

They that go down to the sea in ships
That do business in great waters,
These see the works of the Lord
And His wonders in the deep.

Psalms 107:23-24
(From *Windows in the Sea* by Marion Clayton Link, Smithsonian Press)

Edwin Link

The Triumphs and Tragedies In One Man's Quest to Launch Man-In-Sea

By Hillary Hauser Anderson

Edwin A. Link has been going down to the sea in ships for years. He has devoted practically his whole life, his entire unlimited energy, and his genius to unraveling the wonders in the deep. Almost all of his "business in great waters" has centered around his unique Man-In-Sea, an ambitious program to put man on the ocean floor to live, work and explore. The idea was that if man could work safely at length at 1000 feet he could certainly work at 600 feet, the average depth of the Continental Shelf, a magnificently rich area of natural resources. The Man-In-Sea concept has inspired countless scientists, doctors, aquanauts and divers to probe and discover the mysteries of the ocean.

SEA DIVER

Perhaps the real beginning was in 1959, when Ed Link launched a magnificent 91 foot research vessel called *Sea Diver* for work at sea. Named after Link's first workboat, *Sea Diver* was specially equipped for marine archaeological work, for searching out ancient sunken cities and recovering artifacts. The ship was completely unique in its time and had a diving compartment for equipment, a photo lab, and a special viewing chamber under the foredeck through which workers could view the bottom for signs of wreckage. In May of 1959, under the sponsorship of the National Geographic Society, Smithsonian Institution and the Institute of Jamaica, the *Sea Diver* crew set to work at excavating the sunken city of Port Royal, leveled by an earthquake in 1632. Among their discoveries were a



photographs by Al Giddings



For Ed and Marion Link (far left), the launching of the Johnson-Sea-Link was a giant step for Man-In-Sea. Their courage and foresight has been their gift to Link Port and the entire oceanographic world. Underwater, Ed Link himself (left) participates in one of his subsea projects. Below, researchers surface in the helicopter-like "bubble" sub.



photograph by Tom Purin

complete kitchen with pots and pans, a ship chandler's shop, and a brass watch that had stopped at 11:34, three minutes after the earthquake had struck.

SDC

After Port Royal Sea Diver set sail for Israel where it explored the Sea of Galilee and the ancient port of Caesarea. While *Sea Diver* worked off Italy and other spots along the Mediterranean coast, Ed Link was already busy at work designing what was to become the world's first underwater station. This was the SDC (Submersible Decompression Chamber). In August of 1962, off Villefranche-sur-Mer, Ed Link conducted the first helium-oxygen open water dive to 60 feet for eight hours in the SDC. A month later Robert Stenuit did his pioneering 200 foot dive in the SDC, where he stayed for 26 hours using a helium-oxygen mix. The Stenuit dive constituted Man-In-Sea I, and it was a first big step in deep saturation diving with an ultimate eye on habitats.

