

Cryogenics Spring 2010

Phy 4550 (section 1329)

Phy 6555C (sections 1339 and 8890)

Tuesday/Thursday (5:10 pm to 6:25 pm) Rm 1002 NPB

Right after Physics Colloquium

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HITT RF Remote Login Procedure:

The radio channel number for this room is "07" (zero, seven).

It is **STRONGLY** recommended to login your remote for every class just to be sure it is on the correct radio channel and working before class.

1. **PRESS AND HOLD THE DOWN ARROW KEY** until the **GREEN** light on the remote turns **RED**.
2. **PRESS THE "0" KEY** and you will see the **RED** light flash **GREEN**.
3. **PRESS THE "7" KEY** and you will see the **RED** light flash **GREEN**.
4. **PRESS AND RELEASE THE DOWN ARROW KEY** again and you will see the red light search for the receiver, if it **BLINKS GREEN MULTIPLE TIMES** you are logged in.

Welcome to the Wonderful World of Cryogenics

HITT student response system

I am a:

- A. Physics Major
- B. Physics Graduate Student
- C. Engineering Student (Grad or Undergrad)
- D. Otherwise engaged

Milestones in Civilization

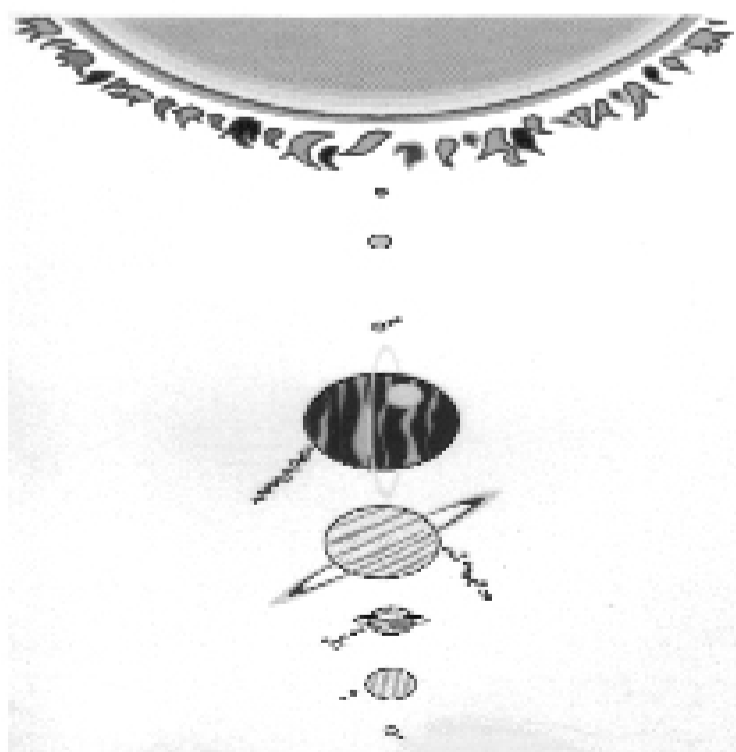
Antoine Laurent Lavoisier



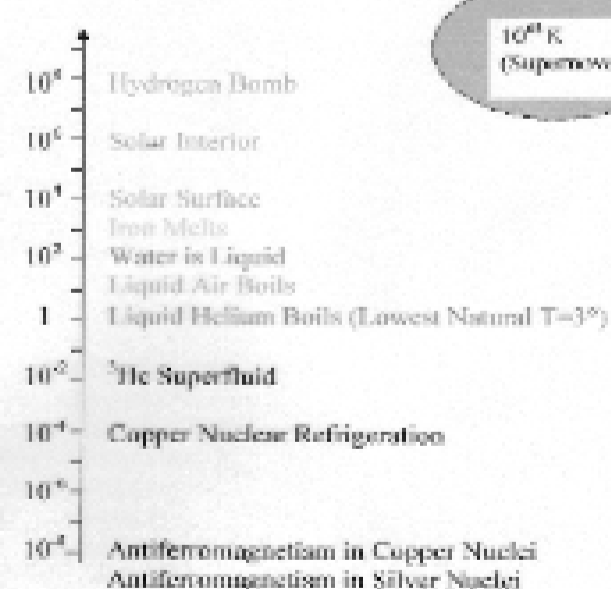
Antoine Laurent Lavoisier, 1788 (1793) portrait
by Royal. Musée de la Ville de Paris

