A PROBABLE NEW METEOR IMPACT CRATER

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Abstract. Kedarath Fountain-Pond, Gujarat, India is a probable new Meteor Impact Crater Fountain-Pond which is irregular, very old and eroded. In this note we report some preliminary observations about it and invite attention of international community of scientists towards its existence and studies and to establish finally whether or not, it is a Meteor Impact Crater. We have also taken some steps in this direction.

1. Introduction and Discussion

Meteor Impact Craters like Barringer Crater, Arizona, United States (see Hoyt, 1987; Shoemaker, 1963) and the Lonar Crater Lake in Buldhana District of Maharashtra, India (see Fredriksson *et al.*, 1973) are rare on Earth's surface. Rare though cratering events are in human experience, it is actually a dominant geological process in the Solar System. As we compare our own countryside with the cratered surfaces of the Moon and other rocky and icy worlds in the Solar System, we might ask why are there so few craters on the Earth? Where have all the craters gone that must have been formed on the Earth? Why don't we see them? Perhaps, we see a few of them, if we look carefully enough. The remains of several probable craters have been discerned from aerial photography by the trained eyes of photo-geologists. The extremely eroded condition of several craters that have been found suggests why many others are completely absent. The geological processes that deform and erode landforms proceed exceedingly rapidly. During our own lifetime, the modification of the landscape by various agents such as earthquakes, floods, glaciers, continental drifts, has been very slight, yet, it occurs rapidly enough to have erased all evidence of terrestrial craters. Our homeplanet thus constantly resurfaces itself, eventually wiping clean the evidence that it has been struck repeatedly by objects from space. Barringer and Lonar Craters themselves are appreciably eroded, although they were formed about 50,000 years ago (see Sengupta and Bhandari, preprint). In a million years there may be little or no trace of these craters. Yet, a million years is only a few thousandths of the age of the Earth. The Earth's volcanic explosion craters bear a striking resemblance to impact craters, hence when Barringer and Lonar Craters were discovered, the debate long raged over whether they were of volcanic origin or impact origin. Finally, the debate was resolved in favour of their impact origin.

On the other hand if the interplanetary space is so empty, how can there be so many scars from impact explosions on most planetary surfaces? Scientists have

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much better ideas now of the interplanetary population of asteroids, comets and smaller bodies that have created craters in the past and still occasionally impact on planets. Astronomers have survayed and have been surveying smaller and fainter asteroids, especially those passing relatively close to the Earth. They have discovered several near-Earth asteroids, Earth-crossing asteroids, planet-crossing asteroids, Apollo, Amore, Aten, and Toro asteroids. It is believed that there are many thousands more. Theoreticians have calculated the permanence and longevity of these objects and chances of their impacting a planet or being moved by the gravity of other planets. Scientists have studied how crater size and form change with different velocities, projectile masses, angles of impact and the surface material strength of targets and the impactors. It has been discovered that if an asteroid is about 150 m across and of stony composition and coming with a velocity in the range 15–20 km s^{-1}, it can make craters like Barringer or Lonar. Asteroids with smaller physical parameters create smaller craters, and with bigger physical parameters, bigger craters.

