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Book Reviews

Meteorites: Flux with Time and Impact Effects

M. M. Grady, R. Hutchison, G. J. H. McCall and D. A. Rothery (Eds)

Geological Society, London, Special Publications 140, 1998

Reviewed by John O'Byrne

On 18 July 1997 Gene Shoemaker, the well-known planetary geologist from Lowell Observatory, was killed in a car accident while pursuing his search for impact craters in outback Australia. In February of that year he had been the keynote speaker at the Fermor Meeting of the Geological Society which discussed meteorite flux and impact effects. His unfinished paper is the first contribution in this collection of papers arising from the meeting and the volume is devoted to his memory.

The idea that impacts of small asteroids or comets may be related to mass extinctions of terrestrial flora and fauna gained popularity with the work of Alvarez and his colleagues in 1980. They cited evidence in rock strata for a large impact 65 million years ago, coinciding with the major Cretaceous–Tertiary (K–T) mass extinction. That impact has now been identified with the Chicxulub crater, a feature ∼180 km across in the rocks below Mexico's Yucatan peninsula. The evidence for this impact is clear, but the environmental consequences are subject to debate and the fossil record is ambiguous. The non-avian dinosaurs and pterosaurs certainly died out at this time, at least in the western interior of North American where the evidence is good. However, they were perhaps the only major terrestrial vertebrate group to become extinct around that time. The idea that other mass extinctions are related to impact events, or even that a periodicity in mass extinctions is related to the Earth's motion through the galactic plane, is much more slender.

This book addresses these questions by presenting the somewhat conflicting evidence of astronomers, geologists and palaeontologists relating to mass extinctions. The broad ideas presented in the various papers are well summarised in an introductory paper by the editors at the beginning of the book. The detail is to be found in the remaining 17 review papers, which are divided into four sections:

- the flux of extraterrestrial material determined by astronomical and statistical techniques
- the meteorite flux determined by studying small meteorites on the ground, primarily in Antarctica and the Nullarbor
- the study of terrestrial craters, including Chicxulub, and the evidence at impact sites, and
- the palaeontological evidence relating to mass extinctions.

As an interested outsider to this field I found it fascinating to have Napier, an astronomer and a chief proponent of a link between periodic impacts and extinctions and geological disturbances, make his case alongside palaeontologists such as MacLeod and Hallam who see no such link. The interested reader can move from these review papers to original publications using the extensive references provided by all the authors.

The study of meteorites on the ground today provides evidence for short term variability in impact rates of small objects, while the conclusions of the astronomers emphasise the need for programs to better estimate the numbers of potential large impactors. However, the larger uncertainties lie in the energy and mass of these objects and, most importantly, the environmental effects of an impact.

The arguments in this book make it clear that the importance of impacts in the evolution of life on Earth remains the subject of intense debate. This book is a well produced survey of the field as of early 1997, with extensive references and the welcome, but somewhat unusual feature in such a compendium, of an index at the back. The relevance of astronomical research to our understanding of the Solar System is obvious. I would recommend it to any library and anyone wishing to understand the debate over mass extinctions.

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On Mars

Patrick Moore

Cassell, London, 1998, 222 pp., ISBN 0-304-35069-9

Reviewed by Simon Johnston

Patrick Moore is a well know populariser of Astronomy and has written many books as well as hosting the BBC Series 'The Sky at Night' for more than 40 years. Most English speakers with a passing interest in astronomy will be familiar with his style of writing and his idiosyncrasies. His latest book, 'On Mars', is an excellently written book taking a tour through four centuries of observations of the red planet from the first primitive telescopes to the Space Age and the electronic Sojourner Rover. I have only a few

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minor quibbles with the book. Moore uses 'Man' and 'he' as generic terms—one would think his editor would have forced him to change this. Also, imperial units are used throughout which might irk the more metrically and scientifically minded amongst the readership. As is usual, Moore is not afraid to jump into the text with his own opinions. This works well in areas where he is expert, such as observations of the planet, but less well in other chapters where, for example, he rejects the idea that some meteorites found on Earth have Martian origin and/or support the idea of life on Mars mainly based on his gut feelings rather than the scientific evidence.

