The Minnesota Meteorite Mystery: Two Unrelated Very Flat Irons

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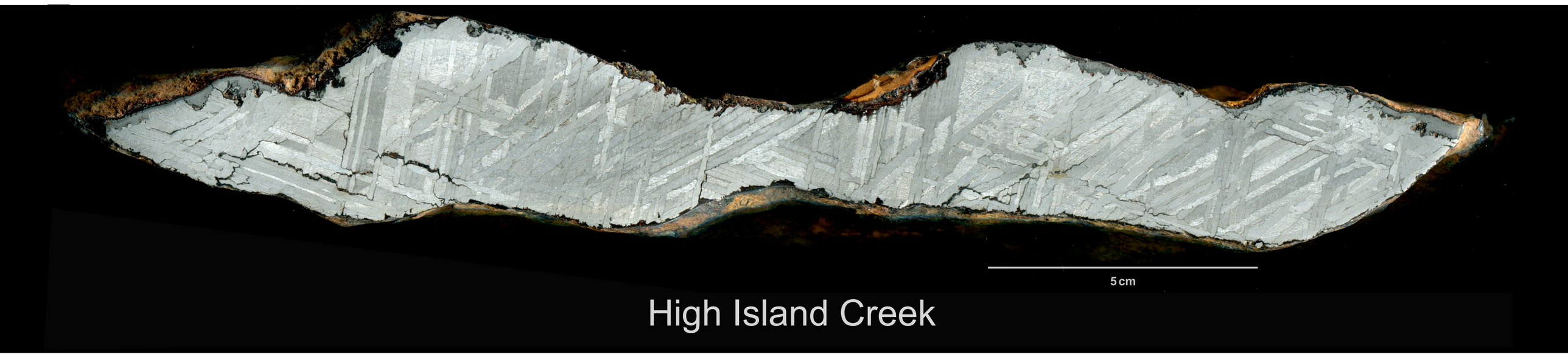
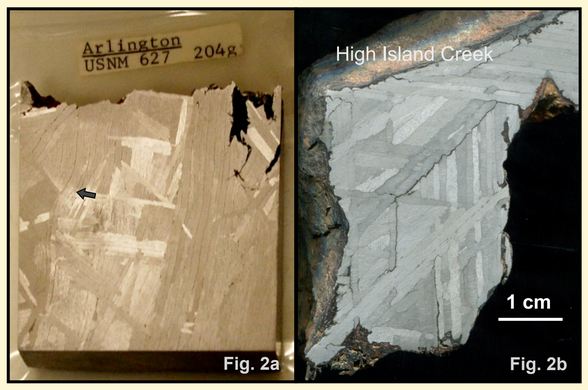


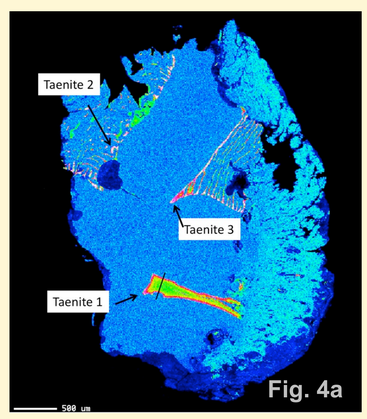
The Meteorites

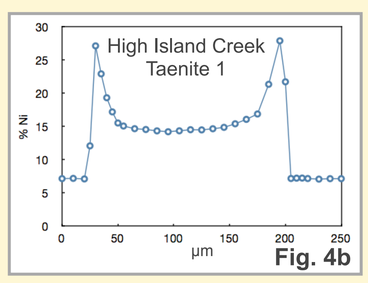
Arlington. Found 1894 near Arlington, MN (see Fig. 1) and recognized as a meteorite 1896. Its original size was about 39×39cm, but only 2cm average thickness. Several samples were taken from the original mass of about 9kg, leaving the main piece of 5.15kg shown in Fig. 3. The chemistry is consistent with group IIE, but unlike most IIE's it has no silicate inclusions. The structure is more irregular than in typical octahedrites from magmatic groups. In Fig. 2a some distortion is visible (arrow), but it is uncertain whether this is pre-terrestrial. The first sample of Arlington was obtained with a sledgehammer, which could account for terrestrial deformation.

High Island Creek. In April 2011 another iron was found ~3.4km SSE of the Arlington site. Like Arlington it is very flat, about 40×22×3.5cm, 15kg. Shape and similarity of surface features (Fig. 3) suggested at first a second piece of Arlington, but the chemical composition is significantly different. Both composition and metallographic structure (Fig. 2b) are typical for group IIIAB.



A small sample was taken near the surface and investigated by electron microprobe. A Ni map and a Ni profile along the black line in 'Taenite 1' are shown below (Fig. 4).