1743 - 1794

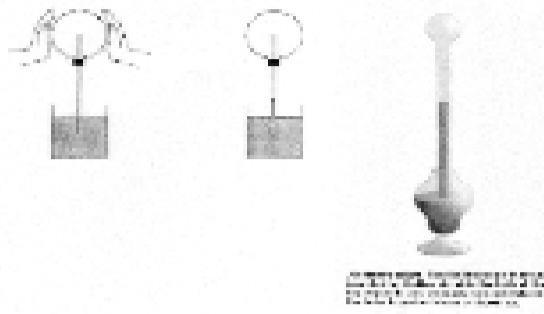
Father of Low Temperature
Physics



Temperature (K)



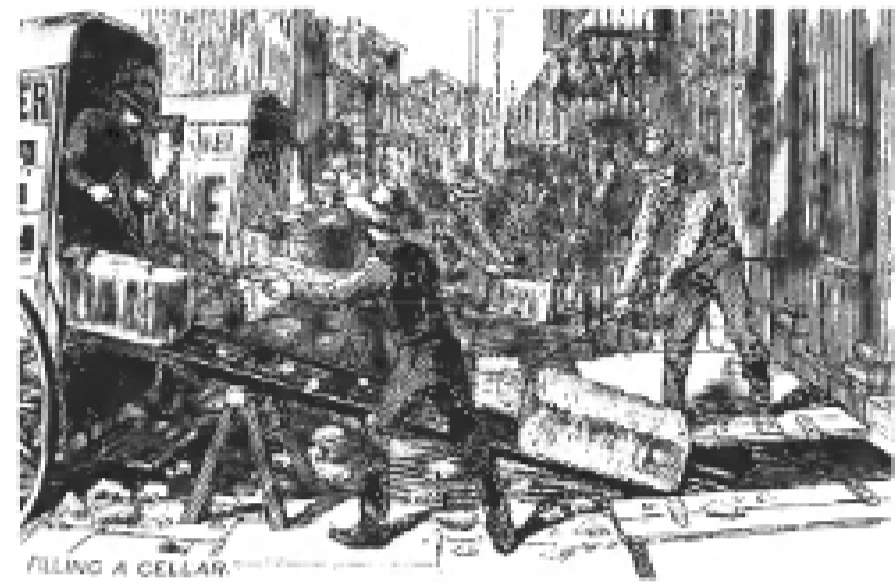
Galileo's Air Thermoscope



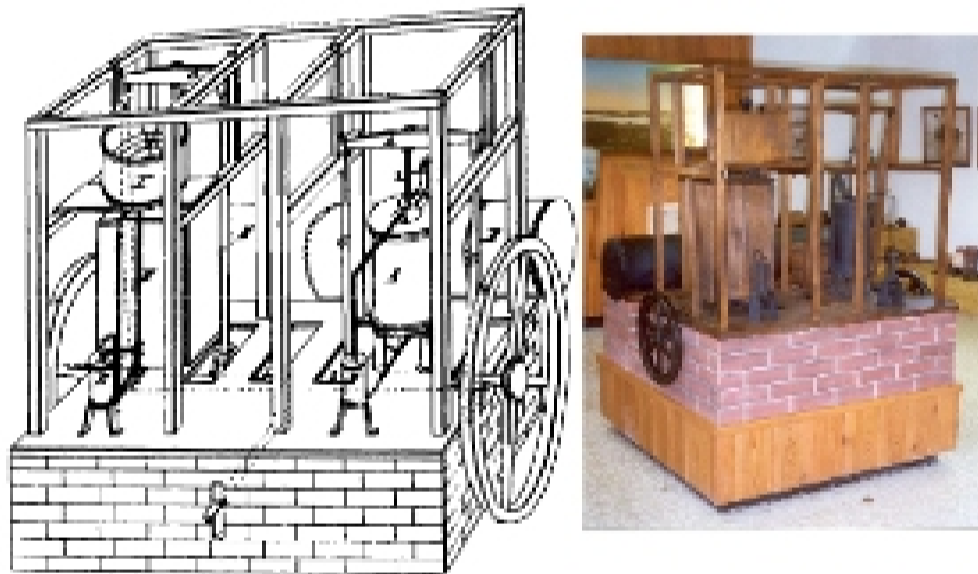
Push the tube into the stopper so that the tube extends about half way into the flask. The flask is then inverted into a beaker of colored water and heated by rubbing your hands together and then holding the flask. As the flask returns to room temperature, the liquid will rise in the tube.

