



Vital Jette (stern) and Edwin A. Link (bow) in a skinless prototype of a Linkanoe.
EDWIN A. LINK, JR., ARCHIVES, BINGHAMTON UNIVERSITY LIBRARIES

Ed Link and his Linkanoe

by Tom McCloud and Bob Snyder

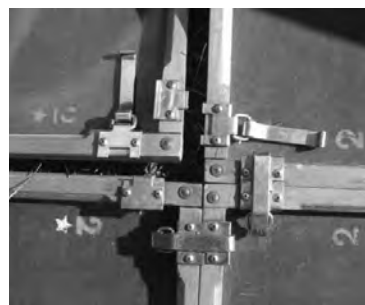
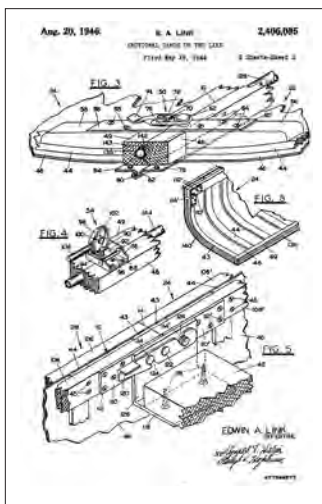
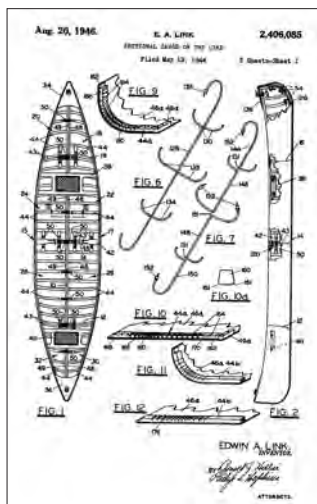
The 1920s were the early days of aviation, and Edwin A. Link, Jr., a teenager at the time, became enamored with airplanes. He hung around fliers, and took “rides,” which passed as flying lessons in those days, and at twenty-three, he earned a pilot’s license.

Born in Huntington, Indiana, in 1904, Ed grew up in Binghamton, New York. He worked in his father’s piano and pipe organ factory, where he showed a knack for all things mechanical. Against his father’s wishes, he did not attend college, but instead repaired motorcycle and airplane engines, managed the Binghamton airport, did “barnstorming” and aerial advertising, and ran a flying school. And it was in Binghamton, about 1929, that he invented the first flight trainer. Utilizing his knowledge of pipe organ pneumatics, he built what became known as the “Blue Box” trainer. The device was perched on a pedestal, which an instructor could control in three dimensions—pitch, yaw, and roll (which, if you think about it, is not so different from paddling whitewater)—giving a pupil the “feel” of piloting an airplane. Link Aviation was born.

In 1929, Marion Clayton, a graduate of Syracuse University and a reporter for the Binghamton newspaper, interviewed the young industrialist, Ed Link. Two years later they married, and through the tough times of the 1930s, they worked together to keep Link Aviation going. When Ed took on a problem, he was fanatical about solving it, working non-stop for long hours, and always with classical music playing in the background. Though sales were slow, and some Link trainers went to amusement parks as novelty rides, Ed continued to develop his flight trainer, particularly by adding instrumentation to school pilots in instrument and night flying.

The British Royal Air Force signed a contract with Link Aviation in 1937 for several hundred trainers. The RAF, however, required that the trainers be manufactured in a Commonwealth nation, and so Link Manufacturing Ltd. was established at Gananoque, Ontario, Canada, just across the St. Lawrence River north from Watertown, New York. Aside from being the closest location in Canada to Binghamton, Gananoque was chosen in part due to its proximity to the Links’ vacation home on nearby Perch Island in the Thousand Islands, and Ed could easily commute by flying his plane the 170 miles between Binghamton and Gananoque. With the start of World War II, the demand for pilots was tremendous. A training center for British pilots was established at Gananoque, in part because the Link trainer factory was there. During the war, thousands of Link trainers were shipped around the world, and tens of thousands of U.S., Canadian, British, Australian, and other Allied-nations pilots received their early flight training in Link “Blue Boxes.” But with the end of the war, the demand for trainers collapsed.

