BOEING

PLANEMAKER TO THE WORLD

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EXCERPTS ONLY

This edition is published by
Crescent Books, distributed by
Crown Publishers Inc.

Produced by
Bison Books Corp.
17 Sherwood Place
Greenwich, CT 06830
USA

Printed in Hong Kong

ISBN 0-517-422700

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Half-title page: The **P-26 Peashooter**, which made its appearance in 1932, was the US Army Air Corps' first all-metal monoplane fighter and probably Boeing's most famous fighter. In its day it was the fastest fighter in service and though outclassed by the time of World War II, it gave a good account of itself in the war's first week.

Title spread: Boeing built the world's biggest building in order to assemble the world's biggest jetliner. Boeing's **Model 747** is the overwhelming choice of major carriers flying long-distance international routes and can be seen at any major airport in the world.

Below: This billboard appeared near **Boeing Field** around 1941 at a time Boeing was pioneering its multi-engined aircraft. By this time the company that had started in a boathouse on Lake Union was one of the world leaders in the field of four-engine aircraft.

THE OTHER BOEING

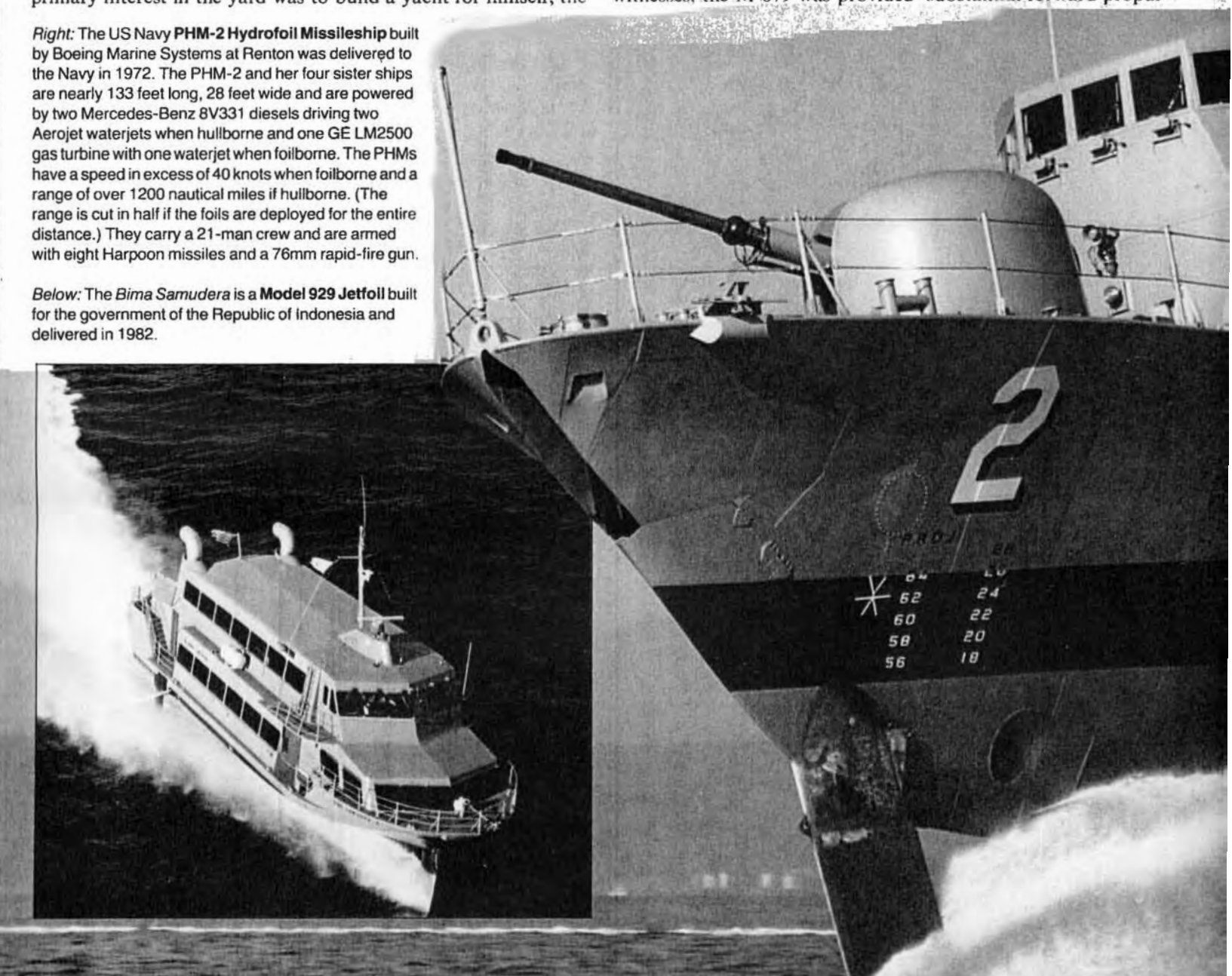
The Boeing Company has passed through many changes since it began in 1916, but its primary aim has been to build airplanes. This is now closely partnered with the manufacture of missiles for national defense, and with inventing spaceships for probing the universe. There is another Boeing, though, one that investigates such terrestrial activities as computer technology, automated transit systems, agriculture, and even ships that fly.