What are the problems with this design?

Natural Ice

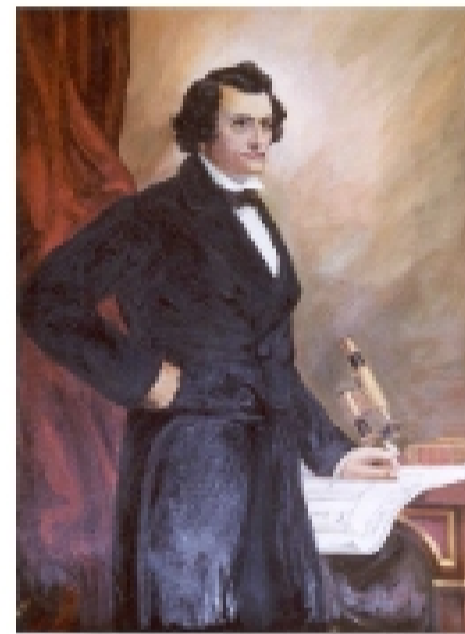


Artificial Ice Machine



Invented by John Gorrie-1850

Rotunda-Washington DC



Ice comes from....

From the Simpsons' featuring the cultivation of ice from the North Pole. When the ice deliveryman arrives at the Quik - E - Mart with his cargo, he says to Apu, "you've got to start charging more than a dollar a bag. We lost four more men on this expedition!" to which Apu replies, "If you can think of a better way to get ice I'd like to hear it."

"If the ice crop was poor, the price rose to the exorbitant rate of \$1.25 a pound." In today's dollar this price corresponds to over \$150 for a typical 3lb bag of ice (3).

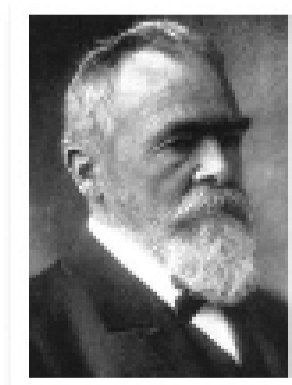
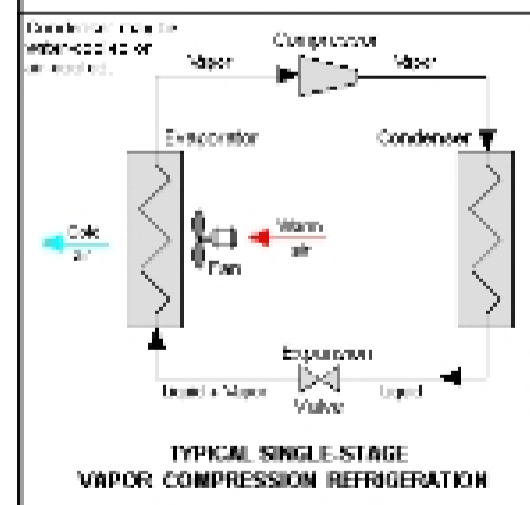
Then



Now



Cold Beer



1873

Carl von Linde

dimethyl ether refrigerant--made Spatenbrau beer

LOX-1877

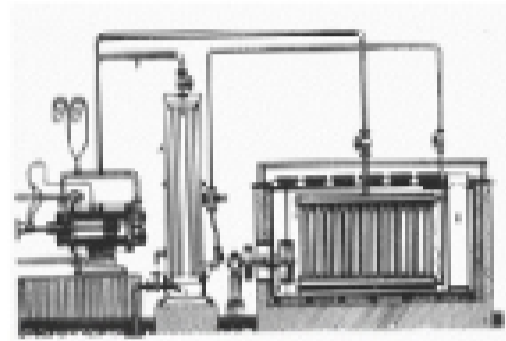


Louis Paul Cailletet (17)