Ed Link was also an outdoorsman, who enjoyed hunting, fishing, and boating. He leased a wilderness retreat at Crooked Lake, Quebec, and he would fly there in his Grumman G44 Widgeon, a twin-engine, five-seat amphibious airplane. (Remember the TV show “Fantasy Island” and —“Ze plane! Ze plane!” The plane that delivered guests to the island was a Grumman Widgeon.) But Link wanted a canoe that could be carried in the plane, and since none was available, he invented one—the Linkanoe. To keep his factory and workmen employed following the war, Ed Link repurposed the Gananoque facility, using it for building several different types of canoes and wooden boats. The Linkanoe was introduced at a public relations event at the Lexington Hotel in New York City on December 12, 1945.



Each section of the canoe is marked. To assemble, it was a matter of matching the numbers and fastening the clamps.

PHOTO: BOB SNYDER

Ed Link's patent for the Linkanoe. He had about seventy-five patents awarded; no 2,406,085 was for a "Sectional Canoe or the Like." This patent shows a sectional canoe of eight pieces, made watertight with a pneumatic bladder between sections. There are photographs of canoes lacking the canvas skin, and it is assumed that these were prototypes built according to the patent design.

Building the Linkanoe

The Linkanoe, though built of wood and canvas, has a construction totally unlike traditional wood and canvas canoes. The canoe consists of ten sections that are assembled into a hard hull, held together by metal clips. Once assembled, the hull is 14½ feet long, 36 inches amidships, 12½ inches deep, and flat-bottomed, with slight tumblehome and moderate shear; it is made watertight with a canvas skin. These ten shaped sections are formed from Micarta, a Bakelite-type hard plastic made by impregnating cloth with phenolic resin, which gives it a dark red-brown color, and

was in use at the time to make things like electrical insulators and mounting plates for the tube sockets for vacuum tubes in radios. Rectangles of Micarta were shaped into hull sections with heat and pressure applied with a screw-press, which had been built in-house, over molds. Because the boat is symmetrical, it is probable that only five molds were required to make the ten canoe sections.

Each formed Micarta section is "framed" to the inside of the canoe with wood. Nearly all the wood used in Linkanoes is a birch laminate, probably made with a phenolic or resorcinol adhesive. These frame members or "ribs" are only ¾ of an inch square, yet contain eleven thin layers of wood! A ¼-inch round groove is cut lengthwise in the center of the laminate along one of the edges. On the corners where these wood strips come together, they are joined with finger-lap joints, additionally secured with a copper rivet. Lacking the "rigidity" that comes with a traditionally-built hull, this construction technique has an obvious advantage: there is none of the "spring-back memory"

Care and Maintenance

Looking for a Linkanoe for restoration? They turn up on eBay several times each year. When examining a boat look for delamination of the wood. If delamination is minor, slivers of veneer can be pushed into gaps and epoxy resin injected into these loose places using a syringe, and then clamped to effect repair. If a rib is cracked, a section can be cut out, and the laminate rebuilt, overlapping at both ends for strength—giving a sort of "stair-steps" appearance to the patch when viewed from the edge.

If the canoe has been poorly stored, the birch may have deteriorated badly, and if that is the case, the damaged area will have to be cut out and replaced. Epoxy does a reasonable job of binding together cracks in the Micarta hull. The steel screws and nails, if rusty, will have stained the wood, and neither rust stain nor rusty hardware can easily be removed. Varnish comes off easily with stripper, which on short exposure does not damage the Micarta.