SPID

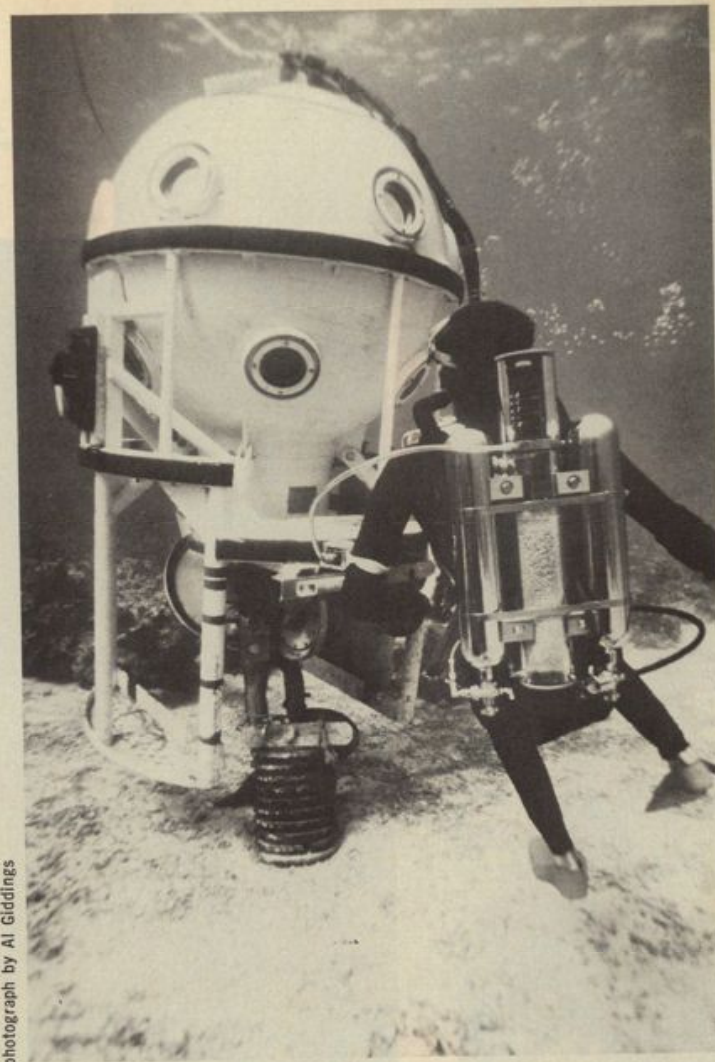
It was obvious that man needed more room to stay at these greater depths for longer periods of time. SPID (Submersible, Portable, Inflatable Dwelling) was the forerunner of all underwater habitats. It was revolutionary in design — completely collapsible, which made transporting less complicated, and the moving of the habitat around on the bottom was much simpler than with the heavy all-metal models. In July, 1964, SPID was the home of Jon Lindbergh and Robert Stenuit for two days and nights at 432 feet. This was Man-In-Sea II and was a record. It was the deepest and longest man had ever stayed underwater. Divers were getting the feel of working on the ocean floor.

Ed Link began other experiments. In 1965-66 he worked with other types of SDCs; he had already designed an underwater tent called *Igloo* and now conducted experiments with it. He also worked up a heliox voice unscrambler, designed manned submersibles and a special sea lift hydraulic crane. The hydrocrane was especially significant because it led to the development of the first small diver lock-out submarine. The crane made it possible to safely haul the sub, as well as other heavy loads, from the water while at sea.

DEEP DIVER

Ed Link collaborated with John Perry on an idea for a small submersible that would allow divers to be pressurized and lock out — that is, leave through a hatch and swim around on the bottom. This idea was to become the first small, pressurized diver lock-out submarine. The sub would be compartmented so that a pilot and observer could operate the sub from a forward compartment, while two divers in the pressurized aft section could exit and return through the hatch. This was *Deep Diver*, a complete miniature submersible, entirely self-contained and capable of reaching depths of 1200 feet.

In 1967 *Deep Diver* was launched, and while the oceanographic world looked on, this remarkable machine made dives up to 1200 feet in the Gulf Stream off the Florida coast and in the Bahamas. Then in 1968 we all heard about the dramatic dive to 700 feet off Adros Island, where two divers — Denny Breese and Robert Cook — locked out of *Deep Diver* and swam around at that fantastic depth. This was the deepest an American had ever been. *Deep Diver* was a mighty contribution to oceanographic science, but Ed Link was not through yet.



