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

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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M. LIBBY

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