

Planetary Wonderings

April Focus: Clarke and Aerobraking

By Mary-Frances Bartels, NASA Solar System Ambassador

Some readers may already know that on March 19 the worlds of science and science fiction lost one of their greatest visionaries, Arthur C. Clarke. He is probably most recognised for authoring the book and screenplay *2001: A Space Odyssey*. His accomplishments, some of which impacted modern society greatly, are too numerous to mention in this article. However, several will be highlighted here.

1. In 1945, he first envisioned the use of artificial satellites in a geosynchronous orbit (orbit always above the same spot on the ground) for communications. This orbit is called a Clarke Orbit in his honor, and has made all modern satellite communications possible (see Oct. '07 PW column on Sputnik for more information on artificial satellites).
2. In 1954, three full years before the launch of the first artificial satellite, he conceptualized the use of satellites for weather prediction, in effect creating a new branch of meteorology.
3. In 1957, he envisioned what evolved to become noise-canceling headphones.
4. His 1962 nonfiction book *Profiles of the Future* and other of his writings inspired Gene Roddenberry to create *Star Trek*.
5. In 1982, in his fictional *2010: Odyssey Two*, a spaceship used aerobraking as an alternative to retro rockets to slow it so that it may get into orbit. This concept is what will be detailed here.

What exactly is aerobraking, and why would scientists want to use it? Aerobraking is used to help put a spacecraft in orbit or to help make its orbit more circular. Before this technique had been utilized, firing retro rockets fulfilled these goals. Using retro rockets is highly costly in terms of fuel, both on the craft itself and the launch vehicle. Aerobraking allows a spacecraft to achieve a desired orbit without the use of its engines, thus requiring a smaller launch vehicle, and ultimately saving money. The technique requires the craft to repeatedly dip briefly into the upper atmosphere of the object being studied, typically a planet, much like a child drags his feet on the ground to slow himself when playing on a swing. The atmosphere provides friction, thus slowing the craft slightly with each pass. While aerobraking saves fuel and money, it comes at a cost in increased time and risk of mission failure. It can take hundreds of “dips” over a period of months before the desired orbit is accomplished. Also, these “dips” cause the craft to heat up which must be factored in when designing the mission.

Aerobraking was first tested, in 1993, during the extended Venus mission of the Magellan spacecraft to circularize its orbit. In 1997, the Mars Global Surveyor (MGS) orbiter was the first spacecraft to use aerobraking as the main method to adjust its orbit. In 2002, this technique was used by the 2001 Mars Odyssey (named in honor of Arthur C. Clarke) craft. Lastly, NASA’s newest Mars orbiting mission, Mars Reconnaissance Orbiter, used this innovative procedure in 2006.

Resource of the Month : www.yurisnight.net In the book *2010* it is a Soviet spacecraft that performs the first aerobraking maneuver. (In reality the USSR is gone now and, to the best of my knowledge, the US is the only country that has employed aerobraking.) The Soviets decidedly were ahead of the USA early on in the space race. Yuri Gagarin was the first human in space, flying on April 12, 1961. For the past several years space enthusiasts have celebrated this success through an event called Yuri’s Night. Special events are held around the globe to commemorate this anniversary. Unfortunately, I could not find any events in Ohio or

surrounding states. It should also be noted that twenty years after Yuri made his historic trip the US Space Shuttle was first launched, on April 12th, 1981. Perhaps you could remember these two accomplishments throughout the month, or throw your own Yuri's Night party!

Activity of the Month: Read up on Arthur C. Clarke. Read one or more of his books. Watch an episode from one of his television shows (some available at the Columbus Library). Then, test your knowledge! Here are some websites with trivia questions on Sir Clarke:
<http://www.geocities.com/jcsherwood/ACCgame1.htm>
http://www.funtrivia.com/quizzes/literature/authors_a-c/ac_clarke.html

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Remember to *keep looking up!*

Sources (not previously mentioned): <http://www.clarkefoundation.org/acc/biography.php>
<http://www.timesonline.co.uk/tol/comment/obituaries/article3582978.ece?token=null&offset=12>
http://www.sptimes.ru/index.php?action_id=2&story_id=25425
<http://mars.jpl.nasa.gov/mgs/overvu/mplan/ab/ab.html>
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<http://www.jpl.nasa.gov/releases/99/mgsbrake.html>
http://www.nasa.gov/mission_pages/MRO/news/mrof-20060830.html