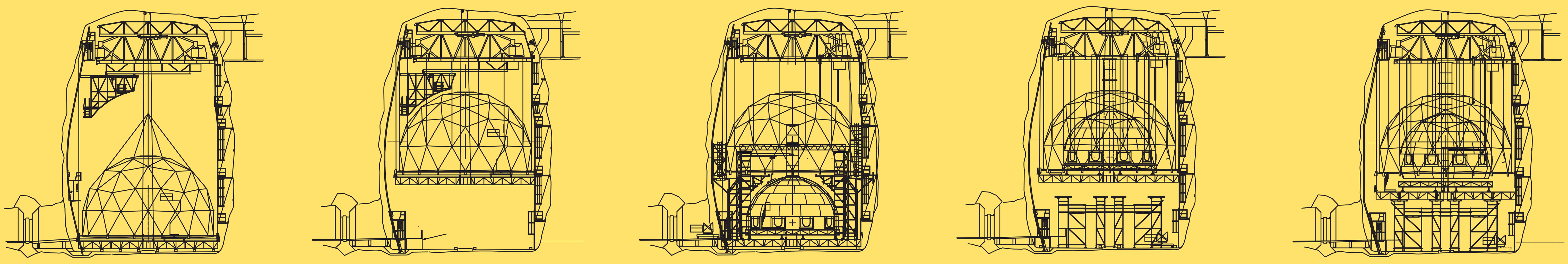
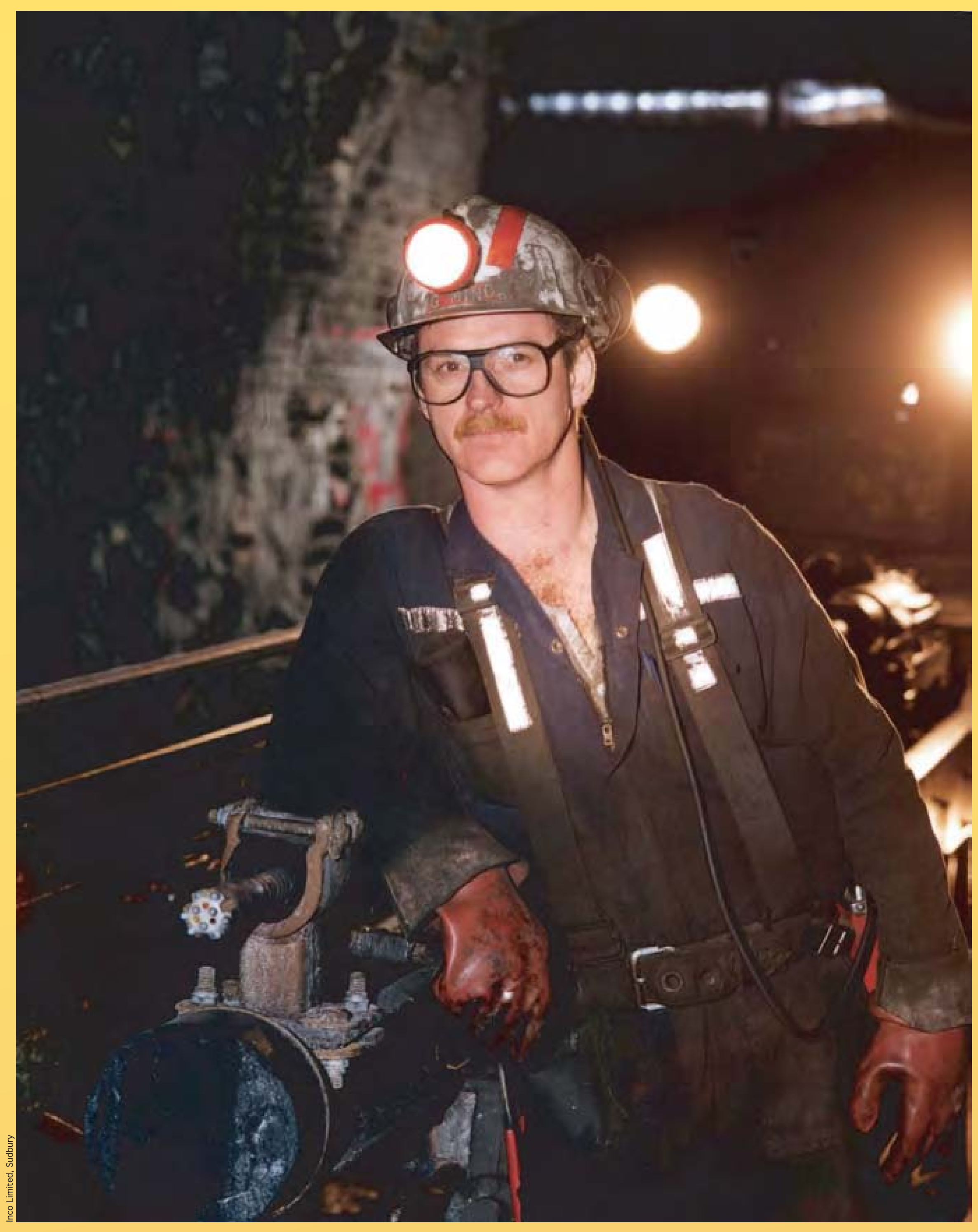


