

John Franklin (1786-1847)

As a British Arctic explorer, he mapped about 1/3 the coastline of North America

In 1845, at the age of 59, he set out with 24 officers, 110 men and three years' supplies to chart the Northwest Passage.

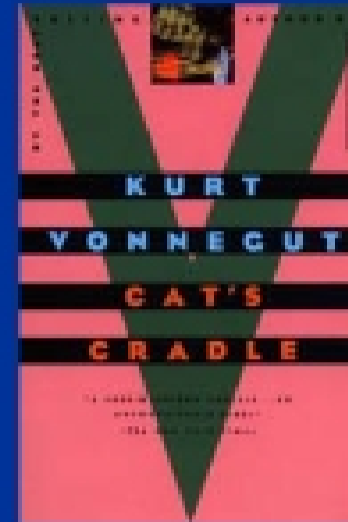
In 1850 the remains of the ships were found along with thousands of bones and a few marked gravesites.

A century later, the bones were scientifically tested, showing that the crew had most likely died of pneumonia and tuberculosis. Toxicological reports showed the presence of lead poisoning. In addition, Made cut marks on the bones of some of the crew suggested cannibalism. The combination of years of exposure to freezing weather, disease and starvation had killed everyone in the Franklin party.



Cat's Cradle

Ice-nine



When ice-nine comes into contact with water, it instantly crystallizes the entire body of water into ice-nine - thus destroying the world.



Brain Freeze

It just might happen to you!

When the cold object touches the roof of your mouth, the blood vessels contract in response in an effort to prevent loss of body heat. As the coldness recedes, the blood vessels relax again, quickly increasing blood flow to the brain. This sudden release is what causes the intense headache sensation.



Especially painful if the ice cream is cooled with liquid nitrogen

Toddlers Found Frozen to Death After Father's Drunken Escapade

Thursday, January 31, 2008

Canadian Mounties are investigating the deaths of two toddlers found frozen to death on the Saskatchewan's Yellow Quill First Nations reserve earlier this week, the **National Post** reported.

Sasha Pauchay, 1, was found dead Tuesday afternoon and her 3-year-old sister, Calence, was found Wednesday, both dressed in light tops and diapers, according to the newspaper.

They were found in a snow-drift-covered area of the reserve between their home and that of a neighbor's, the **National Post** reported.

Their father, Christopher Pauchay, 25, left their home with them sometime after 12:30 a.m. Tuesday without a coat. About 5 a.m. Pauchay showed up at a neighbor's door covered in frost bite and not able to speak, the newspaper reported.

Eight hours later, Pauchay asked about his daughters, according to the **Post**.

The girls' grandmother — Pauchay's mother — told the newspaper she believes her son was taking the children to his sister's home, and that alcohol was involved.

"He was carrying them. But he was drinking, and he must have blacked out," Pearl Pauchay said. "That's what he said when we went to visit him in the hospital."

The Royal Canadian Mounted Police have not decided if charges will be filed against Pauchay.

[http://www.foxnews.com/story/0,2933,327225,00.html](http://wwwfoxnews.com/story/0,2933,327225,00.html)

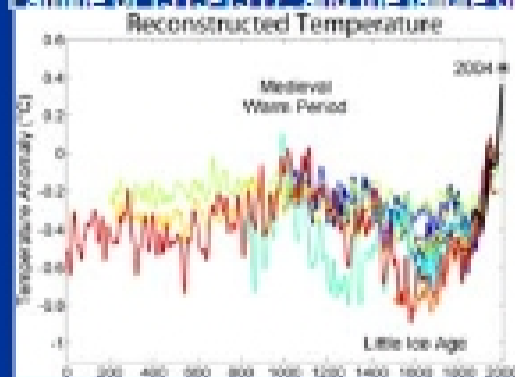
Little Ice Age

circa 1300-1850

- Minor period of cooling ($\Delta T \approx 1K$) following the Medieval Warm Period, possibly caused by increased volcanic activity and decreased solar activity (less sunspots)

- The Little Ice Age featured glacier increases, extremely cold winters in Europe and North America, and widespread crop failures.

