The lunar crater Giordano Bruno is a 20-km crater, very recent in appearance, just on the farside of the moon (latitude 36° N, longitude 103°E). Based on an account in the chronicles by Gervase of Canterbury, Hartung (1) has proposed that the formation of this crater was witnessed by at least five men on June 18, 1178. In addition, laser ranging data (2) show physical librations consistent with an impact of this magnitude and age.

Recently, Hartung (3) has suggested that some of the ejecta from this impact may have reached the earth in the form of solidified liquid spherules. An enormous increase in the amount of lunar ejecta material in the near-earth environment would result from such an impact, but only for an extremely short length of time.

Lunar ejecta will reach the earth either on a direct path or by a chance collision following escape from the earth-moon system (Figure 1). Material following a direct path will arrive at the earth on a timescale of hours to days. The influx of meteoric particles would be unobservable, except for extremely bright fireballs, since the intersection would occur on the sunlit hemisphere of the earth. Masses on the order of hundreds of grams would be required to produce fireballs visible in the daylight. Though some ejecta from Giordano Bruno almost certainly reached the earth on such a path, there can be no confirming evidence in the meteoric observation records.

Particles escaping the earth-moon system temporarily have a much lower probability of intersecting the earth, but there can be observational evidence of such an intersection in the form of enhanced night-time meteor activity. Timescales for intersections from these trajectories are on the order of weeks or months.

Since the emplacement of the ejecta material into space is an extremely short event, the particles will propagate outward in a "wavefront" of very small depth (see Figure 1). The particles in these paths have exceeded the escape velocity of the earth-moon system, and they go into solar orbit with their paths gradually circularizing. The intersection of the earth with this wavefront will generally occur at only one point, and will produce a meteor storm of extremely high activity and short duration.

We have searched through historical records of meteor activity and find that a storm did indeed occur on October 11, 1178 (4). The meteors were seen from Korea, and were described by the phrase "countless stars flew west". These meteors cannot be attributed to any known major shower, and we suggest that they were formed from the collision of ejecta from Giordano Bruno with the earth.

The geometry of the intersection shown in Figure 1 dictates that meteors from such an intersection would indeed have an apparent direction of travel of nearly due west. We also know that the meteors were observed for one night only, thus the stream must have been very narrow (≤5.8×10^5 km). Furthermore, the time between the crater formation and meteor activity (about four months) is consistent with the timescale of the trajectory.

We are presently conducting a computer simulation of the problem (a numerical four-body integration) to determine the true paths of the ejecta leaving the earth-moon system. If the results are consistent with an ejecta-earth collision after four months, then there can be little doubt that the formation of Giordano Bruno was indeed witnessed in 1178.
METEORS FROM GIORDANO BRUNO EJECTA

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REFERENCES


Figure 1. Geometry of the earth, moon, and sun at the time of impact. The arrow shows the direction of impact, (A) shows a ejecta path direct to the earth, and (B) shows the ejecta "wavefront", caused by material in solar orbit. The velocity of the particles at (B) is lower than the earth's orbital velocity so the earth overtakes it several months after the initial crater impact.