The first two chapters set the scene by positioning Mars within the context of the Solar System and a general introduction to the oppositions and phases of Mars and why they occur. Chapters 3 to 6 set the historical context and deal with Mars from the early 1600s and the time of Kepler and Galileo to the start of the Space Age. All the important scientific discoveries are mentioned. Kepler's staggering discovery that the orbit of Mars was *elliptical* around the Sun changed ideas on the 'perfection' of the Heavens forever. Galileo with his new telescope discovered the phases of Mars; Huygens mapped the Syrtis Major feature and discovered the length of the Martian day; Cassini recognised the importance of the polar caps and the Martian seasons and Herschel determined the orbital inclination and lack of an atmosphere. By the 1860s it was tacitly assumed that the light and dark areas on Mars were evidence of seas and continents or vegetation and this set the scene for the controvery of the canals on Mars which raged from 1877 until the mid 1900s. Chapter 4 deals with the canal controversy from the 'discovery' of the canals by Schiaparelli during the opposition in 1877 through to the Mariner fly-by in 1965. Percival Lowell, founder of the Flagstaff Observatory, features prominently. His 24 inch refractor was put to use observing Mars from 1894 until his death in 1916. Lowell was the champion not only of the canals but of the fact that they must have been built by intelligent life in order to transport water from the polar ice caps to the equatorial regions. Moore gives a reasonable account of the controversy and describes the observations for and against the canal theory (including his own using Lowell's instrument; Moore saw no canals). However, I feel he could have been more critical here, especially on those observers who slavishly 'saw' features that Lowell had seen, and who were especially guilty of shoddy science. As we now know, the Mariner fly-bys buried the idea of canals for good. There is no correlation between any (real) Martian feature and the canals of Schiaparelli or Lowell.

Chapter 5 deals with other Martian controversies in the era prior to the spacecraft visits. These include the atmospheric pressure and composition, the composition of the polar caps (water versus carbon dioxide), the surface relief and composition and the so-called 'violet layer' and the 'wave of darkening'. It turned out that virtually all the measurements and theoretical ideas were totally wrong and overturned in the 1960s by the fly-bys. In Chapters 6 and 9 Moore describes the main features on Mars and includes maps and locations of places of interest. I found these chapters rather dull—the maps are of poor quality and Moore himself admits that none of these features are visible through Earth based telescopes.

Five chapters are devoted to the space missions from Mariner 4, which took the first close-up photos of Mars in 1965, through to the Viking Landers in the late 1970s and to the Mars Pathfinder mission in the 1990s. The missions are all expertly described with a sense of the excitement generated in Mission Control as the images came through. In particular Moore's description of the Viking Landers is very good. His descriptions of the very important (but ultimately inconclusive) experiments to detect life on the surface are a model of excellent scientific writing for the lay-person. The Pathfinder mission and the Sojourner Rover are also well covered, although the main scientific findings get rather short coverage.

Moore devotes a short chapter to the possibility that some meteorites discovered on Earth have a Martian origin and that these meteorites may also harbour evidence of primitive life forms from the Martian planet. This idea caused a large stir in 1996; however, the jury is still out on the nature of the meteorites and the nanometre sized 'organisms'. He also has a chapter on the moons of Mars, Phobos and Deimos. These were discovered only in 1877; they orbit so close to Mars that their light is all but lost in the glare of the planet. Moore evokes some nice images of how the moons would look from the surface of Mars—Deimos for example remains above the horizon for 60 hours and goes through its phases twice!

The final chapter enters the realm of speculation as Moore describes his vision for the future Martian Base. As usual, his excitement seems to get the better of him and his vision of cricket in one-third gravity is highly amusing. He ends by hoping that the new century will see us established on Mars. I'm not sure I share his optimism on this point, but all those wishing an up-to-date book on Mars should not hesitate to acquire this one by Patrick Moore.

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