A. Nico Habermann, the Alan J. Perlis professor of computer science and founding dean of the School of Computer Science, died Aug. 8 of a heart attack at his home in Pittsburgh.

Habermann, 62, first dean of the School of Computer Science, had been on leave from Carnegie Mellon since 1991 as assistant director for computer and information science and engineering at the National Science Foundation (NSF). Habermann headed the Computer Science Department from 1980-88.

An internationally renowned computer scientist, Habermann was known for his work in programming languages, operating systems, software engineering and programming environments.

"His death is a tremendous loss to computer science at Carnegie Mellon and to me personally," said President Emeritus Richard M. Cyert, who described Habermann as "honest, forthright and courageous."

Carnegie Mellon held a memorial program for Habermann on Sept. 8 in the Skibo ballroom.

Speaking at the event, Habermann's son Frits, said, "He was a great teacher for his students, but also for his children."

Frederick M. Bernthal, acting director, NSF, said "Nico was a man of many dimensions: devoted husband, father, grandfather, teacher, dean, scientist and scholar and a celebrant and patron of music and the arts."

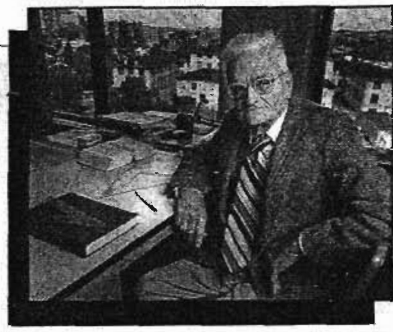
"For me, Nico's legacy is not just a set of papers or a series of accomplishments," said Larry Snyder (S'73), professor of computer science, University of Washington. "The vital part of his legacy is the people that he's touched...his students."

Larry E. Druffel, director, Software Engineering Institute, hailed Habermann's insistence on a studio course in the master of software engineering curriculum, now the most successful part of the program.

"He gave me and many others a tremendous start in our careers," said Merrick Furst, professor, School of Computer Science. "I always knew where I stood. He had a tremendous sense of what was right and wrong, and what was fair. He listened."

A native of Amsterdam, Habermann came to Carnegie Mellon in 1968. He worked, too, as an adjunct professor of computer science at Jiao Tong University, Shanghai, People's Republic of China, since 1986.

Besides his son Frits of Seattle, he is survived by his wife Marta, three daughters, Eveline Killian of Burlington, Vt., and Irene and Marianne Habermann of Pittsburgh, and two grandchildren, Madison and Alex Nicholas, of Pittsburgh.



Clarence M. Zener, 87, a University Professor of physics and a scientist hailed around the globe, died of heart failure, July 2, in Pittsburgh.

Zener's research expanded the theoretical study of solid state physics and often found him decades ahead of the technological application of his discoveries. The Zener diode, a voltage regulator developed in the 1950s, was ultimately used in modern computer circuitry. It grew out of a paper Zener published in 1934.

He helped to develop geometric programming, a standard technique useful in mathematical studies as well as practical engineering and business administrative problems. Zener used geometric programming to show the possibility of economically generating electric power from the ocean by taking advantage of differences in temperature between the warm surface water and cooler waters beneath.

A Carnegie Mellon Magazine article in winter 1985 observed that associates, "when asked to describe the man and his work, abandon the reserve academics traditionally exude when discussing a colleague. They gush superlatives normally slung about by sportscasters. Zener, they exclaim, is a theoretician with astounding insight and matchless versatility."

In the same piece, Hubert Aaronson, professor of metallurgical engineering, termed Zener "A rare, strange genius. He's an unbelievably talented innovator. He's able to go into a fresh field, swiftly comprehend the central issues, address them as a theoretical physicist in a simple but incisive way and make, in a matter of a few months, important and useful contributions."

In a eulogy for the physicist, Rev. David Herndon of the First Unitarian Church characterized Zener, who was once sent to a school for retarded children because his family was puzzled by his slow learning, as "one who recognized neither with arrogance nor with diffidence what he was capable of doing; and we have witnessed in him the strength of one who prevailed against obstacles from an early age."

Zener joined the Physics Department in 1968 after working as dean of science at Texas A&M University and as director of research and director of science at Westinghouse. He had worked, too, at Washington State University, City College of New York and Washington University in St. Louis.

He wrote more than 125 books and papers and was a member of the National Academy of Science and a fellow of the American Physical Society. He received numerous awards.

