Possibility of An Additional Meteorite Crater Near Odessa, Texas*

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Abstract

In the vicinity of Odessa meteorite crater are a number of sinks which, viewed from the air, closely resemble the crater in plan and general configuration. It is suggested that at least one of these sinks may be a meteorite crater modified, since the time of its formation, by the solvent action of ground water on the underlying bedrock.

Several meteorite fragments, the largest of which weighed 1.3 grams, were found around a sink located approximately 1.3 miles southwest of the crater. This sink is about the same size as Odessa crater, but unlike the crater it does not have a rim about it. Moreover, the drainage around the margin of Odessa crater is centrifugal, whereas that around the sink is centripetal.

Preservation of rims about meteorite craters in the Odessa region, or any other area characterized by abundant sinks, would depend largely upon the location of the craters. If a crater were formed in an area of centrifugal drainage, the rim would persist longer than if the crater were formed in an area of centripetal drainage. In the latter instance both the rim and associated meteoritic iron might soon be covered with wash, and the decomposition of buried metorites would be hastened. The sink in question may therefore be a modified meteorite crater.

Odessa meteorite crater is located in western Texas, West about 10 miles southeast of the town of Odessa. Approximately 14 feet deep and 550 feet across, the crater is surrounded by a rim of broken rock that accounts for almost half its depth. The area in which the crater is located is part of the high plains, and the local relief is so small that satisfactory pictures of Odessa crater cannot be taken from the ground[1].

Recently H. H. Nininger has published aerial photographs which show that the area about the crater is more diversified than might be expected[2]. In particular, Nininger's photographs show that the Odessa crater is but one of a number of circular depressions which impart a pocked appearance to this general portion of the high plains.

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[1]Descriptions of the Odessa Crater may be found in: Sellards, E. H., *Economic Geology of Texas* (in *The Geology of Texas*, vol. 2) Texas Univ. Bull. 3401 (1934) pp. 219-220; and "Unusual Structural Feature in the Plains Region of Texas" (abst.) *Geol. Soc. America, Bull.*, Vol. 38 (1927) p. 149.

[2]Nininger, H. H. "Odessa Meteorite Crater," *The Sky*, Vol. 3 (1939), pp. 6-7; 23.

Viewed from the air these depressions appear as dark circular patches which stand in strong contrast against the prevailing light gray of the intervening areas. This is due to the fact that the depressions are floored with grass and scrub mesquite, whereas the areas between depressions have a vegetational cover too scanty to conceal the caliche and limestone country-rock.

With the exception of Odessa crater the nearby circular depressions lie within larger basins of variable size and shape but generally similar in that they are areas of internal drainage. Between these larger depressions are inconspicuous, smoothly contoured divides which rise only a few tens of feet above the basin floors. It is near the crest of one of these rounded upland areas that Odessa crater is located.

Two questions arise from these considerations. (1) Is the location of Odessa crater on a divide responsible for preservation of those features which identify the depression as a meteorite crater? (2) Are any of the nearby "sinks" of meteoritic origin?

Odessa crater was recognized as having been formed by impact and explosion of a meteorite because it is surrounded by a rim of broken rock in which are mingled numerous meteoritic particles. Nor is it likely that the crater could have been better situated for preservation of the rim and exposure of associated meteoritic material. It is notable that the land slopes away from the rim of the crater in all directions. The rim is thus a divide between small drainageways that converge toward the center of the crater and those that diverge radially away from it. For this reason the rim remains sharply defined as it is lowered by rainwash, and additional meteoritic fragments wash from the rim debris with each rain. Very little water finds its way into the crater, so that solution of limestone underlying the floor has not been sufficient to cause caving and consequent destruction of the rim.

The general situation at Odessa crater is shown by the lower of the two blocks in Figure 1. Like Odessa crater the one shown in this diagram is situated on an upland so that the rim is a local divide for the drainage that leads radially into the crater and that which leads radially away from it. The upstanding rim debris, as well as the material that has been washed from the rim both into and away from the crater, is shown in black. Structures in bedrock below the crater are hypothetical, but accord with the writers' ideas on such structures as expressed in earlier papers[3].

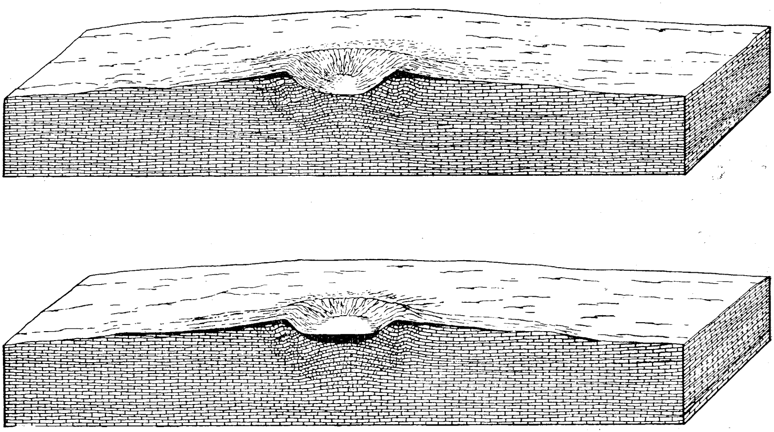

Fig. 1. Two stages in the history of a crater of the Odessa type. The upper block shows the initial stage; the lower block shows the crater after rim materials have been washed into and away from the crater. Original and reworked rim debris is shown in solid black. Frontal sections through the crater show hypothetical structures in the underlying bedrock.