These repairs are simple enough for the basement woodworker, but time-consuming. The metal clamps and braces can be removed and re-plated. But there is no source for replacement canvas skins—you would have to buy canvas and sew one for yourself. A 14.9 oz. "wet finish" OD cotton duck comes close to the original. There are rumors that a Linkanoe, lacking a skin but with lots of duct tape over all the joints, was seen floating on the Susquehanna River near Binghamton.



One of Bob Snyder's Linkanoes showing canvas and how it is attached.

PHOTO: BOB SNYDER



Marilyn Link, Ed Link's sister, by a Grumman Widgeon and row of Linkanoes at an airstrip. The canoe in the foreground marked LINKANOE is Ed Link's personal canoe.

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in these laminates as there would be in steam-bent solid-wood ribs. These ribs were tacked on to the front and rear and along the keel line of each Micarta section with steel “twist” brads. On alternate sections of the hull, a wooden dowel was laid in the $\frac{1}{4}$ -inch groove and tacked there with brads—thus creating a sort of “tongue-and-groove” joint for adjacent sections. For additional strength, there are many flat, steel reinforcing plates—some shaped like wish-bones (fourteen pieces) and others like dog biscuits (eight pieces)—attached to the wooden frame on the inside of the hull with steel screws. An additional strip of laminate, $1\frac{1}{4} \times \frac{3}{8}$ inches, made of three thicknesses of wood, is held onto the top with steel wood screws driven in from the top, giving a sort of “closed gunwale” appearance. Just beneath this gunwale cap on the exterior of the hull, a line of metal furls are affixed with screws set at $4\frac{1}{2}$ -inch intervals. Once section assembly was done, both surfaces were sprayed with varnish. On the exterior of each Micarta section, a serial number was stenciled in red paint, and each section of a single canoe got the same number. The Type C-3 Link Trainer, built in 1943, which is at the Glen Curtis Museum in Hammondsport, New York, is constructed of exactly the same sort of wood laminate and Micarta materials.

To hold the ten sections together there are several metal clamps on each section—twenty-nine in total—which pull adjacent sections of the hull tightly together. The Gananoque factory had a well equipped machine shop that fabricated the metal parts, special tools and jigs, and its own electroplating shop, where all the metal components were nickel plated. Other tools in the shop included a variety of common hand and power tools, Black & Decker drills, screw guns, routers, and such, and a woodworking shop with a planer and jointers which were used in the boatbuilding.

From Plane to Paddle

If you had all the pieces of a Linkanoes lying in front of you, it would not be obvious how they should be assembled. Ed Link had a solution to this problem as well. There are four places where four sections of hull have to come together. A number painted in red is found on each inside corner, near the keel line where it abuts its neighbor. All one needs to do is locate all four number 1s, all four number 2s, and so on, and place them together. The best way to get the hull assembled is to clip together the respective left/right sections, then pull two adjacent bow/stern sections together. When the metal clips are pushed down firmly, they lock, and there are additional metal clamps underneath the gunwale cap to secure the gunwale sections.



The Linkcanoe was built to travel in a plane and it served the same purpose in an amphibious airplane that the dingy serves on a sailboat—to get from the vessel to shore and back. This couple shows how it is done, assembling a Linkanoes on the wing of a Grumman Widgeon.

PHOTO: JOHN TAYLOR



Vital Jette (bow) and Keith Taylor (stern) in a prototype Linkanoe. Taylor was the Link plant manager in 1946, and Jette was the caretaker for Link's wilderness retreat. The birchbark canoe suggests this shot was taken at the retreat in northern Quebec. Francois Rothan, who is a birchbark builder from Quebec, believes the canoe is from one of the Algonquin tribes, and because of the high sheer at the end and the really fine gunwale work, that it may be a Tête de Boule or Attikamek model.

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After all ten hull sections are locked together, the deck plates, seats, and center thwart get installed. The two triangular deck plates, about ten inches long and made of three-layer wood laminate, serve the function of locking together the left and right gunwales. While holding the bow halves (or stern halves) together, it is just a matter of turning the eyebolt that extends from the top, so that a "pinch-bar" pulls up from below to grab underneath the inwales and firmly hold the port and starboard sections together.