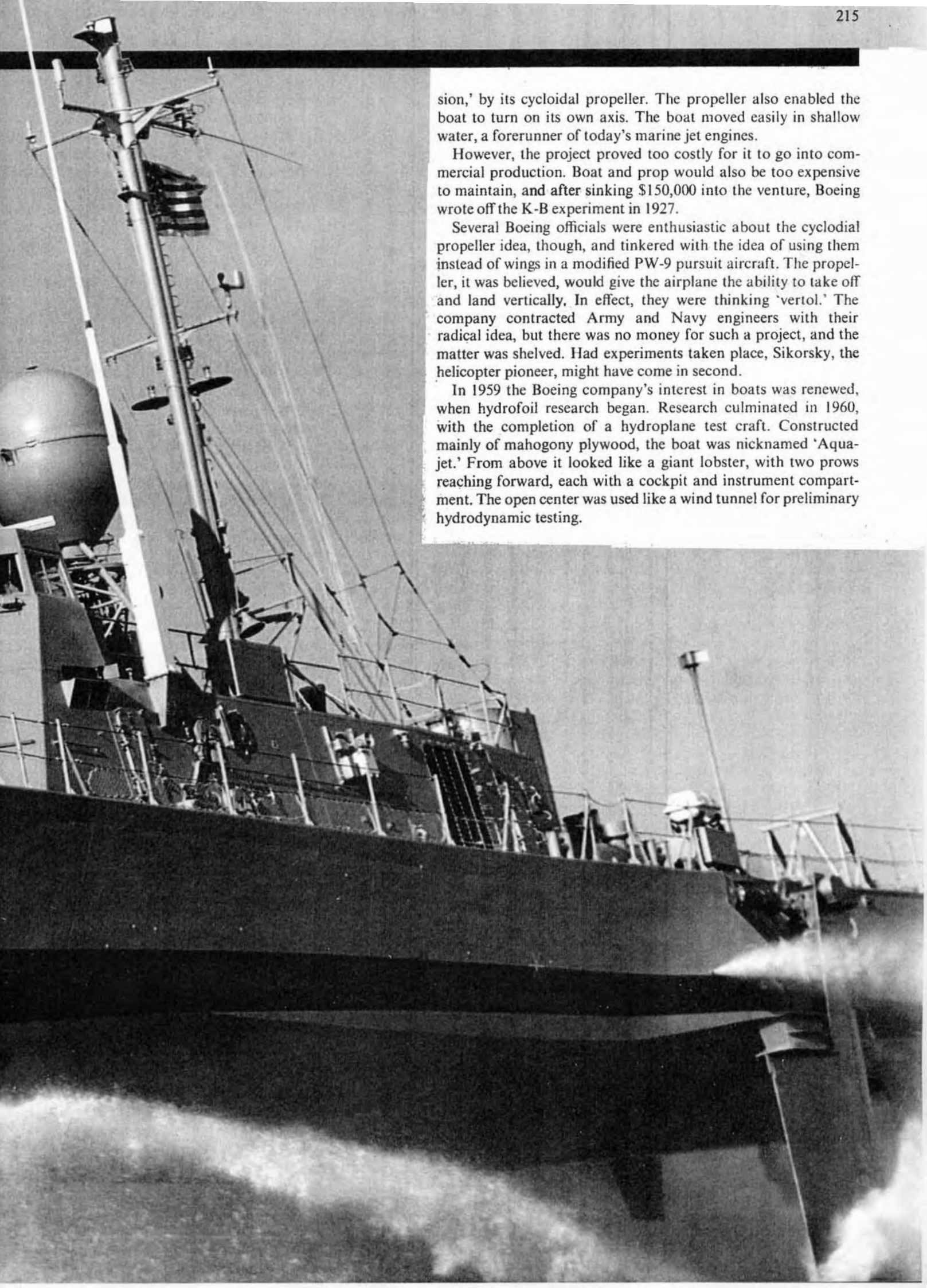
As early as 1910, Bill Boeing showed his interest in boats when he purchased the E W Heath Shipyard in Seattle. Though his primary interest in the yard was to build a yacht for himself, the shipyard became a part of the Boeing airplane factory and Boeing's interest in boats remained.

