HEAT (Heat Pumps) Unit 20 Dr. John P. Cise, Professor Of Physics , Austin Com. College 1212 Rio Grande St., Austin Tx 78701 jpcise@austincc.edu & New York Times November 19, 2008 by Jim Dwyer

Contemplating Heaven, but Drilling Deep Down

A dining room of the General Theological Seminary in Manhattan, which uses a geothermal heating and cooling system.

For millions of years, invisible streams of water have run deep in the earth below Manhattan at a constant temperature of 65 degrees, a source of energy that seems beyond exhaustion — and beyond reach. But eight months ago, a seminary in Chelsea began to pump water from those streams to heat its buildings in the winter and cool them in the summer.

From ground level, geothermal pumps reach 150 to 180 stories down, where the water **is always 65 degrees**.

For the seminary, and now about 60 other places in Manhattan, the unseen bounty of the earth is being harvested by geothermal pumps. Manhattan is geologically suited for these deep wells. **From a depth of 1,500 to 1,800 feet, the pumps deliver the consistently moderate temperatures of underground water to the surface, where it works like a refrigerant.** ***It carries energy. "In the summer, you take the heat from the buildings and put it in the ground," Ms. Burnley said. "In the winter, you take the relative warmth of the ground and put it in the buildings."***

So far, General Theological has drilled seven wells to the end of time — or 150 to 180 stories deep, at least. The seminary has plans for 15 more. When the project is complete, it will be the largest system of geothermal pumps in the Northeast, said Carl Orio, the chairman of Water Energy Distributors, a consultant and contractor that worked on the project. To reach the 65-degree water, the seminary drilled far below the city's Third Water Tunnel, which is about 500 feet down, and far below Cameron's Line, the point where an oceanic plate smashed into the prehistoric North American continent. The first phase of the project was estimated to cost $6 million, but ended up costing $9 million for ***heating and cooling capacity in 80,000 of the buildings'*** 260,000 square feet, according to Dennis Frawley, who managed the project for the seminary.

Introduction & important conversions: C^{air} = 1000J/kg ^{0}C , C = specific heat, air density = 1.205 kg/m^3 , $\Delta F^0 / \Delta C^0$ = 9/5 , 1 m^3 = 35.3 ft^3 , Q = C M (delta t), 4.186 J = 1 calorie Questions: (a) 80,000 ft^2 of the seminary air is to be heated from 60^0 F to 65^0 F. First find these F ^{0} change in C ^{0} ? (b) Assume the height of the 80,000 ft^2 to be heated is 10 feet tall. Find the volume of these 80,000 ft^2 in m^3? (c) Find the mass of the air in this 800,000 ft^3 space? (d) Compute (show the process) the amount of heat (in Joules) extracted from the 65^0 deep geothermal warm water to heat the 800,000 ft^3 space? (e) Find the answer in calories Answers: (a) ~2.78 C^0 (b) ~ 2.27 X 104 m^3 (c) ~ 2.735 X 10^4 kg (d) ~ 7.6 X 10^7 J (e) ~1.816 X 10^7 Cal.