The seats are made of solid wood with an OD (olive drab) canvas-covered cork flotation block underneath. Once the sections are together, the bow and stern seats, positioned 4½ and 12 feet from the bow respectively, can be forced into place and held there by spring-loaded metal clips. The solid wood center thwart is similarly held in. Two struts, hinged underneath the thwart, engage screws on the keel line. When in place, this triangular arrangement forces the center of the hull downward and gunwales apart to establish the hull shape. On top of this center thwart is an oval decal, about 2½ inches long, that reads "Gananoqua Manufacturing Company." On the thwart is a length of shock cord, which holds the paddle blades in place to serve as a portaging yoke. Assembly by one person takes fifteen to twenty minutes.

With the rigid hull assembled, the final step is to stretch the canvas skin over it. Not surprisingly, the skin was

Army-type OD canvas duck, fabricated by the Eureka Tent Company of Binghamton, N.Y. (Would you guess there might have been a lot of OD canvas remaining at Eureka Tent in 1945?) At the time, canvas duck used for Army tents was made water repellent during the dyeing process by adding wax, soap, and aluminum acetate or formate to the dye pot so that the finished fabric contained not less than 3 percent and not more than 6 percent wax. There are two "canoe-shaped" strips of canvas sewn with a simple single seam along the keel line that make up the Linkanoe skin. To provide additional protection and strength to the seam, a 2-inch wide strip of heavy cloth webbing is glued to the exterior along the keel line. Also along the top edge, the canvas is rolled over to the inside by one inch, with a single seam sewn in. Tacked directly onto the canvas at about 4½-inch intervals is a single length of ¾-inch cloth-covered rubber "shock-cord."

On each deck plate is a two-inch circular decal in green, red, and yellow, featuring a standing woman in a short romper holding a large sack in each hand. Along the top of the circle is written "YOU CAN TAKE IT WITH YOU," which was a Linkanoe advertising slogan. A canoe-shape banner with "LINKANOE" printed on it in red ink extends across the decal. On the underside of the deck plate is an aluminum box, which is a hiding place for car keys or storage for a few repair items—maybe a tube of Ambroid



The “LINKANOE” decal (above, left).

The young woman in the decal looks remarkably like the woman loading a canoe into a 1946 Ford in this public relations photograph (above). She has the same style hair, the open-toed sandals, and the short-skirted romper.

A detail from the photograph (left, bottom) illustrates how the paddles could be used to help carry the canoe bags.

PHOTOS: TOM MCCLOUD (TOP) AND JOHN TAYLOR (ABOVE AND LEFT)

glue and scraps of canvas. Inside the box, stamped on the wood, are the words “PATENT PENDING.”

To attach the canvas, the rubber shock-cord is stretched over the thirty-four metal furls on each side just below the gunwales, holding the skin tightly in place over the hull. The boat is now ready for put-in.

Disassembly of a Linkanoe goes quickly until you get to the metal clips that hold the sections together, as they cannot be released using fingers alone. Ed Link knew it was a problem and even designed a solution for it: grab a deck plate and use its curved metal point to get underneath the metal clip and pry it upward to release. With the canoe disassembled, the red and white stars painted

on the hull sections indicate how to stack the sections so they fit most efficiently back into the two canvas storage sacks that the canoe came in. All the hull sections, seats, thwart, deck plates, and skin fit inside these two sacks, if properly packed.

Original Linkanoe paddles were two-piece and were held together with a brass ferrule; the two handle sections were used as carrying handles on the storage sacks. These two sacks could be stored in an apartment closet, then hauled to the lake in the trunk of a car for a day of paddling or fishing fun in the sun.

