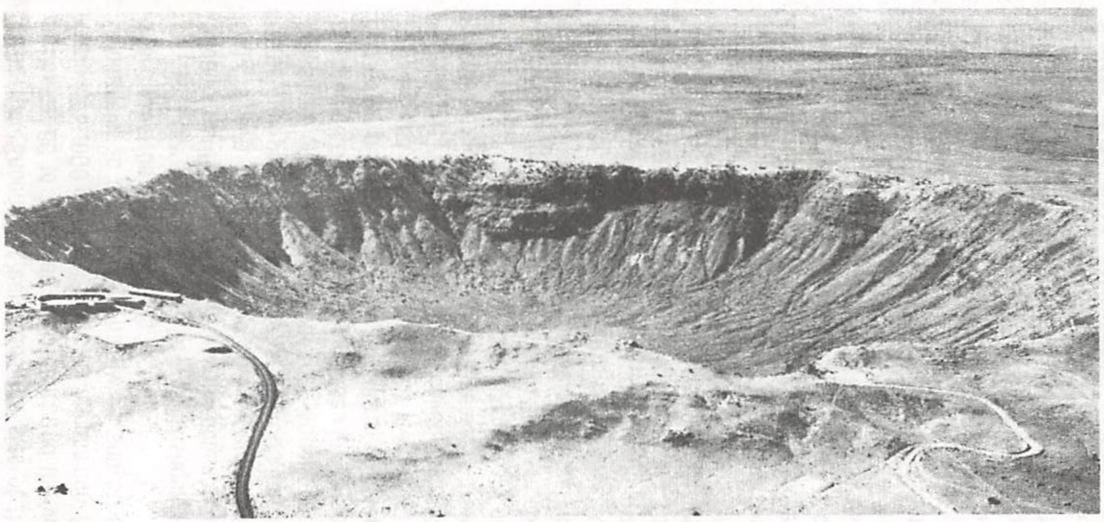
Meteor Crater

BRIEF HISTORY

About 49,500 years ago an unbroken level plain stretched where you now stand. Out of the north a bright pinpoint of light arose rapidly into a blazing sun as it approached this spot. Traveling nearly 43,000 miles per hour, with deafening sound and blinding light, a huge nickel-iron meteorite or cluster of such meteorites, weighing millions of tons, struck the solid rock of the level plain. With forces greater than any recorded nuclear explosion, the main mass was instantly converted to a gaseous state, and a huge mushroom-shaped cloud arose far into the stratosphere. From this cloud rained meteoritic droplets mixed with rock debris. For miles around, every tree was flattened and no living creature survived. Before impact pieces of meteorite weighing up to a ton or more were stripped from the mass by friction of the lower atmosphere. Other pieces were thrown back out of the impact site. Layers of rock were flipped over, and blocks of rock—some as large as small houses—were blasted out. In all, about 300 million tons of rock were displaced, much of it forming the raised rim around the crater.

The floor of the crater is 560 feet deep—equivalent to a 60-story building—and is more than 4,100 feet across; and the rim is more than 3 miles in circumference. If the Washington Monument were erected on the floor of the crater, the top would just about reach the level where you now stand. At least twenty football games could be played simultaneously on the crater floor, and the crater's sloping sides could accommodate two million spectators.

The crater was first reported by white men in 1871. It was thought to be just another extinct volcano. In 1890 nickel-iron meteorites were found on the surrounding plain. Eventually these discoveries led to the suggestion that the crater had been formed by a giant meteorite. In 1891 a leading geologist, G.K. Gilbert, dismissed that possibility after a brief survey. In 1903 Daniel Moreau Barringer, a Philadelphia mining engineer, became convinced that the crater had been created by the impact of a large metallic object, and he assumed that the mass of the meteorite was still buried. He acquired the land and formed the company to explore it. For 25 years his work and scientific research were carried on with great perseverance and much bitter disappointment.



METEOR CRATER ENTERPRISES, INC.

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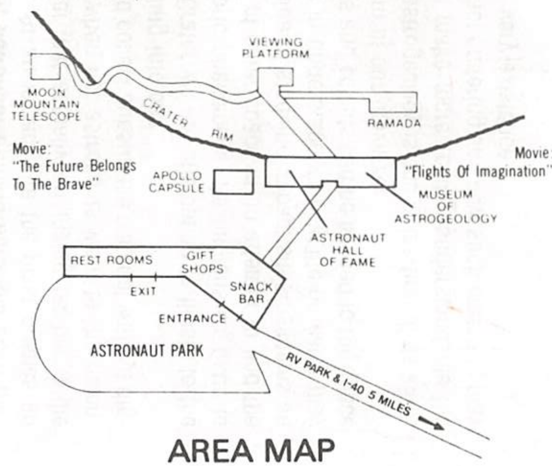
MOVIE SCHEDULE

"Flights of Imagination" (length 7 min.)
On the hour and 30 minutes past the hour

"The Future Belongs to the Brave" (length 5 min.)
20 minutes past the hour and 10 minutes before the hour

LECTURE SCHEDULE

"Meteor Crater History" (length 5 min. 12 sec.)
10 minutes past the hour and 20 minutes before the hour



AREA MAP

Because the crater is roughly round, it was natural to assume that the body that created it lay beneath its center. Consequently, the first shaft was started where the low, white mounds of pulverized Coconino sandstone can still be clearly seen. A few small meteoritic fragments **were** found, but the underlying water table had combined with shattered sandstone to form a highly abrasive mixture that prevented mining to a depth where the main mass of meteorite was suspected to lie.

