Mercury in the 'Schultz Diagram'

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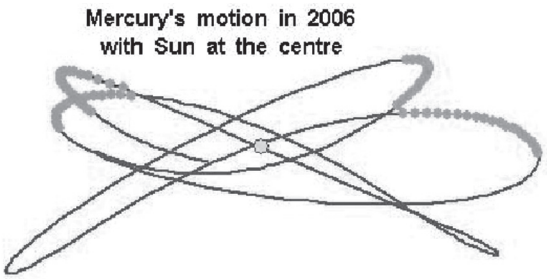
Some people are perplexed by the 'Mercury diagrams' of Joachim Schultz[1]. These denote the motion of Mercury over the course of a year, as seen from Earth, with respect to an immobile Sun at the centre. They use the astronomical co-ordinates called Right Ascension and Declination, which means that it is motion with respect to the Equator-plane of the Earth. So these diagrams show Mercury's apparent motion *with respect to the Earth's equatorial plane*.

They show values of the difference {Mercury-Sun} of the RA and Dec co-ordinates.



Possibly, these diagrams would be clearer, if shown more as a 3-D representation, with Mercury coming nearest to Earth at inferior conjunctions of the Sun, and furthest away at Superior conjunctions. Note the two points at which Mercury's path crosses over the Sun in the year 2006 as shown: one was a 'Mercury transit' when it was seen in front of the sun's disc, in November, the other one happened as Mercury passed behind the Sun. Maybe the lines could be thicker as Mercury comes nearest, and thinner when further away and 'behind' the Sun?

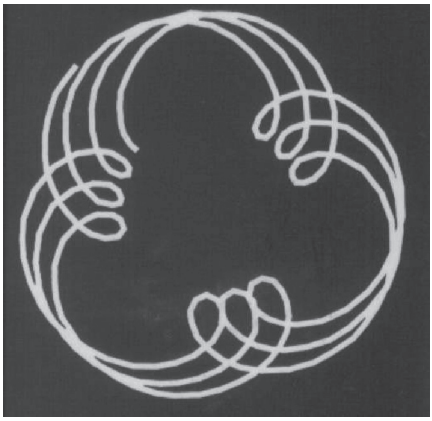
The times of Mercury's visibility for that year are given in some German data from Stuttgart.[2]

1 Joachim Schultz's 1963 *Rhythmen der Sterne* first did these Mercury diagrams.
2 Keller H.U., *Kosmos Himmelsjahr 2006*, Stuttgart Planetarium, 2005. Kindly supplied by John Meeks

Evenings: February 15 – March 2nd, May 31 – June 20th
Mornings: August 5th – August 20th, November 17 – December 10th

It appeared twice as a morning star and twice as an evening star. Why should that be? To find out, I have put these days of visibility onto the Schultz diagram[3]. We then notice what is rather important, that days of visibility *cannot occur* when Mercury is lower than the Sun, in this diagram. This brings home to us, that the diagram depicts an *experience* of Mercury's position. Most of us never get to see Mercury, but I suggest that perusing this diagram may help here!

I suggest that amateur astronomy groups could benefit from making such a Schultz diagram each year, and putting onto it the days when they could see Mercury.



The left and right sides of this diagram correspond to East and West, Morning and Evening visibility of Mercury.

We may here appreciate the angst suffered by Nicholas Copernicus, as he tried to figure out what was happening: 'Mercury tormented me' he wrote, 'with its many twisting and toilings, in trying to explore its motions.'[4]

In contrast, let's now turn to Mercury's motion around the Earth, instead of around the sun. It appears as a triune motion, in fact a merry waltz. The figure shows three years of Mercury's motion, weaving out its loops of retrograde motion as it comes into 'inferior' conjunction with the Sun.

3 I did this in 'Seeing Mercury' letter to the Editor, Journal of the British Astronomical Association, 2006,,116, p.271 (on the web).
4 Copernicus N., *De revolutionibus*, Book V, Ch. 30.

It meets six times with the Sun yearly: thrice 'inferior' i.e. between us and the Sun and thrice 'superior' – can you see these in the Schultz diagram? Only four of these six are visible, that might now be evident to you.

The merry waltz of Mercury

Joachim Schultz's classic astronomy textbook has remained in print in England since it was translated in 1986 by John Meeks. I can't think of any other astronomy textbook of which that can be said! I doubt whether any living British astronomer is capable of writing an astronomy textbook that remains in print.

There is one further fact about Mercury which Mr Schultz might have liked to have included, had he known about it: it rotates once on its axis in space per 58.65 days. That happens to be one-third of a Mercury day, and one-half of its year. So –

Mercury spins three times on its axis in two of its years, experiencing one day.

An observer on Mercury would see the stars go round three times in the sky, every day; and would see the Sun going twice round the zodiac of stars, in the same day. Let's think of it as a merry 1-2-3 waltz rhythm.[5]

For comparison, Venus rotates on its axis even more slowly, once per 3x3x3x3x3 = 243 days, and it performs that rotation exactly twelve times per eight-year period: during that eight-year period Venus weaves out its great pentagram in the sky, of meetings with the Sun. The subtle mathematics here means that the same part of Venus always faces Earthwards at each inferior conjunction, when it comes nearest to Earth, as too it does at each superior conjunction. These are important aspects of the world-harmony, the *music* of Mercury and Venus.

Mercury has the same part of its surface face sunwards at each alternate perihelion. These mercury-harmonies are rather mind-wrenching, and fit in with its traditional mutable and elusive nature – hard to grasp as it is to pick up quicksilver.

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5 The Mercury-year is 87.97 days, its day is 176 Earth-days. The equation linking these periods is: 1/58.7 – 1/88.0 = 1/176 days.