In 1919 three years after the first flight of Boeing's first airplane, he became involved in developing the Hickham Sea Sled. The venture failed, but Boeing in the meantime became acquainted with Professor Frederick Kirsten of the University of Washington. Kirsten was interested in designing a cycloidal propeller and joined Boeing to form a company, K-B Engineering, to develop the idea. A sports boat, the M-879, was constructed to test the propeller, and it was launched in August 1922. According to eyewitnesses, the M-879 was provided 'substantial forward propul-

Right: The US Navy **PHM-2 Hydrofoil Missileship** built by Boeing Marine Systems at Renton was delivered to the Navy in 1972. The PHM-2 and her four sister ships are nearly 133 feet long, 28 feet wide and are powered by two Mercedes-Benz 8V331 diesels driving two Aerojet waterjets when hullborne and one GE LM2500 gas turbine with one waterjet when foilborne. The PHMs have a speed in excess of 40 knots when foilborne and a range of over 1200 nautical miles if hullborne. (The range is cut in half if the foils are deployed for the entire distance.) They carry a 21-man crew and are armed with eight Harpoon missiles and a 76mm rapid-fire gun.

Below: The *Bima Samudera* is a **Model 929 Jetfoil** built for the government of the Republic of Indonesia and delivered in 1982.





sion,' by its cycloidal propeller. The propeller also enabled the boat to turn on its own axis. The boat moved easily in shallow water, a forerunner of today's marine jet engines.

However, the project proved too costly for it to go into commercial production. Boat and prop would also be too expensive to maintain, and after sinking $150,000 into the venture, Boeing wrote off the K-B experiment in 1927.

Several Boeing officials were enthusiastic about the cyclodial propeller idea, though, and tinkered with the idea of using them instead of wings in a modified PW-9 pursuit aircraft. The propeller, it was believed, would give the airplane the ability to take off and land vertically. In effect, they were thinking 'vertol.' The company contracted Army and Navy engineers with their radical idea, but there was no money for such a project, and the matter was shelved. Had experiments taken place, Sikorsky, the helicopter pioneer, might have come in second.

In 1959 the Boeing company's interest in boats was renewed, when hydrofoil research began. Research culminated in 1960, with the completion of a hydroplane test craft. Constructed mainly of mahogony plywood, the boat was nicknamed 'Aquajet.' From above it looked like a giant lobster, with two prows reaching forward, each with a cockpit and instrument compartment. The open center was used like a wind tunnel for preliminary hydrodynamic testing.

Specifications: Jetfoil Boeing Model Number 929

Cruising speed	42-45 knots
Weight	115 long tons
Length	90 ft
Beam	30 ft
Powerplant	two Allison 501-KF turbines, with two Rockedyne PJ-20 waterjet pumps. Engines rated at 3800 hp each
Crew	Two-six, depending on need

In 1962 Boeing Marine Systems (BMS), built another experimental boat, the *Little Squirt*. It was a company-financed vessel, built to prove the feasibility of waterjet propulsion, a system later used on all Boeing hydrofoils. *Little Squirt* demonstrated that hydrofoils have a 50 knot capability, an important quality. Speed was one of the requisites if hydrofoils were to compete with boats of conventional and proven capabilities.

It is generally agreed that airplanes belong in the air, boats on water, but it is different with hydrofoils. They seem to fly over the waves on waterborne wing-like structures. Attached to the hull by a system of struts, the foils lift the boat several feet above the surface, using water in the same way as airplane wings generate lift, allowing the boat to travel with its main bulk unaffected by water resistance.

