ANTARCTIC METEORITES: ANOMALOUS ABUNDANCE OF UNGROUPED IRONS. John T. Wasson, Institute of Geophysics and Planetary Physics, University of California. Los Angeles, CA 90024, USA.

The well-classified iron meteorites are assigned to 13 groups having 5 or more members. The remaining irons are designated "ungrouped"; they consist of about 40 grouplets having 1-4 members. Clarke (1986) noted that the iron meteorites recovered from Antarctica include an anomalously large fraction of ungrouped irons. Wasson et al. (1989) reported classificational data for 11 new Antarctic irons and compared the Antarctic set with the world (including Antarctica) set: 8 of 24 (0.333) ungrouped Antarctic irons vs. 96 of 598 (0.161) ungrouped world irons. Data for 3 additional Antarctic irons (2 ungrouped) and 3 more nonAntarctic irons (none ungrouped) are listed in Table 1. ALH84233 is not closely related to any other meteorite; it may be distantly related to the mesosiderites, but Ir is far lower than in mesosiderites and lower than in any other iron. LEW85369 has a composition closely related to those of the highly reduced (25 mg/g Si in the metal) Horse Creek and Mount Egerton meteorites.

The current ungrouped fraction is 0.370 for Antarctic and 0.164 for the world. In contrast to potential pairing problems that may affect the excess of H chondrites among Antarctic recoveries, none of the ungrouped irons in either set are compositionally similar enough to be paired. It is possible, of course, that some did fall as showers and the remaining pieces have not been recovered, but this uncertainty would appear to be equally true of the grouped irons (some of which are recognized to be fragments from showers). Application of the binomial distribution show that it is ≤0.8% probable that the Antarctic fraction of ungrouped irons reflects a random fluctuation.

Wasson et al. (1989) argue that the difference between the Antarctic and world populations cannot reflect the somewhat higher terrestrial ages of the Antarctic irons since (a) the mean ages of Antarctic irons of ~100 ka is only about 5× greater than that of nonAntarctic irons, and (b) both sets of terrestrial ages are far shorter than the 1-10 Ma mean lifetimes calculated for meteoroids in Earth-crossing orbits. The more likely alternative is that the large fraction of ungrouped irons in Antarctica reflects their smaller median mass (0.5 kg versus 30 kg for non-Antarctic irons).

If the fraction of ungrouped irons is larger in small meteoroids, the phenomenon should be recognizable in small non-Antarctic irons. In Table 2 I list all nonAntarctic irons having recovered masses <1000 g, 7 of which are ungrouped. Historical records are good for the ungrouped irons, but incomplete for many others. I have eliminated those that Buchwald (1975) believes to be paired with larger irons, but tentatively included 5 that may also prove to be paired. The ungrouped fraction is 0.233 (7/30) if the latter are included, 0.280 (7/25) if eliminated. Both fractions increase if irons having poor recovery records are eliminated. In the Antarctic set 8 of 10 ungrouped irons but only 7 of 17 grouped irons have masses <1000 g. Combining the Antarctic and nonAntarctic data yields 40 irons with masses <1000 g of which 15 are ungrouped, an ungrouped fraction of 0.375. The ungrouped fraction of the 564 world irons with masses >1000 g is 0.148. These data clearly support the idea that the ungrouped fraction among small irons is 2-3× as large as that among large irons.

Why does the ungrouped fraction depend on the mass of the meteoroid? For some of the smallest (≤50-g) irons, the answer may be that we would not have called them iron meteorites if they were larger. Examples are two Australian ungrouped irons having masses of 33 and 13 g that, on the basis of composition and structure, appear identical to metal nodules in mesosiderites. However, the anomaly persists even if we eliminate irons <50 g, and it appears that the interplanetary source of small irons differs in detail from that of the larger irons. Wasson et al. (1989) suggest two mechanisms that would lead to small irons sampling a larger range of orbital semimajor axes and thus a larger number of parent bodies than larger irons. It appears that meteoroids are mainly brought into Earth-crossing orbits when they stray into resonance orbits such as that associated with the 3/1 Kirkwood gap (Wetherill, 1985). It appears that small meteoroids are more likely than larger meteoroids to be injected into a resonant orbit because (1) they have higher mean ejection velocities from craters; and (2) their orbits experience more perturbations as a result of large and small collisions, and thus the distribution of semimajor axes will have been broadened by diffusion. The larger the range of orbital semimajor axes populated by the ejecta from a parent body, the larger the fraction of ejecta that will sooner or later make its way into the 3:1 resonant escape window. This mechanism should also lead to enhanced variety among small stony meteoroids when compared to large meteoroids.

References: Buchwald V.F. (1975) Iron Meteorites; Clarke R.S. (1986) LPI Tech. Rept. **86-01**, 28; Wasson J.T. et al. (1989) Geochim. Cosmochim. Acta **53**, in press; Wetherill G.W. (1985) Meteoritics **20**, 1.

Table 1. Concentrations of twelve elements in 6 new iron meteorites.
Concentrations in μg/g except Co and Ni, mg/g, and Sb, W and Re, ng/g.

	cls	Cr	Co	Ni	Cu	Ga	As	Sb	W	Re	Ir	Pt	Au
ALH84233	ungr	12	5.39	64.6	168	14.0	14.4	260	980	<30	<0.003	<0.7	1.07
GRO85201	IIIAB	18	5.15	84.7	146	20.0	7.41	<50	570	<40	0.359	6.2	1.01
LEW85369	ungr	86	3.33	74.2	318	46.8	13.4	420	690	350	3.49	6.3	1.49
Aldama	IIIAB	64	5.12	75.7	158	19.8	5.50	<70	750	50	0.819	8.6	0.739
Caddo	IAB	28	4.83	89.8	362	65.2	13.5	340	860	260	2.49	4.1	1.62
Fairfield	IAB	19	4.69	66.1	141	78.4	12.8	260	1000	160	1.78	5.8	1.55

Table 2. NonAntarctic iron meteorites having masses (in parentheses; units are g) less than 1000 g. Meteorites believed to be paired have been eliminated and it is moderately probable that the footnoted irons are also paired. Most masses based on Buchwald (1975).
IAB: Tacoma[*] (17); Niagara[+] (115); Thoreau[±] (550); Niederfinow (287); Alexander County[*] (192); Casey County (~800); Black Mountain (~800). **IIAB:** Wathena (566); El Mirage (598). **IIE:** Garhi Yasin (380); Techado (810). **IIIAB:** Hayden Creek[×] (270); Kapunda (518); Emmitsburg (~450); Bluewater (~550); York (835); Maldyak (992). **IIICD:** Wedderburn (210); Freda (268); Föllinge (400); Quarat al Hanish (593); Thompson Brook (77). **IVA:** Cranberry Plains (~600). **ungrouped:** Britstown (544); Gay Gulch (483); Kofa (490); Dehesa (280); Linville (442); Murchison Downs (33); Pennyweight Point (13). No small irons are known for groups IC, IIC, IID, IIF, IIIE, IIIF, or IVB.

[*] Canyon Diablo? [+] Toluca? [±] Odessa? [×] Livingston, MT?