- Possibly resulted in Icelandic population decreasing by half, the Great Famine of 1315-1317, and the failure of Norse settlements in Greenland



BLEVE

Acronym for Boiling Liquid Expanding Vapor Explosion

- Can be caused by :
 - Excess heat that raises the pressure and causes rupture
 - Small rupture that lowers the pressure inside the tank causing liquid inside to become vapor faster than it can be expelled, leading to explosion



Video: <http://www.youtube.com/watch?v=SjnGsZQVPOc>

Trains collide, liquid nitrogen fertilizer spilled into Mississippi river

- December 17, 2008, 5:30 a.m. two freight trains collide in Minnesota
- 26 total cars derailed, 31,000 gallons of liquid nitrogen fertilizer dumped
- Fertilizer consisted of 28% liquid nitrogen



Liquid Nitrogen causes eutrophication (process promoting excessive plant growth and decay) in rivers, which causes:

- Drinking water contamination
- Increased water turbidity
- Depletion of dissolved oxygen
- Fish mortality

Cryogenic Dewar Leak

- Cryogenic dewars are often used to store chemical products which are gases at atmosphere temperature, some are noxious. (Such as chlorine can cause respiratory disease)
- Liquid will vaporize in room temperature, it will affect both people and plants in large area.
- In transportation and storage, leak can be extremely dangerous to people if it happens in urban place.



A chlorine leak accident occurred at Nanchang, China caused 282 people hospitalized. Residents rush to safe places after leak.

March 1979: Three Mile Island Accident



Long term health effects of animals and plants exposed to radiation leaked from TMI is still debated.

- A nuclear reactor in Middletown, PA almost melted down due to a lack of coolant.
- A faulty pressure-relief valve was responsible for leaking cooling water from the reactor's core.
- TMI was not catastrophic. The reactor Temp. was brought down before the reactor could breach its containment.

The Three Mile Island Disaster



The Three Mile Island Nuclear Generating Station near Harrisburg Pennsylvania underwent a partial meltdown on March 28th 1979, releasing over 40,000 curies of radioactive Krypton and as much as 13 million curies of other radioactive gases.

The disaster was caused by a defective valve in the cooling system, allowing coolant to leak out. The reactor overheated and burst, releasing radioactivity into the coolant. Hydrogen gas was produced, filling the cooling system. The accident was eventually brought under control.

The cleanup from this disaster cost an estimated 1 billion dollars. The disaster also discredited the safety of nuclear power production in the public eye, and was likely responsible for the reduction in the amount of new reactors being constructed.

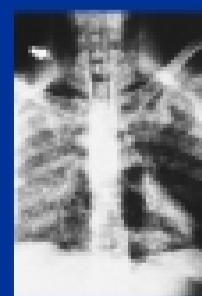


LN2-room TU Darmstadt, 1996

- ventilation above height of head
- Student fills 30 l and 5 l Dewar. While filling second 5 l Dewar he loses consciousness.
- Liquid nitrogen continues to flow
- Student gets frostbites and suffocates.
- After 30-40 min another student finds him, turns off nitrogen and on way to door loses consciousness as well.
- A third student being on the same floor takes him out of the room.

Too much Oxygen?— Oxygen Toxicity

- A 47-year-old experienced underwater cave diver, with no significant medical history, was diving with two tanks -- one containing compressed air, the other a 30% mixture of oxygen and nitrogen (nitrox).
- After a 19 min dive, he was seen floating head down, unresponsive: "his flippers moving as if he was thrashing" noted by a witness.
- Cardiopulmonary resuscitation was attempted, but abandoned after 45 minutes due to no response.



postmortem x-rays and autopsy of the body revealed large amounts of gas in the venous system of the neck and limbs and in both sides of the heart.

Foamy blood and gas were found in all chambers. Analysis of gas from the right ventricle showed O₂ (20.4% by volume), and N₂ (79.5%).

There was beating of the tongue and protrusion on the lungs and heart. The brain (1740 g) showed mild cerebral edema and a microscopic perivascular haemorrhage in the floor of the fourth ventricle.

Fig: Postmortem chest x-ray, showing gas in both sides of the chest and in the neck veins

So what exactly happened?

