



A woodcut of the 1492 Ensisheim meteorite fall, perhaps one of the earliest witnessed in the West.

## EARTH SCIENCE

# Mind your head

From Roman reverence to dinosaur extinctions, **Birger Schmitz** is riveted by a history of the meteorite.

In the third century AD, the Roman empire briefly worshipped a meteorite. A blackened rock that had fallen from the skies in Syria was given godly status by the transsexual priest-emperor Elagabalus. In one ceremony, Elagabalus walked backwards before a horse-drawn chariot that carried the stone, his eyes fixed upon it, with gold dust strewn at his feet. Sadly, after Elagabalus began to dress in women's clothes, married a Vestal virgin and requested a sex change from the imperial surgeons, he was dismembered and thrown into the Tiber. The fate of the meteorite is not known.

This fascinating episode can be found alongside many others in Ted Nield's latest book, *Incoming!*, which charts how our ideas about stones falling from the skies have developed over millennia. Rich in detail, informative and entertaining, it challenges the stereotype that heavenly bodies hitting Earth are bad omens or doomsday triggers.

The book is in three parts. The first

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For more on the Alvarez theory of dinosaur extinction: [go.nature.com/8wroxk](http://go.nature.com/8wroxk)

section describes the transition from humankind's belief that these unusual stones were either terrestrial or came from God, to the modern scientific understanding of their origins in the Solar System. The second section relates the discovery by physicist Luis Alvarez and his geologist son Walter in 1980 of the huge meteorite that hit Earth 65 million years ago, now widely held to have wiped out the dinosaurs. In the third part, Nield explores today's research frontier, describing evidence that a storm of meteorites hit Earth around 470 million years ago and coincided, not with a mass extinction, but with a dramatic rise in biodiversity.

Nield describes the fall of the Ensisheim



**Incoming! Or, Why We Should Stop Worrying and Learn to Love the Meteorite**  
TED NIELD  
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meteorite in what was then Germany (now Alsace in northeastern France) in 1492. The event was interpreted by the royal advisers to Maximilian I of Habsburg as a sign of good fortune for his conflicts with the Turks and the French — a prediction that held true. Locals wrapped the miraculous stone in heavy chains inside Ensisheim's church to prevent it from shooting off again. We also learn about how the evolution of our scientific understanding of meteorites was linked with transitions to more liberal and democratic societies in Europe. The physicist, musician and inventor Ernst Chladni (1756–1827) is usually held as the father of modern meteoritics, but Nield describes many illustrious characters who laid the foundation for the paradigm shift triggered by Chladni's slim 1794 paper, in which he correctly identifies the nature of meteorites.

**“Locals wrapped the miraculous stone in heavy chains inside Ensisheim's church to prevent it from shooting off again.”**

One such character is the great French chemist Antoine-Laurent de Lavoisier, who in the 1770s analysed the chemistry of a newly fallen meteorite and noted its anomalous nature compared with other rocks. But he insisted that meteorites formed by the action of lightning in the upper atmosphere. Lavoisier was executed at the guillotine — the Revolutionary judge cut short his final appeal, saying: “The Republic needs neither scientists nor chemists.”

Nield explains how his and others' opinion of dinosaur extinctions has changed over the years, having written in the past of his doubt that a meteorite impact was mainly responsible. He has now moved towards the majority view that the Alvarez group basically got it right. That is, the impact of an asteroid measuring some 10–15 kilometres across triggered the extinction of most of Earth's animal species, including all the dinosaurs, at the transition of the Cretaceous to Tertiary periods. This hypothesis, now tested in hundreds of studies, has gained almost universal acceptance. A notable exception is Princeton University palaeontologist Gerta Keller, who has combated the idea for decades. Nield argues for a compromise — that a big impact did harm nature, but that the extinctions had more varied causes.

Compromises belong in politics, not in science. I started my career in the 1980s as a non-believer of the impact theory, and even published with Keller. But I have now seen the Cretaceous–Tertiary boundary clay layer at about 50 geological sites

worldwide. In the marine records, this thin, iridium-enriched clay bed always occurs exactly at the level at which the microscopic foraminifera typical of Cretaceous oceans disappear almost completely.