There are two basic types of hydrofoil boats. On one, the foils ride on or near the surface of the water, following its contours, rising and dipping with the waves. At times this can let passengers in for a rough ride. A number of vessels using this type of foil are currently in use, mainly in Europe and Asia.

The other hydrofoil operates with its foils fully submerged. Being completely under water, this hydrofoil is unaffected by waves and other surface turbulence. The result is a smooth ride, even in rough water. BMS builds several different types of vessels with completely submerged foils.

Working on Navy contracts, BMS has experimented with a variety of hydrofoils. In 1965 the Navy awarded a contract to Boeing to build a hydrofoil gunboat. Named *Tucumcari* after the city in New Mexico, it was the first of its kind in naval history. Designated PGH-2, for Patrol Gunboat Hydrofoil-2, the *Tucumcari* was launched in July 1967, and 'flew' first in October. The vessel did not have a conventional propeller, but used Boeing's waterjet system of propulsion. Water was drawn through the craft's rear foil struts into a pump, then jetted through nozzles under the stern. There were no lubrication problems and no complicated transmission system as is required on propeller craft. A 3100shp gas turbine supplied the foil-borne power, while a second waterjet pump, powered by a 150bhp diesel, drove the ship during slower hull-borne operations.

The *Tucumcari* was 74.6 feet long, with a 19.5 foot beam, and was capable of speeds over 50 knots. It displaced approximately 60 tons, and the hull and superstructure were aluminum. The foils and struts were of corrosion-resistant steel. This swift little ship, a relative of the World War II PT-Boats, was manned by one officer and 12 crewmen. She had a short, but noble, history. After serving in the coastal waters off Vietnam, she was assigned to the Navy's Amphibious Force at Little Creek, Virginia. She became the prototype for the Patrol Hydrofoil Missileship (PHM). In the fall of 1972, the *Tucumcari* ran aground in the Caribbean and was decommissioned.

In November 1971 BMS was awarded a contract to design the Patrol Hydrofoil Missileship. With years of experience to draw on, BMS produced a satisfactory plan, and the company was awarded a construction contract.

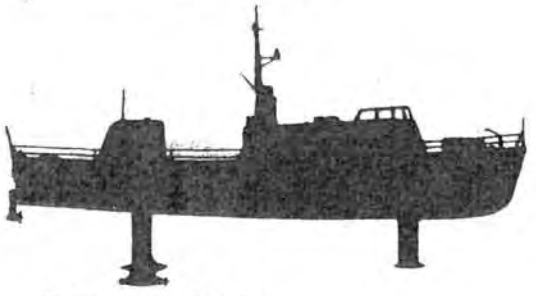
On 9 November 1974, the first missileship, *Pegasus*, was launched. Designated PHM-1 by the Navy, she made her first 'flight' on 25 February 1975. In October that year, *Pegasus* made a record sailing from Seattle to San Diego in 31 hours and 21 minutes, averaging 37 knots. As the ship was 131.2 feet long, with a beam of 28.2 feet, and a displacement of 239.6 long tons, such speed was to be noted. It was, and a contract for five more PHMs was granted. Named after the constellations, as was the first, they are the *Hercules*, PHM-2, *Taurus*, PHM-3; *Aquila*, PHM-4; *Aries*, PHM-5 and *Gemini*, PHM-6.

Fully submerged foils and advanced automatic control systems give PHM the missile platform stability and ride comfort in heavy seas usually found only in large ships. A powerful offensive armament makes the PHM an effective weapons system for strike, patrol and surveillance missions. Waterjet systems, pioneered by Boeing, speed the craft along, when flying on its foils, or when traveling on its hull. The foil-borne system consists of a single Aerojet Liquid Rocket Company waterjet capable of pumping approximately 90,000 gallons per minute.

BOEING HYDROFOIL DEVELOPMENT

1962: Little Squirt

1963: Fresh 1



1963: PCH-1 High Point

1968: PGH-2 Tucumcari

It is driven by a General Electric LM 2500 marine gas turbine. When hull borne the ship is powered by two 30,000gpm Aerojet waterjets. Each is driven by a Mercedes-Benz 8V331 diesel engine. Foil-borne cruising speed is in excess of 40 knots. The ship can be operated by as few as six officers and men on any watch, but berthing is provided for 24. The normal crew is 21, four officers and 17 enlisted personnel.