Meteor Craters, like Barringer and Lonar, are a proof of the damage a meteorite can wreak. A collision with the Earth occurred as recently as 1908, when a small asteroid or a comet exploded near the Stony Tunguska River in a remote area of the desert of Siberia in USSR. The blast destroyed scores of square kilometers of forest, was heard 800 km away and set the night sky of Europe aglow for days. Earth is under constant danger from space-born projectiles in the form of comets, asteroids, and meteorites. Rabe (1972) and Rawal (1991a,b, 1992) suggest that these projectiles may have originated not only from the Solar Oort cloud of comets and from the mainasteroid belt between Mars and Jupiter but also from Trojan clouds located at the stable as well as unstable Lagrangian points associated with the orbits of planets and also from Oort clouds of comets that existed surrounding the satellite systems of planets, when the planets and their satellite systems were formed a long time thereafter, and that the Oort clouds are nothing but the boundaries to the satellite systems of planets. Of course, presently, we do not see the Oort clouds of planets surrounding the satellite systems of planets. It appears that through the age of the Solar System, the Sun and the planets have shattered them to a finish. Many of the comets from the Oort clouds of planets have come down to their respective planet making craters on its surface, many have left the Solar System altogether and many have been captured by the Sun with the help of planets, and raised their status as comets or asteroids of the Solar System, some of which are seen even today in the form of planet-crossing asteroids or comets moving throughout the Solar System. Some of these planet-crossing comets or asteroids, due to gravitational perturbation of the Sun and planets, have come to the planets, creating craters on them. Thus the stuff of the planetary Oort clouds might have got exhausted.

The several Trojan asteroids have long been known to exist at the stable Lagrangian points associated with the orbit of Jupiter (see Chebotarev, 1967). Recently clouds of several hundreds of Trojan asteroids have been discovered at

these points and it is believed that there may be many thousands more Trojan asteroids at L_4, L_5–Lagrangian points of Jupiter (see Van Houten *et al.*, 1970; Rabe, 1972). It is interesting to note that recently the Trojan objects have been discovered associated with the orbit of Earth by Winiarski (see *Sky and Telescope*, February, 1991), of Mars by Holt and Levy (see *Sky and Telescope*, October, 1990; January 1991) and of satellites like Dione and Tethys (see Rawal 1991a,b, and all references mentioned therein). Not only Trojans exist or once existed at the stable Lagrangian points associated with the orbit of each and every planet and satellite of the Solar System, but they also exist, or once existed at the unstable Lagrangian points associated with the orbit of each and every planet and satellite of the Solar System as well. They might have escaped or may have been escaping from time to time from their original locations to become the comets or asteroids of the Solar System (see Rabe, 1972 and Rawal, 1991a,b) some of which are seen even today in the form of planet-crossing asteroids or comets moving throughout the Solar System. These objects might have come down or may have been coming down to their respective planet and created craters on its surface.

Here in this note, we would like to report the existence of a probable new meteor impact crater and invite attention of the international community of scientists towards its existence studies and to establish finally whether or not it is a meteor impact crater.

2. A Probable New Meteor Impact Crater

Kedarnath Fountain-Pond (22°31′N, 70°12′E), India (Figures. 1–2) is an irregular, very old, and eroded depression on the sedimentary rocky surface of the region. It forms a circular *arc* of length about 700 m and is nearly 10 m deep and filled with water all the time. Around most of the circumference, the rim is raised about 10 m above the surrounding plain. It appears to be a part of much larger circular, very old and eroded crater of size 1500 m. The author is the first to suspect it to be a meteor impact crater and here he is announcing it accordingly. However, it remains to establish it finally as a meteor impact crater and to determine its age. Figures 3–7 show the photographs of its different parts.

It appears to have been formed by an impact of a small asteroid or a cometary nucleus not more than 150 m arcross. The impactor had come from a western direction at a very low angle and hit the Earth at this place raising an arc-shaped earth-collar about 10 m high and spreading ejecta all around, mainly on the western region in front of the raised collar. It appears that the small asteroid was made up of sedimentary material and as it had hit the ground at a low angle, it was unable to create a deep, impressive bowl-shaped crater like Barringer or Lonar at that place below which there is a thick layer of sedimentary rocks, but instead it shattered itself into pieces, producing a shallow crater. However, it appears that the collision impact had produced a deep hole in the Earth at that place out of which water-fountain had emerged which keeps the Pond full of water all the

Fig. 1. The Map of India showing the location of Kedarnath Fountain-Pond near Halvad in Saurashtra, India. Artwork by Pramod A. Rane of Nehru Centre, Bombay.