Foraminifera are single-celled creatures with a calcite shell. Hundreds can be found fossilized within just one cubic centimetre of marine sedimentary rock. It would have required a cataclysmic catastrophe to obliterate billions of them across the world's ocean. And we know for sure, on the basis of many mineralogical and chemical studies, that the iridium layer originates from a major meteorite impact. The precise coincidence of these two events is so compelling that it is difficult to understand how anyone can doubt a direct relationship between them. Nevertheless, on the whole, Nield gives a credible account of this major scientific discovery.

**"For 2 million years, shards of a shattered asteroid bombarded Earth."**

The rest of the book deals with the recent finding of more than 90 fossil meteorites — all of which are a stony form called L-chondrites, measuring 1–20 cm in diameter — buried in a quarry of Ordovician marine limestone in Sweden. The meteorites that fell on that ancient sea floor can be linked by isotopic and geochemical analyses to the largest known break-up in the asteroid belt in the past few billion years. The L-chondrite parent body, measuring more than 100 km across, was hit 470 million years ago, possibly by a comet from outer space that shattered it into billions of pieces.

For 2 million years afterwards, shards of it bombarded Earth. One or two of the meteorites may have been almost as large as the body that took out the dinosaurs. Yet strangely, this bombardment coincides with the Great Ordovician Biodiversification Event, when biodiversity on Earth rapidly increased from an all-time low to modern levels. Although researchers are still uncertain as to how this happened, Nield gives an insightful account of the ways these events can be related.

On my night table there is a pile of books in which the bookmark never made it beyond page 60. From these, I've derived a personal definition of a good book: one where I can't stop reading until the end. *Incoming!* is just such a book. ■

**Birger Schmitz** is professor of geology at the University of Lund, Sweden.  
e-mail: birger.schmitz@geol.lu.se

## GASTRONOMY

# A visual feast

Felice Frankel grapples with a 20-kilogram cookbook.

It took me 40 minutes to unpack *Modernist Cuisine*. The 6-volume, 2,400-page set of books by culinary experimenters Nathan Myhrvold, Chris Young and Maxime Bilet weighs more than 20 kilograms and arrives wrapped in clean white paper and encased in a clear plastic box, from which each of the five main volumes can be retrieved: History and Fundamentals; Techniques and Equipment; Animals and Plants; Ingredients and Preparations; and Plated-Dish Recipes. The sixth volume, Kitchen Manual, is a simpler spiral-bound handbook intended for use in the kitchen, containing some 1,500 recipes referred to in the larger volumes.

The care given to the packaging of this collection foreshadows the precision that went into its production. It is a masterpiece filled with historical references and scientific explanations of why, for example, thickening liquids is important for taste, or why food browns during cooking. Nothing is left out, it seems. The pages are designed to form a monumental narrative and visual story, written and illustrated with passion and an obsession with getting it right. The authors' expertise blends science and cuisine: Myhrvold is a former physicist, Microsoft scientist and now entrepreneur with a lifelong interest in cooking (see page 575); Bilet and Young trained under innovative British chef Heston Blumenthal;

and Young also holds degrees in mathematics and biochemistry.

Photography is used to powerful effect. Myhrvold is a serious photographer, and he and Ryan Matthew Smith have created technically remarkable, often breathtaking and informative photographs. Some are purely decorative, such as their high-speed camera image of a bullet passing through six eggs. But the most innovative technique they have developed is the cutaway. To show what was happening inside food as it cooked, the team literally cut pots, woks and pans in half and cooked recipes in them. The cross-sectional images are laid out and annotated with scientific information, such as labels for zones of conduction, condensation and convection. Each image is a marvel.

I haven't yet tested the recipes. And I am not sure I will ever feel the urge to try the Edible Soap Bar with Honey Bubbles, for instance, or to replace my own fabulous pulled pork recipe (in which I cook an inexpensive cut for three hours



**Modernist Cuisine: The Art and Science of Cooking**  
NATHAN MYHRVOLD,  
CHRIS YOUNG AND  
MAXIME BILET  
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A cutaway image from the *Modernist Cuisine* cookbook.

R. M. SMITH/THE COOKING LAB