BIBLIOGRAPHY.

1. 1903: MILLER. Science, n. s., vol. 17, pp. 114–115.
2. 1903: WARD. Amer. Journ. Sci., 4th ser., vol. 15, pp. 316–319. (With cut showing external appearance of the 13 lb. mass.)
3. 1903: MILLER. Science, n. s., vol. 18, pp. 243–244.
4. 1905: WARD. Proc. Rochester Acad. Sci., vol. 4, pp. 193–202. (Illustrations of largest stone.)
5. 1907: FARRINGTON. Meteorite Studies II. Publ. Field Columbian Mus., Geol. ser., vol. 3, pp. 111–112.

Battle River, see Victoria.

BEAR CREEK.

Jefferson County, Colorado.
Here also Aeriotopos, Bear River, Colorado, Denver County, and Jefferson.
Latitude, 39° 48′ N., longitude, 105° 5′ W.
Iron. Fine octahedrite (Of) of Brezina; Caillite (type 18) of Meunier.
Found, 1866; described, 1866.
Weight (estimated), 227 kgs. (500 lbs.).

The first account of this meteorite was by Shepard [1] under the title of "Colorado" and was as follows:

If neither of the two preceding irons are likely to be represented in our collections there is certainly a prospect that it will be quite otherwise with the mass just discovered upon the eastern slope of the Sierra Madre Range of the Rocky Mountains.

For my acquaintance with this discovery I am indebted to the kindness of Mr. J. Alden Smith, a practical mineralogist, at present residing in Colorado. This gentleman has transmitted to me by mail a very interesting cleavage lamina, 1.5 inches long by three-fifths of an inch wide and one-eighth thick, and which shows on one edge a portion of the natural coating of the meteorite. His letter, dated June 21st, is very brief, though it contains important particulars which I can not withhold from the scientific public until his return to the East in the coming autumn. By means of the promised specimens he expects to bring with him on his return, I hope to be able to give a more circumstantial account of the discovery.

The detection of the mass, and which has occurred only within a few weeks, is due to Messrs. Wilson and Morrison, by whom Mr. Smith was shown to the locality. It is situated within a very deep ravine, at the elevation of 8,000 feet above the ocean and surrounded with high mountains on all sides. The exact dimensions of the mass are not given; but its weight is supposed to be several hundred pounds. "It seems to have struck a crevice in the solid ledge, and thereby to have been much shattered at one extremity—a circumstance that enabled the finders to detach several small pieces." They inferred the fall to have taken place at a very remote period, as the mass exhibited a coating of oxyds half an inch thick. "Its composition is principally the native metals, iron, nickel, cobalt, a little manganese, and a trace of copper. In some parts, iron forms the chief ingredient, while in others nickel and cobalt are largely in excess."

The specimen in my possession exceeds every iron I have seen in the perfection of its crystallization. It is as coarsely crystalline as that of Arva (Hungary) or Cocke County (Tennessee), but much more intimately laminated with schreibersite than either. The laminæ of this substance are unusually thick and possess a light color together with a bright luster. As they are disposed in accordance with the octahedral cleavage of the iron they render the Widmanstättian figures strikingly apparent without polishing or the use of acids. No pyrites or graphite is visible in my specimen. Specific gravity=7.43.

Further details were given by Henry [2] the same year in the American Journal of Science, as follows:

Professor Henry has transmitted to the editors a note respecting the discovery of a mass of iron in a deep gulch near Bear Creek, Colorado Territory, about 25 or 30 miles from Denver, and 800 or 1,000 feet below the top of a steep hill. Mr. James L. Wilson, who describes it in the Daily News published at Denver, Colorado Territory, May 14th, states that it was at first mistaken by himself and Mr. G. R. Morrison, who accompanied him, and who had seen it before, for the "blossom" or "iron hat" of a mineral lode. "It is irregular in form, being about 22 inches long, 9 to 10 broad, and 14 wide. Four of its faces are flat and two rounded. This form indicates it to be a fragment of a much larger mass. It is magnetic. Its weight is estimated at 500 pounds. The force with which it struck the rocks at the time of its fall had so shattered one end as to enable the discoverers to break off a piece that weighed about 11 pounds. Its composition appears to be iron, nickel, cobalt, and copper, unequally distributed in its mass. In one part the nickel and cobalt are largely in excess of the other metals, while in other parts iron forms the chief ingredient. These metals are aggregated and highly crystallized. A coating of the oxyd of iron half an inch thick has taken the place of the shining black crust observed on aerolites when they first reach the earth. The less oxydizable metals, nickel and cobalt, still remain in their metallic state in this coating of iron rust."

