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THE ICEMAN OF SVALBARD

Some say that life began in fire. Hauke Trinks thinks it began in ice, and is bent on taking the hard route to prove it. Quirin Schiermeier tells the Arctic adventurer's tale.

Hauke Trinks is obsessed with ice, specifically sea ice — ordinary frozen sea water. What others see as a frozen wasteland, this 63-year-old German physicist sees as the kind of place where the first chemical steps that led to life may have occurred.

Trinks has undertaken daring Arctic expeditions to investigate whether, in the freezing conditions, the right mix of chemicals produces RNA molecules; many think these could have been the basis of early life. Recent lab experiments seem to lend support to Trinks's hypothesis that RNA molecules could have got their start in the frigid, rigid molecules of sea ice.

Trinks's approach to the problem is unusual. In 1999, the former president of the Hamburg University of Technology sailed alone for a year in a fjord in the Norwegian archipelago Svalbard, and set up a floating research laboratory on the boat.

H. TRINKS

Cool experiment: Hauke Trinks combines science with a thirst for adventure.

His adventures there sound like a Jack London novel. A polar bear tore apart his rubber dinghy. When he ran out of food, he switched to dog food and hunted seals. When he got toothache, he pulled out the culprit with pliers — with plenty of rum serving as anaesthetic.

Despite the hardships, two years later, Trinks wanted to go back. The governor of the archipelago forbade him to go alone, so this time he took along former librarian Marie Tièche, whom he had met one night in a Svalbard pub.

For several months in complete darkness, Tièche held the fort while Trinks studied the physical and chemical properties of sea ice. "It's a rather tough job out there — you spend most of your time and energy just trying to survive," he says.

The sea ice is a far cry from the toasty environments, such as hydrothermal vents or warm ponds, that others have proposed as possible locations for the origin of life. But some scientists agree with Trinks: ice could be just right. Complex RNA molecules often degrade at high temperature, and liquid water is thought to be too reactive to support the chemical evolution of RNA. A frigid environment, possibly on an ice-encrusted 'snowball Earth', could therefore be more hospitable. Cold could even facilitate the chemical reactions needed for nucleotides — the building-blocks of RNA — to link together into RNA molecules. Perhaps minerals trapped in the sea ice, or surface effects of ice crystals, assist the reactions, says Gerald Joyce, a molecular biologist at the Scripps Research Institute in La Jolla, California.

Deep frozen

By measuring the physical features of sea ice, such as its electrical properties, Trinks hopes to better understand the kind of environment in which he thinks early chemical reactions may have taken place.

But because other biological molecules permeate the ice, testing whether sea ice provides ideal conditions in which the nucleotides of RNA link up is next to impossible out in the field. To do this, Trinks joined forces with Christof Biebricher, a biochemist at the Max Planck Institute for Biophysical Chemistry in Göttingen, Germany.

> "Studies like this really help us think about where to go next." — Donna Blackmond

Biebricher created artificial sea ice in a freezer, turning the freezer off and on every few hours to simulate the temperature fluctuations of the Arctic. He added a group of nucleotides, and waited.

A year later and a half later, Biebricher thawed and analysed the samples. He found a rich harvest of RNA, with nucleotides linked together in chains more than an order of magnitude longer than those seen in other origin-of-life studies — including the famous experiments done at higher temperatures in the 1960s and 1970s by chemist Leslie Orgel.

Orgel himself encouraged Trinks and Biebricher to submit their paper, and its publication in October[1] caused a ripple of excitement in the chemical-evolution community.

"This is fascinating," says Donna Blackmond, a physical chemist at Imperial College London. "Studies like this really help us think about where to go next experimentally. Maybe we should look at lower temperatures."

Trinks's paper takes a long run-up, first describing the complex properties of sea ice. Sea ice is quite different from freshwater ice, he explains. It's made of salt-free ice crystals enveloped by membrane-like layers of water, highly concentrated brine, carbon dioxide bubbles and salt crystals. The network of countless channels and compartments could provide surfaces on which RNA molecules could assemble and grow.

Many scientists working on the problem think that life's last common ancestor, which arose more than 3.5 billion years ago, was heat-loving. But this does not disprove an icy beginning, says Alexander Vlassov, a biochemist with the biotech firm SomaGenics, based in Santa Cruz, California, and author of a recent review on the subject[2]. The earliest RNA molecules could have started out in cold environments, before moving to warmer ones.

Still, every hypothesis about the origin of life is impossible to prove conclusively. And even if Trinks's idea stands up, it would solve only a part of the problem, says Joyce. The question of where the initial building-blocks came from remains unanswered, for example.

In the meantime, Biebricher is busy replicating and improving his experiment. And Trinks left Germany on 11 February for Spitsbergen, where he is once again taking measurements of his beloved sea ice. ■

Quirin Schiermeier is *Nature*'s German correspondent.

1. Trinks, H., Schröder, W. & Biebricher, C. K. *Orig. Life Evol. Bios.* **35**, 429–445 (2005).
2. Vlassov, A. V., Kazakov, S. A., Johnston, B. H. & Landweber, L. F. *J. Mol. Evol.* **61**, 264–273 (2005).