Subterranean Architecture

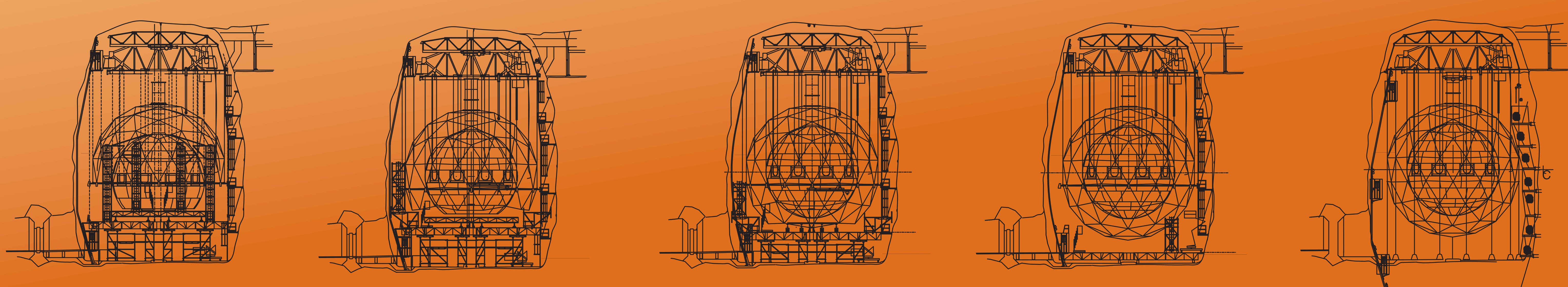
Extreme Mining

"For over three years, we miners worked in the deepest part of the Creighton Mine, blasting, shovelling and hauling out over 60,000 tonnes of rock, to carve out the cavern that would house that neutrino experiment.

"Inco developed cutting-edge excavation technology to support us. After all, we were digging the largest cavity at that depth in the world!"



The excavated cavity, two kilometres (1.2 miles) below Earth's surface, required the latest in mining techniques.



