

Appreciation
The Life and Work of
Bill Heronemus,
wind engineering pioneer

by

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The Life and Work of Bill Heronemus, wind engineering pioneer

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ABSTRACT

William Edward Heronemus, Captain, USN (Ret.), Professor Emeritus, University of Massachusetts at Amherst, born April 16, 1920, died November 2, 2002. This is a memorial record and obituary of a remarkable wind power engineer, Bill Heronemus of the University of Massachusetts and, previously, of the US Navy. The author, a previous student and close colleague, writes personally, with much input and support from other colleagues and previous students. The aim is not only to record research, development and commitment at the early stages of modern wind power, but also to honour an admirable pioneer. Bill Heronemus is credited with foreseeing the 1973 Oil Crisis and thereafter wind power developments that have since been realised, including offshore wind farms. He is also credited with teaching and motivating many students who later became professional of modern wind power development and commerce. The obituary Note has been written from personal knowledge and from many written and verbal communications from colleagues and friends of Bill Heronemus who worked with him at different stages of his life. Details are referenced, with other records kept with the author.

1. INTRODUCTION

Bill Heronemus is known the world over as the “father of modern windpower” and the inventor of the wind turbine array, windship, wind furnace and offshore hydrogen flotilla ideas. He is generally credited with the invention of the terms “windfarm”, “windshaft” and “windsmith” in wide use today. All the present researchers in wind turbines owe the grasp of the fundamentals to Bill Heronemus’ work of the 1970s, when he and his cadre published many, many reports on windpower, along with the earlier pioneers forming the backbone of all the engineering, which was yet to come. Wind turbine engineers the world over know of Bill’s work, and quietly credit him with the original plan and vision, because most of us knew that he steadfastly avoided any public adulation or praise for his work, which he considered just to be “plain old common sense”. Bill Heronemus was an engineer’s engineer. He was humble, and would have been horrified and embarrassed to see his life in print like this. But he gave us a vision and a legacy for our own dreams, and changed many lives.

2. A SUMMARY OF THE WORK OF BILL HERONEMUS

The exert below was written in 1968 by Bill Heronemus as Professor of Civil Engineering at the University of Massachusetts in Amherst [1]:

“In the immediate future, we can expect the ‘energy gap’ to result in a series of crises as peak loads are not met. The East Coast will be dependent on foreign sources for most of its oil and gas. The environment will continue to deteriorate in spite of ever-increasing severity of controls. Air pollution, oil spills and

thermal pollution are likely to be worse, not better in 1985. In the face of the continuing dilemma: 'power vs. pollution', a third alternative [to nuclear and fossil energy] must be sought. It may be found in the many and varied non-polluting energy sources known to exist in the US or its offshore aggregate. These energy sources, tied together in a national network, could satisfy a significant fraction of our total power needs in the year 2000".

Thus Bill Heronemus not only predicted the worldwide energy difficulties which were to come, including nuclear power plant failures, but saw the grand scale of future of renewable energy development [28]. This included solar thermal, land-based and offshore wind [29], and ocean thermal energy. He had encyclopaedic knowledge of power plants, oceanography and engineering, and he was able to present his arguments in a practical and convincing way.

Originally from a dairy farming family in Lancaster, Wisconsin, Bill Heronemus attended the US Naval Academy at Annapolis, and was commissioned Ensign, USN, on December 19, 1941. He was immediately assigned as Gunnery Officer on the destroyer USS Woodworth, and fought in the campaigns in the Solomon Sea and Western Pacific, where he was awarded the Bronze Star with Combat 'V' for his actions under fire. Later in the war and being an engineer, Lt. Heronemus was reassigned to the famous battleship USS North Carolina in February 1945 as the Engineering Auxiliary Officer. After the war, he attended MIT to complete his MS in Naval Architecture & Marine Engineering; his chief interest was the propulsion of warships and submarines. At the Portsmouth Naval Yard in 1948, he became a Submarine Engineering Duty Officer, and he spent the next 17 years in the US Navy working on the design and construction of the US nuclear submarine fleet. He was a central figure in the unprecedented Cold War effort to establish a formidable US nuclear submarine fleet under three Presidents, which was pivotal in maintaining *detente*. In 1963, Bill Heronemus became the Assistant Naval Attaché to the Court of St. James in London, England.

