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ROCKS FROM MARS

Ken Tapping, 4th April, 2017

So far we have found getting on for 100,000 meteorites scattered on the surface of the Earth. Some of these rocks from space are raw material left over from the formation of the Solar System, and are therefore just a continuation of the now-slowing process of planet building. However, some of them are bits knocked off other planets. Around 150 of them are bits of the planet Mars. They were ejected into space by volcanic eruptions in Mars' early history, or more recently by meteoric impacts. They spent millions of years or longer orbiting around the Sun until they finally collided with our planet. How then can we determine where these rocks came from, and what can they tell us?

Meteorites are usually recognizable because their surfaces look blackened, melted or glazed. This happened during the last few seconds of their journey here, as they smashed into our atmosphere at tens of thousands of kilometres an hour. Friction heated their surfaces to thousands of degrees, melting them and blasting material away. Now think about how they started their journey. They were explosively ejected upwards with enough speed to get into space. Mars has an atmosphere, and the same sort of frictional heating and melting happened there on the way up as happened here when the rocks were on their way down. In doing so samples of the Martian atmosphere got trapped as tiny bubbles in the molten surfaces of the rocks. These samples were securely contained when the rock got into space, and the melted rock solidified. On arrival at Earth, frictional heating melted the surface again, trapping some of our atmosphere. When the falling rock had slowed to subsonic speeds, the airflow would have cooled off the rock, so that by the time it hit the ground it was no longer partially melted.

We can drill into the rock to find those tiny bubbles of trapped atmosphere and analyze them. Trapped samples of our atmosphere are easy to identify. We know the composition of the Earth's atmosphere extremely well. Let's assume we have found some samples of some other atmosphere. How do we determine what planet that particular atmospheric mixture came from?

The Moon, where some meteorites have come from, has no atmosphere. Neither does Mercury. Venus' atmosphere is a toxic mixture of carbon dioxide, sulphuric acid and other chemicals. The asteroids don't have atmospheres. Jupiter, Saturn, Uranus and Neptune have deep, dense atmospheres covering whatever rocky or icy body is concealed beneath, and it is unlikely anything could be knocked off into space. If it did, the atmosphere sample would contain gases like methane, ammonia and hydrogen. Titan, Saturn's largest moon, has an atmosphere, of nitrogen, with some methane and other hydrocarbons. The bubbles of alien atmosphere in the meteorite are none of the above. That leaves Mars.

Moreover, thanks to the landers and rovers now on the Martian surface, we know the composition of Mars' atmosphere almost as precisely as we know the composition of the Earth's. It is 96% carbon dioxide, 1.9% argon, 1.9% nitrogen, and traces of oxygen, carbon monoxide, water and methane. We can be sure we have a Martian rock sample.

Most of the Martian meteorites are made up of igneous rocks blasted from deep inside the planet. However a few fragments of rock came from closer to the planet's surface. Some contain carbonates and sulphate minerals. These require mild surface temperatures and liquid water. In the Solar System we have only two worlds that fit the bill: Earth, and Mars as it was long ago. However, as yet no Martian meteorite contains solid evidence of life.

Mars lies low in the Southwest after sunset. Jupiter rises soon after dark and Saturn in the early hours. The Moon will be Full on the 10th.

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