Prospects for meteors from 73P/Schwassmann-Wachmann 3 in 2006

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Observations of meteors from the disintegrated Comet 73P/Schwassmann-Wachmann 3 reported in 1930 are reviewed and considered highly doubtful, the maximum found by simulations being certainly missed. The shower is also called the τ-Herculids. Numerical particle simulations show no evidence for enhanced activity of the shower in 2006.

1 Visual data and the 1930 event

The orbit of Comet 73P/Schwassmann-Wachmann is sufficiently close to that of the Earth that it may cause a meteor shower. Discovered in May 1930, the Comet became particularly interesting when it showed a dramatic increase in brightness during September and October 1995. What happened was that the object broke up into pieces of which at least three were optically separated first in December 1995. The actual break-up occurred much earlier, most likely even before the brightening of the comet (Sekanina et al. 1996).

A comprehensive account of the historical observational records was given by Lüthen et al. (2001). We would like to review the questionable report of 1930 here with some details. We use comprehensive citations of the Japanese sources, since they are not easily accessible in today's astronomical libraries. A prediction of the radiant of the meteors of Schwassmann-Wachmann 3 was given in the Bulletin of the Kwasan Observatory of the Kyoto Imperial University, Japan (henceforth called 'Kyoto Bulletin') No. 171 of May 14. Along with an approximate orbit and an ephemeris for the Comet, a radiant position at $\alpha = 15^{\rm h}38^{\rm m}$, $\delta = +44^\circ$ was predicted (note that the position was wrong and was corrected in Kyoto Bulletin No. 173). The closest encounter was computed for Jun 9.7, at 0.0086 au. After this was published, an immediate 'discovery' of a new shower was reported in Kyoto Bulletin No. 172 of May 23. Details appeared in Kyoto Bulletin No. 173: "In Bulletin 172 it was announced that a splendid display of new special meteors was observed on May 21 by Mr. T. Miyazawa and several other members of the Kwasan Observatory. The number of those meteors was estimated as many as 14 in 68 minutes through variable clouds (or, 11 in 25 min. or, 100 or over by Mr. Nakamura) so that it was impossible to record all of them." Because of the rapid decline of activity in the subsequent nights, it was concluded that these meteors were not caused by 73P/Schwassmann-Wachmann 3, whose closest orbital encounter was expected more than two weeks later, for June 9/10. Kyoto Bulletin 174 reports on the observations on that night for which the prediction held:

"These expected showers of meteors were successfully observed by Mr. K. Nakamura and others at the Kwasan Observatory mostly on June 9 and 10." We cannot rely on the fact that other witnesses saw the event, since the Bulletin says about Nakamura that he "was practically the sole observer of this rich display owing to the faintness of the meteors." The event was actually reported by *a single* observer. Nakamura must have had an unusual eyesight as it is said that "almost all of those meteors were very faint, and only a few of them were as bright as 4th magnitude." One may conclude that meteors of magnitude +5 and +6 were most abundant. The Bulletin further reports "that bright moon light was always interfering the field observers. Moreover, clouds and mists were frequently visiting the Observatory during the season, and that especially so on the critical nights of June 9 and 10 when bright lunar haloes were high above the southern horizon." Even an observer with extremely good vision will not be able to see an abundance of +5 and +6 meteors under such unfavourable conditions. This and the fact there is no backup observer leads us to the assumption that there was no outburst of τ-Herculid activity observed in 1930.

However, the story is even more complicated, since numerical simulations of particles of Comet 73P/Schwassmann-Wachmann 3 do show a concentration of meteoroids on June 8.3–8.4. The same date and time were found from dust trail computations by Lüthen et al. (2001) and more extensive particle simulations by Wiegert et al. (2005) caused by the 1880, 1886 and 1892 trails. The timing is about one day before the observation of Nakamura. The (Japanese) night of June 8/9 was apparently cloudy at Kwasan Observatory as there is no report about that night, but of other nights.

We may also assume that the Kwasan observatory received a lot of criticism on the observing report as Bulletin 174 contains an appendix in which I. Yamamoto defends the meteor observations of the "specialists". How special K. Nakamura was showed already his observation of the 1921 June Bootids which later led to the assumption there was an outburst of meteors. The meteors he plotted were listed by Yamamoto & Nakamura (1922); we plotted them in Figure 2. Many of the meteors start within the radiant area and move out up to 10°. This is geometrically impossible and indicates limited trustworthiness in the recordings of that observer. However, Nakamura learnt his lesson and plotted Figure 1 for the 1930 Schwassmann-Wachmann-3 event.