A native of Indianapolis, Zener is survived by his wife, Ruby; daughters, Jean Lepley of Seattle and Ann Edwards of Pittsburgh; sons, Robert of McLean, Va., and Thomas of Irvine, Calif.; and 11 grandchildren.

Two Test Projects to Seek Power From Ocean's Heat
By WALTER SULLIVAN
New York Times (1923-Current file); Apr 22, 1974;
ProQuest Historical Newspapers The New York Times (1851 - 2006)
pg. 1

Two Test Projects to Seek Power From Ocean's Heat

By WALTER SULLIVAN

Groundwork is being laid for realistic testing of the hypothesis that substantial amounts of energy could be derived, at low cost and with no pollution, from temperature differences within the oceans.

Two conceptual designs for oceanic power plants of this type are in preparation on an academic level, and the National Science Foundation, which is financing these studies, is offering $1.8-million for further development, chiefly by industry.

It has been calculated that the heat being carried by the Gulf Stream through the Florida Straits between Miami and the Bahamas could be harnessed to produce all the electricity now used by the United States.

The proposed plants would use warm surface water to vaporize a "working fluid," such as propane or ammonia, that vaporizes at a temperature as low as that of tropical surface water. The vapor would drive power plant turbines and then be condensed back into a fluid by frigid water brought up from great depth.

The warm water and cold water would flow through the system in great volume, whereas a much smaller amount of

Continued on Page 42, Column 4

Two Test Projects Will Seek Low-Cost Power From Ocean Heat

Continued From Page 1, Col. 3

working fluid would be constantly recycled through the turbines.

Of the conceptual designs the one being prepared by Dr. William E. Heronemus and his colleagues at the University of Massachusetts in Amherst is the most detailed. The plant would be moored some 25 miles off Miami, drawing up cold water through a conduit attached to its tether line.

Warm water would be swept through the system by the natural flow of the Gulf Stream. The working fluid, at least initially, would be propane and the generated power would be transmitted to the Miami electrical system by submarine cable.

The other design was described at the New York Academy of Sciences, 2 East 63d Street, recently by Dr. Clarence Zener of Carnegie-Mellon University in Pittsburgh. In the 1930's Dr. Zener laid the theoretical basis for the zener diode, a basic component of modern electronics.

His group at Carnegie-Mellon has been using computer models of various schemes to assess their costs, net energy production, pumping demands and materials requirements. As Dr. Zener pointed out in an interview before his talk, a variety of subtle effects must be taken into account, such as the slow conduction of heat through smoothly flowing liquids.

Economic Question

The key problem, he added, is to determine whether the units (evaporators) that transfer heat from warm water to the working fluid and those (condensers) that transfer heat from that fluid to the cooling water can be built economically. Because the temperature difference between the two water streams is not great, the flow must be massive to produce useful energy.

Surface water throughout the tropics remains at about 77 degrees Fahrenheit and the deep water is at about 40 degrees. The necessary flow would be comparable to that through a hydroelectric plant producing the same amount of electricity.

One way to reduce the cost of the huge evaporators and condensers needed for such a plant would be to submerge each such unit at a depth where the water pressure equals the pressure within that unit, making it possible to use light construction. For a system using propane as the working fluid, according to the calculations of J. Hilbert Anderson, this would require the evaporator, drawing water from near the surface, to be deeper than the condenser, drawing water from the depths. The latter would be 154 feet down, whereas the evaporator would be 278 feet below the surface.

At $165 a Kilowatt

In 1966 Mr. Anderson and his father, who formed Sea Solar Power, Inc., in York, Pa., estimated that such a plant would cost $165 per kilowatt of generating power. Dr. Zener believes that, despite inflation, this is still valid in view of the savings in more recent designs.

By contrast, he says, a fossil fuel plant costs about $340 per kilowatt, but its delivery of power is far simpler than that for a plant out at sea.

Dr. Zener is cool to the idea of placing the initial plants in the Florida Straits. While it is said that such plants would not seriously affect the heat load of the Gulf Stream, the latter plays so critical a role in ameliorating European climate that any tampering with it would raise political problems.

The swiftness of the current there is also a challenge. While it would obviate the need to pump warm water into the system—a saving of perhaps 5 per cent in energy demands—it would place a heavy strain on the moorings. Dr. Heronemus himself estimates the tension as high as 22 million pounds, despite streamlining of his submerged units.

