skewed: The decay produces a muon (a cousin of the electron) and an antimuon less often than it makes an electron and a positron. In the standard model, those rates should be equal, says Guy Wilkinson, a physicist at the University of Oxford in the United Kingdom and spokesperson for the 770-member LHCb team. "This measurement is of particular interest because theoretically it's very, very clean," he says.

The result is just one of half a dozen faint clues LHCb physicists have found that all seem to jibe. For example, in 2013, they examined the angles at which particles emerge in such B meson decays and found that they didn't quite agree with predictions.

What all those anomalies point to is less certain. Within the standard model, a B meson decays to a K meson only through a complicated "loop" process in which the bottom quark briefly turns into a top quark before becoming a strange quark. To do that, it has to emit and reabsorb a W boson, a "force particle" that conveys the weak force (see graphic, previous page).

The new data suggest the bottom quark might morph directly into a strange quark—a change the standard model forbids—by spitting out a new particle called a Z′ boson. That hypothetical cousin of the Z boson would be the first particle beyond the standard model and would add a new force to theory. The extra decay process would lower production of muons, explaining the anomaly. "It's sort of an ad hoc construct, but it fits the data beautifully," says Wolfgang Altmannshofer, a theorist at the University of Cincinnati in Ohio. Others have proposed that a quark–electron hybrid called a leptoquark might briefly materialize in the loop process and provide another way to explain the discrepancies.

Of course, the case for new physics could be a mirage of statistical fluctuations. Physicists with ATLAS and CMS 18 months ago reported hints of a hugely massive new particle only to see them fade away with more data (*Science*, 12 August 2016, p. 635). The current signs are about as strong as those were, Altmannshofer says.

The fact that physicists are using LHCb to search in the weeds for signs of something new underscores the fact that the LHC hasn't yet lived up to its promise. "ATLAS and CMS were the detectors that were going to discover new things, and LHCb was going to be more complementary," Matias says. "But things go as they go."

If the Z′ or leptoquarks exist, then the LHC might have a chance to blast them into bona fide, albeit fleeting, existence, Matias says. The LHC is now revving up after its winter shutdown. Next month, the particle hunters will return to their quest. ■

PALEONTOLOGY

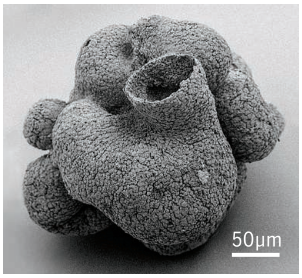
Early animal fossils at risk

Mining operation in China threatens fossils and embryos that may be the oldest known animals

By **Kathleen McLaughlin** *in Beijing*

Paleontologists have argued for years about the identity of the enigmatic curling shapes and embryolike spheres found in the 600-million-year-old rocks of the Doushantuo Formation in China. But some say those fossils, no bigger than a grain of salt, may be the remains of some of the world's first animals. Now researchers fear that the rock formation may be pulverized, along with its cargo of fossils, before scientists can identify the creatures and what they may reveal about the evolution of animals. A massive phosphate mining operation in southern China threatens the site, and scientists are urging the Chinese government to step in to protect it.