The radiant position found by Nakamura was within 2–3° of the predicted one. Despite the low entry velocity of the τ-Herculids, the radiant position was probably little altered by zenithal attraction since the radiant was nearly in the zenith as seen from Japan at that time. Today's better knowledge of the orbital elements of the Comet and their evolution leads to a radiant position which was 10° away from the old estimate. The plots by Nakamura (1930) are shown in Figure 1; we have added backward prolongations to most of the meteors.

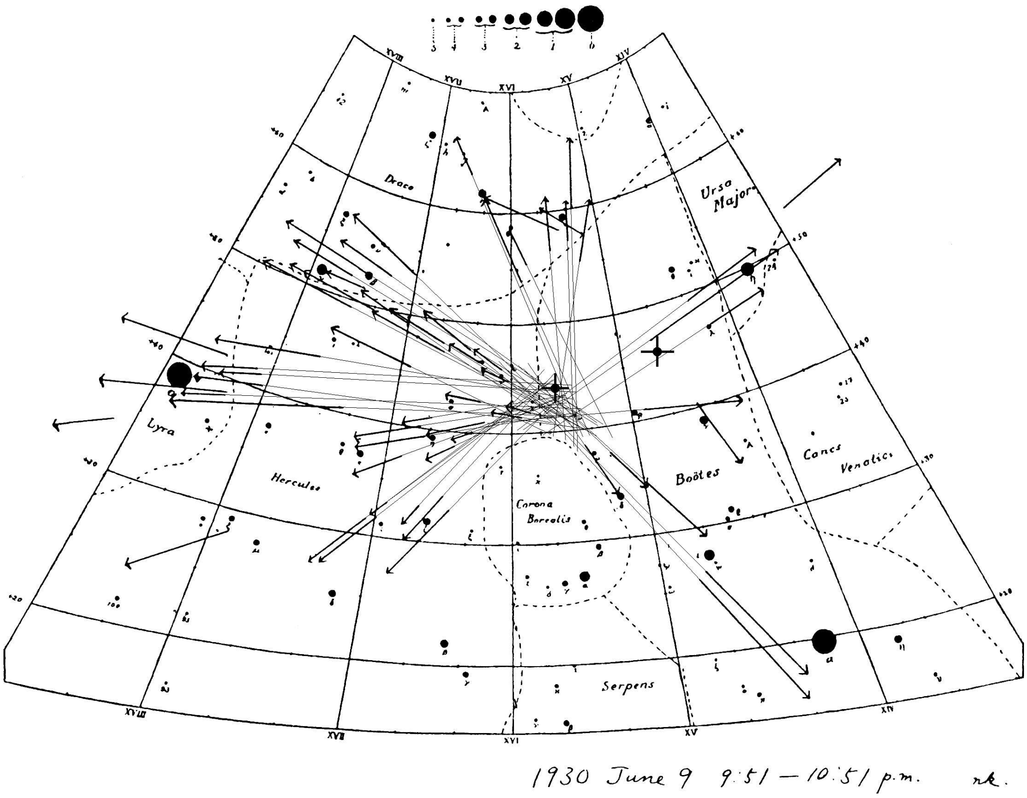

Figure 1: Meteor positions reported by Kaname Nakamura for the 1930 τ-Herculids. We have added backward prolongations to the original figure by Nakamura (1930). We also plotted the prediction of the radiant according to the knowledge in 1930 (left cross) and according to present knowledge of the Comet's orbit and its evolution (right cross).

We also added the radiant prediction of the erratum in Kyoto Bulletin 173 with which Nakamura was actually faced when starting his observations (left cross). The theoretical radiant position in 1930 according to today's knowledge of the Comet and its orbital evolution is the right cross. The Figure indicates that Nakamura was very much led by strong expectations; the difference in positions should have been detectable visually.

The activity in other years must have been very low as far as the time of the year was covered by observations. Weak radiants which may be associated with the τ-Herculids have been reported since the end of the 19th century. A ZHR of 3 may have been reached in 2000 as reported by Japanese observers, but their listed radiant position lies 20° south of the position we assume for the τ-Herculids today ($\alpha = 220°$, $\delta = +46°$, see also Section 2). The activity in 2001 was widely monitored but turned out to be virtually absent (Arlt 2001).