A Short-Lived Venture

As neat a package as the Linkanoe was, it apparently was not a financial success. Though intended to be carried in an airplane, it is not a light canoe, weighing 65-70 pounds, probably because of all the metal clips and reinforcing. Whether the canoe parts were imported into the U.S. from Canada, or the canvas skins exported to Canada, there were tariffs to be paid. The canoe sold for \$169.50, F.O.B. Binghamton; other canoes sold at the time were cheaper. It was not a “showy” canoe, and maybe folks had seen enough OD canvas in the previous five years to last a lifetime.

During the three years of production, the Gananoque factory made perhaps 4,000 sectional watercraft, which includes the Linkanoe, a Linkskiff (which had the same hull as a Linkanoe, but with a center seat and oarlocks), a folding square-stern Linkboat, and a 9-foot Linktender.



The Linkanoe in two neat packages.

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The Hillcrest facility in Binghamton with a display of all the Link watercraft.

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A sail kit was offered as an accessory. Gananoque also produced two rigid wooden boats, the 15-foot Heron and the 12-foot Carcarry that are not believed to be included in these production numbers. Production ceased November 1, 1949, and a close-out sale was announced to liquidate inventory. Unsold inventory was returned to the Link Aviation Binghamton plant. Former employees there recount stories of a large storage room filled with canoe parts. One Link employee in Binghamton bought one hundred Linkanoes for less than \$50 each and sold them in his sporting goods store in the early 1950s. Well into the 1950s, Link employees were sometimes given a Linkanoe as a bonus for a job well done. These “bonus” canoes may have been made up from whatever parts were available in the factory, including both parts of unsold boats and parts that had been returned, and seconds. When a customer would return a defective section of a boat, it was replaced, but the part that was sent out did not necessarily have section numbers that matched the customer’s canoe. Today, a Linkanoe with nine identical numbers and one that is different, probably indicates that the different section was a replacement. If most of the numbers are different, then it was probably a “bonus” canoe made up of parts garnered from the stock in the factory. If the owner was a non-paddler, the bonus canoe often ended up in the basement, which explains why many Linkanoes have turned up in the Binghamton area. If they have been stored dry, the hulls are often found in excellent shape, but the canvas skin, after fifty years, is always dry-rotted and unusable.

Having made his fortune in the manufacture of the Link Trainer, the Linkanoe and its lack of success was only a minor sidelight in Ed Link’s life. He is quoted as saying that he had never been much interested in making money, though he knew it was necessary for survival. Running a big company was not something Ed enjoyed. “Ed is perfectly happy as long as he has something to repair; the more it taxes his ingenuity the better,” an old friend said. He gradually withdrew from Link Aviation in the mid-1950s, and that company eventually became part of Singer Corporation.

Not the kind of guy who retires at the age of 55, Ed Link soon developed new passions, continuing to innovate and invent along the way. Ed always liked boating and sailing. He became interested in competitive ocean sailboat racing, and by using his knowledge of aviation weather maps, was able to compete very effectively against much more experienced sailors. His next pursuit was underwater exploration, and along with industrialist Seward Johnson, established the Harbor Branch Foundation in Ft. Pierce, Florida (now a part of Florida Atlantic University), and built the Johnson Sea-Link research submarine. (Several Sea-Link articles appeared in *National Geographic*, including “Exploring the Drowned City of Port Royal,” by Marion Clayton Link [February 1960: 151-183]).

Despite various health conditions, Ed Link continued to be very active in his 70s, restoring two Link pipe organs to working condition. He died of cancer at his home in Binghamton in 1981.

Ed Link's many inventions were great technical contributions to both aviation and deep sea exploration. Late in his life, he estimated that 500,000 people had learned to fly in Link Trainers. His quirky little canoe, though just a footnote in the history of canoeing, is still a most interesting sidelight.

