Newly Discovered Older Iron Meteorites Within the City Limits, Laramie, WY

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Introduction: Recently I moved just outside of the developed land of the city and acquired a dog, whereupon I learned that dogs must be walked every day. In walking over the open high plains, I frequently walked within the worn dirt tracks that crisscross much of the prairie, and within these tracks, I saw small (<3 cm), shiny, black quasi-spherical rocks. My specialty in magnetism of rocks led me to assume that these pieces were some type of iron concretion generated by current Earth weathering. Over my long career, I had developed a disdain for the magnetic overprint iron weathering imparts to Earth rocks, so I ignored most of these objects. Later a friend living a few miles away, Donn Sneddon, came to me insisting he had found meteorites. After much skepticism and research, I realized that his objects and my "iron concretions" were all iron meteorites. Then another friend found a relatively large object (~6x3x3 cm, weighing 175 gm) adjacent to a gravel pit in the southern part of the town (and the site yielded several more). Together, the discoveries suggested a fairly large area of fall. At this juncture, this iron meteorite fall has been observed to cover over 96 sq km.

Meteorite Locations and Descriptions: Meteorites have been examined at three locations, the high plains, the lower flanks of the nearby mountain to the east, and the top of the range nearest the plains. The greatest numbers of meteorites examined are those embedded in the high plains colluvium. This land has been open terrain for a long time; therefore, a great many tracks have been deeply worn into colluvium by the repeated passage of conveyances for over 100 years (horse, wagons, motorized vehicles). The dryness of the landscape preserves these tracks for lengthy periods of time. Repeated usage of these tracks has caused them to be eroded, many to depths of 5 to 13 cm. The meteorites are easily observed lying in these tracks, their abundance depending on track orientation in relationship to meteorite flight orientation. A great abundance of material, many hundreds of pieces, has been observed within tracks in the colluvium. The depth to the meteorites were buried in the colluvium can be determined from track edges; typical depth of burial is 1 to 8 cm, depending on size.

Sizes of the meteorites observed in the tracks and on gravel-capped surfaces of the plains range from <0.5 cm or less (essentially dust) to 4 cm in diameter or long dimension. Approximately 85% of the meteorites have fusion coats, either complete or partial (Fig. 1). These meteorites closely physically resemble those of the 1947 Shikote Alin fall.

Meteorites also were observed on the lower flanks of the mountain range, flat sedimentary rock surfaces dipping into the basin. Larger meteorite pieces occur on these surfaces, typically 4 to 6 cm in long dimension. A great many of these pieces appear to have a single spallation surface: a curved surface, suggesting that they spalled off a larger meteorite fragment. Some apparent impact scars are visible.

A mountain range (Laramie Range) borders the town and plains to the East. Pennsylvanian-Permian sedimentary strata form the top of the Laramie Range adjacent to the Laramie Basin, and the tilted flat rocks at the range base. Thick limestones are interbedded with sandstone-mudstone. We examined part of the adjacent top of the mountains, but found only a few small (1-2 cm) meteorites. However, we observed numerous (>30) heavily weathered small depressions in limestone. These depressions commonly are +/- one meter in diameter. The depressions are surrounded and floored by fused rock. The fused rock is chert in bright red to yellow colors with some black chert interlayered. The cherts show abundant evidence of fluid flow largely along bedding planes. Exposed surfaces are commonly highly glossy and striated. The red chert always overlies the yellow chert; the black chert occurs on top of and between layers of red chert. Breccias with bubble holes mark some of the chert.

Flight Direction: On the plains, the directions of some trails of meteorites were measured with a Brunton compass. The direction was found to be approximately N 30 E. On the mountain top, the sedimentary layers have dips of ~20 degrees; however, in one small area the layers repose at ~45 degrees, fortuitously facing the approximate direction of flight. The craters impacted here (~5) are better preserved, and the impacted layers suggested flight towards N 28 to N 30 E.

Flight Height and Indications of Molten Nature: Several pieces of evidence suggest that the meteorites of this shower were flying quite close to Earth's surface. On the plains, drainage incisions and erosion provide topography with a relief of up to 10m. A relationship of meteorite fall to this topography is quite clear. In instances of sharp relief, a greater abundance of fallen meteorites is observed about 2/3 of the distance up a scarp and on the top surfaces adjacent to the scarp. Additionally, the meteorites near the top and on the top of these topographic features are notably larger than the ones low on the slopes.