Later Dr. Barringer discovered that a rifle bullet fired into thick mud, even at a flat angle, would always create a round hole. This was an important clue. Looking at the far slope of the crater—its southeastern side—you will see, as Dr. Barringer did, that the rock strata arch up more than 100 feet above the levels elsewhere on the walls of the crater. This observation, coupled with the fact that most of the loose pieces of meteoritic material had been found northwest of the crater, led Dr. Barringer to conclude that the mass had come in at an angle from the north and had buried itself beneath the southeast rim of the crater. Looking again at the southeast rim, you will see a notch with a streak of red earth running from it. Drilling was started at that notch, and at a depth of a thousand feet increasing numbers of meteoritic fragments were brought up by the drill. At times, for hours without progress, the drill would gouge into something harder than itself. Then, at 1,376 feet, the drill jammed completely—apparently wedged in meteoritic debris. The drill cable broke, funds were exhausted, and the exploration had to be abandoned in 1929. By this time, however, most scientists had accepted Dr. Barringer's theory of the impact origin of the crater. Although he died that year, Dr. Barringer had lived to see his theory accepted. Today in scientific circles the crater is called Barringer Crater in recognition of his work. His family still owns the property and regards it as a public trust. In 1968 the Department of the Interior designated the site a natural landmark.

Two later attempts were made to locate the main mass, but these efforts also were stopped by objects that could be neither penetrated nor pushed aside. Now, however, modern sophisticated testing procedures have replaced the old method of drilling a hole and examining the findings. Today testing is done by electrical and sound wave measurement, gravitational and magnetic studies, and seismographic work. Based on these procedures, scientists now believe that the major portion of the meteorite—about 80 percent—was vaporized at impact, 5 percent was physically blasted out, and 10 percent remains beneath the south rim of the crater. The remaining 5 percent had been stripped off by atmospheric friction before impact.

Dr. Eugene Shoemaker, former chief scientist of the astrogeological branch of the United States Geological Survey in Flagstaff, wrote his doctoral thesis on this crater and today is also probably the best informed man on the geology of the moon. Dr. Shoemaker estimates the size of the mass that struck as 80 to 100 feet in diameter and the velocity of the mass at 43,000 miles per hour. For a mass only 80 to 100 feet in diameter to dig a hole a mile wide and 60 stories deep, speed must be the governing factor.

Two new minerals—coesite and stishovite—were identified here. Both are high-pressure polymorphs of silica—SiO_2, silicon dioxide—altered to a different mineral by extreme high pressures equivalent to 20,000 times atmospheric pressure, or 300,000 pounds per square inch. Although coesite and stishovite can be produced in the laboratory, they had never before been found in nature, until identified at an impact site. Coesite has since been identified in connection with other geological features called astroblems. These features are the ancient scars of meteorite craters—some of them huge and as much as 500 million years old.

In more recent years much work has been completed here at Meteor Crater in the fields of planet comparison, astronaut training, and crater mechanics. Photographs of our moon and the other planets have shown clearly that the craters on their surfaces were caused by meteoritic impact collisions, and photographs of our earth's surface have shown that it, too, has been hit many times by large meteorites. Nearly all the craters thus formed on the land masses of the earth have been leveled by erosion. Some are known to be much larger than this crater, but this one is the **first** and the **largest** definitely identified on the basis of the meteorites found in and around it. It is also the **best preserved** crater on earth.

All the Apollo astronauts were given extensive training here at Meteor Crater. Much knowledge was gained in the fields of crater geology, crater mechanics, and meteoritic study that, coupled with their astronaut training, opened the door for a more comprehensive study of the moon. As our scientists are extremely interested in what lies beneath the surface of the moon, astronaut training here has been particularly significant. At an impact site the blast creates an outer flap of material that actually originated far below the surface; therefore, when our astronauts went to the moon, they knew they could collect subsurface material without digging a hole or crawling into one.

Here at Meteor Crater we are attempting to illustrate the importance of meteoric phenomena. As humans continue to explore the regions of outer space in an attempt to find the origin of life, the value of studying impact sites assumes an ever-increasing role in understanding how life on earth may have begun. Meteors and comets can be likened to the space transportation system of our universe.

Our museum of astrogeology is one of the first of its kind, and we hope it will make more readily understandable the technicalities of impact cratering and how such cratering may have influenced our very existence.

Thank you.