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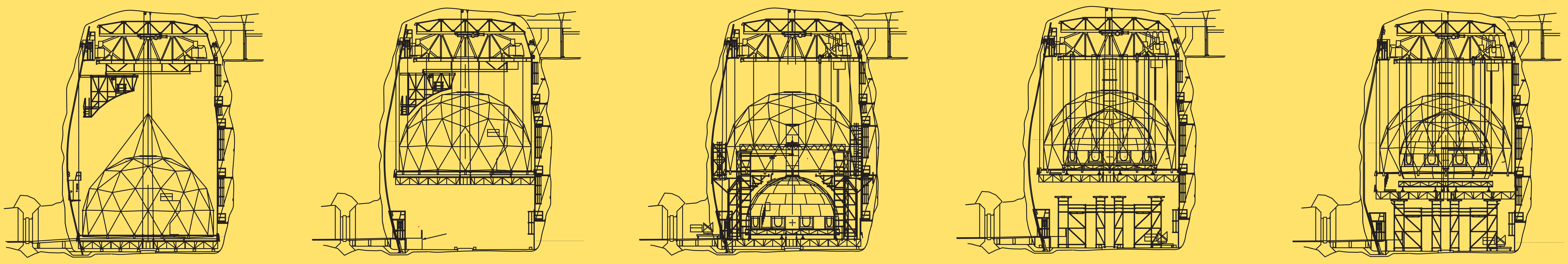
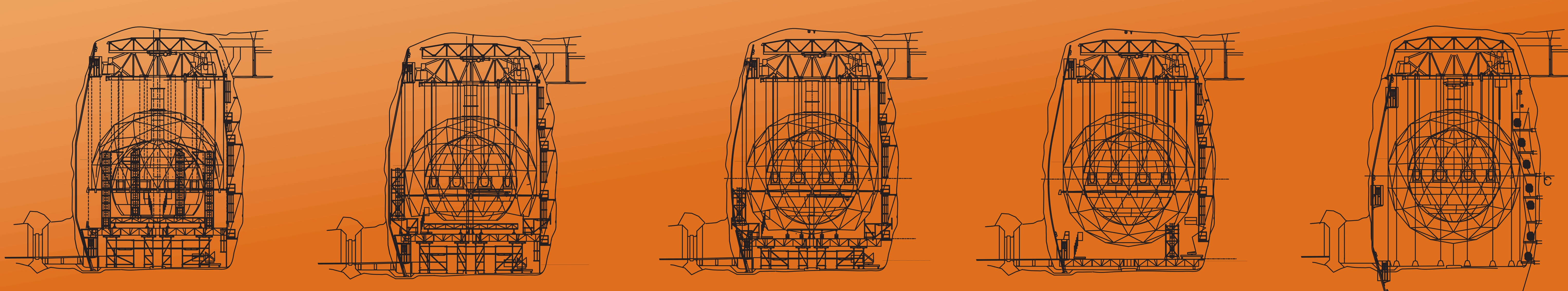


Clean as a whistle

To avoid contamination of the sensitive experiment, not only are visitors "cleaned" before they enter the Observatory, but the water and the heavy water used in SNO are purified to unprecedented levels. The SNO water purification system was designed by Carleton University physicists and built by Sepratech in Ottawa.



