the required water flow for a commercial plant—some 3000 cubic meters per second or about as much as the Nile River carries—it must be 30 meters in diameter. The Washington Monument would fit easily inside.

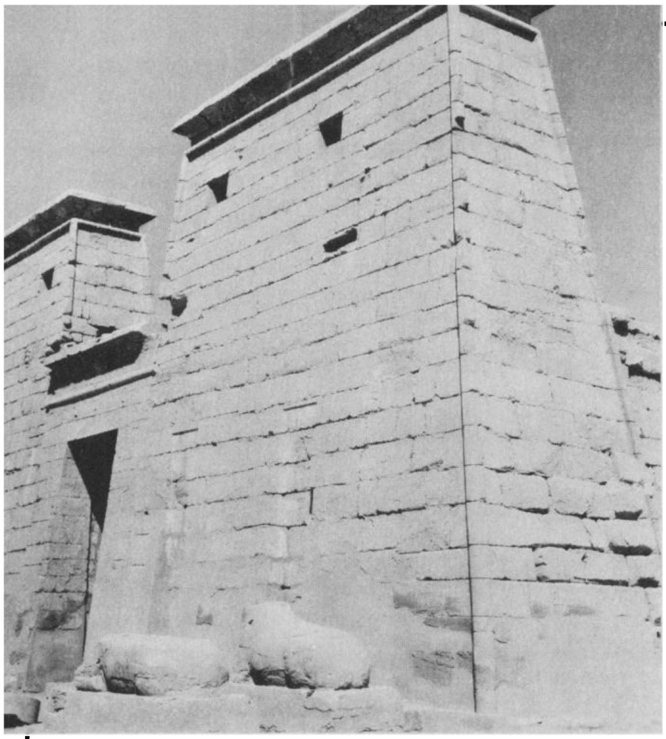
Such a cold water pipe "stretches today's technology," says Richard Scotti of the National Oceanic and Atmospheric Administration in Rockville, Maryland. Scotti has been estimating the forces the pipe will experience, and they are huge. According to William Richards, head of DOE's ocean energy program, concrete or steel could survive these forces, and specially reinforced plastic looks promising and is about to be tested. With the cold water pipe, as with other challenging OTEC components, the crucial question is not whether it can be built, but how cheaply it can be built and maintained.

While tests and experiments can help to solve some of the problems facing and raised by OTEC, others may be recognized only the hard way. One of these is the influence of OTEC on the oceans. Although there is little doubt that, individually, even commercial-sized OTEC plants will not disturb the ocean, a fleet of facilities exploiting the resource to the hilt may affect the ocean adversely. For instance, if a significant fraction of ocean heat is converted to electricity and redistributed by OTEC pumps, then the ocean surface may cool slightly, with unforeseen consequences for local weather patterns. In a way, the effect of OTEC on the oceans is self-limited: if the temperature difference between surface and deep water decreases, so does OTEC's power output and benefit-cost ratio. Other problems include spillage of ammonia, and legal questions that must be addressed before plants start operating.

Of the problems facing OTEC, "none appears to be a showstopper," says Robert Cohen of DOE. The consensus of experts is that OTEC plants can be built and operated with existing technology. If OTEC-1 tests are encouraging, then the next step, they say, is to build a pilot plant. It would be designed to generate around 40 megawatts of electricity continuously and cost on the order of $250 million—the price of 1 day's oil imports. If the pilot plant is successful, OTEC would presumably be on its way. Already, Puerto Rico, Hawaii, and ammonia companies are clamoring to use the first commercial OTEC electricity, because according to current estimates OTEC power will be cheaper to generate, where there is warm ocean water, than power from fossil fuels.

—BEVERLY KARPLUS HARTLINE

Irrigation Threatens Egyptian Temples



U.A.R. State Tourist Administration Photo

Temple of Karnak at Luxor, Egypt.

The annual flooding of the Nile River has, for centuries, been slowly destroying the ancient temples along its banks. Although the floods are now curbed by dams, the temples, such as those in the Karnak area, continue to deteriorate, and two Canadian chemists think they know why. The culprit is salt, they say, the same agent that attacked the shrines during the predam era. As it crystallizes, salt mechanically breaks apart the sandstone foundations and walls of the temples.

In bygone years, the salt came from the river. As the temples dried out after each flood, the tiny amount of salt dissolved in the river water remained in the sandstone and caused it to crumble. Archeologists hoped that the dams, by stopping the flooding of the Nile, would stop the decay of the temples. Yet recent inspections reveal that deterioration continues.

The salt now comes from water that runs through the ground from nearby irrigated fields, say Thomas Billard and George Burns of the University of Toronto. They calculate that near the Great Temple of Karnak about 2.4 grams of salt per year crystallize in a square meter of land, as the underground water seeps toward the surface and evaporates. "The current salinization of the temple is more insidious [than that caused by flooding], because it is continuous and cumulative," explains Billard. "Over a period of 50 to 100 years it should cause a lot of deterioration."

The Great Temple is on unirrigated land where the water table has been raised to within 2 to 3 meters of the surface by intense irrigation of nearby fields. Because the water table is so close to the surface, water drawn out of it by capillary action evaporates readily. Dissolved salt remains in the soil (and in the foundations of the temple). According to the calculations of Billard and Burns, more than 90 percent of the water draining from fields near Karnak evaporates in unirrigated ground. The remaining water returns to the river.

Salting of foundations may be a problem in other arid regions where fields are irrigated, Billard and Burns warn. It may threaten the existence of many great monuments in Egypt. According to Billard, the Egyptians are working on a solution. They hope that, by draining the area of the Great Temple, salinization will be reduced to a harmless level. If the water table is far underground, water will not evaporate as rapidly as it does now; thus much less salt should be deposited near the surface.

—BEVERLY KARPLUS HARTLINE