photograph by Al Giddings

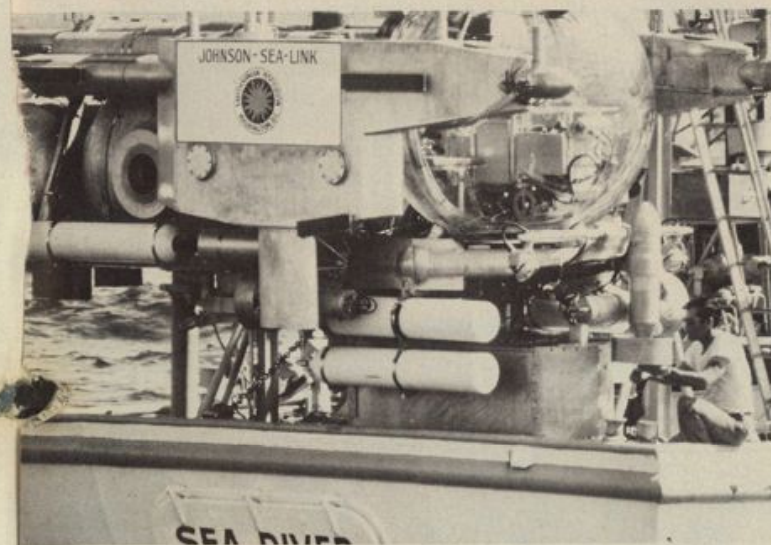
THE BUBBLE SUB

In 1969 ground was broken for Link Port. Located between Vero Beach and Fort Pierce, Florida, Link Port was to be a marine science center and future home for the Harbor Branch Foundation — a marine lab established by J. Seward Johnson. Today at Link Port there are scientists everywhere you look, conducting experiments, comparing data and doing research. While the building of Link Port was going on, Edwin Link was at work bringing forth a design for a second small submersible. Nicknamed the "Bubble Sub," the submersible would feature a transparent, acrylic, spherical chamber forward for unobstructed, near-360-degree observation. For marine researchers this was a definite plus. An aluminum alloy compartment aft would have a hatch for lock-out diving operations. Capable of 1000 feet, it would be the "Apollo" of the deep diving subs.

In January of 1971 the bubble sub, christened *Johnson-Sea-Link*, was launched. The sub, named after its donors, Edwin A. Link and J. Seward Johnson, was a gift from the two men to the Smithsonian Institution. It looked to all the world like an underwater helicopter. It weighed nine tons and measured 23 feet in length, and the big acrylic bubble offered scientists an unparalleled view in and of the deep. It was easily transportable and would be available to researchers,



When launched, *Sea Diver* was the only ship of its kind, specially outfitted for archaeological work at sea. It has also been mother ship for *Johnson-Sea-Link*. At far left, Walter Starck (with *Electrolung*), swims toward the SDC.



photographs by Tom Purin

scientists and divers. The day of the *Johnson-Sea-Link* launching was a giant day for Man-In-Sea.

It is significant that Ed Link had the courage to launch the *Sea-Link* at a time when other well-known and very costly submersibles were sitting on land with no hope of getting wet. Big corporations such as Westinghouse, Lockheed and Grumman had already beached their small submersibles. They were enormously expensive and almost impossible to sell. Maintenance and operating costs were out of sight. Link and Johnson had put the *Johnson-Sea-Link* in the water for about \$400,000. By comparison the *Alvin* had rung up \$2,000,000, the *Aluminant* \$3,500,000, and the Navy's DSRV-1 a whopping \$41,000,000 — all of them drydocked.

"FOR BETTER OR WORSE"

The *Johnson-Sea-Link* was the culmination of years of experimenting, planning, and extreme effort on the part of a man whom many consider more than brilliant. In his endeavors to launch Man-In-Sea, Ed Link had worked out problems which would baffle the best of the magna cum laudes. Not only had he worked out decompression tables to take men deeper, he had solved mechanical problems with the equipment and machinery he had designed. While he was developing rescue operations he was making scientific findings and learning for himself the wonders of the deep. And, at

the conclusion of each successful phase of the Man-In-Sea project, when most men would be content to sit back and relax, Ed Link would convey the feeling that he had only started, that much more had to be done — the mark of the true artist and gifted genius.

In her book, *Windows in the Sea*, Marion Link summarizes: "By the end of the decade, Ed realized, what was now only a bit of experimentation here and there would be commonplace. The oceans of the world would teem with vast programs of exploration and development made possible by the successors of this small bubble sub and the many new devices now in the making."

And, to emphasize the significance of the *Johnson-Sea-Link* launching, she continues: "For better or for worse, Man-In-Sea was at last on his way."

SUNDAY, JUNE 17, 1973

The *Johnson-Sea-Link* had made over 100 dives off Florida, in the Keys and in the Bahamas with all systems operating smoothly. Only 10 months before it had gone to 1100 feet. Everything was going fine when four scientists took the sub down on June 17, 1973, for a diving project sponsored by the Smithsonian Institution. They were conducting a study of fish on an artificial reef (scuttled destroyer *Fred T. Berry*), 20 miles off Key West, Florida. The four were: Clayton Link, 31, Supervisor of Life Support Systems and son of Edwin and Marion Link; Al Stover, 51, an expert submariner; Archibald (Jock) Menzies, 30, an ex-commercial diver and pilot of the sub; and Robert Meek, 27, an ichthyologist and scientist with the Harbor Branch. Link and Stover were in the rear "lock-out" compartment while Meek and Menzies were in the acrylic sphere. The compartments had no passageway between.