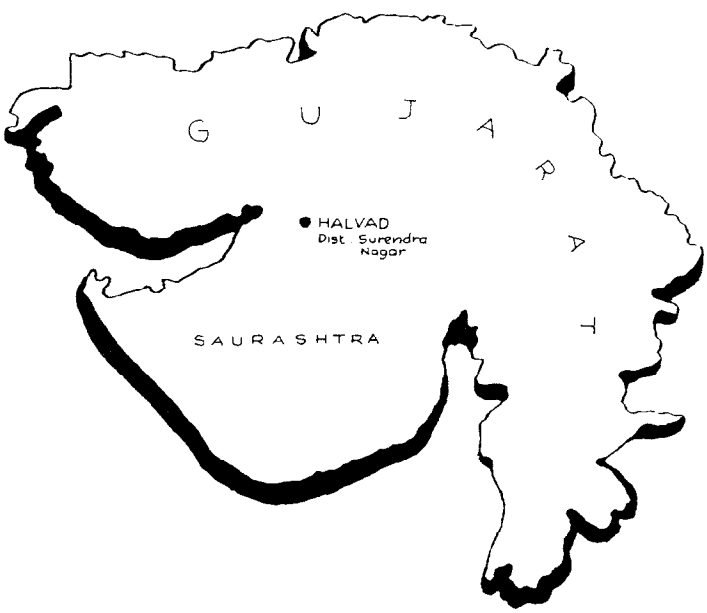

Fig. 2. Close up of Gujarat showing the Location of Kedarnath Fountain-Pond near Halvad in Surendranagar District of Saurashtra in Gujarat, India. Artwork by Pramod A. Rane of Nehru Centre, Bombay.

Fig. 3. A part of Kedarnath Meteor Impact Crater Fountain-Pond near Halvad in Saurashtra, India. Photo taken by the author on January 25, 1992.

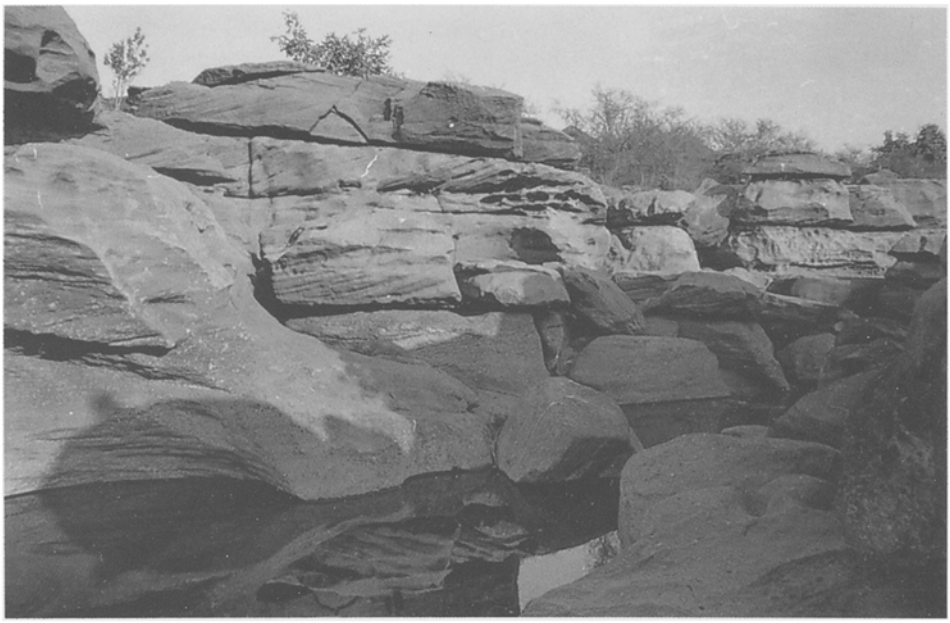

Fig. 4. A part of Kedarnath Meteor Impact Crater Fountain-Pond near Halvad in Saurashtra, India. Photo taken by the author on January 25, 1992.