Boeing is not excluding the commercial possibilities of hydrofoils, and BMS has developed the *Jetfoil*. Hailed as a new dimension in marine transportation, the *Jetfoil* hydrofoil for commercial passenger use was announced in October 1972. The first one, Model 929-100, was launched 29 March 1974. Jetfoil service was initiated on 25 April 1975 by Far East Hydrofoil Ltd between Hong Kong and Macao.

The Jetfoil combines fully submerged, computer-controlled steel foils on an all-aluminum hull. Ride quality is unmatched by any other marine craft, assuring all passengers an unobstructed view, smooth and serene, even in rough seas. Environmentally, the Jetfoil claims kudos, too. Because only narrow struts pierce the water when foil borne, there is almost no wake. The Jetfoil is so well constructed that it had no problem finding certification in such diverse countries as the US, China, Venezuela, Belgium, Japan and Britain.

The ship has a 30-foot wide cabin, which allows for two decks with large seats. The standard configuration Jetfoil, the Model 929-100, can carry up to 250 passengers and provide space for luggage and galleys. Design flexibility permits variations according to what the customer needs, and as many as 350 seats can be provided.

Jetfoils are now in use throughout the world, from China to the Republic of Indonesia, making a total fleet of 18 vessels. A derivative, HMS *Speedy* (Model 929-115) was built for the British Royal Navy for North Sea patrols. Though the US has not used this remarkable design yet, it seems likely that the foreign market will expand.

In the spring of 1950, Lloyd Hull tested a Kenworth truck using a Model 502 175hp Boeing-developed gas turbine. Truckers who saw the twin-stacked vehicle were curious. They liked the engine, because the 502 weighed only 200 pounds. A standard diesel engine could weigh up to 2500 pounds. By any trucker's definition, that difference meant profits in the payload cargo. Development of the 502 continued, but *Boeing Magazine* for July 1951 revealed that the gas turbine seemed destined for a military rather than a commercial career. Pinpointing it further, the 502 was being tested on Navy boats in Lake Washington, adjacent to Seattle.

Improved 502s in the 240–330hp range were tested on everything military from tanks to helicopters to hydrofoils to pumps. A 520 series was developed by Boeing's Industrial Products Division, producing up to 600hp. Still another model was able to net 550hp. It might be pointed out here that Boeing had reserved model numbers 500–599 for industrial non-aircraft products. Models 502, 520, 540, 551 and 553 were gas turbine engines.

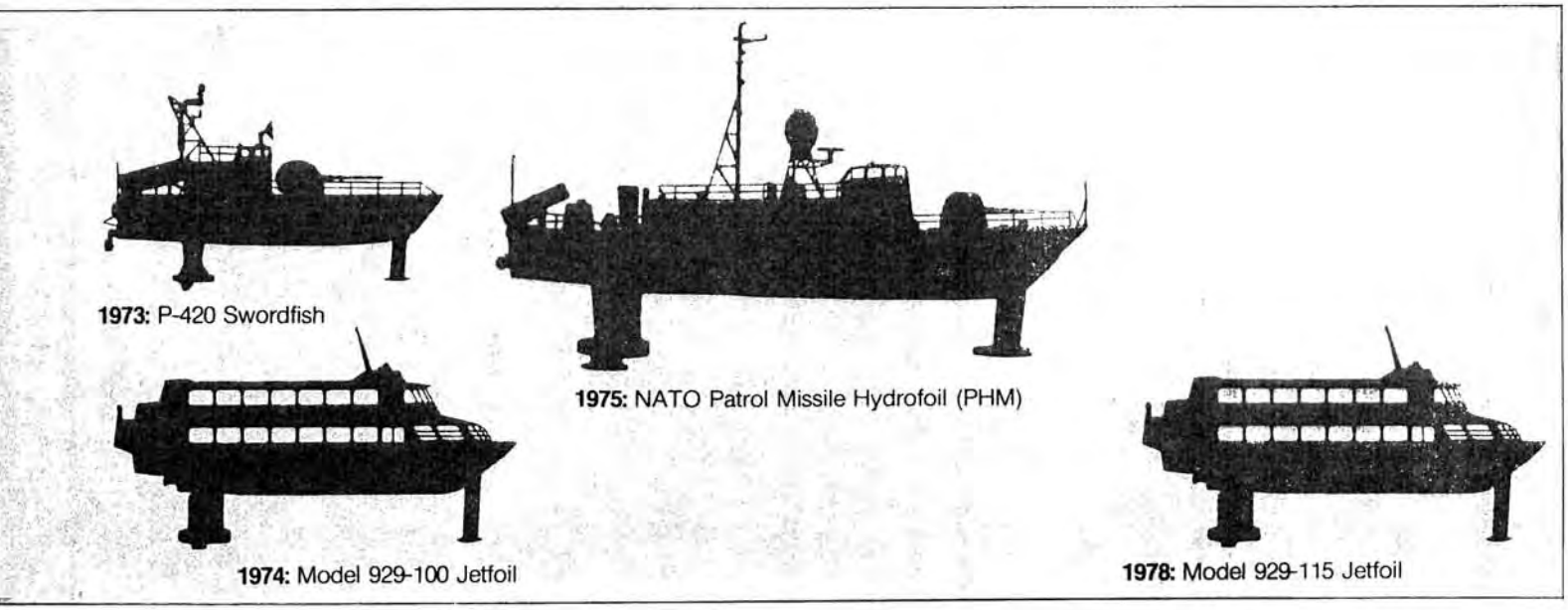
There were many firsts for Boeing gas turbines. They included the world's first turbine and twin turbine helicopters, first turbine highway truck, first turbine locomotive, commercial boat, earth-moving tractor, racing car, minesweeper and landing craft.