The relatively dark zone in bedrock beneath and peripheral to the crater represents the zone of shattering formed when the meteorite that produced the crater struck and exploded.

The original shape of Odessa crater would be restored approximately were the material that has washed from the rim both inward and outward moved back to the periphery of the depression. This imaginary condition is shown in the upper block of Figure 1. These diagrams show two stages in the evolution of the crater of the Odessa type and emphasize that, situated on a divide, such a crater would retain its diagnostic features after a con-

[3]Boon, J. D., and Albritton, C. C., Jr., "Meteorite Craters and Their Possible Relationship to Cryptovolcanic Structures," *Field and Laboratory*, Vol. 5, No. 1 (1936), pp. 1-9; "Meteorite Scars in Ancient Rocks," *Field and Laboratory*, Vol. 5, No. 2 (1937), pp. 53-64.

siderable interval of erosion under the prevailing semi-arid conditions.

Odessa crater would not have remained so well preserved had the meteorite which formed it fallen in one of the nearby basins rather than on a divide. A crater situated near the center of one of the basins would in time have its rim covered over by sediment washed down from nearby slopes. Associated meteoritic fragments likewise would be buried. With runoff leading centripetally into the crater, solvent action on the underlying limestone would be hastened, and the crater might be converted into a sink. Caving around the sink would be expected to proceed rapidly, because rocks marginal to and beneath a meteorite crater are shattered and traversed by many joints. Organic acids derived from plants growing around the relatively well watered sink would aid in decomposing buried meteorites. A crater situated along the side rather than at the bottom of one of the basins would probably undergo similar though slower transformation into a rimless sink. It may be concluded that the diagnostic features of a meteorite crater located on one of the low divides in the Odessa area would be preserved longer than those of a similiar crater situated in a basin.

If meteorite craters can be converted into sinks under the conditions outlined above, it is possible that some of the sinks near Odessa crater are transformed meteorite craters. Nininger's picture shows that the single established crater is near the center of an irregular line of sinks trending roughly northeast. In the following discussion the sinks will be numbered in order from northeast to southwest. Sink number 1 is about 1.5 miles northeast of the crater. It is a shallow depression almost circular in form and about 700 feet in diameter. This sink is filled with water following heavy rains. Sink number 2 is approximately 3.1 miles southwest of the crater. If this sink had a rim it would closely resemble Odessa crater in size and form. Local drainage is centripetally directed into this sink, which holds water for a few hours after heavy rains. Sink number 3 lies one-half mile beyond number 2. It is

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circular in form and much larger than the others. Sink 3 is filled with water over a considerable part of the year. Other sinks similar to the three mentioned above are found in this area.

On several occasions the writers have visited these sinks and the crater with the purpose of learning whether they are genetically related. In May, 1939, the senior author, accompanied by Mr. George Pavey, made a careful search with a strong magnet for meteoritic iron near sink number 2. Through the diligence of Mr. Pavey a number of small fragments were picked up which closely resemble the meteoritic fragments found near Odessa crater, and which upon subsequent laboratory examination were found to contain nickel. Later the writers returned to the area and made a more intensive search for meteorites around the three sinks. No meteorites were found around sinks one and three, but additional fragments were found around number two. All of these fragments were small, the largest weighing only 1.3 grams. However, these particles have the same general shape and external appearance as those of similar size collected from Odessa crater (Fig. 2). This, considered

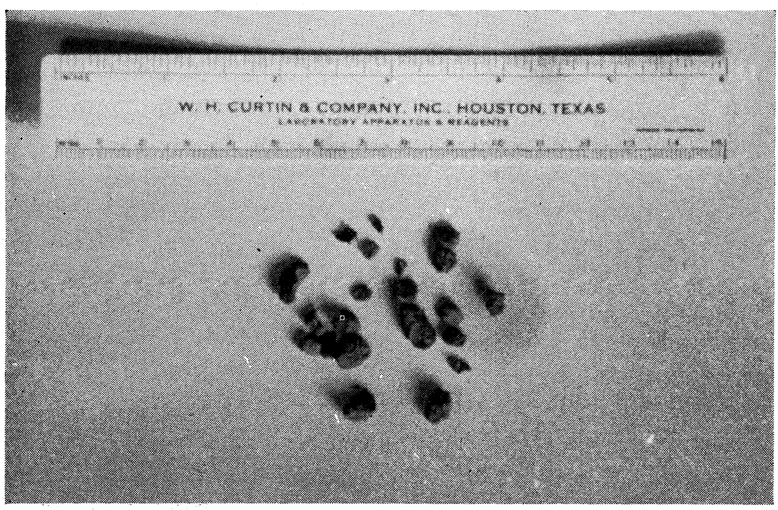

Fig. 2. Meteorites found around sink number 2. These particles are now on display at Hyer Hall, Southern Methodist University.

with the fact that the particles gave good tests for nickel, leaves little doubt that the metallic fragments found around sink number 2 are of meteoritic origin. It is possible that this sink was originally a meteorite crater, which owing to its situation in an area of centripetal drainage, was transformed into a sink after the manner already outlined in this paper.