Fig. 5. A part of Kedarnath Meteor Impact Crater Fountain-Pond near Halvad in Saurashtra, India. Photo, taken by the author on January 25, 1992.

Fig. 6. A part of Kedarnath Meteor Impact Crater Fountain-Pond near Halvad in Saurashtra, India. Photo, taken by the author on January 25, 1992.

Fig. 7. A part of Kedarnath Meteor Impact Crater Fountain-Pond near Halvad in Saurashtra, India. Photo, taken by the author on January 25, 1992.

time. When the asteroid collided, it threw in space thousands of tons of dust, sand and soil exposing the lower layer of sedimentary rocks to the sunlight. Due to high pressure and temperature generated during the impact event, many of the rocks in the region have turned into shock-metamorphic rocks which are seen even today lying in and around the Kedarnath Fontain-Pond.

The whole region to the west of the Crater-Pond shows many small and big destructions and damages. These appear to be due to the fallen parts of the meteorite rushing down to the region from the western sky. Figure 8 shows how the Kedarnath Crater Fountain-Pond could have formed. Preliminary observations indicate that it is not a man-made crater-Pond or an ordinary Pond, nor is it a stream and may also not be of volcanic origin, but in all probability, it seems to be a very old and eroded meteor impact crater. We have started scientific investigations to establish whether or not, it is a meteor impact crater.

3. Conclusions

Preliminary observations indicate that Kedarnath Fountain-Pond is not a man-made crater-Pond or an ordinary Pond, nor is it a stream and may also not be of volcanic origin, but, in all probability, it seems to be a very old and eroded meteor impact crater, In fact, it is a part of a much larger, very old and eroded meteor

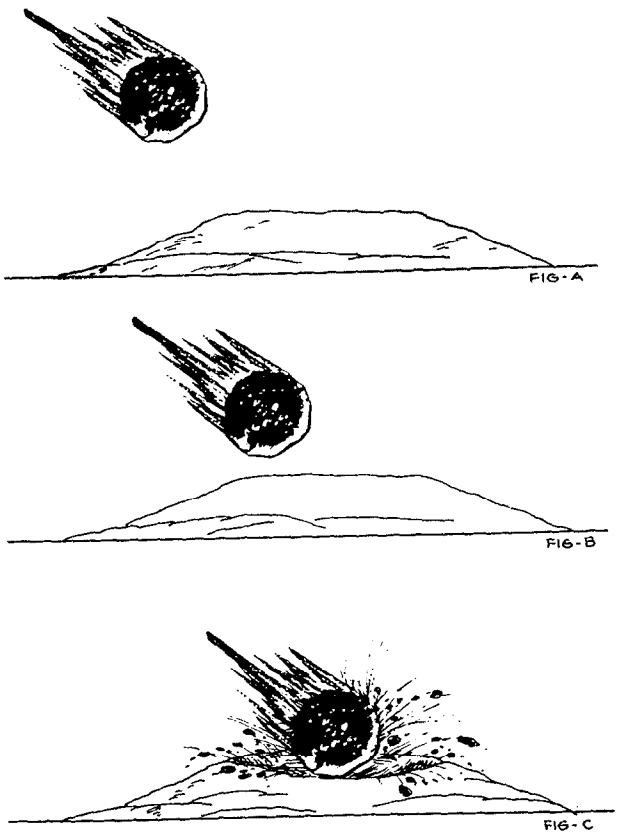

Fig. 8. This picture shows the path along which an asteroid is believed to have struck to create Kedarnath Fountain-Pond near Halvad in Surendranagar District of Saurashtra in Gujarat, India. Artwork by Pramod A. Rane of Nehru Centre, Bombay.

impact crater. However, remains to establish it finally as a meteor impact crater and to determine its age.

We would like to invite attention of international community of scientists towards the existence and studies of this probable new meteor impact crater and to establish finally whether or not, it is a meteor impact crater. We have also taken some steps in this direction.

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