Postscript

The factory at Gananoque, along with the boat molds and tools, was sold to Charlie Cliffe in 1960. Charlie had started working there in 1947 at age nineteen, and for many years he continued to build Cliffe Craft wooden powerboats—strip-built up to fifteen feet and lapstrake up to thirty feet—in the former Link factory. Good friends of the Links were Jim and Tony Lewis, founding trustees of the Antique Boat Museum in Clayton, N.Y., which is just across the river from Gananoque. The museum also houses the Marion Clayton Link Archives. In 1970 the Edwin A. Link Hall of Engineering was dedicated at Syracuse University, the Link Building at Florida Institute of Technology houses the Department of Marine and Environmental Systems, and in 1993 the Marion Clayton Link Endowment in Creative Writing was established at Binghamton University.

Linkanoe Database

How many Linkanoes, Linkboats, and Linkskiffs are still out there? We don't know. Between us we have six-and-one-half canoes (Tom has "one-and-one-half;" Bob has five). There are two, plus a Linkboat, at the Antique Boat Museum in Clayton, N.Y., and another at Florida Institute of Technology. If you have a Linkanoe or other Link-built boat or know where one is located, please let us know. Try to include the number, which is in red paint on each section, and note if the number is the same on every section. Let us know how the Linkanoe is rigged—for paddling, rowing, or sail. And include the history of the canoe—who bought it, where and how was it used, who is the present owner. E-mail to tommccld@gmail.com or rsnyder@binghamton.edu.

Authors

Tom McCloud, WCHA member no. 4654, is a chemist and whitewater paddler who has been learning antique canoe restoration from the guys in the Upper Chesapeake chapter in Havre de Grace, Maryland. His Linkanoe was originally purchased by Dr. Herrick Johnston, a chemistry professor at Ohio State, in about 1946. Johnston's field was cryogenics and his research led to the use of liquid oxygen and hydrogen in rockets. The Linkanoe traveled with the family along with a small Gilkey

collapsible tow-behind camper. He purchased the canoe from Peggy Johnston Gurney, who with her husband and three children, lived in many places around the world, and the Linkanoe always went with them. In Iran in the 1970s, they lived in an apartment building with a vertical airshaft, and lacking any other space, hung the canoe there in an airplane drop bag. Tom has never been able to locate a serial number on this hull. If there is someone out there who knows the tricks of sewing a canvas skin, and can save Tom a painful learning experience, he would like to talk with him or her.

Bob Snyder lives in Binghamton, New York, and has worked at Binghamton University for many years. He collects canoes and currently has twenty-five, including five Linkanoes.

Sources

The Roberson Museum in Binghamton, N.Y., has a display on Ed Link and his aviation trainers, and a Link pipe organ, but not a Linkanoe. A twelve-page booklet "Ed Link and the Linkanoe" is available from the Roberson Museum gift shop (<http://www.roberson.org>) for \$3. A portion of the Link Aviation Co. archives primarily relating to the Link Trainer, but with some Linkanoe-related photos are at Binghamton University, <http://library.binghamton.edu/specialcollections/linkdigital.html>, with another archive pertaining to the Sea-Link submarine at the Evans Library, Florida Institute of Technology, Melbourne, Florida, <http://www.lib.fit.edu/edwin/biography.php>.

Contributing to this article were Charlie and Mollie Cliffe. Charlie still lives near Gananoque in Wilstead, Ontario, and still builds wooden boats of the St. Lawrence Rowing Skiff style. See <http://www.wilsteadwoodcraft.com>.

Also contributing was John Taylor, whose father, Keith, was the factory manager in Gananoque in 1946. He provided additional bits of useful information and photos.

Information on waterproofing of canvas during the WW II era came from the United States Army Quartermaster Museum, Fort Lee, VA, <http://www.qmmuseum.lee.army.mil>

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Susan Van Hoek with Marion Clayton Link, *From Sky to Sea: A Story of Edwin A. Link* (Flagstaff, Ariz.: Best Pub. Co., 2003). A chronology based on Marion Link's diaries with and emphasis on Link submersibles.