Waves reveal earth's secrets

A seismographic method of measuring earthquake shock waves has provided some new information about the earth's structure. "We can journey to the center of the earth with seismological methods," said Professor Freeman Gilbert at a physics department lecture Monday.

Through, seismology, the study of earthquakes, scientists have been able to gather information about the earth's shape and composition by studying the shock waves produced, Gilbert said.

Data collected recently supports the theory that the inner core is solid, he said. Seismographic information has shown that the earth's outer core is liquid, but debates continue about the composition of the middle core, Gilbert added.

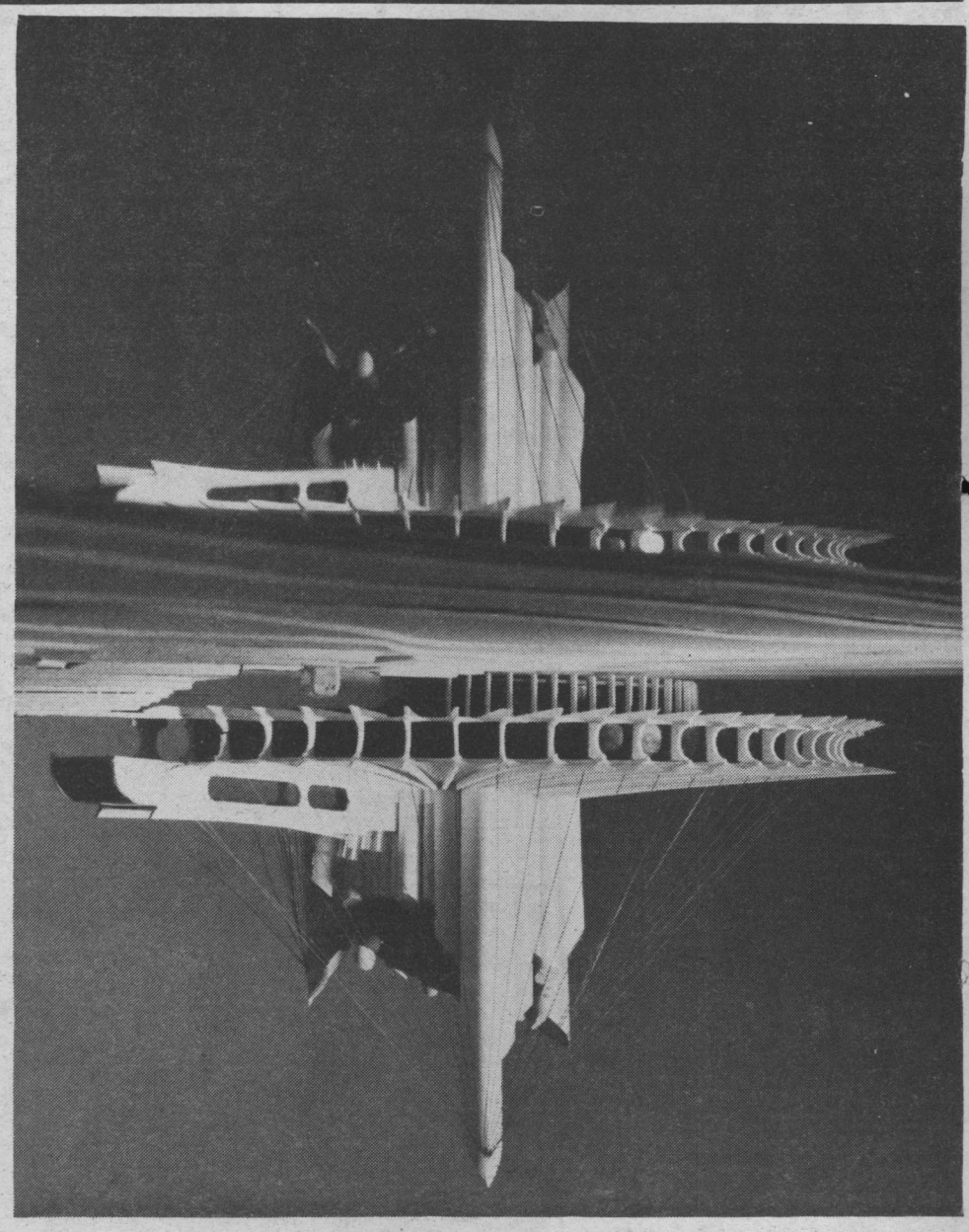
Shock waves near the middle of the earth disappear rapidly, indicating that the outer core is liquid. Other studies suggest there is a solid inner core with a radius of 1220 km, he said.