To achieve such streamlining the condensers and evaporators would lie horizontally, which to Dr. Zener is a disadvantage. His own scheme provides for vertical tubes in the evaporator so that the bubbles of newly formed vapor can rise unimpeded. His plant would be placed in less swift-moving waters where warm seas flow into the Caribbean between the island chain of the Antilles.

From such remote sites the energy would have to be "packaged" for transport. The favored scheme is to use the generated electricity to separate water into its components—oxygen and hydrogen. If this were done at depth in the sea, the gases would already be compressed and could be shipped, in that state, via tanker.

Hydrogen is regarded as a potential fuel of great efficiency and there are a variety of demands for oxygen.

Two deadlines have been set by the National Science Foundation for more advanced proposals. The first, on May 7, concerns schemes for testing design concepts, subsystems and components. Initial tests would be ashore. Then "proof of concept" experiments would be carried out at sea and perhaps, initially, on an island or coastal site close to deep water. For the initial studies $300,000 is available.

The second deadline, July 9, relates to more specific problems such as the design of pumps, problems of corrosion and fouling by marine life, construction methods, anchoring, environmental effects, energy delivery (for example, in the form of hydrogen, compressed air or batteries) and by-products such as fresh water or shellfish. For this category $1.5 million is available.

According to Dr. Lloyd O. Herwig, director of advanced solar energy research and technology at the N.S.F., a number of large industrial concerns are showing an interest in the project and considerable support is expected from the Navy.

Clarence Zener
Carnegie-Mellon University

S O L A R S E A P O W E R
VERSUS
N U C L E A R P O W E R

Heat Exchangers as Key to Economical Solar Sea Power

The work potential stored in the thermal gradients in the tropical oceans is the only renewable source of power which has the potential of satisfying the growing needs of the world population.

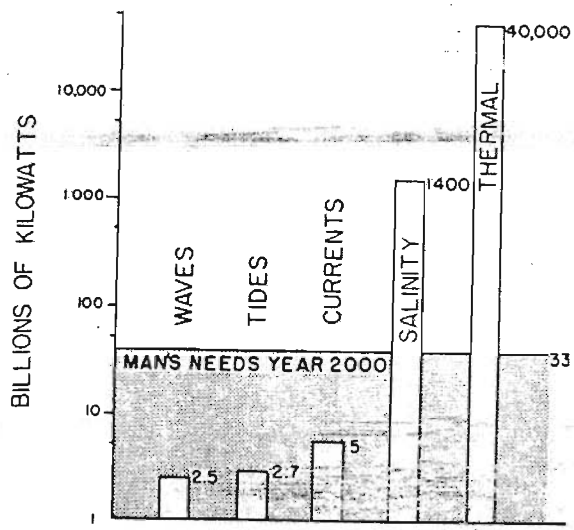


Figure 1
Power Dissipation Rates in Ocean
(after Isaacs, Jnl. Environmental Studies 4, 201 (1973)

The only industrialized nation which is adjacent to tropical waters suitable for SSP is the U.S.A.