On the other hand it is possible that the meteoritic particles are fortuitously associated with the sink in question. Four alternate explanations for their occurrence will be considered briefly.

(1) The meteoritic particles around the sink may have been brought there by man. This would be a more likely possibility were the particles larger. They are not sufficiently large or conspicuous to attract attention and arouse curiosity; indeed they could not have been found without the aid of the magnet.

(2) Possibly the meteoritic particles around sink number 2 are simply small masses that accompanied the fall of the giant meteorite that formed Odessa crater. At present this possibility cannot be ruled out.

(3) The particles in question may be fragments blown from the site of Odessa crater when the main bolide struck and exploded. In order to test this possibility the writers made a study of the distribution of meteoritic fragments around Odessa crater. No irons were found at distances greater than 300 feet from the rim except in one quadrant, in which pieces were found up to distances of 800 feet from the rim of the crater. This quadrant is the northeast one; sink number 2 lies southwest of Odessa crater. However, it should be noted that meteorites have been found southwest of the crater at distances greater than 800 feet. Professor Lincoln La Paz has discovered an iron meteorite about 1,300 feet southwest of Odessa crater[4]. This discovery was made with the aid of a machine especially designed for locating meteoritic material. The significance of this find with respect to the apparent concentration of

[4]Bryan, Kirk; Personal communication dated January 4, 1940 .

meteorites northeast of Odessa crater will become apparent only after the entire Odessa area has been thoroughly and systematically searched for meteoritic irons.

(4) The particles may have washed from the rim of Odessa crater to the margin of the sink. This is not regarded a likely possibility, inasmuch as the present surface drainage does not lead from the rim of Odessa crater to the sink.

In summary it may be stated that a number of small meteorites have been found around a sink situated a little more than a mile from Odessa meteorite crater. At present it cannot be demonstrated that these meteorites have any relationship to the origin of the depression about which they were found. With regard to size and shape the sink is similar to Odessa crater, but there is no rim about the sink. On the other hand it is noteworthy that Odessa crater, situated as it is at a center for centrifugal drainage, is located in the best possible position for preservation of the rim and exposure of associated meteoritic fragments. The sink, conversely, is located near a center for local centripetal drainage; under such conditions a rim could not long persist, and there would be a tendency for rainwash to bury rather than to expose meteoritic particles. The sink in question may therefore be a modified meteorite crater, and other sinks in this region may be of the same origin. The writers are not suggesting that the thousands of sinks on the high plains of Texas are modified meteorite craters, but they believe that some of the sinks around Odessa should be critically examined with that possibility in mind—especially since meteorite craters seem to occur more commonly in clusters than singly[5]. Under conditions like those prevailing in the Odessa area it is unlikely that a meteorite crater of size and depth comparable to the Texan example could long escape being converted into a rimless sink—unless, like Odessa crater, its rim happened to be a center for centrifugal drainage.

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[5]Boon, J. D., and Albritton, C. C., Jr., "Established and Supposed Examples of Meteoritic Craters and Structures," *Field and Laboratory*, Vol. 6, No. 2 (1938), pp. 44-56.

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Sequent Occupance in the Central City Area, Colorado

Mary Grace Gillespie

Man's desire for the precious metals has taken him into remote areas of the earth. This untiring search for gold lead to the exploration of the canyons of the Rocky Mountains. In 1859 there appeared in an isolated mountain valley of northern Colorado, a small settlement, later to be known as Central City, that boomed suddenly, lived brilliantly, and died quickly, only to be revived in 1932.

In the summer of 1849 seven natives of Georgia while on their way to California made camp at the confluence of Cherry Creek and South Platte River. That autumn gold was discovered in the stream gravels, but winter weather prevented the prospectors from exploring the creek to its source. When spring came they went on to California, and remained there for several years prospeccting for gold. Later, these men became discontented, sold their claims in California, and returned to Georgia. Before leaving California they drew up an agreement whereby they would return to the Rocky Mountain region. In 1858 with an additional four men they set out again for their old campsite. Separating into two parties they explored in different directions. One group ascended Boulder Creek Canyon while the other crossed the front range to Fall River, Spring Gulch, and Russell Gulch, and discovered the rich gold bearing sands of that area. With the approach of another winter season the explorers abandoned further prospecting and returned to their camp on the South Platte.

By 1858 news of the gold discovery in Colorado had spread eastward to the Atlantic Coast. Here was a great