Bill retired from active duty at the rank of Captain in 1965, and went to United Aircraft Corporation as the Engineering Manager, still pursuing power systems. In 1967, Bill took the job of starting an Ocean Engineering department at the University of Massachusetts. The OE work included oceanography, marine biology and geology as well as naval architecture, which Bill taught personally in a very difficult two-semester course. We were lucky to have had him for a teacher and mentor.

In the late 1960s Bill Heronemus correctly predicted a coming energy crisis, and began a national debate on energy policy, advancing the use of "Grand Scale Renewables" to replace gradually fossil fuel and nuclear energy. Bill was already an expert on structures, power systems and the oceans, and quickly learned ocean thermal and wind energy by using the literature available in the 1960s, the work of the other pioneers: Juul, Champly, Hutter, Betz, Percy Thomas, Golding, Shefter, Lacroix, Helge Petersen, Sabinin, Vadot, Stodhart, Putnam, LeCours, Honnef, Claude, Chilcott, and many others. To their work, he added support structures for Multiple Arrays (Fig 1), Wind Ships, Flotillas and a Hydrogen Storage System to firm the power. He enlisted practically the entire engineering faculty of UMass, and presented a landmark proposal urging the National Science Foundation in 1971 to accelerate renewables research and development [1]. The Proposal was audacious, including putting many wind turbines on a space array, on Wind Ships out at sea in Flotillas, to harvest the wind energy there producing hydrogen fuel and anhydrous ammonia fertilizer via electrolysis. The Grand Scale Offshore Wind Power System was showcased in the December 1975 issue of *National Geographic Magazine*. It depicted a 34-turbine array Wind Ship moored at sea in a Flotilla, converting seawater to hydrogen fuel. This concept was widely circulated in the technical

and popular press, but no funding came to UMass because the competing interests were too strong. The offshore windpower concept was eagerly adopted by the Energy Research and Development Administration (later the US Department of Energy), who funded GE and Westinghouse, using Bill's ideas. Their results were mediocre, and seemed to discredit offshore windpower, but our technological culture is very close to realizing that vision now.

Bill's energy debate grew, with his appearances before Congress and many government agencies and utilities, each time presenting feasible plans for renewable energy [2, 3, 6, 8, 10, 12, 13, 15, 17, 21]. This culminated in the Carter Administration recognizing the wisdom of the Plan, and in 1975 with UMass getting a contract with NSF to design and construct the Wind Furnace and Solar Habitat, a 10m wind turbine heating a single-family solar home via large hot water storage tanks (Northeast Utilities would not permit us to produce grid electricity). The *WF-1* was commissioned on Nov. 6, 1976. The installation, though idle, still stands on the UMass campus, and is a well-known landmark to all of us who studied wind energy then.