It is impossible to obtain direct information about the earth's core very far below the surface, Gilbert said. The best indirect method of study measures the speed at which shock waves produced by earthquake's travel through the earth.

The waves the earthquake produces move at different speeds, and scientists can predict the rate at which they will travel through different types of material, he said.

For example, between the crust and the upper mantle there is a sharp boundary in composition. There is also a change of wave speed from six to eight km per second, he said.

Other sources of shock waves, such as nuclear explosions, can be studied in the same manner as earthquakes. However, the largest nuclear explosions produce about the same impact as moderate quakes. Large earthquakes produce shock waves of 1000 times that intensity or more.



Ted Coldwell/Queen Elizabeth Planetarium.

A proposal for a new planetarium and space sciences centre has been developed by the Edmonton Space Sciences Foundation (ESSF). This building, designed by Douglas Cardinal, will primarily provide information about the planets and astronomy although ESSF Chairman, Alicia Maluta, hopes the facility will attract live shows and the performing arts. This project is competing with 15 others for part of the $10 million municipal fund allocated by the province to celebrate Alberta's 75th anniversary. ESSF is negotiating a river valley site for the planetarium, estimated to cost $6.7 million to build.

Booze linked to defects

Alcohol consumed by pregnant women and birth defects in newborns are linked by a disease called fetal alcohol syndrome (FAS), says Alberta Alcoholism and Drug Abuse Commission (AADAC) representative Doreen Shore.

Although adults with a fully developed liver can "burn off" alcohol, a fetus cannot, she says. The alcohol consumed by the mother crosses the placenta, the baby's main nourishing organ, and is passed on to the fetus. Since the fetus does not have a complete set of enzymes to break down the alcohol, and its liver is underdeveloped, the fetus is slower to metabolize the alcohol and carries it for twice as long as the mother.

Babies born to mothers who drink while pregnant may be abnormal in several ways. Usually, the babies are shorter and lighter, and will remain that way even after intensive post-natal care. FAS children also have small heads, joint and limb deformities and heart defects. Not all of these features will necessarily be present in all FAS babies.

The first three months of the pregnancy are the most critical and during this time alcohol is most damaging to the fetus, says Shore. Moderate drinking, 20-30 grams of pure alcohol per day, will result in FAS features in 10-15 per cent of newborns. Heavy drinking (40-60 grams per day), will result in abnormalities in 30 to 50 per cent of the children, says a report form the Karolinska Institute in Stockholm.

FAS can also hinder mental development. "Mental retardation is th emost serious and frequent finding: of 126 FAS children tested, 85 per cent scored below average intelligence," says the report. These children might also exhibit behavioural problems such as hyperactivity, Shore says.

For further information, call Doreen Shore at AADAC Community Services, at 427-4267.

Solar alternative

The seasonal extremes of hot and cold felt in Edmonton do not at first seem to be suited to solar heating. However, a passive solar heating system, in which heat is naturally controlled, combined with a backup furnace, is a viable and economical method of heating buildings here.

Trombe walls are an example of a passive solar heater feasible in this climate. A trombe wall faces south and is built of concrete about one foot thick. The surface of the wall is painted dark green or black to enhance the wall's ability to absorb radiation. As the sun heats the surface of the wall, heat is driven through the wall's thickness by the temperature difference.

