

# nature

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## MAKING SENSE OF METEORITIC CHONDRULES

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wrong and von Baer right (as Richard Owen and Thomas Henry Huxley urged in the 1840s and 50s), then the application to von Baer was needed. If recapitulation really did happen after all (as Fritz Müller and Ernst Haeckel later argued), then that could be explained too. If there were exceptions, such as barnacles with their complex larval and simplified adult forms, Darwin could also reason about them: not, as Richards supposes, to show that they "did not refute the general principle of recapitulation", but as an application of a general theory to a test case.

There is no doubt that Darwin was interested in embryology. It provided important evidence for evolution and stimulated him to apply his theory in the manner that gave him "so much satisfaction". But nothing in Richards' book proves that Darwin believed recapitulation "has to be true" or that it was a necessary rather than a contingent "deductive consequence" of Darwin's general theory. □

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## Investigating ancient enigmas

Robert Temple

**Natural Knowledge in Preclassical Antiquity.** By Mott T. Greene. *Johns Hopkins University Press: 1992. Pp. 182. \$28.50, £18.*

MOTT Greene is a brilliant and original investigator of ancient enigmas. This lucid and thoroughly accessible book contains seven essays exploring aspects of knowledge in antiquity up to the time of Plato. The first essay is a devastating attack on conventional notions of 'pre-history'. Greene tears to shreds the cosy assumptions that there can be such a "buffer zone" between "the biological ascent of hominids" and "the 'ascent to civilization' of the abstract 'mankind' of humanistic historical writing." He exposes the wishful thinking, the unwarranted assumptions and the modern myth of "the boundary between 'us' and 'them'" — "the myth that we are somehow special and different or even new".

The central importance of the book, however, is Greene's discovery that Hesiod's *Theogony*, a Greek mythological poem of the eighth century BC, preserves eyewitness descriptions of the eruptions of two ancient volcanoes — Thera (Santorini) circa 1470 BC and Mount Etna in Sicily (either the eruption coincident with Thera's or the eruption of 735 BC). As the author of a book on the history of geology, Greene knows this subject well. He is aware, for instance, that in the past 10,000 years there have been 5,564 identifiable eruptions of 1,343 volcanoes, 627 with specific dates. But the close survey of several volcanoes in the Mediterranean has allowed him unambiguously to match two of them to the two different eruptions described in *Theogony*.

The eruption of Thera is portrayed in the section of the poem known as the Titanomachy. Greene breaks down the poem's description into 15 successive stages and shows that these precisely

match the kind of eruption that took place at Thera, and supplements the work with much fascinating volcanic information, including results of a study in 1963 of the volcanic island of Surtsey. Green's case is strongly convincing, especially as "there is a complete one-to-one correspondence with no missing elements and . . . they are all in the correct order." This is an important discovery, showing that the violent Thera explosion was so traumatic that a detailed eyewitness account of great accuracy was preserved for seven centuries before being incorporated into Hesiod's mythological poem.

Greene also seems to have resolved, in a truly ingenious manner, the interminable debate over the identification of the sacred intoxicant *soma* in ancient India. It was *not* the fly-agaric mushroom. And he explains how Thales, credited with being the first scientist philosopher of Greece, actually managed the 'impossible' feat of diverting the Halys River to enable King Croesus's army to cross. As a hydraulic engineer, Thales understood the principles of meanders and diverted the river into an empty crescentic channel, a remnant of a former oxbow lake, merely by cutting through the silted-up entrances upstream and downstream. Now flowing in channels, the river became fordable without undue effort or time spent digging a fresh channel. So the diversion of the Halys was not a mere "mythical accomplishment".

Greene is a promising iconoclast whose investigative work should continue. He explains that the MacArthur Foundation made this book possible — let us hope more such results emerge from its largesse. □

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## Celestial beams

R. J. Cohen

**Astronomical Masers.** By Moshe Elitzur. *Kluwer: 1992. Pp. 351. Dfl.75, \$45, £26.*

It is doubtful whether anyone could have predicted the existence of celestial masers. Yet the conditions for maser action, so difficult to produce in the laboratory, are easily achieved in interstellar space. Molecules warmed by an energy source, such as a young star, can be excited into a population inversion (so that more molecules are in high energy levels than in the ground state) over a wide range of conditions. The lines in the molecular spectra are then amplified to produce powerful beams of radiation detectable even in distant galaxies. Masers give us unique information about comets, circumstellar matter, star-forming clouds and active galactic nuclei, and also the intervening interstellar medium that is probed by the maser beam. With the development of radio-mapping techniques, masers have become an important astronomical tool, allowing us to study these regions on milliarcsecond angular scales.

Celestial masers were discovered by accident, and serendipity continued to play a large part in the development of the subject until quite recently. Part of the difficulty is inherent. Because maser radiation is strongly beamed, we cannot recover the source structure and physical conditions uniquely from our observations. But another part of the difficulty was simply historical timing. Masers were discovered too early. Proper understanding of the phenomenon had to await developments in radio interferometry and access to the millimetre and far-infrared wavebands. Now that these are all available, the picture is clearing, and new maser lines are at last being successfully predicted.

With the subject entering a new phase of maturity, Moshe Elitzur has chosen an ideal time to produce this book. It is aimed at "graduate students embarking upon research in astronomy" and is destined to become the standard introduction to the subject. Elitzur is particularly successful at relating the theory of masers to undergraduate physics. Not all graduates will have the necessary grasp of molecular spectra to be content with the short summary given here, but in other respects the book is exemplary. The author develops difficult concepts of radiative transfer, escape probability, pumping, saturation and beaming, clearly and thoroughly, adopting the didactic style of standard textbooks on electricity and magnetism. He carefully explains