On that day, in June, the *Johnson-Sea-Link* became tangled in a cable from the scuttled destroyer at 351 feet while trying to pick up a fish trap.

"SUBMISS/SUBSINK"

On Sunday, June 17, the U.S. Coast Guard flashed a message to the Chief of Naval Operations in Washington: "Submiss/Subsink," a dreaded message that was the beginning of a tragic 36 hour ordeal for Link the father; Link the inventor. For an accurate chronology of the rescue attempt we refer to Ocean Science News:

"The rescue operation got off to a slow start. *Tringa*, a Navy submarine rescue ship normally used for hard hat diving operations (it carries no diving bell), arrived on site about six hours after the first signal, at 4:07 p.m. Sunday. It set up a four-point mooring by 8:15, but found itself 50 feet off position, and had to re-moor. That was done by 10:45 p.m., now twelve and a half hours after the alert that there was a 'civilian submersible incident' taking place. By 3 a.m. Monday divers had gotten within 10 feet of the DR/V (at 2:30 a.m. Stover and Link had probably lost consciousness), but the Navy decided it would have to use its "Roving Diving Bell" — already on its way from San Diego.

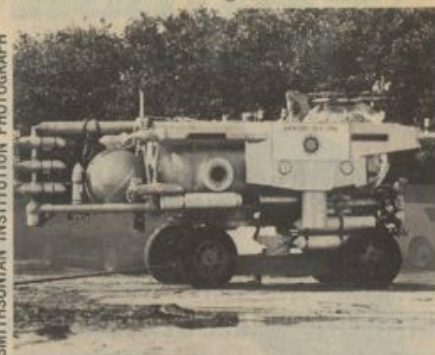
"First try with the bell was about 9:20 a.m. Monday. It failed because of the current. Second try was completed at 12:55 p.m., the bell going no lower than 300 feet and getting hung up itself on the scuttled destroyer, the *Berry*. At 12:59 p.m. Meek and Menzies, in the forward compartment, had started to use the air from the emergency breathing system on the sub.

"Other help was coming. Alcoa's *Seaprobe*, with its special grappling device, was on the way. Perry Submarines readied two submersibles with mechanical arms

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SMITHSONIAN INSTITUTION PHOTOGRAPH

(PS2 and PC8); the PS2 was launched from the deck of the Navy sub *Amberjack* (it submerged and PS2 just floated off) — but its sonar malfunctioned and it never got to the site. The commercial salvage vessel *A. B. Wood*, chartered by the Navy Ordnance Laboratory, finally accomplished the rescue by sending down a Naval Ordnance Lab Sled, regularly equipped with T.V. and sonar — and specially fitted with a hook with which it grabbed the *Johnson-Sea-Link* and hauled it to within 30 feet of the surface." Navy divers removed television gear from the sled before surfacing with the DR/V.

In the front compartment Meek and Menzies were alive and well, but Link and Stover, who had been unconscious for hours, were feared dead.

On the surface decompression treatment was given to Meek and Menzies. Pressure had built up in their compartment because they were forced to breathe intermittently from the sub's compressed air supply. Toward the end of their 36 hour ordeal, the CO₂ absorbing baralyme had begun to lose its effectiveness and the CO₂ level was becoming critical. Because of the confined space of the compartment, their exhalations had built up the pressure inside and they were decompressed on the surface as a safety measure. Their acrylic chamber had insulated them from the cold 40 degree water outside, and consequently their breathing rate had been fairly normal.