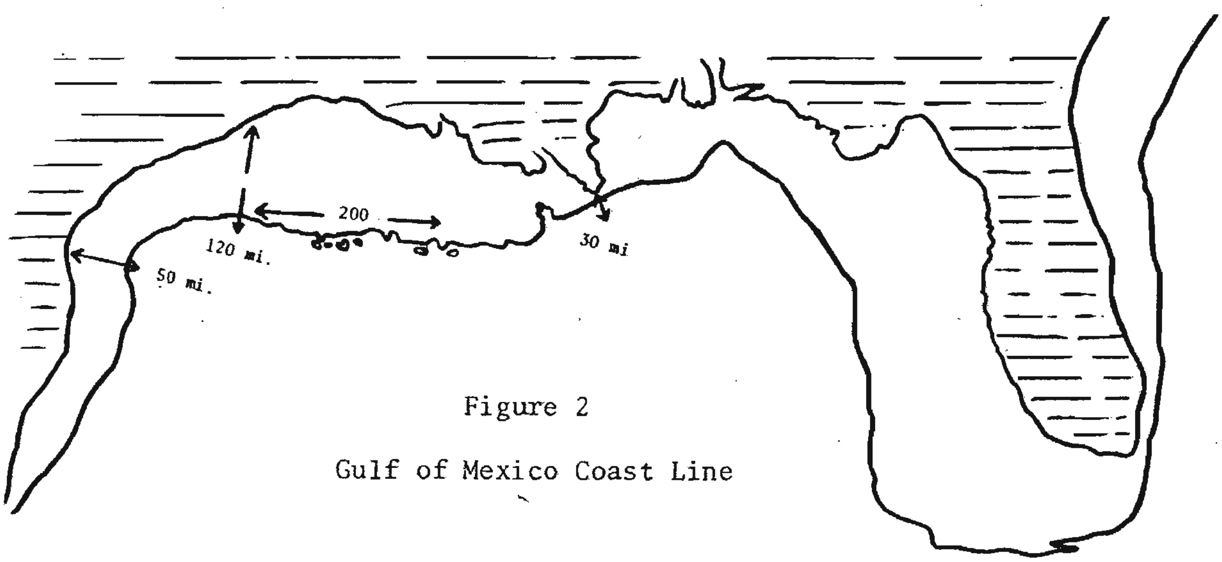


Figure 2

Gulf of Mexico Coast Line

Heat exchangers are the key to the economic feasibility of closed cycle SSPP's. For several years we at CMU have discussed how the heat transfer coefficients for small ΔT's could be economically increased several fold. This improvement has now been demonstrated by Rothfus at CMU by using axial fluting of ~10 mill depth. On the water side the heat transfer is increased 1.5 to 2 by the area ratio. On the working fluid side the heat transfer is enhanced several fold by the synergistic effect of surface tension and surface waves. With these heat exchanger improvements it is anticipated that the capital costs of SSPP's will be well below $1,000/kw capacity.

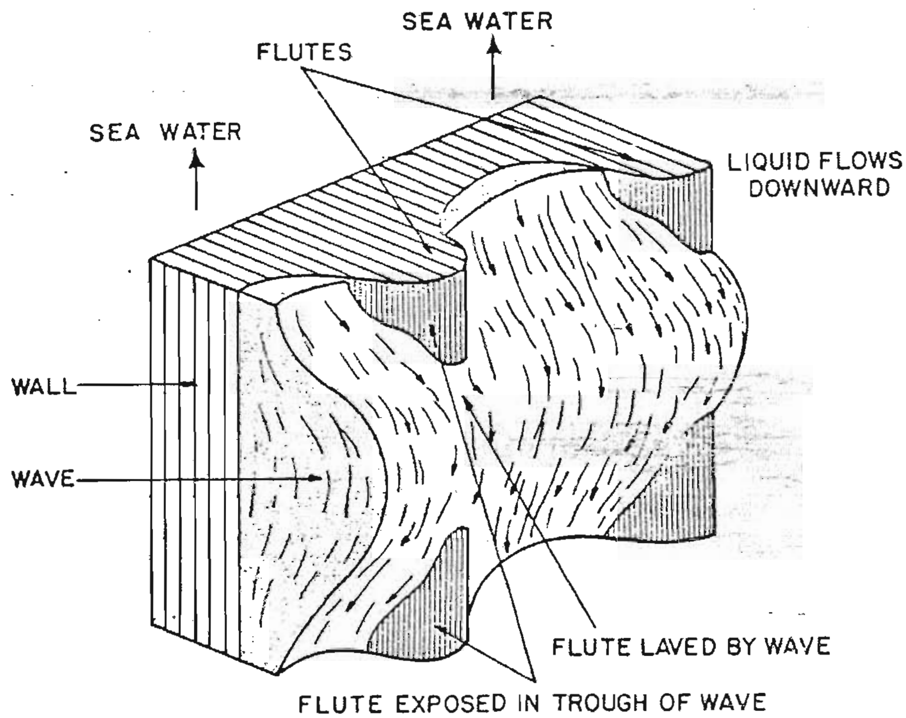


Figure 3

Enhancement of Evaporation by Surface Tension & by Surface Waves in Falling Film (after Rothfus)

The $1,000/kw Nuclear Myth

The nuclear industry is speaking of capital costs of ~$1,000/kw for nuclear power plants initially planned this year to be completed in the mid 1980's. A look (Fig. 4) at the historical comparison between the publicly estimated and the actual final costs suggests the final actual costs of these plants will be ~$2,000 per rated kilowatt capacity. A look at the historical record (Fig. 5) of actual capacity of large nuclear plants vs. rated capacity suggests that the actual final costs per effective kilowatt capacity will be more like $3,000, or

$3 billion for a 1,000 megawatt plant. We conclude that SSPP's with enhanced heat exchangers will make a better investment.

