

WHY NOT GIVE MARS A RING LIKE THAT OF SATURN?

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Abstract

With a view to test the famous Roche hypothesis, it is suggested that, in the near future space programme, Phobos, the inner satellite of Mars, be pushed inside by a properly arranged atomic explosion so as to cross the Roche limit of Mars. Phobos is uniquely suitable for this field experiment in astronomy, since its present orbit is not far outside this Roche limit nor its mass too great for the push of an atomic explosion.

Recent reports of the discussions arranged in London and Washington on the occasion of the Hundredth anniversary of the discovery of Phobos and Deimos have very aptly highlighted the shift in the emphasis of future space probes from Mars to its two tiny satellites (Hughes 1977). Speculations regarding their origin are numerous, no doubt, but the strong possibility of their having first formed as asteroids in the space between Mars and Jupiter and then by chance moved near to Mars to be caught by it and retained as its own permanent satellites, is worth considering. Similar conjectures also exist in respect of most of the non-Galilean satellites of Jupiter, those of Saturn except the giant Titan, and also those of Neptune except the massive Triton. On the other hand, Pluto, the outermost known planet in the solar system, is thought to have been an erstwhile satellite of Neptune!

Do such events really take place and how often ?

(1) An answer to such questions or clues to such answer, it is surmised, can be obtained if we concentrate our attention on the satellites of Mars, obviously because they are tiny enough to be real asteroids and are now within our reach. Another mission, a Viking 3, be undertaken to alight on Phobos with a view to carry out a search for the geological, chemical and structural engineering aspects of this tiny, queer shaped body, having blackish grey surface with numerous craters. The necessary clues in the form of accurate observations *in situ*, thus obtained, may well go a long way to solve these conjectural migrations of small bodies in the solar system.

(2) Next, having performed this mission, the final experiment to be performed by Viking 3 lander would be to test actually the validity of the concept of Roche limit. Some external force needed for Phobos to change its orbit suddenly and to cross the Roche limit can be derived from a properly planned atomic explosion, a novel use of atomic energy for a peaceful purpose. This would answer well, since the mass of Phobos is quite small (1.1×10^{16} kg) and its orbit is not too far outside (only 700 km) from the Roche limit of Mars. In fact, it would be achieved by adopting the Hohmann orbit for going from the present orbit with a radius of 9,400

km and a period of 7 hours 29 minutes to an orbit of radius of 8,700 km and a period of 6 hours 39 minutes 30 seconds. This would necessitate the least of effort when properly manipulated.

The duration of travel along this path may be a few hours only, and will offer an opportunity for a continuous watch of the events. After this new orbit is achieved, it would, most probably, depend upon the structure of Phobos, how long it would take for it to break up into numerous pieces and to form a ring around Mars. The exact prediction of time perhaps need not bother us for the present but perhaps a fair guess could be made based on the strength of the material of typical meteorites available to us and the rate of change of force of gravity of Mars at this distance.

(3) Turning to Saturn and Uranus, one may then ask the question, were their rings also formed this way? — a direct entry of asteroids into their Roche limits? Knowledge of chemical analysis of the surface materials of the small bodies in the Saturn's rings may be relevant to this question and an attempt to collect a few samples from the Saturn's rings by one of the two Voyagers, though hazardous, may perhaps be the only immediate solution.

The total mass of Saturn's rings is estimated to be about 2.27×10^{25} grammes, which is (i) less than one third the mass of Moon and (ii) about 38 times the mass of Ceres, the largest of asteroids. Because of (i), the three outer rings of Saturn are so brilliantly visible by the reflected sunlight and because of (ii) a similar broad ring, if produced around Mars out of the material of Phobos alone, may not be so visible even at its much closer distance, both from the Sun and Earth.

Addendum:— However, no attempt is made here to estimate the visibility of the rings of Mars, if and when produced, as has been made by Sinton (1977) in the case of the newly discovered rings of Uranus.

References :

- Hughes, D. W. 1977, *Nature*, 267, 757.
Sinton, W. M. 1977, *Science*, 198, 503.