The men in the back compartment, however, did not have any insulation from cold since the compartment was constructed of highly conductive aluminum. Therefore their breathing rate was considerably faster than that of the men in front. Also, because of the cold, their baralyme was not as effective. Baralyme, which scrubs CO₂ from the atmosphere, progressively loses its effectiveness as temperature drops below 70 degrees. As the atmosphere in the aft compartment reached critical CO₂ levels, Link and Stover went on their air supplies—first breath-

ing air and then mixed gas. They were breathing rapidly due to cold. Their exhalations in the small space had raised the pressure in their compartment to ambient pressure (351 feet). On the surface the aft compartment underwent lengthy decompression, but in any case it was too late for Link and Stover who died bravely doing what they loved best.

AL STOVER

Al Stover, father of eight sons (one was killed while taking paratroop training), and husband of Lucy, was affectionately nicknamed "Smokey." Stover was a well-known, well-liked and extremely fine man of the sea, with a wide and varied background revolving around submersibles. He retired from the Navy in 1959 where he was involved in submarine medical duties. He taught diving physiology while in the Navy. Following his retirement he worked at a dive shop in Groton, Conn., which was owned by another retired Navy man, Bob Canary. Stover was teaching diving physiology, but it was at this point that he learned how to swim and dive himself.

About the time he started working for Canary, Stover went to work for Electric Boat Co., Groton, in the Submarine Medical Branch. He worked in the R&D department of EBC, became pilot of the *Star 1*, the first model of the midget subs, and eventually became chief pilot of the entire line of *Star* subs. When Reynolds bought the *Aluminaut* from Electric Boat Co., Bob Canary was chief pilot and Stover was assistant pilot. After three years the Navy beached the *Aluminaut* and Stover went to work for Perry Submarines as operations manager. In spring of 1973 Stover went to work for Edwin Link. He had been at Link Port just two months at the time of the tragic accident, and would have been captain of the newly commissioned *R/V Johnson*, a research vessel designed specially to carry the *Johnson-Sea-Link* sub and her crew to sea.

CLAYTON LINK

Clayton Link shared his father's love for the sea and had the Link inquisitiveness when it came to the things of the marine world. After receiving a Bachelors degree in psychology from Colgate U., New York, Clay Link went into the Navy. He was a top Navy diver and a professional in underseas operations, notably in his research into life support systems and underwater safety. Clay Link worked with Ocean Systems in the late 60's in engineering and operations, search and salvage missions. He also found time to earn a Bachelor of Science degree from the University of Washington, Seattle, in

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marine biology and went on to do graduate work in that field. In 1971 he came to the Smithsonian Institution, Ft. Pierce Bureau, at Link Port, where he worked in a supervisory capacity on Life Support Systems for submarines and chambers. He had a gift for writing and did much of the technical writing on these systems. He also participated in an underwater safety seminar sponsored by the Smithsonian. In the area of diving medical physiology, he was an observer and wrote technical papers from what he saw in watching a team project supervised by Dr. David Youngblood.

Most important, Clay Link was one of his father's proteges and was prepared to carry on the Link ideal from the Smithsonian Harbor Branch Consortium out into the ocean world.

As a co-worker at Link Port so aptly puts it, "Clay was his father's son in devotion to ideals, intelligence in his work and love for his family. He was his mother's son in his gift for writing and in the warm affability that made him such a pleasant person." Clayton leaves a one year old son, Stephen, and a wife, Maurine. The loss to all of his associates at Link Port and to all the diving world, and most of all, to Edwin and Marion Link, cannot be measured.

THE NOBLE FEW

Both Clay Link and Al Stover, frontiersmen, have given us all something of themselves — most of all a better understanding of the problems ocean scientists face, how much there is to learn and how far there is to go. It is a tragedy such as this that would naturally cause a re-evaluation of efforts and raise the question as to whether it has all been worth it. However, we must understand that if man were afraid to take risks, he'd still be huddling inside a cave with a club in his hand. If man had been content to merely protect what he already had, rather than to invent and explore, he would have been forever committed to an eternity of fear and uncertainty.

In inventing, exploring and reaching out, there are a noble few who accept the pioneering risks as part of the greater goal that is achieved through even the most difficult of trials. The noble few — these scientists and inventors — seem to know that setbacks of the gravest nature cannot crush the expression of the genius or of the spirit. Perhaps this is best exemplified in the words of the great man-of-the-sea himself, Edwin Link, who, in the deep of his darkest hour had said:

"We've got to try harder." >