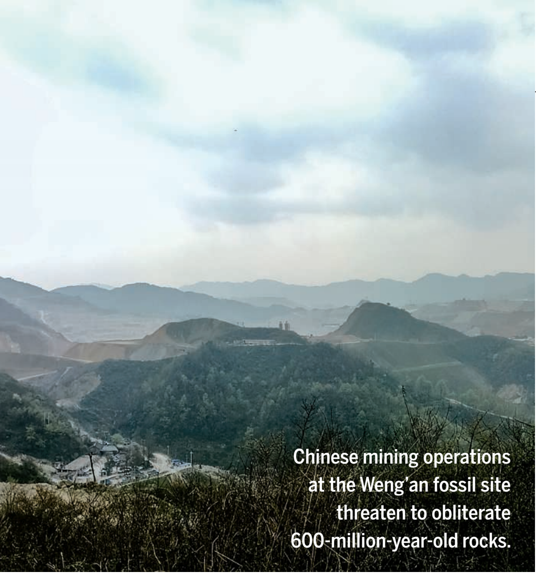
The mining operations, which produce raw material for fertilizer, are already destroying unique fossil evidence at a distressing rate, says Zhu Maoyan, fossil expert and professor at the Nanjing Institute of Geology and Palaeontology in China. The site, with its mysterious Weng'an biota, is located in rural Guizhou, a Chinese province bordering Vietnam. Piecemeal phosphate mining has taken place there for years, but a large-scale project that began in 2015 could wipe out the entire site, including a wealth of as-yet-undiscovered fossils—a "disaster [to] all human beings," Zhu says. The mining project already has demolished one of the three key fossil sites, he says.



This tiny tubular creature, only half a millimeter across, was unearthed at the Weng'an site and may be the world's oldest sponge.

"If you want to know about how animals evolved on Earth, this site is the most important one we know of," says David Bottjer, earth sciences professor at the University of Southern California in Los Angeles, who has been visiting the Weng'an site to collect fossils since 1999, a year after their discovery (*Science*, 6 February 1998, p. 879). "If this fossil deposit is lost, we will lose this unique window on evolution of life, which may never be replaced."

Weng'an fossils—putative embryos and occasional adults—lived 30 million years before the oldest widely accepted animals: the Ediacaran biota found in Newfoundland, Canada, and other sites. Those sea creatures, which come in an array of bewildering shapes, represent a lost era of life on Earth: They were later replaced during the Cambrian Explosion, when animals with more familiar body plans burst onto the scene. As precursors to the Ediacara, the Doushantuo fossils "provide an unparalleled window into the early evolution of lineages leading to animals and possibly [the evolution of] animals themselves," says Douglas Erwin, a paleobiologist at the Smithsonian Museum of Natural History in Washington, D.C.



Chinese mining operations at the Weng'an fossil site threaten to obliterate 600-million-year-old rocks.

The phosphate coveted by miners also helped preserve the ancient fossils. Bottjer explains that after the organisms died, phosphate replaced their tissues cell by cell, yielding exquisite soft-body preservation at tiny scales. "With a focus on the embryos, we have been able to learn a lot about the developmental process for early animals," he says. "We are just beginning to understand fossils of adult animals, which are also found but which are much rarer than the embryos."

Some scientists still maintain that the spheres and other forms represent not animals but some kind of precursor, as a paper last month in the *Journal of the Geological Society* argued. But a 2015 study in the journal *Evolution* identified an unusually well-preserved fossil as most likely being the world's oldest known sponge.

Regardless of the dispute, says Zhu, "the majority of the science community considers Weng'an's fossils invaluable" for deciphering the origins of animals. He led a group of concerned international scientists, including Erwin and Bottjer, to meet with government officials earlier this month to appeal for curbs on the mining. Officials at all levels of government, from local to national, listened to the scientists' concerns.

The officials must balance that plea against local interests: The phosphate and fertilizer industry is the pillar of the local economy, supplying 60% of total revenue to the Weng'an county government, according to one account in Chinese media. But after the meeting, Zhu says, officials took incremental steps to protect the fossils, halting mining "in the parts of the site that are most likely to hold fossils and the most vulnerable to being dug out." He says he believes that the government is beginning to understand the global significance of the Weng'an biota and hopes that they will act to stop mining permanently. ■

Kathleen McLaughlin is a writer in Beijing.