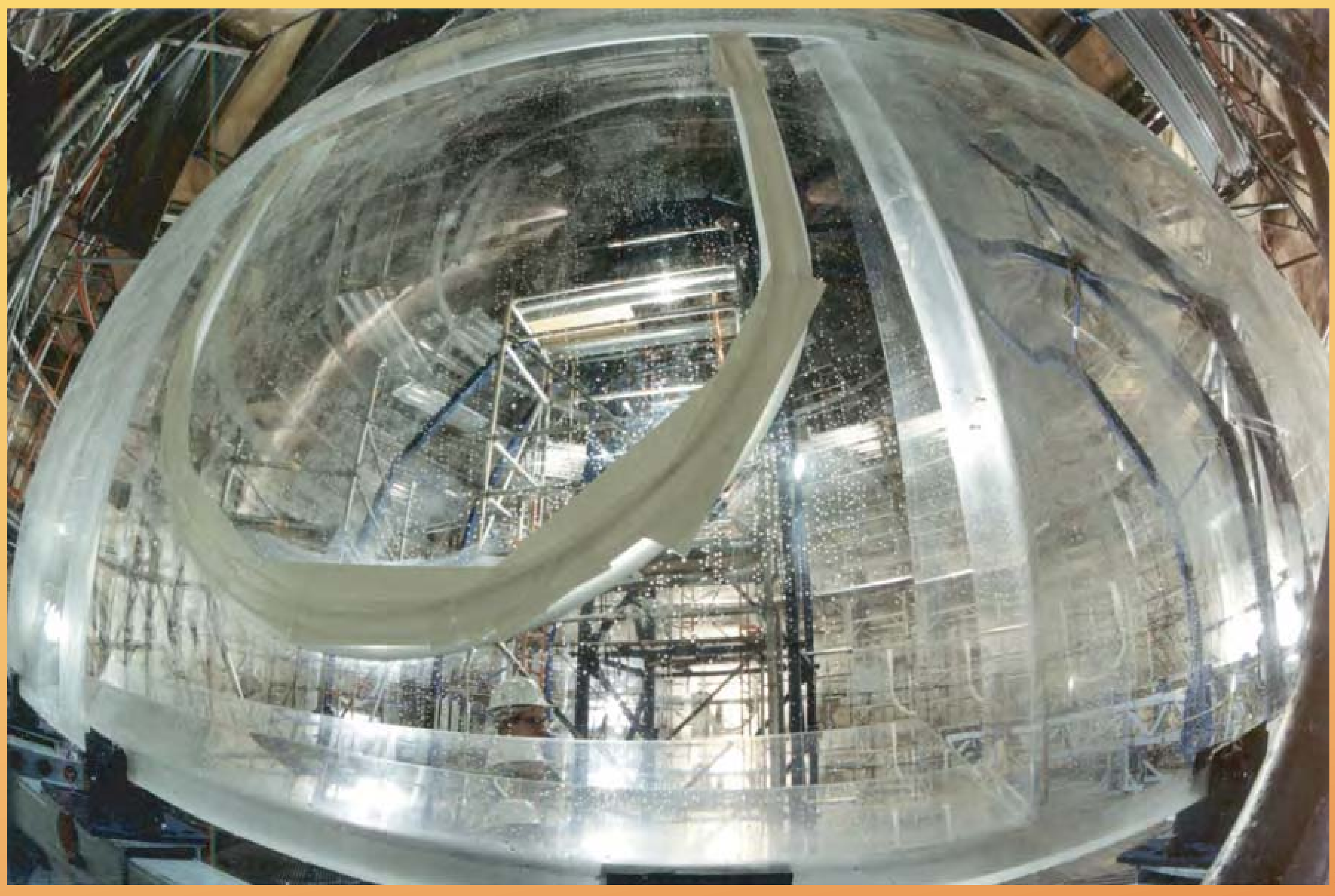
Floating Ball of Water

A Whale of a Thing

The world's largest acrylic vessel holds the heavy water. At 12 metres (39 feet) in diameter, the sphere could not fit into the mine hoist shaft! As a result, it had to be assembled underground from 125 pre-formed panels.

Ropes hold the sphere in place, but they do not have to support all of its weight. Like a colossal whale, the vessel is bouyed up in a bath of ordinary water, which fills the cavity.

The acrylic vessel, built to hold the heavy water which is essential to the experiment, is being inspected.



Wire ropes, looped through channels in the shell, support the vessel from above. The tension on these wires is monitored and is adjusted automatically.

Seeing the Light

Keeping an Eye on the Heavy Water

Neutrino interactions in heavy water release an electron which travels so fast that it generates a cone of light that spreads out like a sonic boom. A device called a photomultiplier tube (PMT) can convert this light into an electric current.