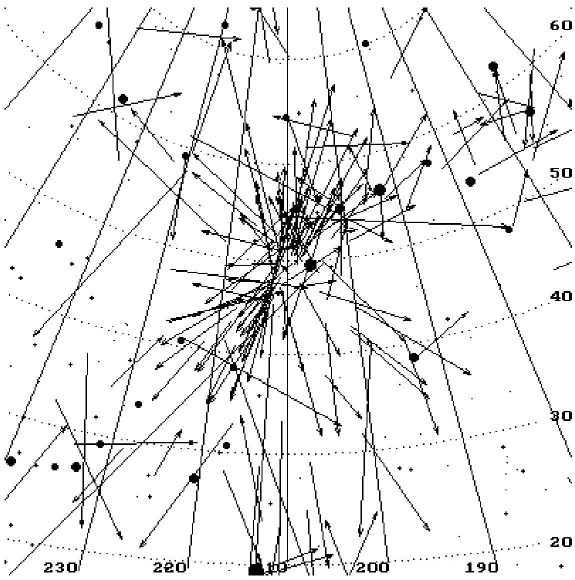

Figure 2: Meteor positions reported by Nakamura for the alleged 1921 outburst of the June Bootids. The meteor positions are taken from Yamamoto & Nakamura (1922).

2 Prospects for 2006

The orbital evolution of particles ejected at all the perihelion passages of the Comet since 1801 was calculated in a computer simulation. All these particles move individually with varying ejection conditions at the comet and various perturbations by other planets. Their orbital nodes where they cross the orbital plane of the Earth are plotted as dots in Figure 3. The curve with dates on it is the Earth's orbit. There is no clump of nodes of particle orbits which lies anywhere near the orbit of the Earth. Very few particles cross the ecliptic at places which are passed by the Earth on June 1–2. They are too few to restrict possible weak activity to these two nights. A monitoring of the period May 28 to June 6 seems more recommendable than promoting a

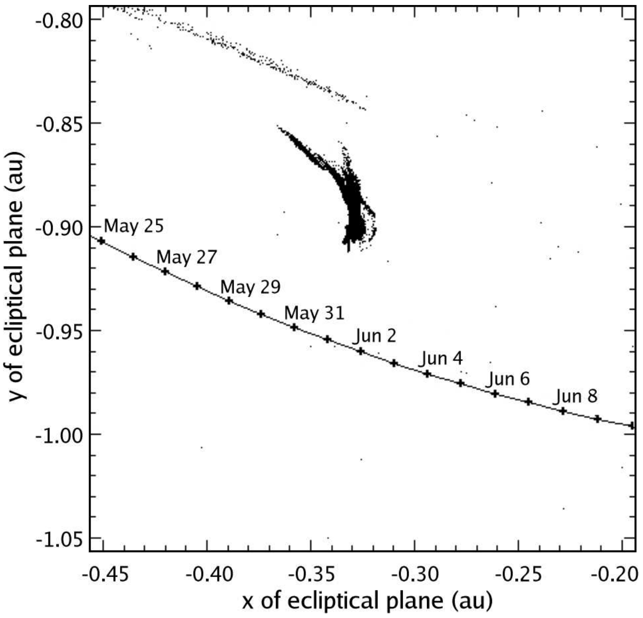

Figure 3: Distribution of orbital nodes of simulated particles for 2006. The particles were ejected at the perihelion passages of 1801 and later (after Wiegert et al. 2005)

single night. The radiant computed from the position of the particles shown in Figure 3 with the program developed by Neslusan et al. (1998) gives a radiant located at $\alpha = 207°$, $\delta = +31$. This differs significantly from the values in the year 2000.

According to the simulations, the activity level in 2006 must be much lower than in 1930. After the above considerations, the latter return may actually have passed undetected, on June 8, 1930, and we cannot scale the activity level by that return. If the period of interest is monitored in 2006, one should not be misled by the designation of the shower, the τ-Herculids. The radiant is also not at the position shown in Figure 1. It will be located several degrees west of ϱ Bootis, actually a little bit north of the globular cluster M3.

The entry velocity of the particles is extremely slow. At $v_\infty = 16$ km/s, all the meteors appear very slow, much slower than nearly all sporadic meteors, and clearly slower than ecliptical meteors radiating from Ophiuchus/Scorpius at that time of the year. The waxing Moon will be at high declinations and disturb the observations moderately as it sets rather late given its young age.

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