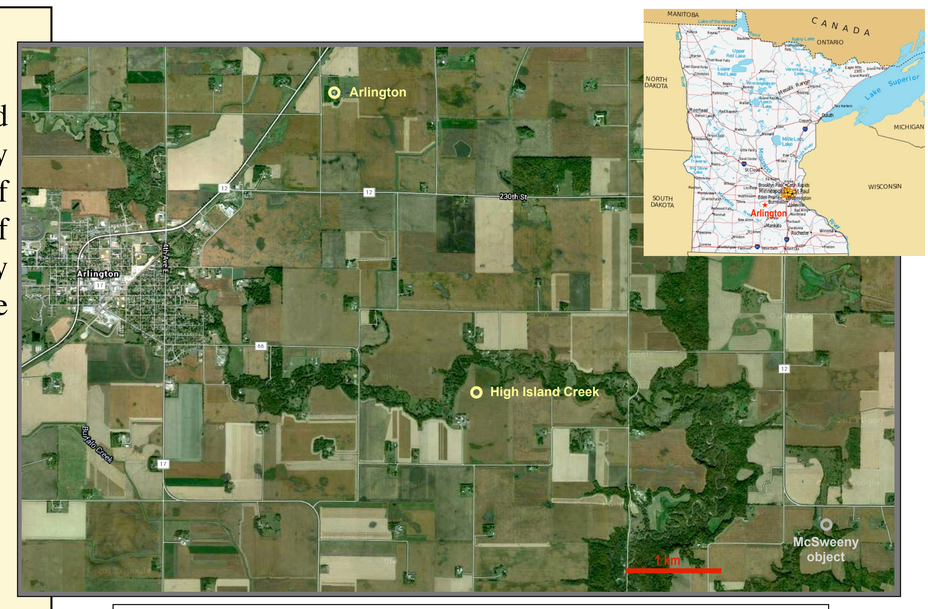
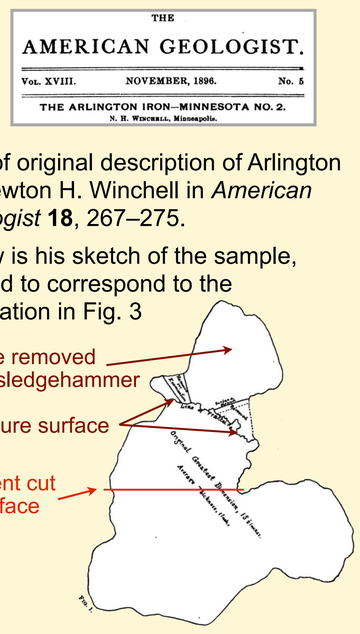


Fig. 1. Find localities of the **Arlington** and **High Island Creek** meteorites. A third meteorite was allegedly found in 1896 at the locality marked "McSweeny object," but the sample is lost.


THE
AMERICAN GEOLOGIST.
Vol. XVIII. NOVEMBER, 1896. No. 5
THE ARLINGTON IRON—MINNESOTA NO. 2.
N. H. Winchell, Minneapolis.

Title of original description of Arlington by Newton H. Winchell in *American Geologist* **18**, 267–275.

Below is his sketch of the sample, rotated to correspond to the orientation in Fig. 3

Fig. 3. Comparison of surface features of **High Island Creek** (top, on cm grid) and **Arlington** (bottom; approximately same scale). "Front" (left) and "back" (right) surfaces are different from each other, but corresponding sides show similar features on both meteorites.
The High Island Creek piece shown is the entire mass, the Arlington sample is the main remaining piece after cutting, about 58% of the original meteorite.

	Ni	Co	Cr	Cu	Ga	Ge	As	Ru	W	Re	Os	Ir	Pt	Au	group
	mg/g	mg/g	µg/g	µg/g	µg/g	µg/g	µg/g	µg/g	ng/g	ng/g	ng/g	µg/g	µg/g	µg/g	
Arlington	83.6	4.48	13	281	21.4	64.9	14.7	8.8	1.13	845	9.1	7.52	11.4	1.400	**IIE**
High Island Creek	78.6	5.10	110	170	21.2	<50	5.42	7.0	0.94	160	1.07	2.25	11.5	0.727	**IIIAB**

Minor and trace element composition of Arlington and High Island Creek (NAA data). The taxonomixally most important and discriminant elements are marked in red.

The Mystery

Possible explanations for the close proximity of find localities and the unusual flat shape of both meteorites.

1. **Coincidence**. Finding two unusual irons within a distance normally typical for a paired fall makes a coincidence not very likely, although it is the easiest explanation for the chemical difference.
2. **Terrestrial concentration**. The land surface is a young (~12,000 yr BP) glacial deposit. Both meteorite falls are likely to be younger than this. Even if they are not, glacial transport does not produce shape-sorting or preferential enrichment. There seems to be no other plausible terrestrial mechanism.
3. **Extraterrestrial sorting**. This assumes that the two meteorites arrived in the same bolide. Their chemical difference precludes a common primary parent body, but fragments of different primary parent bodies could be incorporated into a secondary "rubble pile." An example of a body that might be capable of shape-sorting is asteroid 66391 (1999 KW4) whose shape and moonlet suggest that components migrate to the equator and are sometimes ejected due to rapid rotation. This requires a complex but not impossible sequence of breakup, accretion onto the rubble pile, sorting, ejection, compaction into the final bolide, and fall.

4. **Other Theories, Hypotheses, Suggestions, or Wild Guesses are welcome!**