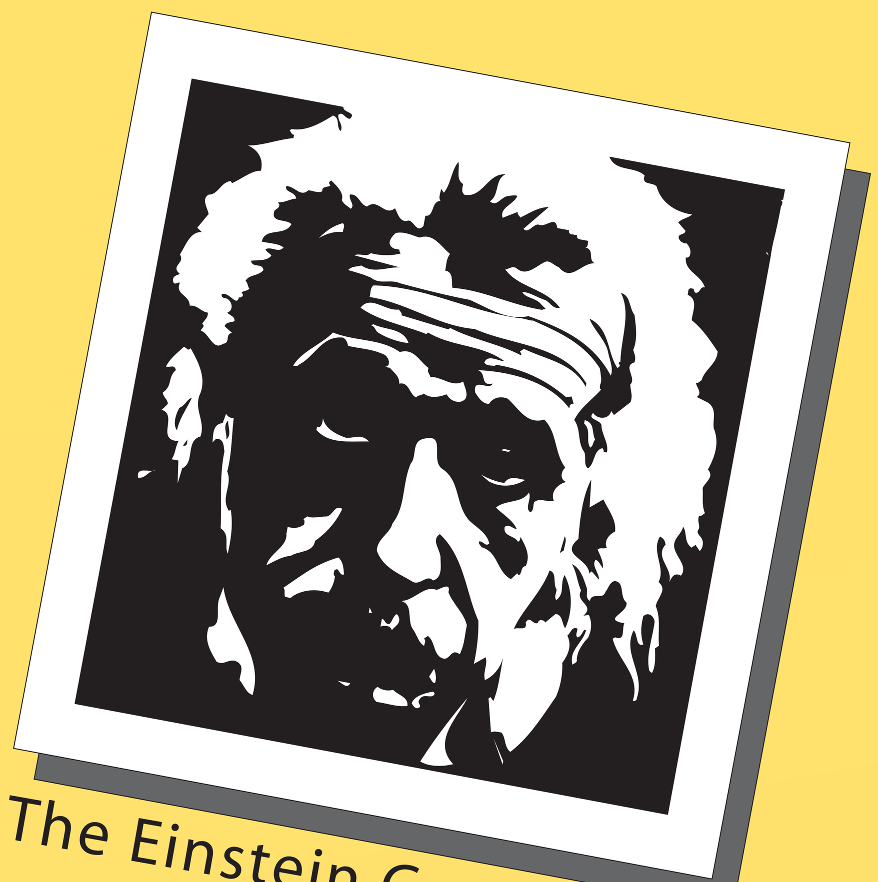
Almost 10,000 photomultiplier tubes surround the sphere of heavy water, looking for the tiny flash which signals that a neutrino has been snagged.

