aged wasps. Some of these alternative pollinators are managed, at a much smaller scale, which itself is risky because rare events — such as disease or environmental change — are more likely to wipe out small populations than large ones. Other domesticated plant species rely exclusively on native bats or birds, whose fate is linked to habitat destruction.

Changes in abundance have been monitored for only a small fraction of the species known to be effective pollinators; there is a growing list of factors implicated in population declines. In the United States, honeybee colonies have more than halved since 1947 (from 5.5 million to 2.4 million). Parasitic mites and pathogens, insecticides used to control crop pests and displacement by Africanized honeybees, are all to blame and may also affect managed populations of non-*Apis* pollinators. Toxic effects of secondary compounds produced by genetically engineered plants are suspected. Habitat modification is probably still the prime culprit in the decline or endangered status of several species of wild pollinators.

A sustained pollinator decline in North America, for example, would mean lower yields from crops that depend on animals for pollination, and so prices would increase; or there would be less variety available as farmers switch from growing insect-pollinated crops to the restricted range of self-fertilizing ones that give reliable fruit or grain production.

Farmers have known for centuries what the public and legislators may be accepting just in time: a field of crops without pollinators is a harbinger of a greater calamity. *Status of Pollinators* offers a host of straightforward and complementary recommendations to help prevent crop failures and the collapse of native plant communities. There isn't a silver bullet to zap the problem: simultaneous application of a variety of solutions will be necessary to sustain a healthy and diverse community of pollinators nationwide.

For example, we need more research entomologists, plant-population biologists, geneticists, agricultural ecologists and systematists. To identify regions vulnerable to pollination failure, we should run international pollinator-monitoring programmes. For long-term pollinator security, Mexico, Canada and the United States should pursue collaborative breeding programmes to identify and manage pollinators other than *Apis*. Land-use practices friendly to pollinators should be adopted by industrial, public and residential landowners. Educational institutions should promote awareness of the intimate connection between plants, their pollinators, our diets and our economy.

In the United States, only a continent-wide commitment to the protection of pollinators will allow future generations to enjoy the fruits of their labour. ■

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Glitter bugs

M. LIBBY

Nick Thomas

A pile of dead insects and an assortment of disassembled antique-watch mechanisms would probably be destined for the rubbish heap in most homes. In the pretty coastal town of South Portland, Maine, a young artist combines biology and technology to create bioart sculptures (www.insectlabstudio.com).

Artistic inspiration — he refers to it as his 'epiphany' — first struck Mike Libby in the late 1990s. He happened on a particularly colourful beetle lying dead beside a vending machine. Months later, he assembled his first gear-laden insect from the salvaged workings of an old Mickey Mouse watch, which he transplanted into the beetle.

Libby calls his blending of nature and technology "a celebration of natural and man-made function". He collects local insects such as butterflies, dragonflies and beetles, but many of his specimens now come from companies that supply insect collectors and entomologists, enabling him to adapt his art to exotic species from around the world.

With the eye of an artist and the skill of a surgeon, he replaces the bugs' innards with recycled cogs, springs, dials, steel and brass gears, as well as more modern resistors, capacitors and light-emitting diodes (LEDs). These he carefully glues together to create the bionic bugs. The operation takes 20 to 40 hours.

One of his largest projects, shown here, is the 12-centimetre-long Central American grasshopper, *Tropidacris dux*, more commonly called the giant brown cricket. So large is the wingspan of this mega-insect that hunters have been known to blast it with shotguns, mistaking it for a bird.

Libby adorns *T. dux* with brass and copper parts to complement the grasshopper's orange–brown body and wings. The massive specimen carries a suitably hefty price tag: $950.

With today's microelectronics, a logical extension to Libby's art might be to make it interactive — an LED that actually glows, or a wing that flaps. Yet the artist deliberately avoids applying active electronic components in his works.

