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Embracing the cold

In mid-February, as COVID-19 infections were starting to accelerate around the world, American researchers revealed the first 3D structure of the SARS-CoV-2 spike protein, which allows the virus to gain entry into cells. This was achieved with cryoelectron microscopy (cryo-EM), a technique that involves flash-freezing samples in solution and then bombarding them with a beam of electrons to produce thousands of images, which are stitched together with software to reconstruct the 3D shape. Three scientists were awarded the 2017 Nobel Prize in chemistry for developing the technique, which has made such advances in recent years that it now allows detailed imaging of biomolecules, viruses and cell organelles.

This is just one of many ways in which freezing temperatures are used in science and technology. For example, modern radio telescopes have cryogenic receivers that are cooled with liquid nitrogen or helium to increase detection sensitivity. If this is not done, the thermal noise generated by electrons and atoms in the electronic circuits and other materials would swamp the faint signal from space.

The term cryogenic (derived from kryos = Greek for cold, and genic = producing) is generally considered to relate to temperatures between −150°C and −273.15°C, or absolute zero, where there is no heat at all, nor any motion of atoms and molecules. Cryogenics includes both the study of how to produce these very low temperatures, and how materials behave at such temperatures.

Cryogenics has a variety of applications in industry too. Cryogenic hardening involves treating steels and composites with cryogenic temperatures to improve corrosion resistance, while cryogenic grinding – also known as cryomilling – cools materials to make them brittle and easier to grind. The latter is widely used to manufacture or recycle plastics and other polymers, even turning old car tyres into rubberised playground surfaces or sport turfs. It is also used to produce fine powders such as spices and coffee in the food-processing industry, which also relies heavily on cryodessication, more commonly known as freeze-drying.

Of course, we use freezing to preserve our food too, and chill our drinks with blocks of ice. In South Africa, ice doesn't occur in the natural environment in large quantities for very long, but many other parts of the world experience months of icy landscapes, much like those in Disney's Frozen movies. The frozen parts of the planet make up the cryosphere, which plays a vital role in regulating global climate, but is itself severely threatened by climate change.

In this issue of *Quest*, we focus on ice and freezing temperatures, and present some scientific endeavours and technological innovations in this field.

Sue Matthews
Quest Editor

Lesi siqephu se *Quest* sibheka iqhwa nokwehla kwamazinga okushisa, kwimvelo Kanye nase lebhu.

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