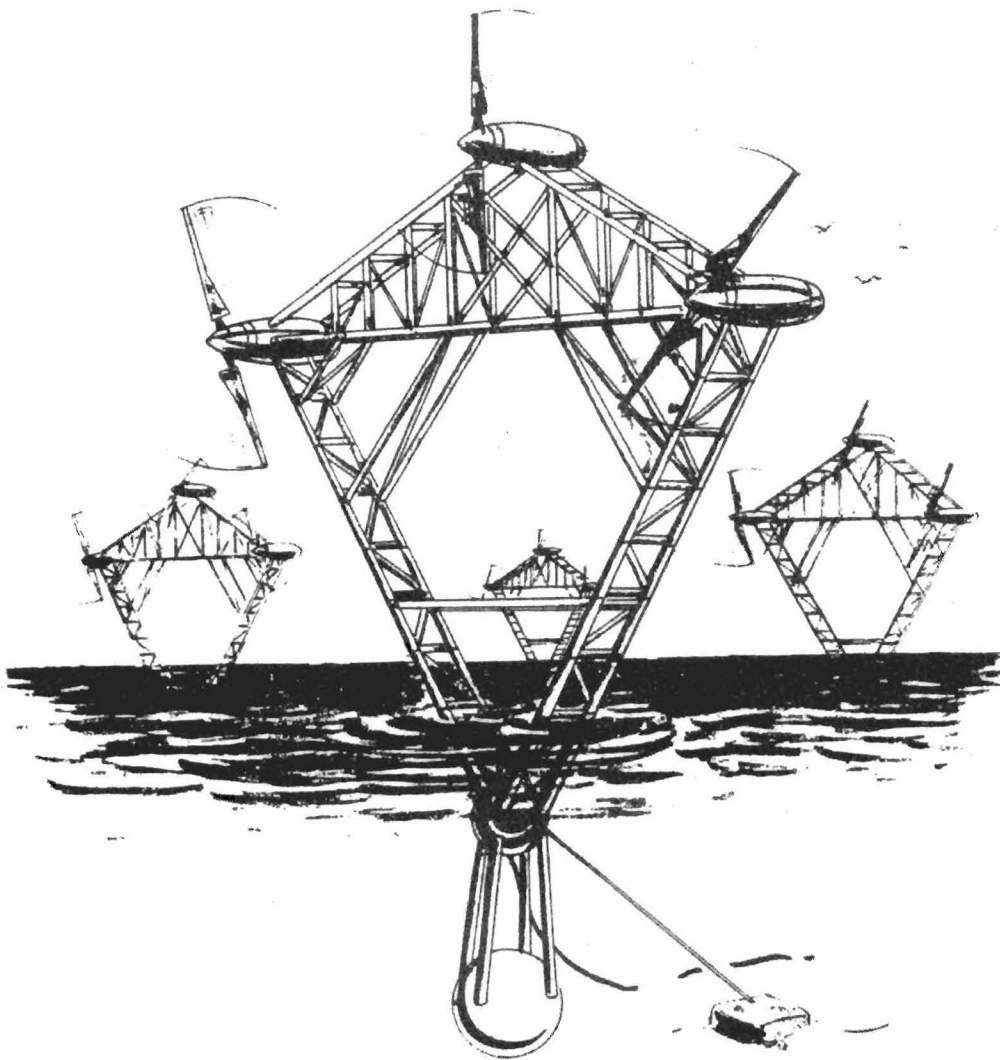


Figure 1 Design for a multiple-array wind turbine structure, produced by Bill Heronemus and his colleagues at the University of Massachusetts in the early 1970s. The concept predicted offshore windfarms. The turbines on this array were based on the Russian Yalta machine of the 1930s, as described in the classic book by Golding (reprinted 1976)

In 1972, Bill founded the Wind Power Group in the UMass Engineering Department. Bill personally enlisted other professors from mechanical, electrical, and civil engineering to lend their leadership and expertise to the program, notably, Jon McGowan, Dick Monopoli, Duane Cromack, Bob Kirchhoff, Frank Kaminsky, Al Russell and Merit White. This team of professors generated a group of undergraduate and graduate students to work in renewable energy under Bill. The major efforts were offshore windpower and ocean thermal energy. Since we were all eagerly learning about wind turbines, Bill and the author gave the first course in windpower engineering to the students in 1972. Under Jim Manwell's leadership this course has continued as an official UMass engineering course of study, unbroken ever since then, culminating with a comprehensive textbook [33]

This UMass Renewable Energy Project was long-lived, due to Bill's consistent lobbying and pushing the DOE to implement solar, wind, and ocean thermal energy. The graduates from the windpower course numbered 8 in 1974. These were the students who designed and built the Wind Furnace. In subsequent years, the number of students grew, and this cadre of graduates formed the core of the US wind industry, both in founding wind energy companies and staffing the national agencies, principally NREL (National Renewable Energy Laboratory). Dozens of Bill's students still work in the wind industry and DOE, and the "UMass Mafia", as it is fondly known, is still the strongest core of close professionals in the field in the world. These UMass graduates were, and still are, eagerly sought by the now-large wind turbine companies.

