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CATALOGS OF METEOR RADIANTS

by Gerald S. Hawkins

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Catalogs of Meteor Radiants

By GERALD S. HAWKINS[1]

A large percentage of the meteors that fall on the earth do not belong to the major showers and we may class them as "sporadic" meteors. A recent study (Hawkins, 1956a, 1956b) of sporadic meteors has shown that their individual radiant points cluster towards the ecliptic and that their orbits tend to lie in the plane of the solar system. This study was carried out by radar methods in which pulses of radio energy were reflected from the ionized trail of the meteor. By reinterpreting the visual observations which have accumulated in the past 150 years or so, it is possible to find out more about the distribution of sporadic orbits.

Early observers, prior to 1900, recorded the direction of flight of meteors and attached great significance to the intersection of a group of paths when they were drawn on a star chart. In the case of a meteor stream, of course, an intersection defined the direction of the tangent to the orbit of the stream and was known as a "group" radiant. A radiant determined in this way, however, becomes extremely unreliable in the case of weak streams and in most cases would represent only a meaningless, chance intersection of unrelated meteor paths. For this reason, almost every radiant recorded in the great catalogs of the early meteor astronomers is spurious. But although the radiants are fictitious the data are not entirely worthless because they do indicate in a statistical sense the general distribution of sporadic radiants.

A total of 3,035 radiant points is recorded in the catalogs of Denning, Backhouse, Bartfay, Corder, Denza, Gregg, Gruber, Herschel, Heis, Kobold, Konkoly, Konvesligethy, Maggi, Neumayer, Sawyer, Serpieni, Schiaparelli, Schmidt, Tupman, Weiss and Zesioli (see Denning, 1886). The number of radiants lying in 10° intervals of declination δ is given in figure 1. Since these observations were made in mid-northern latitudes the visibility of the radiants becomes progressively worse as δ decreases from 90° at the celestial pole. The table gives a correction factor which takes account of the time a given part of the sky is above the horizon and also allows for the variation of meteor rate with elevation of the radiant point (Hawkins, 1952).

Declination	*Correction factor*
−20°	8.4
−10	4.5
0	3.1
10	2.3
20	1.9
30	1.6
40	1.4
50	1.2
60	1.1
80	1.0

This correction factor has been applied to the radiant distribution in the great catalog of Denning. Figure 1 shows the resulting curve, which indicates that the radiants tend to concentrate at declinations +20° and +45°.

The first peak is considered to be a true concentration of radiant points. Since a major part of the observing was carried out in the long winter nights when the ecliptic was high in the sky (at $\delta \sim +20°$) this peak represents the clustering of radiant points towards the plane of the solar system.

The second peak corresponds to the declination which passes through the zenith of the observers. Most meteors have a downward component in their angular motion across the sky so that there is always a tendency for a spurious group radiant to appear in the region of the zenith. This second peak, therefore, is

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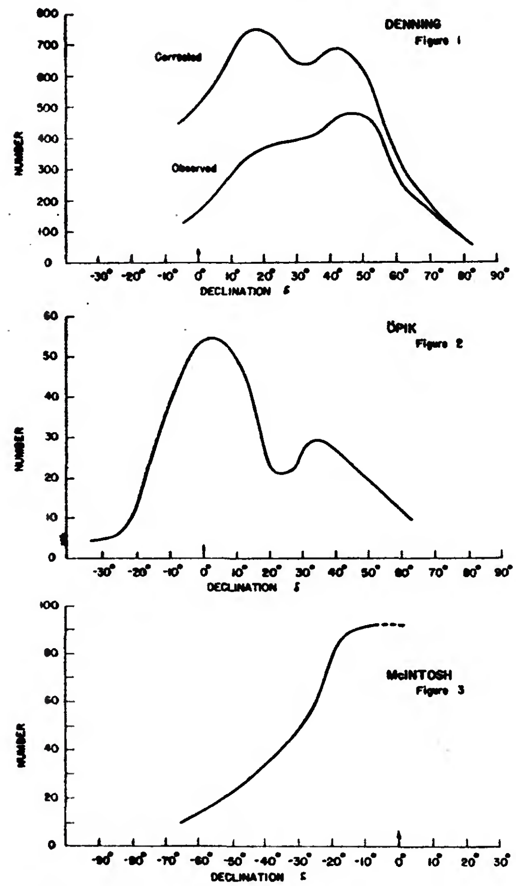

FIGURES 1–3.—Distribution in declination of apparent radiants of sporadic meteors, as found by Denning, Öpik, and McIntosh.

an indication of the errors in the catalog and may be neglected.

Öpik (1934) attempted to deduce a statistical method for rejecting spurious group radiants. From the 2,000 radiants observed by the Arizona meteor expedition, 223 were selected as probably true. These, however, still did not represent permanent streams as they did not recur in successive years. The distribution in declination from Öpik's catalog is shown in figure 2. No visibility correction has been applied, as the observations were made at latitude 35° N, where the ecliptic passes close to the zenith. The distribution shows clearly the concentration in the plane of the solar system and a subsidiary spurious peak corresponding to the declination which passes through the zenith.

Observations made in the Southern Hemisphere are not numerous, but McIntosh (1935) has compiled a catalog containing 323 radiant positions, in which rigorous selection rules were applied to minimize the radiants produced by spurious intersections. The latitude of the observations was 35° S, where the ecliptic passes close to the zenith, so that again no visibility correction has been applied. An analysis of this catalog produces the distribution shown in figure 3. It can be seen that the concentration towards the ecliptic is confirmed in the Southern Hemisphere. This catalog probably represents the best observations of weak meteor streams yet made, because the results show no signs of the spurious grouping of radiants that one may expect at the zenith of the observer.

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Abstract

Denning's historic catalog of 3,035 radiant points has been examined in the light of modern knowledge. The cataloged radiant points show the expected concentration towards the plane of the ecliptic and in addition show a concentration at the declination corresponding to the zenith of the observer. This second concentration is spurious and indicates the percentage of fictitious radiants that have been included, in error, in the catalog. The visual work of Öpik and McIntosh shows more clearly the concentration in the plane of the ecliptic, and the percentage of spurious radiants is considerably reduced.

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