

ORIGIN OF THE LONAR CRATER*

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THE Lonar Lake ($19^{\circ} 58' 45''$: $76^{\circ} 34' 0''$), a remarkably circular depression situated near Lonar village in the Buldana District of Maharashtra, has attracted the attention of scientists since first described in the 19th century. The shape and morphology of the depression are that of a crater and previous investigators (La Touche, 1912) have favoured an explosive eruption or a collapse as the causative phenomena. Recent work (Beals, 1960) on circular features in several parts of the world ascribed either to cryptovolcanic phenomena or to meteorite impact, has provided the impetus to study the Lonar structure in more detail. Geophysical investigation and reconnaissance geological studies of the area were conducted by the Geological Survey of India in the first half of 1963.

The depression is unique in an otherwise gently rolling or flat topography, and no such feature is known in the surrounding country. The Lonar structure measures about 2,000 metres across at the surface and the large circular depression has a lake at its bottom. The depth from the rim to the lake level is about 140 metres and the sides of the depression are at 30° to the horizontal. A fairly continuous raised rim or bank (about 70 to 100 metres wide and 3 to 20 metres high) surrounds this depression. Previous observers (Nandy and Deo, 1961) have reported that the lake in its deeper central portion shows 5 metres of water followed by 30 metres of lake silt. The water spread of the lake is about 265 acres, and having no outlet, the waters are saline.

The Deccan trap lava flows (Cretaceous-Eocene) are the only rocks exposed for several miles around. These are amygdular or massive tholeiitic basalts that form several sub-horizontal flows. Around the Lonar crater, these flows show quaquaversal dips of about 10° suggesting a gentle domal structure. Large-scale faulting, intense shattering and brecciation and dykes are absent. The results of the seismic investigation of the structure are in general conformity with the drilling data (Nandy and Deo, 1961) and indicate the presence of a highly weathered or brecciated basalt below the lake silt.

Several similar structures have been attributed to cryptovolcanic phenomena (Bucher, 1963). The central 'high' and the annular depression are, however, absent at Lonar and intense fracturing, faulting, brecciation, collapse structures associated with such phenomena are also lacking. But the raised rim, domal dips and shape support the theory.

The chief obstacle in accepting a volcanic or cryptovolcanic theory is the age (La Fond and Dietz, 1964) of the depression. Such evidences as the drainage pattern, stream incision, breaching of the rim, embayment of outline, thickness of lake silt, and comparison with the Barringer Crater, show that the depression could not have originated earlier than Pliocene. In the absence of any volcanic or magmatic activity in the area after the Deccan trap episode in Eocene, it would appear unlikely that the structure could be related to magmatic activity.

The strikingly circular outline, depth-diameter ratio, raised rim, age and lone occurrence of the Lonar structure favour the meteorite-impact theory. Other crucial criteria like fracturing, brecciated material, impactite structure like shatter cones, 'mountain meal', glass or fusion crusts, ejected debris and meteorite fragments, could not be found. Trace element determinations of Ni, Co and Ti in rocks, soil, silt and vegetation in the crater showed no anomalous concentrations that could be ascribed to a nickel-iron meteorite.

The available data, therefore, are equivocal and the lack of intense fracturing and brecciation is an intriguing feature, whatever be the favoured theory of origin. The drilling data (Nandy and Deo, 1961) and the geophysical investigation provide evidence of a possible brecciated zone at the lake bottom. Investigation of this zone by diamond drilling may throw further light on the origin of this interesting structure.

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