"I don't want them to look cheap or toy-like," he says. "Any activity or function should be in the mind and imagination of the viewer." ■

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Multicultural legacy

The Mathematics of Egypt, Mesopotamia, China, India, and Islam: A Source Book
edited by Victor J. Katz
Princeton University Press: 2007. 712 pp. $75.00, £44.95

George Gheverghese Joseph

Mathematics was an important part of many ancient cultures, not just the Greek. These peoples were also at the forefront of notable discoveries, as recorded in *The Mathematics of Egypt, Mesopotamia, China, India, and Islam*.

This pioneering work provides English translations of mathematical texts from each of these regions and cultures, and a better understanding of their contributions to mathematics. There are nuggets of information difficult to find elsewhere. The use of non-mathematical sources, particularly letters and administrative documents from Egypt and Mesopotamia, reveals the practical applications of mathematics and the scribes who composed and used the documents.

Each chapter is devoted to one region and presented by a well-known scholar — Annette Imhausen for Egypt, Eleanor Robson for Mesopotamia, Joseph Dauben for China, Kim Plofker for India and J. Lennart Berggren for the Islamic world. Each author examines the content and impact of primary mathematical sources on the individual cultures. Chapters are roughly structured so that a selection of texts and commentaries follow an introduction, and end with a list of sources and secondary references.

Dauben's study of Chinese mathematics is notable for its length (roughly 200 pages) and

TECHNOLOGY

Earliest known non-lithic tool

As the holiday celebrations get underway, ponder a moment on the small implement bent on prizing an echo of the feast from between your teeth. Henry Petroski was so intrigued by the toothpick that he has written more than 400 pages about its technological and cultural evolution, heavily spiced with historical anecdote (*The Toothpick*, Knopf, 2007).

Chapter titles give the flavour — see 'The tragic heiress'; 'Talking round a toothpick'; 'The fatal martini'; 'The butler did it'.

The toothpick's history stretches back some two million years, as indicated by scored hominid fossil teeth. The Tibetans integrated toothpicks into their jewellery. And in case you ever need to know, New England's Charles Forster invented the first automatic toothpick-making machine in 1869.

Toothpicks over the ages were usually made of metal or wood; goose or porcupine quills were convenient too. Pliny the Younger advised against vulture feathers because "they cause a bad smell", and recommended instead the needle-like bones of a hare.

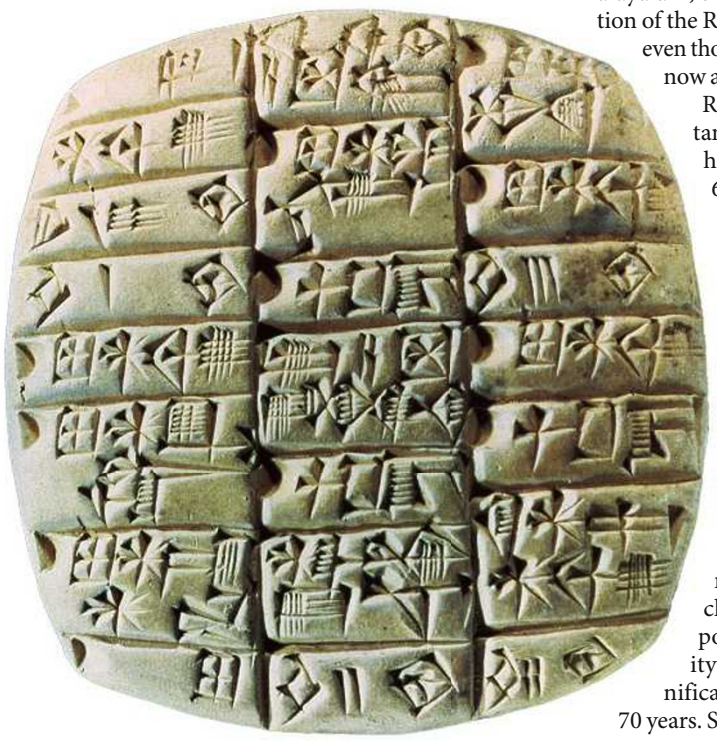
Toothpicking has been victim to both social censure and prescribed etiquette. Pictured here is a Japanese lady from the Meiji era, grasping a toothpick with her fingers held in the accepted pattern.