During the 1980s, Bill worked on ocean thermal energy conversion (OTEC) [31]. He proposed large OTEC plants abroad and in the US, along with wind turbines in appropriate locations, at a yearly cost starting with two billion dollars and increasing over the years. He took leave from the University to start his own company, Ocean Wind Energy Systems. Co-operating with the Alfa-Laval company, the plan was to build a prototype OTEC. The estimate was that such energy systems should cost no more than current generating plant, but would produce no pollution, no fuel shortages, no price increases and a simple, labour-intensive technology offering more ample and more balanced employment.

US Windpower was founded by Stanley Charren and Russell Wolfe in 1976; the company became the first major US wind turbine manufacturer. This company undertook to build "windfarms" based on Bill's ideas and the original Wind Furnace design. US Windpower (later Kenetech) became the largest wind energy firm in the world, and succeeded in erecting thousands of windmills. Charren and Wolfe credit Bill with the vision and plan which "created the entire windpower community", and then "staffing it with his own students and graduates". Bill lived to see windpower grow into a major industry and way of life in the world. He particularly enjoyed the offshore windfarms. He pursued his own research and designs through the '80s and '90s, with help from his previous students. In 1998, Bill and the author founded Ocean Wind Energy Systems, Inc. to implement the Wind Turbine Array, Windship, Wind Furnace and Hydrogen Flotilla and codify Bill's vision and designs in patents.

Bill Heronemus was a member of the Society of Naval Architects and Marine Engineers, ASME, American Society of Naval Engineers, International Solar Energy Society (ISES), Marine Technology Society, Sigma Xi, Phi Eta Sigma and the American Wind Energy Association. He was the recipient of the Chancellor's Medal at UMass in 1977, an NSF grantee, 1963-68, and awarded the Lifetime Achievement Award by the American Wind Energy Association in 1999: "In recognition of the inspiration that he provided to an entire generation of wind energy engineers and of a vision for the wind industry that is only now starting to be realized".

In his AWEA 1999 acceptance speech, Bill said:

"There is an absolute requirement for the Earth to remain in thermal balance within our solar system. There is only one ultimate solution to the global warming problem: total reliance upon solar energy. And the most productive of all solar energy processes is the wind energy process." He continued, saying, "Wind power needs to be developed at a steady and appropriate pace, but the free market capitalistic system that we hold so dear will not do the job. There is need for massive governmental interference. If we wait for the private sector to reduce the greenhouse gases linked to our fossil fuel use, it will be too late."

He remained active until the last days of his life, writing in 2000 [32]:

"Renewable energy is mandatory for the future of mankind. Wind energy is one of the best sources, and the technology already exists to tap it. Europeans are moving quickly in this direction, while Americans are dragging their feet"

In conclusion, the following paragraph is taken from a published obituary [34]:

"Heronemus' crusade to expand energy sources makes sense to us and is more relevant than ever today, when many people believe the quest for oil is a destabilizing factor in world politics. But ideas such as his found little favour in the US, where "black gold" has always been king. Wind power, being less tangible than other energy sources, just doesn't excite the imagination of the energy industry the way a gushing oil well does. The industry's fears of competition also played a part in its rejection of Heronemus' ideas. A source of power that is easily obtained, renewable and doesn't require extensive supporting industries - in short, one that upsets the established order and could compromise profits - is viewed as a threat rather than a possible solution to a problem... We don't want to give the impression that William Heronemus' struggle to promote alternative energy sources was in vain. Far from it; his vision is becoming a reality in Denmark, which hopes by 2040 to supply 50% of its electricity through renewable energy sources - a large portion of it from offshore wind turbines. William Heronemus is gone, but his ideas live on. They are needed now more than ever, and we'd like to see them given more consideration, especially in the United States. There is little to lose and much to gain".

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