PHOTO: CHRIS BROWN

SCIENTIFIC COMMUNITY

A moonshot for chemistry

Proposal to automate the synthesis of natural product molecules could be a boon for drug discovery

By **Robert F. Service**
in San Francisco, California

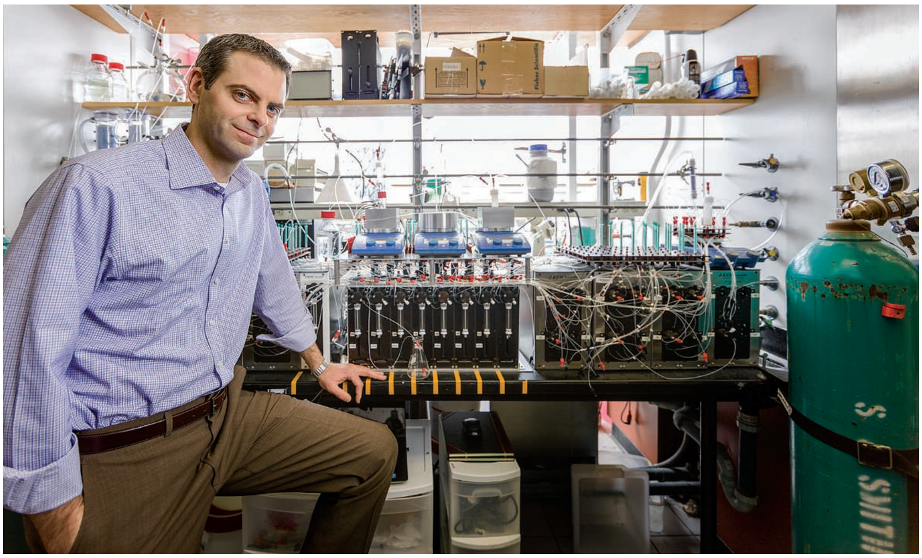
Martin Burke is a tad envious. A chemist at the University of Illinois in Urbana, Burke has watched funding agencies back major research initiatives in other fields. Biologists pulled in billions of dollars to decipher the human genome, and physicists persuaded governments to fund the gargantuan Large Hadron Collider, which discovered the Higgs boson. Meanwhile chemists, divided among dozens of research areas, often wind up fighting for existing funds.

Burke wants to change that. At the American Chemical Society (ACS) meeting here earlier this month, he proposed that chemists rally around an initiative to synthesize most of the hundreds of thousands of known organic natural products: the diverse small molecules made by microbes, plants, and animals. "It would be a moon mission for our field," Burke says. The effort, which would harness an automated synthesis machine he and his colleagues developed to snap together molecules from a set of premade building blocks, could cost $1 billion and take 20 years, Burke estimates. But the idea captivates at least some in the field. "Assuming it's a robust technology, I would have to think it would be revolutionary," says John Reed, the global head of pharma research and early development at Roche in Basel, Switzerland. "Even if it only allowed you to make half the compounds, it strikes me as worthy."

Natural products have countless uses in modern society. They make up more than half of all medicines, as well as dyes, diagnostic probes, perfumes, sweeteners, lotions, and so on. "There's probably not a home on the planet that has not been impacted by natural products," Burke says.

But discovering, isolating, and testing new natural products is slow, painstaking work. Take bryostatins, a family of 20 natural products first isolated in 1976 from spongelike marine creatures called bryozoans. Bryostatins have shown potential for treating Alzheimer's disease and HIV, and demand has skyrocketed. Yet chemists must mash up 14 tons of bryozoans to produce just 18 grams of bryostatin-1. Synthesizing new bryostatins is equally hard, each one requiring dozens of chemical steps.

Burke thinks there is a better way. Two years ago, he and colleagues unveiled a machine that can link a variety of building blocks Lego-wise to create thousands of natural product compounds and their structural relatives (*Science*, 13 March 2015, p. 1190). Now he says the approach can be scaled up. Molecular biologists have already automated the synthesis of short strands of DNA, proteins, and sugar chains, revolutionizing



Martin Burke says his synthesis machine could turbocharge chemists' ability to create natural products.

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Editor's Summary

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Kathleen McLaughlin (April 20, 2017)

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