It is pretty certain from this not satisfactory description, that this is an example of an iron meteor-mass found where it has fallen, the shattering of the mass and of the adjacent rocks being rarely observed. It was exposed by a

freshet which had washed away the loose stones and earth. This is the same mass noticed by Professor Shepard at page 250 of this issue, who appears to have been in possession of some scales from the concussion which disintegrated the specimen. We have taken steps to obtain more detailed information respecting it.

The next year Smith [3] published an analysis of the meteorite as follows:

The first of these irons (Russel Gulch) I described in the September number of this journal, calling it the "Colorado meteorite." Owing to the discovery of another in the same territory (specimens of which have been in my possession for some little time), it will be proper to designate the first mass as the "Russel Gulch" iron and the other as the "Bear Creek" iron. Of this last there are two short notices in the November number of this journal. The specimen of it in my possession has enabled me to make a thorough examination of the constituents. The piece I have has a portion of the exterior attached.

As has already been stated by Professor Shepard, it is coarsely crystalline and laminated from the effects of decomposition between the crystals; the surface contains considerable pyrites, although Professor Shepard did not discover any in his specimen. I was enabled to separate and analyze magnetic pyrites, schreibersite, and nickeliferous iron. Of the magnetic pyrites sufficient was separated to make a quantitative determination, which was as follows:

Sulphur	35.08
Iron	61.82
Nickel	.41
Insoluble residue	1.81
	99.12

The schreibersite was not obtained in sufficient quantity for a complete analysis; about 50 milligrams of the pure mineral gave all the constituents usually found in this interesting mineral.

The nickeliferous iron, constituting of course the great bulk of the mass, was composed as follows:

Iron	83.89
Nickel	14.06
Cobalt	.83
Copper	minute quantity
Phosphorus	.21
	98.99

The laminæ of iron are often very brilliant, having the luster of silver, and caused me to suspect more nickel than was found. It was supposed that in the decomposition of the crystals the iron would disappear more rapidly than the nickel, and that by a process of cementation the nickel would accumulate in the laminæ; but from careful examination of the process of decomposition there is no doubt that the interior of the mass will not differ materially in its composition from the analysis already given of the nickeliferous iron. Besides the minerals already mentioned, and which properly belong to the original mass, there is much oxyd of iron containing some nickel arising from the decomposition of the surface.

Shortly after, Jackson [4] also published an analysis, as follows:

I received last Tuesday, November 6, a piece of meteoric iron from Rev. Mr. Thompson, who brought it from Colorado, and who had negotiated for the large mass with the intention of presenting it to the Boston Society of Natural History. I have just learned that Professor Shepard, through the agency of a friend in Denver City, has secured the original mass, said to be 2 feet in diameter, for his cabinet. It appears, from Professor Shepard's letter to me, that it is the same mass that is mentioned in the last (September) number of your journal, page 250. I made the chemical analysis of it before being aware it was the same meteorite described, and since no previous analysis of it has been made I offer mine to you for the journal, Professor Shepard expressing a desire that it should be published.

The piece of meteoric iron given me by Mr. Thompson, who brought it from Colorado, weighs 4 ounces. It has been heated in a forge fire in order to cut it more easily; but still the Widmanstättian figures come out when dilute nitric acid is applied to the polished surface, as distinctly as possible, and consist of a series of small, nearly equilateral triangles with the lines well defined and quite elevated. On one side of the specimen was a crust about one-eighth of an inch thick, consisting of sulphid of iron. This probably, in the unaltered meteorite, is a bisulphid of iron mixed with oxyd of iron.

A portion of the clean metal sawed off from the mass has a specific gravity of 7.692.

On chemical analysis by the most approved method, separating the iron from the nickel by succinate of ammonia and determing the nickel as oxyd of nickel, and then analyzing this oxyd for cobalt and copper—a separate portion of the meteorite being employed in analysis for the tin, which was twice determined, and the nitric solution being tested for phosphoric acid and sulphuric acid, etc.—the results of my analysis in per cent are as follows:

Metallic iron	90.650
Metallic nickel	7.867
Metallic cobalt	.010
Metallic tin	.020
Insoluble matter consisting of a little silica, schreibersite, and chrome, as proved by blowpipe investigation	.950
	99.497

Brezina [5] classed the meteorite as an octahedrite with fine lamellæ in the Hraschina group. He gives the breadth of the bands as 0.5 mm. and notes that the plessite is bright.