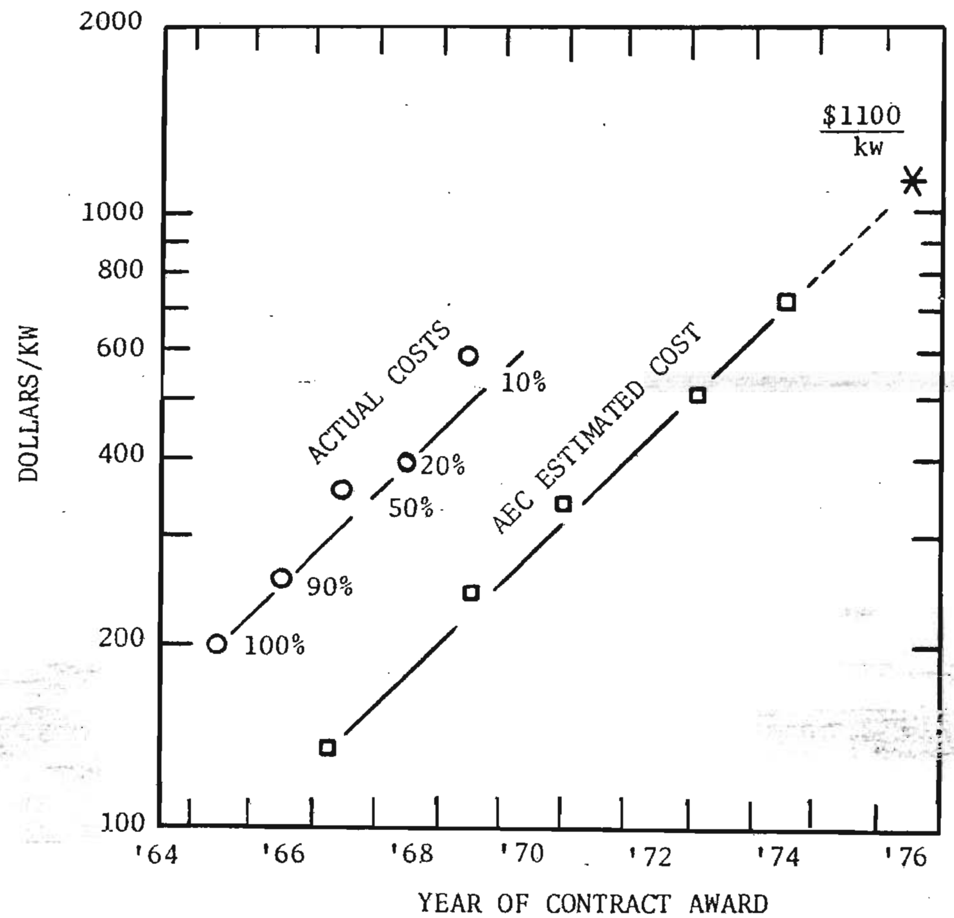


Figure 4

Estimated and Actual Capital Costs/kw of Nuclear Plants vs. Year of Announced Plans

Estimated Costs: WASH-1345 (October 1974).

Actual Final Costs: ERDA, Industry Relations, "Central Stations Nuclear Plants" Quarterly.

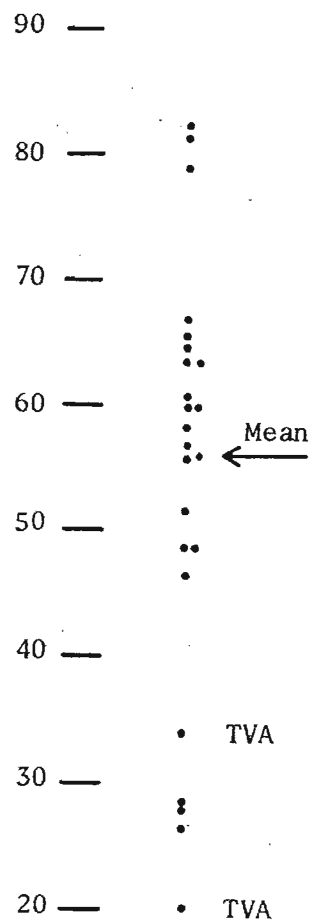


Figure 5

Average Capacity Factor

for All Nuclear Plants over 750 Megawatts.

Data: Nuclear Industry, January 1976, p. 18.