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ON THE

ESTHERVILLE, EMMET COUNTY, IOWA, METEORITE OF MAY 10th, 1879.

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On the Estherville, Emmet County, Iowa, Meteorite of May 10th, 1879; by Charles Upham Shepard, Emeritus Professor of Natural History in Amherst College.

For the circumstances attending this third fall of aerolites in the State of Iowa since the year 1847, I am indebted to a notice published in the Chicago Times by Mr. S. E. Bemis, and to letters from Mr. Howard Graves and Mr. Henry Barber of Estherville.*

The fall occurred at 5 P. M. on the 10th of May, attended by a terrible explosion, resembling the discharge of a cannon, only louder. It seemed to proceed from a region high up in mid-air; and was followed by a second report, more like a heavy blast. This again was succeeded by one or two more reports, that may have been echoes of the two first. Nearly a minute after, a rumbling sound was heard, apparently passing from the northeast to the southwest. The sky was clear at the time, or only a few fleecy clouds were visible. An observer, Mr. Charles Ega, looking in the direction of the report, could see nothing on account of the sun's rays; but following with his eye the direction of the roaring sound that succeeded, he saw dirt thrown high into the air at the edge of a ravine, one hundred rods northeast of where he was standing. At a like distance, still farther away in the same direction, a similar disturbance of the ground was seen by Mr. Barber. Another witness, Mr. S. W. Brown, living three-quarters of a mile distant, being in the edge of a wood, and having his eyes directed upward at the moment for the inspection of some oak trees, saw a red streak in the heavens; and while looking at it, the explosion took place. It appeared to him, that the meteor was passing from west to east; and that when it burst, there was a cloud at the head of the red streak, which darted out of it like smoke from a cannon's mouth, and then expanded in every direction.

On examining the ravine where a body was seen to strike, a hole in the ground was discovered, twelve feet in diameter and six in depth. It was filled with water. Within this hole, at a depth of fourteen feet below the general surface of the ground, the large mass, weighing four hundred and thirty-one pounds, was found. It had penetrated a stratum of blue clay to the depth of six feet, before its progress had been arrested. The mass measured twenty-seven inches in length, by twenty-two and three-quarters in breadth, and fifteen in thickness. Its surface is described as "fearfully rough," with ragged projections of metal. From one of these a portion was detached, and shaped into a finger-ring. After much searching, there have

* A short notice of this meteorite's fall, by Professor S. F. Peckham, is given on page 77 of this volume.—Eds.

since been found in the immediate vicinity of the hole, several smaller masses, varying in weight from one to eight ounces; also one mass of four pounds, and another of thirty-two.

At the distance of two miles from this spot, in a westerly direction, a mass of one hundred and fifty-one pounds was also discovered. It was imbedded in a dry, gravelly soil, at the depth of four and a half feet. This specimen is in the possession of the University of Minnesota at Minneapolis.

Description of the Meteorite.

The specimens thus far received (for which I am indebted to Mr. Graves), though numerous, are all small, the largest weighing only 147·7 grammes: nevertheless, accompanied as they are with a general description of the main masses, they afford the means of arriving at a tolerably clear conception of the general character of this very remarkable meteorite. It is marked by the unusual prevalence of chrysolite and meteoric iron, the former probably constituting two-thirds its bulk; also by the size and distinctness of the chrysolitic individuals, together with their pretty uniform, yellowish-gray or greenish-black color; and by the ramose or branching structure of the meteoric iron. Nearly one-half of the chrysolite, however, is more massive, approaching fine granular, or compact. Yet in this condition it is still highly crystalline, and difficultly frangible. This portion is of an ash-gray, flecked with specks of a dull greenish-yellow color. The luster is feebly shining. It is without any traces of decomposition; on the contrary, it is throughout a fresh, undecomposed crystalline aggregate. Especially is it observable, that the stony portions nowhere present traces of the oolitic, or semi-porphyritic structure, so common in meteoric stones.

The mean specific gravity of four examples of the stony portion was found to be 3·35. The crust upon this variety is of the usual thickness, black, without luster, and much wrinkled. One of the fragments shows a cavity of half an inch area, completely lined with a shining dark-green glass, as if from the perfect fusion of chrysolite.

The meteoric iron, besides being in ramose branches, is also in enveloping coatings around the chrysolite, somewhat as in the Pallas and Atacama irons. The specific gravity of this aggregate, cleared of the stony part, was 5·97; that of the large specimen of 147·7 grams, was 4·54. The presence of schreibersite in the metal is apparent to the naked eye; also traces of the Widman figures which so constantly attend its presence, and to which they owe their production.

A very remarkable appearance is exhibited by the meteoric iron in some of the specimens. It is the bright silvery whiteness of the metal where it forms a portion of the exterior of the

stone. It appears to have been fused and is surrounded on all sides by the black crust, coming from the stony material. It will be interesting to know whether this character prevails over the main mass from which these fragments were separated. If such should be the fact, it would give us a second case in which meteoric iron seen to fall, reached the earth in the possession exteriorly of a high metallic luster. The other instance is that of the Dickson County meteorite, Tennessee, July 30, 1835.

The chrysolite, in large distinct concretions and highly crystalline individuals, deserves a particular notice. Some of these show imperfect crystalline facets, and nearly all the larger ones possess eminent cleavages. In a few instances they are nearly transparent and gem-like. Specific gravity (on 0·77 grams) = 3·50.

The next most conspicuous species present is troilite. This also is in distinct individuals, sometimes as large as a pea. It is highly crystalline, rarely presenting splendent crystalline facets, whose color approaches silver-white. The proportion in which it exists is apparently large, and may equal two per cent.

Next in importance comes the feldspathic mineral, presumably anorthite. It is highly crystalline, white, lustrous and nearly transparent, resembling in these particulars the similar mineral found among the ejecta of Vesuvius.

Among the specimens are two very distinct examples of an opal-like mineral of a yellowish-brown color, which I take to be chassignite. Its luster is resinous, structure imperfectly slaty, to massive and conchoidal. A small granule of chromite occurs in one of the fragments of the massive chrysolite.

Such are the minerals thus far distinguished in the Estherville meteorite. As a whole, it differs widely from the normal meteoric stones. These differences consist, in the first place, in the unusual prevalence of a chrysolite similar to that found in the meteoric irons; secondly, in the large proportion of meteoric iron present, and in the manner in which it is involved with the chrysolite; thirdly in the fresh and highly crystalline condition of all the constituents of the meteorite. Nothing like an aggregation of pulverulent, ash-like grains, more or less rolled into oolitic shapes, so common in meteoric stones, is discernible. The stony portions much more resemble the olivinic rocks of extinct volcanos, particularly those of the Eifel district.

Judging from the specimens in hand, it cannot properly be referred to any group of meteoric stones with which we are acquainted. It would rather appear to be a connecting link between the Litholites and the Lithosiderites, though it may possibly find a place in the Eucritic group of the former, in which case it would form an order by itself.

New Haven, June 27, 1879.