Meunier [6] grouped the meteorite as Caillite, and described its structure as follows:

> The figure given by the iron of Bear Creek is finer than that of the iron of Caille, and in some characters it departs a little from the type without being altogether distinguishable. The kamacite, in little bands alternating with the lamellæ of tænite, forms compact groups, at times thick, which surround places occupied, now by plessite associated with tænite, and now by pyrrhotine enveloped by an extremely thin layer of graphite. Schreibersite occurs in scales at times quite abundant.

Leick [7] noted a parting in the troilite of Bear Creek, which indicated that it crystallized in the isometric system. The planes which he recognized by goniometric measurement were those of the cube and dodecahedron. Later, however, he [10] concluded that these measurements were not trustworthy. He found [8] the troilite of the meteorite a good conductor of electricity.

Preston [9] gave the following note regarding the locality of the meteorite:

> Bear Creek has been noted in most catalogues as having been found in Denver *County*, Colorado, which is a mistake, as Colorado has no county by this name. It was first mentioned by Shepard as found upon the eastern slope of the Sierre Madre Range of the Rocky Mountains. Again Henry notes it as found in a deep gulch near Bear Creek, about 25 or 30 miles from Denver. Smith in describing this meteorite gave it the name of Bear Creek. As Denver is on the boundary line between Arapahoe and Jefferson Counties, and as there is a Bear Creek extending clear across Jefferson County from west to east, emptying into the Platte, according to Henry's description, this would bring the locality of the Bear Creek meteorite in the western central part of Jefferson County. Therefore, it seems likely that the iron noted in the Shepard collection as "Jefferson, 30 miles from Denver," is in reality a portion of the Bear Creek meteorite labelled "Jefferson" meaning Jefferson County, and that the date of fall, June, 1867, is an error. Particularly so as the Bear Creek is described by Henry as being "shattered at one end," so that small pieces could be readily detached.
>
> Denver County has evidently been substituted for Denver city in many of the meteorite lists, as no county is given in any of the early reports of the Bear Creek meteorite. Moreover, the Sierre Madre Range is west of Denver, and Bear Creek is described as having been found on its *eastern slope*, which, in all probability, would bring it in Jefferson County. So it would seem best that "Jefferson" should be discarded entirely as a distinct fall and be called Bear Creek, and that Denver County in all meteorite lists should read Denver city.

Cohen [11] described the structure of the meteorite as follows:

> The lamellæ are long, straight, swollen, seldom grouped, and consist of strongly hatched granular kamacite, with very fine etching pits and well-developed tænite. Since the hatching lines penetrate without hindrance the forks between the granules, the latter are separation phenomena and do not indicate a granular structure of the kamacite. The fields are uniformly distributed and vary little in their size. They are strongly developed, although somewhat subordinate to the bands. The gray, rather bright plessite consists, as a rule, of grains whose size averages 0.03 mm., and varies between boundaries of 0.02 and 0.10 mm. On strong magnification grains appear in it surrounded by delicate tænite-like borders and separated by fine veins distinguished by lack of luster and by a dark color from the nickel-iron of the grains. Since it is remarkably depressed it is perhaps a nickel-free or nickel-poor iron. At the edge of the fields the grains go over into short, compressed bands. Plessite of this character was described by Tschermak from Ilimæ. Tænite ramifies into many fields and the kamacite grains often lie isolated in the tænite groundmass which is sharply distinguished by its smooth surface, luster, and light yellow color, and seems to be an outgrowth of the tænite surrounding the bands. Again, in other fields, the dull, depressed black veins extend, producing a very fine-grained or striated structure, and form a groundmass in which are imbedded isolated kamacite grains. Finally, some fields show combs which, in consequence of their unusual breadth, are plainly outgrowths of the bands. Rarely does the intimate structure of plessite exhibit itself so clearly. Schreibersite is very richly present. In part it forms large crystals up to 15 mm. in length, occasionally showing hieroglyphic forms; in part there are smaller individuals which either lie in the bands, producing a lumpy shape, or are surrounded by typical swathing kamacite. At times one can plainly see that the latter is a deformed lamella, since one such lamella of normal development widens at the end to a ring which incloses a grain of schreibersite. In addition, small shining grains and short rods occur in many bands which likewise appear to be schreibersite but could also be cohenite. Large troilite nodules surrounded by swathing kamacite show a peculiar angular-granular appearance and a lamellar structure of each grain gives a resemblance to the so-called coral ore.

The meteorite is chiefly preserved (436 pounds) in the Amherst collection.

BIBLIOGRAPHY.

