MICROBIOLOGY

Cells hint at roots of complex life

'Asgards' isolated and grown in the lab could be similar to cells that evolved into eukaryotes.

BY JONATHAN LAMBERT

Scientists in Japan report that they have isolated and grown microbes from an ancient lineage of archaea — single-celled microbes that look, superficially, like bacteria but are quite distinct — that was previously known only from genomic sequences.

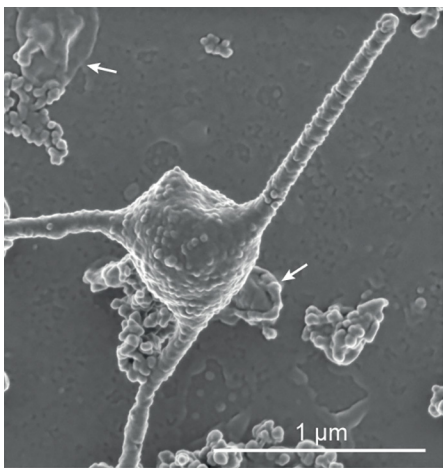
The work, posted online as a preprint (H. Imachi *et al.* Preprint at bioRxiv http://doi.org/gf5z2n; 2019), gives scientists their first look at the kinds of organism that could have made the jump from simple, bacteria-like cells to eukaryotes — the group of organisms whose cells have nuclei and other structures, and which includes plants, fungi and humans.

"This is a monumental paper that reflects a tremendous amount of work and perseverance," says Thijs Ettema, an evolutionary microbiologist at Wageningen University in the Netherlands.

The mysterious group, called Lokiarchaea, rose to prominence from microbial muck dredged up off the coast of Greenland. In 2015, Ettema and his colleagues sequenced genetic fragments from the sediment and assembled them into fuller genomes of individual species (A. Spang *et al. Nature* **521**, 173–179; 2015).

One genome was clearly a member of the archaea, but also had some eukaryote-like genes. The researchers called it Lokiarchaea, after Loki, the trickster of Norse mythology.

Soon, other labs found more Loki-like archaea, and together these formed the Asgard archaea, named after a mythological region inhabited by Norse gods. Many analyses suggest that some distant Asgard-like ancestor gave rise to all eukaryotes.



H. IMACHI *ET AL.*

Wisp-like protrusions make this candidate new strain look like 'an organism from outer space'.

Proponents of this view think that, some 2 billion years ago, an Asgard-like archaeon gobbled up a bacterium, sparking a mutually beneficial relationship known as endosymbiosis. The bacterium would have evolved into mitochondria, the 'powerhouse' organelles of the cell that helped to fuel eukaryotes' rise.

But no one had succeeded in growing Asgards in the lab.

To cultivate sea-floor microbes, Hiroyuki Imachi, a microbiologist at the Japan Agency for Marine-Earth Science and Technology in Yokosuka and his collaborators built a bioreactor that mimicked the conditions of a deep-sea methane vent. They then waited 5 years for the slow-growing microbes to multiply.

Next, they placed samples from the reactor, along with nutrients, in glass tubes, which sat for another year before showing any signs of life. Genetic analysis revealed a barely perceptible population of Lokiarchaea. The researchers patiently coaxed the Lokiarchaea into higher abundance and purified the samples.

Finally, after 12 years of work, the scientists produced a stable lab culture containing only this new Lokiarchaeon and a different methane-producing archaeon. The authors declined requests for interviews from *Nature*'s news team while their paper was under review at a journal.

Like other archaea and bacteria, Asgards have relatively simple interiors, but their external surface can produce wisp-like protrusions. "I don't think anyone predicted that it would look like this," says Ettema. "It's sort of an organism from outer space."

The team reports that the cultured Lokiarchaeon produces energy by breaking down amino acids, as predicted from genomic studies. And, because the researchers could extract and sequence DNA from a pure sample, rather than sediment containing a multitude of organisms, their findings could confirm that Lokiarchaea do contain numerous eukaryote-like genes.

Ettema says that many more Asgards will need to be cultured for researchers to work out whether, and how, Asgard-like archaea gave rise to eukaryotes. ■

FUNDING

Mexican science suffers under budget cuts

Research institutes are rationing electricity to save money.

BY GIORGIA GUGLIELMI

Austerity measures recently enacted by Mexico's president are pushing the country's scientific efforts — chronically underfunded for years — to a breaking point, according to researchers.

As part of broader cost-cutting measures aimed at freeing up money for poverty-alleviation programmes, in May, President Andrés Manuel López Obrador cut 30–50% of the money that federally funded institutions — including centres supported by Mexico's main research funding agency, the National Council of Science and Technology (CONACYT) — spend on travel, petrol, office supplies and salaries for temporary workers.

Several research institutes say that, since then, they have rationed electricity and sacked temporary workers. Scientists have cancelled conference travel and international projects, and have relied on crowdfunding campaigns to pay for supplies. The monetary uncertainty has also deterred Mexican researchers working abroad from returning to take jobs at home.

The measures came on top of a roughly 12% cut to the 2019 budget for CONACYT that López Obrador's administration enacted in December 2018. The move left the agency with 18.8 billion pesos (US$960 million).

"Mexican science has never been well funded," says Antonio Lazcano, a biologist at the National Autonomous University of Mexico (UNAM) in Mexico City. But the austerity measures, on top of the cuts to CONACYT's budget, threaten to hamper the recruitment of early-career researchers, as well as the monitoring efforts for potential disasters such as