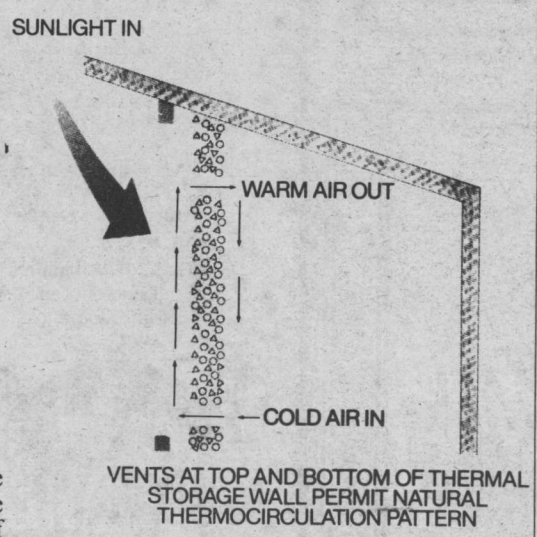
Trombe walls are designed so that by the time the sun begins to set, the heat that had beamed down on the wall begins to heat the building. When the temperature of the surrounding air drops below that of the heat storing materials they begin to reradiate their heat.

Glass windows located in the trombe wall not only allow shortwave radiation in but prevents the escape of longer wave reradiated energy. This method of conservation can be made more efficient by using movable shutters over the windows at night.

Passive systems usually provide enough energy to comfortably heat a home for two overcast days. A furnace can provide back-up heat when necessary.

Some passive solar systems can be incorporated into houses without any alteration to construction.

More information about solar energy can be obtained from the provincial government's department of energy and natural resources.



A passive solar system, such as the trombe wall illustrated, is characterized by naturally controlled heat flow. Such systems can be effective as partial solar heaters, even in Edmonton's harsh climate.

What went wrong at Three Mile Island?

relative perspectives

by W. Reid Glenn

Several inopportune actions that the operators initiated at the TMI-2 plant can be seen in hindsight to be responsible for the core destruction. Faulty indications from a malfunctioning plant were the initial failure, however.

One has already seen how the instrument air system initiated the sequence of events. The event printer, a slow speed teletype machine wired to the plant computer, informed the operators of alarm conditions. At the height of the accident it was three hours behind real time and was subsequently lost for 5½ hours. This primary data link from the supervisory computer was thus not available and kept the operators in the dark.

The physical state of water in the core (sub-cooled liquid or superheated vapour) could only be determined by reference to steam tables. It was not immediately obvious then to the operators that they were running into problems. Microprocessor control systems now can alleviate this deficiency.

A primary shortcoming was that stem position of the faulty relief valve was not available. The pressure of the vessel into which the valve discharged should have indicated to the operators that this valve was open. Alas this pressure was displayed behind the main control panel.

The high pressurizer level, a consequence of relief valve operation, was misinterested by the operators who cut emergency core cooling flow believing it was not necessary. Such confusion undoubtably resulted from the conflicting and oft times nonexistant data.

One hundred minutes into the accident, the water level dropped below the top of the fuel in the core. Forty minutes later, 75% of the fuel was dry and it rose to temperatures just below 2400 degrees F (from 600 degrees F). Zirconium reactions continued to release more heat and hydrogen keeping some temperature sensors off scale from more than 30 hours.

The hydrogen within the core is not condensible like steam and prevented resumption of normal cooling. It was necessary to blow down this gas into the containment vessel in order to resume natural cooling some 15 hours after the start of this incident.

The hydrogen released from the burning core formed an explosive mixture in the containment vessel ten hours into the accident. A pressure spike of 28 PSIG was recorded when this gas burned. The containment vessel is designed for a 75 PSIG over pressure and so was not heavily damaged by this deflagration.

It is likely that another year will pass before any attempt is made to reenter the containment vessel. First the large quantities of radioactive gas and water must be cleansed so background radiation levels again permit human entry. Only then could the task of unloading the destroyed nuclear core be attempted.

It is possible that the utility would attempt to start TMI-2 again as a coal firing plant since the secondary steam side is relatively undamaged. This would defer the high costs of repairing the crippled nuclear plant. --