1. 1866: Shepard. Amer. Journ. Sci., 2d ser., vol. 42, pp. 250–251.
2. 1866: Henry. Mass of meteoric iron in Colorado Territory. Idem, pp. 286–287.
3. 1867: Smith. Amer. Journ. Sci., 2d ser., vol. 43, pp. 66–67.
4. 1867: Jackson: Analysis of a meteoric iron from Colorado. Idem, pp. 280–281.
5. 1885: Brezina. Wiener Sammlung, p. 210.

6. 1893: MEUNIER. Révision des fers météoriques, pp. 52 and 57.
7. 1894: COHEN. Meteoritenkunde Heft 1, pp. 188 and 191.
8. 1898: COHEN. Meteoreisenstudien VII. Ann. K. K. Naturhist, Hofmus, Wien, Bd. 13, p. 58.
9. 1902: PRESTON. Proc. Rochester Acad. Sci., vol. 4, pp. 77–78.
10. 1903: COHEN. Meteoritenkunde, Heft 2, p. 248.
11. 1905: COHEN. Meteoritenkunde, Heft 3, pp. 301–302.

BEAVER CREEK.

West Kootenai district, British Columbia.
Latitude, 51° 10′ N.; longitude, 117° 30′ W.
Stone. Crystalline spherical chondrite (Cck) of Brezina; Sigenite (type 35) of Meunier.
Fell between 3 and 4 p. m., May 26, 1893; described 1893.
Weight, 14 kgs. (31 lbs.)

A detailed description of this meteorite was given by Howell,[3] Hillebrand,[4] and Merrill[5] as follows:

In the number of "Science" dated July 21, 1893, I (Howell) gave a brief history of this meteorite as then known, and proposed the above name from the stream near which it fell.

The accompanying cut gives a fair idea of the stone as first seen by me. It measured 6 by 7 by 9.5 inches and weighed 22.5 pounds. About 3 or 4 pounds had been broken from the bottom as shown in the cut. The original weight must have been approximately 26 pounds and the length 12 inches.

After repeated efforts and much correspondence I have been unable to secure any more of the fall. The reports at first stated that two smaller pieces of a few pounds each were seen to fall. This, however, seems to have been a mistake, as only one other piece of 4 or 5 pounds, so far as I can learn, was seen. A portion at least of this smaller piece was broken into fragments and distributed the same as the most of that which was broken from the larger mass before it came into my possession, July 6, 1893, by purchase from Mr. James Hislop, a civil engineer, who found and dug it up the morning after it fell and brought it to Washington. It buried itself in the earth about 3 feet—2 feet in soil and 1 foot in hardpan.

The direction of the hole was south 60° east, true meridian, and at an angle of 58° with the horizon. Fresh earth was scattered about the hole in all directions, but farthest (10 feet) in the direction from which the stone came.

It fell between the hours of 3 and 4 p. m. May 26, 1893, near Beaver Creek, West Kootenai district, British Columbia, a few miles north of the United States boundary and about 10 miles above where the creek joins the Columbia River.

The report was heard by persons within a radius of nearly 25 miles, and it was believed by many who heard it that larger pieces must have fallen than those secured. The stone is a typical aerolite of very pronounced chondritic structure, has the usual fused black crust, but has one feature unlike any other meteorite with which I am familiar. Beneath the crust there is a slight oxidation for a distance of from one-half to three-quarters of an inch which seemingly must have occurred before it struck the earth, and for which thus far no satisfactory explanation is suggested.

There is no occasion to further describe the character of this stone as that part will be found fully discussed in the accompanying paper by Doctors Hillebrand, of the U. S. Geological Survey, and Merrill, of the U. S. National Museum.

CHEMICAL DISCUSSION BY DR. W. F. HILLEBRAND.

The material received for chemical examination was in a crushed state, much of it in fine powder, being the waste resulting from cutting the rocky mass. There was scattered throughout it some organic matter derived from a burnishing brush, which, though insignificant as regards weight, rendered useless any attempt to look for organic matter proper to the meteorite itself.

Of this mass, 26.1892 grams, after repeated separation under alcohol by an electro-magnet, yielded 5.0710 grams of magnetic material which still contained over 10 per cent of unmagnetic substance, as shown by the following analysis:

Analysis of magnetic material.

Fe	80.21	88.456
Ni	7.78	
Co	.44	
Cu	.026	
Silicates	5.17	
SiO_2	1.31	
MgO	1.31	
FeO	1.20	
Fe_3O_4	.83	
FeS	.77	
P_2O_5	.057	
Al_2O_3, CaO, Alk., and loss by diff	.897	
	100.000	