The Photoelectric Effect

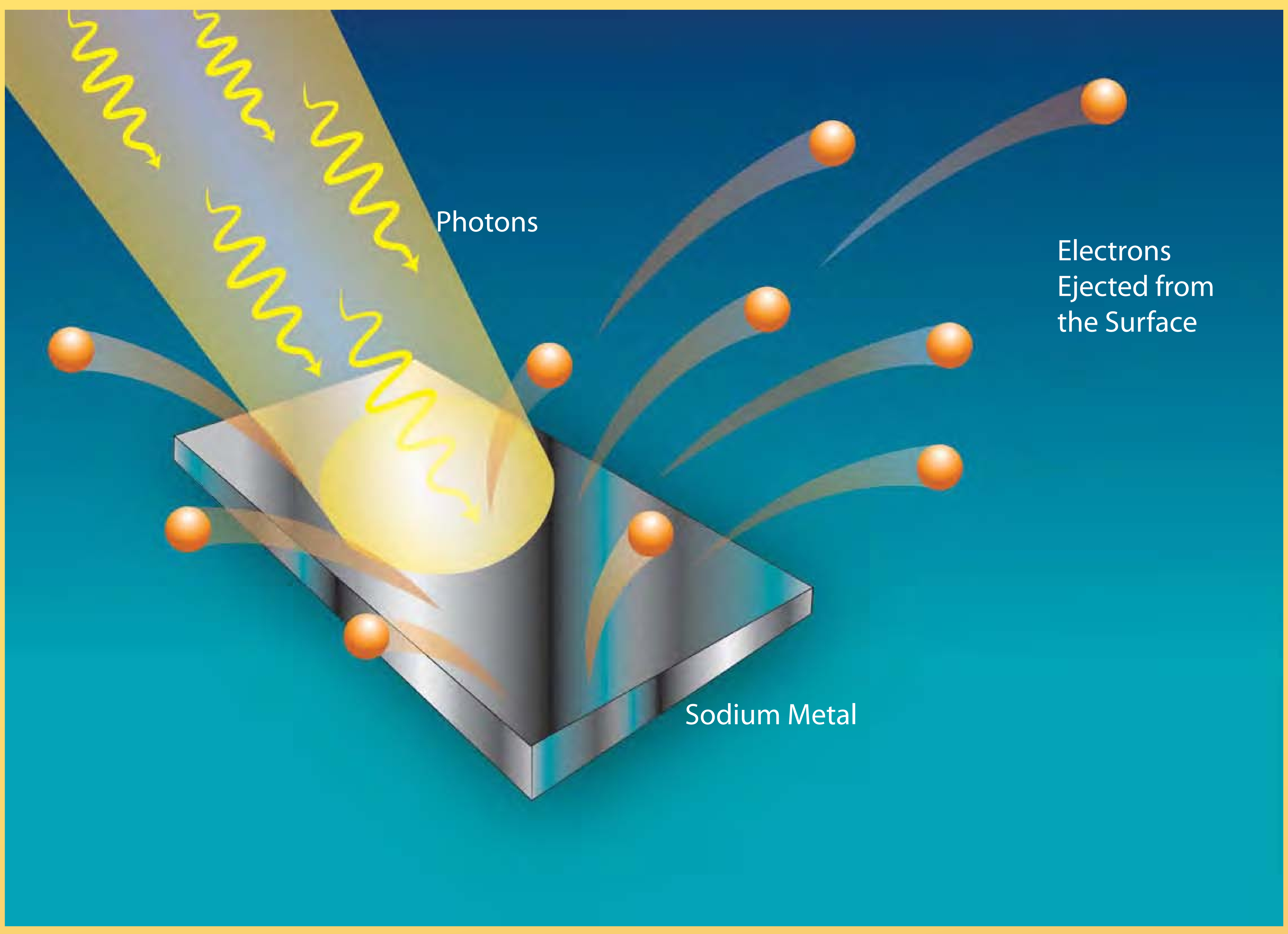
A Quantum Leap Forward

For over 100 years, it has been known that some metals emit electrons when light shines on them: the brighter the light, the more electrons. Einstein explained the effect by describing light as a stream of particles, or photons.

Einstein’s conclusion supported the development of Quantum Mechanics. This theory describes positions and energies over very tiny distances, where events are determined by chance. Ironically, Einstein became an opponent of this theory, famously asserting that "God does not play dice with the Universe."



The Einstein Connection



CHECKING 1, 2, 3 . . .

As it moves about within the sphere of heavy water, the laserball emits a tiny flash of light that is registered by every photomultiplier tube (PMT). This helps scientists understand the transparency of both the heavy water and the acrylic sphere. The laserball calibration device was developed by members of the Physics Department at Queen's University in Kingston, Ontario.

Queen's University collaborator, Dr. Peter Skensved, Århus University, Denmark, prepares to calibrate the PMTs, August 2000.

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I'm HIT!

Recognizing a Neutrino

In the SNO detector control room, operators monitor data acquisition and electronic systems 24 hours a day.

The cone of light triggered by a neutrino interaction hits a ring of photomultiplier tubes. They then send their signal to banks of electronics for digitization and computer processing.

Racks of specially designed electronics monitor the nearly 10,000 PMTs. They relay data, including precise timecodes, from "events" in the heavy water to the computer, which sounds an alarm when a neutrino event may have occurred.