in Rio, at the next General Assembly. And there’s also the related problem of the boundary between what is a star and what is a planet. But for now we have a basic definition of a planet and the IAU will work on the other issues. Who will name trans-Neptunian objects and the new category of dwarf planets, and how they will go about it is something that has been waiting in the wings. The IAU wanted to see how the resolution turned out before setting up these mechanisms.

The debate generated a huge amount of public and media interest, first that we were gaining some planets, then that Pluto was being demoted in some way. I don’t think that it does matter scientifically, but there is a certain degree of culture shock to be overcome. I’ve had some astrologers complaining that they will now have to make pretty big changes, despite the fact that Pluto is still up there, orbiting and influencing our lives in the same way it always has done. What we have now is a special class of dwarf planets, with Pluto as king. We have not yet got an acceptable name for these objects, but that’s a good thing in many ways. It’s a great opportunity for public debate, and to talk about how science evolves as knowledge changes. That’s a very powerful weapon. ●

Prof. Jocelyn Bell Burnell has just retired as Dean of Science at University of Bath.

the IAU General Assembly

The first members of the dwarf planet category are Ceres, Pluto and 2003 UB313 (temporary name). More dwarf planets are expected to be announced by the IAU in the coming months and years. Currently 12 candidate dwarf planets are listed on IAU’s dwarf planet watchlist, which keeps changing as new objects are found and the physics of the existing candidates becomes better known.

The dwarf planet Pluto is recognized as an important proto-type of a new class of trans-Neptunian objects. The IAU will set up a process to name these objects.