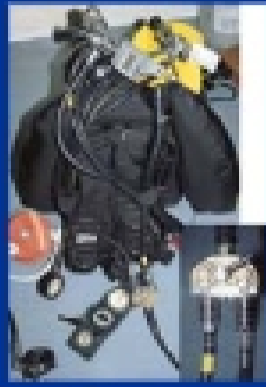
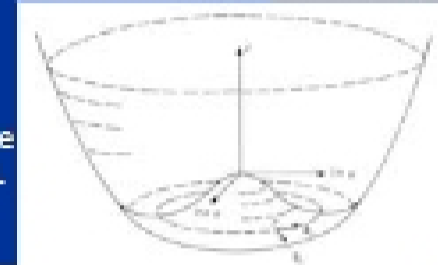


Figure 2. Equipment used by the diver, showing the 50% oxygen/nitrogen gas tank (yellow, right), compressed-air tank (black, left), yellow tape marking the compressed-air circuit, and two-way valve which controlled the source of the air supply.

- Examination of the subject's diving equipment re-revealed that he had been breathing the 50% oxygen/nitrogen mixture for most of the dive.
- The cause of death was drowning after oxygen toxicity, as documented by the coroner.
- Using a 50% oxygen/nitrogen mixture at 47 m depth, the diver had been exposed to a partial pressure of oxygen of 271 kPa (2.9 atm), possibly for as long as 19 min.
- This gas mixture should be used only at depths less than 14-18 m (depending on the duration of exposure).

BCS: gauge-symmetry VIOLATION

- When Bardeen, Cooper, and Schrieffer published their theory of superconductivity in 1957, Yoichiro Nambu and others noted that the BCS superconducting ground state lacked the gauge invariance of the underlying electromagnetic theory.
- Nambu concluded that the superconducting ground state results from the spontaneous breaking of the underlying gauge symmetry.



PHYSICS TODAY, December 2008

Superconducting Magnet Quench

- Liquid helium and LN₂ are usually used to keep the coils of a superconducting magnet below their critical temperature.
- If part of the magnet goes normal (becomes resistive) this can cause rapid heating and quickly boil off the helium and nitrogen.
- When going from a liquid to a gas He expands to 754 times its initial volume and LN₂ expands 694 times.
- This expansion can be dangerous in itself but will also push out all of the breathable oxygen in the room potentially causing workers to asphyxiate.
- These cryogenics are particularly dangerous because they are colorless and odorless.



The K-152 Nerpa Accident



- The K-152 *Nerpa* is a Russian attack submarine that was commissioned in October 2008 after a decade of delayed construction.
 - In November 2008 the *Nerpa* was undergoing sea trials. It's first underwater test run was November 8.
 - At 8:30pm, the fire extinguishing system "went off unsanctioned," causing the front two compartments to be sealed and filled with freon R-114B2 gas.
 - 20 men died of asphyxiation, including 17 civilians. 41 more were injured from the effect of the cold gas.
- Controversy:**
- Survivors say the warning sirens sounded only after the gas poured in.
 - The submarine was overcrowded for the testing and some say there were not enough masks on board.
 - Some of the breathing kits failed after a few minutes; it was reported that some of the dead were wearing the masks.
 - The accident was blamed on Dmitry Grobov, who many consider a scapegoat since he was a skilled specialist and it would require more than one person to activate the system.

Sources: ABC News Australia, BBC News

Indium Seal Failure

- **Task:**
 - Test MEMS beam devices in vacuum under low temperature.
- **Why indium seal?**
 - Indium creates effective and reliable *hermetic* tight hermetic seals.
 - We coated indium with vacuum grease to prevent it sticking to other metals.



The cryostat with our probe and me



The probe cap, indium and vacuum grease

Indium Seal Failure

- Too much grease caused the indium seal failed but not until the probe was lowered into liquid helium.
- One day later, our signal was gone. But we didn't know there was a leak, and naturally decided to raise the probe to have a look.

I was standing on the cryostat and raising the probe. Suddenly a puff broke the silence in our lab.

The leaked liquid helium in the "hermetic" probe became gas of thousands larger size. It broke out from the weakest point of the probe – the valve.



The valve where the gas broke through