Happily, the modern toothbrush has barely dented the popularity enjoyed by the toothpick over millennia.

COLLECTION OF H. PETROSKI

clear, comprehensive coverage of the subject. It offers some new and surprising information, such as the recent discovery of the oldest extant text *Suan Shu Shu* (or 'Book of Numbers and Computation'). This dates to around 200 BC and has led to a rethinking of the origins of Chinese mathematics.

Beggren's Islamic mathematics rigorously surveys the sources. It contains an interesting excerpt from al-Kuhi, discussing why and how one should learn mathematics and how to 'prove' results. Both Dauben and Beggren's contributions call into question views expressed by some historians on the role of proofs in non-Western mathematics, particularly in Chinese mathematics.



LOUVRE, PARIS/THE BRIDGEMAN ART LIBRARY

A Mesopotamian accounts table in cuneiform script from 2400 BC.

This brings us to Indian mathematics. Plofker includes Mahavira's (from about 850 AD) paean to the art of calculation in *Ganitasarasangraha* ('Compendium of the Essence of Mathematics'). The period covered is as vast as that of Chinese mathematics, from Vedic Sulbasutras (800–600 BC) to Kerala mathematics (1350–1600 AD), and Plofker uses excerpts from earlier translations as well as from a forthcoming translation of the Kerala text of *Kriyakramakari* ('Operational Techniques') of Sankara Variyar. The problem with fitting such a broad sweep into a single chapter is that excerpts and commentaries have to be tailored, or left out. This is particularly true of Kerala mathematics, where the seminal text in Malayalam, the *Yuktibhasa* ('An Exposition of the Rationale'), is not referred to, even though an English translation is now available.

Robson's chapter on Mesopotamian mathematics contains her own translation of some 60 tablets and an exhaustive discussion of this historical and social context. Example is piled upon example of Babylonian mathematics, some no different from those before. Robson's contribution highlights the issue of what this book is for: is it a conventional source book of translations, or a taster for the curious?

This dichotomy becomes more evident in Imhausen's chapter on Egypt. Imhausen points to the limited availability of sources and lack of significant discoveries over the past 70 years. She makes use of literary and administrative documents that, apart from their mathematical import, provide a useful backdrop to the social and economic concerns of the day. I searched in vain for one of the iconic calculations in Egyptian mathematics (problem 79 in the Rhind papyrus), which is a table listing numbers of houses, cats, mice, wheat and so on, in increasing powers of seven and showing how the sum of this geometrical series can be obtained. Indeed, there are only a few examples of calculation (without an explicit algorithmic basis) and visualization (only two diagrams out of about 15 in the original papyri).

There are a few misprints and verbal infelicities. Maps to accompany each chapter would have been helpful, as would a more comprehensive introduction and an expanded index. All the same, this book is an essential resource for anyone wishing to know more about how the mathematics of the different regions influenced and shaped the development of world mathematics. ■

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New science-art award

Entries are now being accepted for the new Niche Prize, awarded by the Royal Institution of Great Britain and *Nature*. The most original, arresting image or installation conveying a scientific idea in an inspiring, beautiful and artistic way will win the honour of being on prominent display for a year when the Royal Institution reopens next spring following a £20 million (US$41 million) refurbishment. Judges include Susan Greenfield, director of the Royal Institution, Philip Campbell, editor-in-chief of *Nature* and Lady Ritblat. Prizewinners will be part of a key moment in the Royal Institution's 208-year history of celebrating science. The closing date for entries is 22 February 2008. For guidelines and an entry form, see www.rigb.org. To discuss this competition and other science and arts collaborations, see http://network.nature.com/forum/sciart.