41. ON THE WIDTH OF THE GEMINID SHOWER AT FAINT RADIO MAGNITUDE

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ABSTRACT

A search for major streams has been performed among the orbits of meteors observed with the six station meteor radar of the Harvard-Smithsonian Radio Meteor Project at a limiting radio magnitude of about +10 on the visual scale.

The analysis of the Geminid shower from observations made in December 1961, 1962, 1963 and 1964, shows some evidence that meteors belonging to this stream are detected at an earlier date than the bright photographic meteors. From observations made on December 28–31 of the same years during the hours in which the Geminid radiant is within the collecting area of the six station system, 15 orbits were identified as possible members of the shower.

It is suggested that the stream might be active for a period longer than the previous observations indicated.

During the period November 1961–November 1965, the multistation radar system of the Harvard Radio Meteor Project (Hawkins, 1963) was recording meteor echoes on a weekly schedule of observations. The pulsed radar was operating at a wavelength of 7·33 m with an average peak power of 3·5 Mw to detect meteors brighter than magnitude +10. From the recorded echoes about 19000 orbits were computed, and a search for major streams has been performed among the orbits of the period November 1962–November 1965 (Baker and Forti, 1966) using the D criterion proposed by Southworth and Hawkins (1963) to distinguish meteor streams from sporadics. During that period the Geminid shower was poorly observed. The present study was carried out on all the orbits of the period November 30–December 31 of each year, including 1961 during which the stream was observed almost continuously.

311 Geminid meteors were separated from the sporadic background. A preliminary study led to the rejection of 18 orbits with differences from the average elements that were too large to be attributed to measurement errors, and 15 additional orbits not matched in time. The measurement errors, mainly due to the atmospheric winds, can be as large as 2°–3° in the position of the radiant.

Table 1 shows the number of meteors identified in each year as Geminids and how the 15 rejected orbits were distributed. The mean elements of the 278 Geminid orbits

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Table 1

Number of Orbits

	November				December															
Year/Day	30	1	2	3	4	6	7	8	9	10	11	13	14	15	16	17	18	28	29	30	31
1961					9	11	9	13	19	33	54	31	22	14							
1962				10	5								8			4	3				
1963			3												2	1				4	4
1964	2	4											12	9				3	4		

Table 2

Observational quantities for the Geminid shower

	α	δ	v_∞	a	$1/a$	e	i	ω	Ω
Whipple	112° 43′	32° 26′	36·44	1·382		·898	23° 86	324° 36	261° 2
Nilsson (1960 data)	109° 4	30° 0	34·3		·84	·88	16° 4	325° 7	259° 4
Nilsson (1961 data)	109° 4	30° 7	34·2		·75	·89	18° 5	324° 5	260° 1
Kaščeev	110° 36′	32° 18′	36·15	1·32		·892	23° 2	325° 9	260° 0

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and their systematic variations are as follows:

$$\alpha = 111{\cdot}1 \pm 0{\cdot}6 + 0{\cdot}9(\lambda_\odot - 259{\cdot}0)$$
$$\delta = 31{\cdot}9 \pm 0{\cdot}3 - 0{\cdot}1(\lambda_\odot - 259{\cdot}0)$$
$$V_\infty = 35{\cdot}97 \pm 0{\cdot}32 - 0{\cdot}1(\lambda_\odot - 259{\cdot}0)$$
$$a = 1{\cdot}38 \pm 0{\cdot}05$$
$$e = 0{\cdot}90 \pm 0{\cdot}00$$
$$i = 23{\cdot}4 \pm 0{\cdot}8$$
$$\omega = 326{\cdot}4 \pm 0{\cdot}5$$

These data show a good agreement with the result listed in Table 2, which shows radiants and orbital elements as given from photographic observations by Whipple (1954) and from radar observations by Kaščeev *et al.* (1963) and Nilsson (1964), the latter obtained in the Southern hemisphere.

Upon investigation of the 15 meteors rejected for lack of matching in time, it was found that their radiant and orbital elements were consistent with those of the shower within the measurement errors. This fact, and the detection of Geminids at the beginning of December (Table 1), suggest the possibility for the stream to be wider than previously supposed even if the echo rate is lower than in the usually observed period between December 6 and 16. However, no conclusions can be reached at the present time for the lack of observations on the period December 19–27.

In Figure 1 the Geminid echo rate vs. solar longitude is plotted. In Figure 2 the ratio

$$\left(\frac{\text{stream echo rate}}{\text{average sporadic echo rate}}\right)$$

vs. solar longitude is plotted with both quantities corrected for the variations in sensitivity of the equipment.

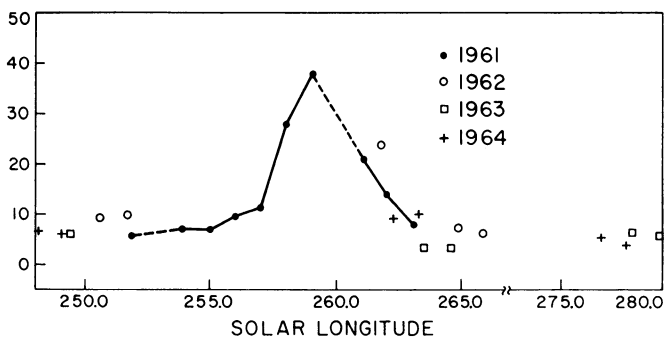

FIG. 1. *Changes of the Geminid echo rate with solar longitude.*

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As indicated in Figure 2, the faint meteors are distributed fairly symmetrically around the point $\lambda_\odot = 259{\cdot}0$. Because of this symmetry it is possible to say that the curve has its maximum there, even if we do not have any observations available for December 12. Even if a higher value of the stream-sporadic ratio were determined

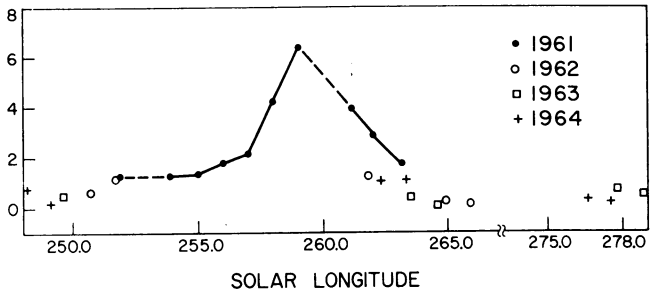

FIG. 2. *The ratio of the Geminid echo rate to the average sporadic echo rate, corrected for the variations in sensitivity of the equipment, as a function of solar longitude.*

for December 12, it would still be higher than that found for $\lambda_\odot = 261{\cdot}2$, the value corresponding to the maximum activity found by Whipple and Hawkins (1959) for the photographic Geminid meteors. There is, therefore, some evidence that the faint radio meteors have their maximum activity earlier than the bright photographic meteors.

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DISCUSSION

Millman: Does the gap in orbits, December 6–13 for the years 1962–64, mean that the equipment was not operating during these periods?

Forti: Yes.

Kaiser: Was there any evidence in 1962 for a second centre of activity associated with the Geminids, such as was found in Sheffield?

Forti: Unfortunately no observations were available for the period in question, so it is impossible to confirm your observations.

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