The market for the Boeing turbine seemed assured, but in 1969 the business was phased out. Competitors were making good products, and Boeing decided not to compete. The company decided that the money used on gas turbine development could be better employed on new airplanes and aerospace research. So Boeing bowed out.

With the swift proliferation of computers throughout the world, Boeing set up the Boeing Computer Service, BCS, in 1970. Its purpose was twofold: to fulfill the data processing requirements of The Boeing Company and to offer advanced information processing services to commercial and government markets. It currently services more than 2500 customers in the US, Canada, and Britain. To transmit data reliably and economically, BCS operates one of the largest privately managed telecommunications networks in the world. Major data centers are located in Philadelphia, Wichita, Vienna (Virginia) near Washington, DC, and two in the Seattle metropolitan area at Bellevue and Kent.

The people of BCS provide computer support services for business, scientific, engineering, industrial and government uses, as well as nationwide consulting, educational and other training services.

Ten years after its inception, the number of BCS commercial customers had risen to over 2500, including a substantial number of very large corporations. Because of increased demand for commercial data processing services in the fields of financial management and design engineering, BCS is emphasizing products relevant to these activities. Under one such contract, electronic funds transfer services are being provided to a con-

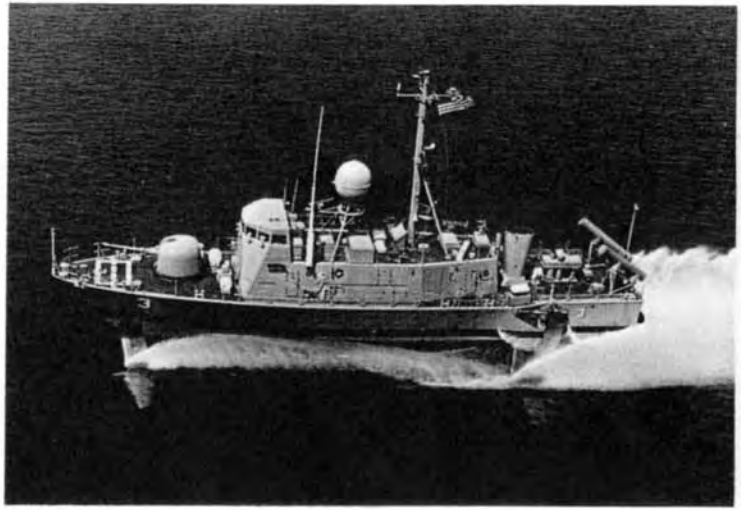


1973: P-420 Swordfish

1975: NATO Patrol Missile Hydrofoil (PHM)

1974: Model 929-100 Jetfoil

1978: Model 929-115 Jetfoil



Above: A **Model 929** jetfoil in service with Sealink on the English Channel.

Above right: The US Navy's **PHM-3** during trials on Puget Sound in 1982.