Some of the plains meteorites were observed to contain embedded pieces of gravel or sand on one face (Fig. 2). The arrangement suggests that the meteorites were partially molten in flight or became molten upon impact. The abundance of this type of meteorite material is about 3% of the plains meteorites.

Some plains meteorites exhibit crystals on their exteriors. Cubic or octahedral crystals protrude from beneath the fusion coats.

Among the meteorite fragments from the lower mountain slopes, many display cubic and octahedral crystals growing from one or more surfaces (Fig. 3a). A number of these crystals are quite large, projecting 1.5 to 2 cm on the exterior. About 60% of the meteorites on the lower mountain slopes exhibit crystals on the exteriors. Many have been oxidized subsequently to rusty colors. The abundance of crystals in this environment suggests that these meteorites were partially melted in flight or melted upon impact.

Composition: Surprisingly, most of the meteorites are only very weakly magnetic. Only a few displayed significant attraction to rare earth magnets. Polished sections were made from three samples, for the purpose of microprobe investigation of composition. Unfortunately, these sections showed the reason for the seemingly non-magnetic character: despite nice fusion coats, all three are heavily oxidized on the interiors. These specimens appear too altered for accurate compositional determinations. However, a few others are not heavily oxidized, and the polished surfaces of two display drop-like, rounded inclusions, probably an iron sulfide (Fig. 3b). These will be prepared for microprobe analysis. A few others that are strongly attracted to the magnets are likely to have escaped significant oxidation and will also be prepared as polished sections.

Age: Age is problematic at present. Pieces of chert with embedded meteorite fragments show working by Indians; a few are complete tool points. These chert fragments occur both on the lower mountain slopes and on top of the mountains. According to the resident anthropologists, the Indians probably came into this area between 8000 to 10,000 years ago.

A number of meteorites from both the plains and the lower mountain slopes have appreciable caliche rinds. Wyoming is exceedingly dry, averaging about 4.3 cm of moisture per year. The thick caliche rinds might indicate something about residence time on the ground, but might only indicate the environment during the fall, possibly a winter or early spring fall, when snow covered the ground. Likewise, some of the meteorites have heavy lichen coatings, again possibly pointing to excessive moisture at the time of the fall.

Educational value: The meteorite falls in and adjacent to a university town prompted me to use the extraterrestrial stones to incite children's interest in science. Through the university NASA office, I organized a meteorite "hunt" on my 40-acre property. This meteorite "hunt" was conducted as an activity of the NASA summer camp. This activity was one of my attempts to reestablish interest in Science in US students (the parents seemed as interested as their children). The participants were 8 to 14 years old. After my 20 minute meteorite lecture, the students were loaded aboard a school bus for the two mile trip. The students were allowed to keep the meteorites they found (which were a great many). In fact the excursion ran about one hour overtime. Next summer another such activity will be conducted.

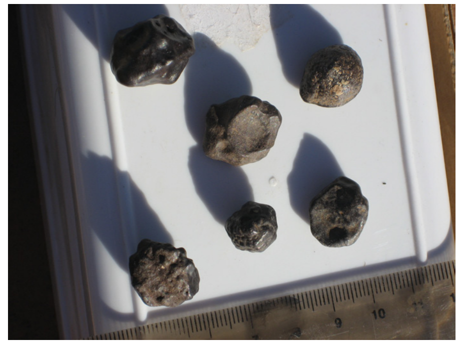

Fig. 1 Plains meteorite fragments.

Fig. 2 Embedded sand and gravel

Fig. 3a Octahedral crystals

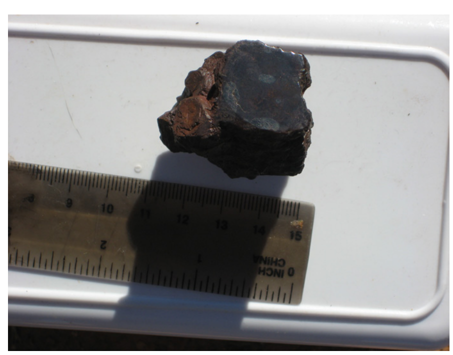

Fig. 3b Sulfide inclusions