The Lafayette Meteorite*

By H. H. NININGER

Nothing is known regarding the time at which this remarkable meteorite fell, but its fresh appearance renders it practically certain that it had not lain on the earth for a very long time before it was picked up and protected against abuses of a mechanical nature. The story is told that a colored student of Purdue University reported that a number of years ago while fishing at the edge of a little lake he was frightened by the falling of a stone at a distance of only a few feet from him. This

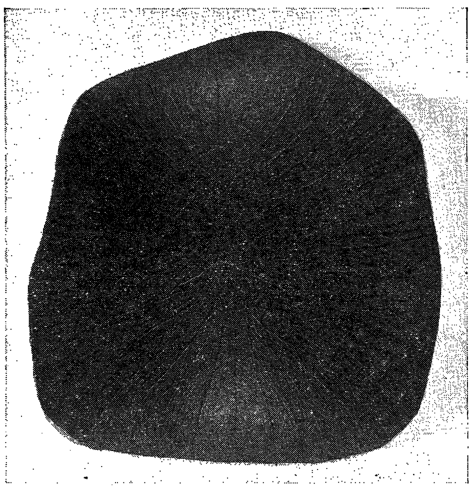

FIGURE 1.
FRONT VIEW OF THE LAFAYETTE METEORITE.
The arrangement of the thread lines evidences an oriented flight. The entire surface here shown consists of a blackish fusion crust. Reduced to one-half linear scale.

stone he later dug from the soft mud and found it to be "shaped just like a corn pone" and of about the same size. For a time he preserved the stone. It was thought that he had brought it to the University, but these reports have not been substantiated for the reason that the person could not be located.

Whatever its history the meteorite was first recognized by Dr. O. C.

*The Lafayette meteorite was to have been described by the late Dr.O.C.Farrington of the Field Museum. Subsequent to his death a search through his papers revealed no notes on the specimen. The honor of describing it was extended to the writer. Certainly no more beautiful meteorite was ever described and surely no one could have done it so well as would Dr. Farrington, had he lived.

The photographs used in this paper have been selected from those prepared for Dr. Farrington by the Photographic Department of Field Museum.

Farrington while classifying some minerals and rocks for the department of geology in Purdue University in 1931. Up until that time the stone had been regarded as a glacial boulder or pebble and the surface markings were thought to have been scratched due to its glacial origin.

To a student of meteorites the Lafayette stone at once becomes a very impressive example of the results of an oriented flight through the atmosphere. So far as is known to the writer no meteorite records such a flight more perfectly or more graphically.

As shown in Figure 1 this aerolite is almost perfectly symmetrical, being of a form which partakes about equally of the characteristics of a low pyramid and a section of a sphere, with a base which is almost flat but slightly convex.

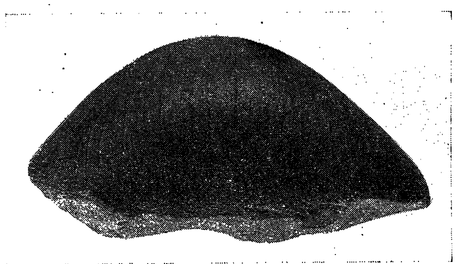

FIGURE 2.
SIDE VIEW OF THE LAFAYETTE METEORITE
as viewed from the bottom of Fig. 1.
Showing a tendency for the threadlines to develop a bead-like condition. The dark area near the apex is due to a shadow. A portion of the base is seen in the lower part of the figure. Reduced to one-half linear scale.

At a glance the position of the stone in flight is quite evident, for its spheroidal front is abundantly and almost evenly beset by a host of fine crinkley ridges of blackish glass which radiate from its central point; or rather from an elongated apical area, for the four sides of the original pyramid from which the present form seems to have been shaped were not exactly equal. Consequently, the thread lines meet on a sort of comb or ridge about 2 cms long.

The thread lines or ridges are not all of equal prominence but consist of principal or primary ridges which arise in the central area and continue unbroken to the periphery. Of these, 27 were computed. Between each two of the primaries are one to three secondaries which arise short of the central area and continue to the periphery. These may be in some cases quite as prominent as the primaries near the periphery but are usually less so. Besides the primaries and secondaries there are more or less abundant, smaller and less distant, ridges intermingled with which are abundant points and protuberances of various forms.

Above we have referred to the crinkly nature of these thread lines or ridges. In some places this characteristic merges into a sort of beaded condition. This is particularly true in more sheltered areas such as that shown in the lower central portion of Figure 2 where the lined surface stands almost vertical to the base. Altogether the lined surface of the stone gives one the impression that it has been formed by the cooling down from a condition in which the surface of the entire front was in a liquid state to a temperature below the melting point of the stone which allowed the molten matter to congeal while in the process of being swept away. The high viscosity of the liquid resulted in the formation of more or less perfect beads where the sweep of air was not too powerful. The numerous small prominences between the thread lines are due in part to the same process. Apparently, however, these have to some

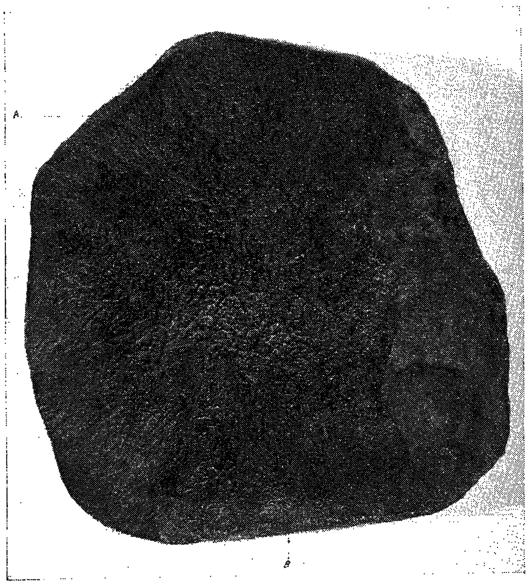

FIGURE 3.
THE BASE OF THE LAFAYETTE METEORITE.
Showing abundant small gas-explosion pits and the ridge (A) formed by the spilling over of fused material from the forward side. At the right the crust has been broken away. Another small piece has been detached near the lower left-hand corner.

extent resulted from the unequal melting of the underlying particles of stone, so that the more resistant points have been left projecting up under the glassy crust.