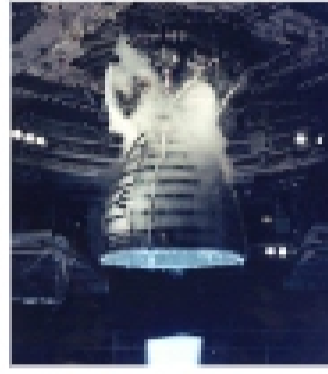


Raoul Pictet (18)

French



Cailletet & Pictet's oxygen liquefaction process (19)



Space Shuttle Main Engine (2)



Zygmunt Brodzki (20) Stanislaw Ulam (21)

Polish

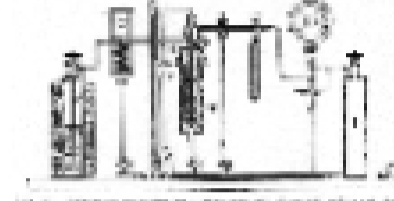


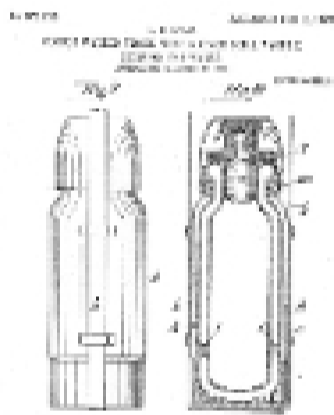
Diagram of a rocket engine (22)



Diagram of a rocket engine (23)

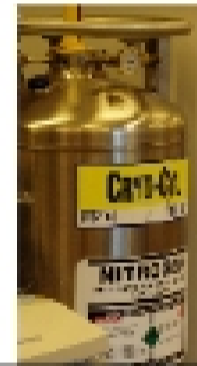
Dewar Flask

Jules Violle in 1882

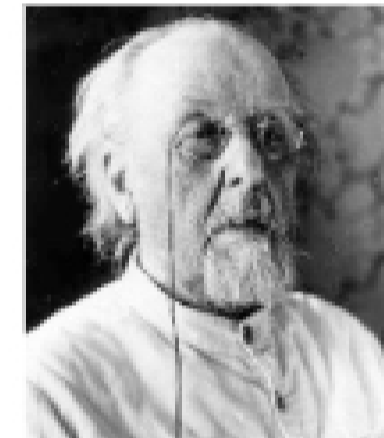


Dewar's improvement in 1892?

Vacuum insulation and silvering



Father of Rocketry



Konstantin Tsiolkovsky 1903

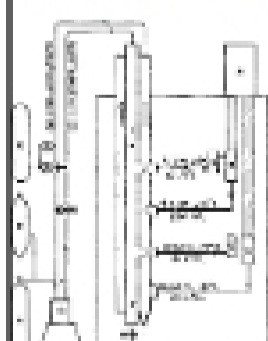
Identified LH_2 and LO_x as the respective fuel and oxidizer of choice, and also suggested use of multi-stage rockets

Liquefaction of helium - 1908

Kamerlingh Onne in Leiden

Joule-Thomson Effect

Samuel C. Collins - 1947



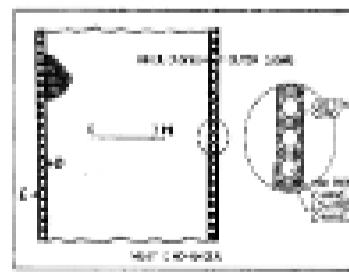
Gas Flow



Cryostat



cross-section



Heat exchanger

Blood Storage and Handling

In 1915, Dr. Richard Weil discovered that refrigeration in conjunction with citration (to prevent blood clotting) allowed for the storage of blood for several days. Until then, blood transfusions needed to be made directly from donor to recipient. Refrigerated "Percipitation" of blood also developed.