such as the Dutch and British East India Companies. Around a century later, the German cockroach hitched a ride into Europe, and from there spread around the world.

Cleo Bertelsmeier, a researcher of invasive species at the University of Lausanne in Switzerland, says it was exciting to see how the study was able to map the genetic data to historical events. The use of genomics was essential to understanding the dispersal of the German cockroach, because "this is already quite an ancient invasion, they became so abundant that there is no way, without such tools, to know that this is not a native species from Europe", she says.

German cockroaches owe their success to their extraordinary adaptability, says Franz Essl, an ecologist at the University of Vienna. They readily adapt to highly modified environments, such as human-occupied niches; they have a short reproductive cycle; and they are very opportunistic, qualities that "also make them prone to be transported as hitchhikers to new places", says Essl. "That's a perfect combination of ingredients for making a species very successful in a human-shaped world."

'EPIGENETIC' CELL RESET PAVES THE WAY FOR LAB-GROWN SPERM AND EGGS

Technique wipes away tags on DNA that must be reprogrammed as reproductive cells develop.

By Heidi Ledford

The day when human sperm and eggs can be grown in the laboratory has inched a step closer, with the discovery of a way to recreate a crucial developmental step in a dish.

The advance, described on 20 May in *Nature*, addresses a major hurdle: how to ensure that the chemical tags on the DNA and associated proteins in artificially produced sperm and eggs are placed properly. These tags are part of a cell's 'epigenome' and can influence whether genes are turned on or off. The epigenome changes over a person's lifetime; during the development of cells that will give rise to sperm or eggs, these marks must be wiped clean and then reset to their original state.

Eggs in a dish

"Epigenetic reprogramming is key to making the next generation," says Mitinori Saitou, a stem-cell biologist at Kyoto University in Japan, and a co-author of the paper (Y. Murase *et al. Nature* https://doi.org/mxhw; 2024). He and his team worked out how to activate this reprogramming — one of the biggest challenges in generating human sperm and eggs in the laboratory, he says.

But Saitou is quick to note that his lab's epigenetic reprogramming is not perfect.

"There is still much work to be done and considerable time required to address these challenges," agrees Fan Guo, a reproductive epigeneticist at the Chinese Academy of Sciences Institute of Zoology in Beijing.

Growing human sperm and eggs in the lab would offer hope to some couples struggling with infertility. It would also provide a way to edit disease-causing DNA sequences in sperm and eggs, sidestepping some technical complications of making such edits in embryos. But in addition to its technical difficulty, growing eggs and sperm in a dish — called *in vitro* gametogenesis — would carry weighty social and ethical questions. Allowing genetic modification to prevent diseases, for example, could lead to genetic enhancement to boost traits associated with intelligence or athleticism.

Epigenetic reprogramming is key to the formation of reproductive cells — without it, the primordial cells that give rise to sperm and eggs stop developing. Furthermore, the epigenome affects gene activity, helping cells with identical DNA sequences to take on unique identities. Researchers know how to grow mouse eggs and sperm using stem-cell-like cells made from skin. But the protocols used don't work in human cells. "There is a big gap between mice and humans," says Saitou.

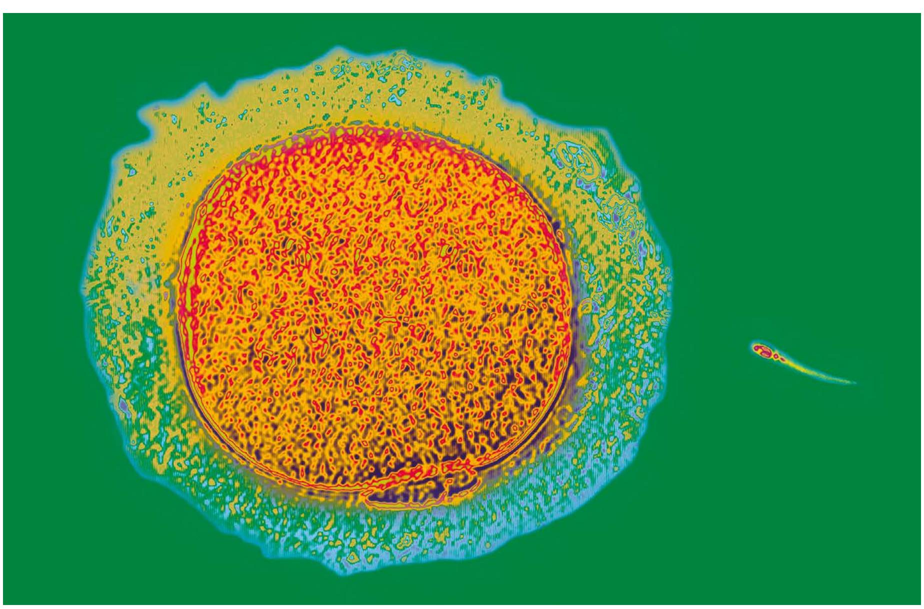
Pressing reset on the epigenome

Saitou and his colleagues began to search for a way to control epigenetic reprogramming in human cells. They found that a protein called BMP2 was essential for this step and that adding it to their cultures promoted epigenetic reprogramming. The cells grown in this culture progressed further in their development than did cells in cultures without added BMP2.

After epigenetic reprogramming, the cells' development halted again. But each step towards *in vitro* gametogenesis holds "immense significance", says Guo. Saitou's team is seeking to nudge the cells further along the path to becoming sperm and eggs.

The researchers carefully analysed epigenetic marks in their lab-grown cells and found that although many of the imprints had been wiped away, a few remained. This means that the reprogramming might be incomplete — which could have serious consequences if such cells were used for reproduction, potentially leading to disease, says Saitou.

Such caveats are important, he says: these results, along with other developments in the past few years, could fuel speculation and false claims that a solution is just around the corner. "I think in maybe five years or so, things will get more settled," he says. "And then only the good science will remain."



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A sperm cell (right) swims towards a human egg (artificially coloured).