The base of the meteorite presents a decidedly different appearance. The wind-swept condition, which we have just described as obtaining on the forward convex portion, ends abruptly at the periphery where the almost flat base meets this convexity. Here, as is shown in Figure 3 is a noticeable ridge (A in Fig. 3) formed by the accumulation of spilled-over molten material from the forward side. An examination of this ridge reveals that it is a porous black glass or slag which shows but little indication of any exposure to strong air currents. What evidence there is of such exposure is found in the form of short humpbacked ridges (*B* in Fig. 3) with pointed ends. These tend to lie in a plane parallel with the base of the meteorite and are seldom longer than one millimeter. These short ridges project toward the center of the base.

The entire base inside of the described ridge is covered with a heavy coating of slag or glass which is beset with little pits or craters—true gas explosion craters. This pitted surface appears to have been developed in a situation where almost no atmospheric disturbance existed save for occasional puffs which now and then dipped down from the terrific blast which was sweeping above it as the displaced atmosphere closed in furiously behind the on-moving projectile. Traces of these dips are recorded in very slight but perceptible drift lines reaching center-ward from the periphery, fading out usually before arriving at a point half way to the center.

Here in the wake of the moving mass was apparently an almost perfect vacuum. We find, however, in this stone no evidence that the heavy rear crust represents accumulations from the air-blasted forward side of the stone as has been suggested by various writers regarding certain meteorites and to support which we have found evidence in some cases. Had the rear crust been the result of over-spilling from the forward side then it should be heaviest near to the periphery where the bulk of the load would have been dropped, and a thinning of the crust should be noticeable between this and the center. Such is not the case, however. What we find is the very narrow ridge at the periphery, already referred to, with a uniformly heavy crust over the central portion. This crust in the central area evidences not the slightest disturbance from air currents. On the contrary, it appears to have been produced in a state of perfect calm, as, for example, in the glazing furnace of the potter. The many bubble-pits indicate a shallow seething pool of molten material which existed undisturbed. We may safely conclude that the rear side of the moving meteorite was free from the air blast which impinged so forcibly against its forward and lateral exposures, except for comparatively slight gusts which briefly swept an outer zone intermittently.

We may think of this rear side of the meteorite as a furnace, for over its edges came the violently heated blast of air which closed in to fill the constantly forming vacuum which was always advancing rapidly enough to elude the inrushing air. This super-heated and highly compacted air produced a very effective furnace between itself and the base which differed from the front exposure of the meteorite mainly in being in a state of calm, or rather being in a vacuum.

In meteorites traveling at several miles per second we encounter a condition which differs notably from that which obtains at lower velocities. The drop-shape with a rounded front and a tapering rear, which is considered the least resistant form in mechanical devices, is seldom attained in meteorites, probably for the reason that the velocity is too great. Consequently the destructive erosion which would be expected on the lateral and leaward slopes is not in evidence. In fact, the drop-shape is notably absent in meteorites. In the few instances where found, such as the Boogaldi and Charlotte irons, we find the evidences of aerial conflict limited to the rounded large end which was the forward end in flight probably because of its form rather than that the form resulted from this position.

Examination by the writer of several thousands of completely encrusted individual meteorites or bolides has convinced him that there is a critical velocity beyond which aerial friction operates differently from its effect at lower velocities. Above this critical velocity the leaward rear slopes of the moving body tend to escape the destructive effects of friction. Among meteorites which show evidence of an oriented flight there is a strong tendency toward flattish bases, such as the Lafayette stone exhibits. Even in those where the base is convex there is in many cases no indication of rapid erosion such as is evidenced on the anterior surface.

The interior of the Lafayette stone constitutes one of those rare instances of a meteorite which shows no metallic inclusions on a polished surface. Three polished surfaces were examined. In none was there found any trace of nickel-iron.

The interior appears almost uniformly of an olive drab color viewed from a distance. Closer scrutiny reveals that it is an aggregate of slender prismatic crystals of the color described, together with a sprinkling of lighter and darker particles some of which are almost black.

There is no suggestion of a chondritic structure visible on any of its three cut surfaces examined, nor on the portion of interior which has been exposed by the breaking away of the crust in a few places. The meteorite therefore falls in the division of achondrites. Dr. W. A. Waldschmidt of the Colorado School of Mines examined a sample of the stone and found it to be mainly a monoclinic pyroxine, probably diopside. Apparently, therefore, it should be classed with the nakhlites of Prior.

Because the location of the fall is not known it shall be known as the Lafayette meteorite which is the name of the city in which Purdue University is located.

The principal mass of the stone (about 600 grams) is preserved in the Geological Collection of Purdue University. Complete sections are also included in the Collections of the Field Museum and of the writer.

Colorado Museum of Natural History.