

THE INA QUARTERLY

A PUBLICATION OF THE INSTITUTE OF NAUTICAL ARCHAEOLOGY

FINISTERRE PROJECT

A trove of 16th
century Spanish
shipwrecks

THE DIVING ARCHAEOLOGIST

INA's contributions
to techniques
and technology

SHIPWRECK IN SRI LANKA

An Ancient Cargo Ship in
the Indian Ocean



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The Institute of Nautical Archaeology is a non-profit organization whose mission is to continue the search for the history of civilization by fostering excellence in underwater archaeology.

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If you are interested in submitting an article for publication please contact the Editor at inaq@nauticalarch.org

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LETTER FROM THE PRESIDENT

Please join me in wishing INA — and the *INA Quarterly* — a Happy 40th Birthday! We view this milestone as a chance to reflect upon what our members have told us about what they value most about INA, which is the fieldwork and the field reports.

For the past five years, INA has published the *INA Annual* as a complement to the *INA Quarterly*.

In order to fill the pages of the *Annual*, however, we were forced to remove field reports from the *INA Quarterly*, while

the time required to produce the *INA Annual* meant that the information in it was always at least one year old. So in the interests of ensuring that INA's archaeological discoveries reach our loyal members in a timely fashion, I have chosen to suspend publication of the *INA Annual* and return INA field reports to their traditional place on the pages of the *INA Quarterly*.

This first issue of 2013 contains field reports from two young and ongoing INA projects at Godavaya, Sri Lanka, and Finisterre, Spain. Features of this and future *INA Quarterly* issues include current news and event announcements, book reviews, people profiles, and a dive safety component, among others.

Of course, 40 years ago INA was AINA, and what would become the *INA Quarterly* began life as the AINA newsletter. The 'A' was dropped in 1976 when INA became affiliated with Texas A&M University, which welcomed INA by launching an autonomous graduate program in nautical archae-

ology. It seemed only appropriate to honor the nearly four decades of shipwreck research that have resulted from this symbiotic relationship by giving the *INA Quarterly* an updated look, inside and out.

Also new for 2013 is INA's website address: www.nauticalarch.org. This URL better captures both our calling and our identity as a non-profit organization committed to research, exploration, excavation, preservation, and education.

Whether you have been a loyal INA member for decades or you are brand new to INA, in this issue of the *INA Quarterly* you will meet some of the researchers, scholars, students, staff, and directors who have made this a truly exceptional organization — even more can be found on the INA website.

Please remember that contributions to INA are tax-deductible; tell your friends that memberships start at just \$40 per year. Members receive four issues of the *INA Quarterly* each year and discounts on nautical archaeology publications through Texas A&M University Press!

Thank you for being part of INA and please direct any feedback or suggestions to me at: president@nauticalarch.org

Dr. Deborah Carlson
President of INA



NEWS & EVENTS

A gift from Frances Rich, INA's 40-year milestone; the National Endowment for the Humanities gala; and our administrative office renovation

A RICH LEGACY FOR INA

The Institute of Nautical Archaeology was the recent beneficiary of a \$1.7 million gift from the estate of Miss Frances Rich (1910–2007), American actress and sculptor. Miss Rich enjoyed an acting career that included roles in Unholy Love (1932) and The Thirteenth Guest (1932). She earned a Bachelor's degree from Smith College in 1931 and went on to study sculpture in Paris, at the Boston Museum School, and at the Cranbrook Academy of Art. INA Founder Dr. George Bass first met Miss Rich more than 20 years ago and it was their friendship that led to her interest in INA (see INA Quarterly 24.4: 24-25):

"It was apparent on first meeting Frances Rich that she was remarkable. Already in her 80s, she alone dived into the sea from the top deck of the vessel chartered for

the 1991 INA cruise along the Turkish coast. Having thoroughly enjoyed the exhibits in the Bodrum Museum, she modestly confided that she was a sculptor and would like to do my bust. That led to a bond as I regularly visited her in Payson, Arizona, first to pose and later simply to enjoy her friendship. When sitting still for hours, one talks, but mostly listens. I learned that she was the daughter of silent movie actress Irene Rich, also learned that Frances was one of the first women to join the Waves in World War II.

Growing up as a child of Hollywood, Frances had friends from director John Ford to actress Katherine Hepburn with whom she toured Europe. In the early 1930s, Frances herself appeared in films and on Broadway, but did not pursue an acting career. Instead, after graduating

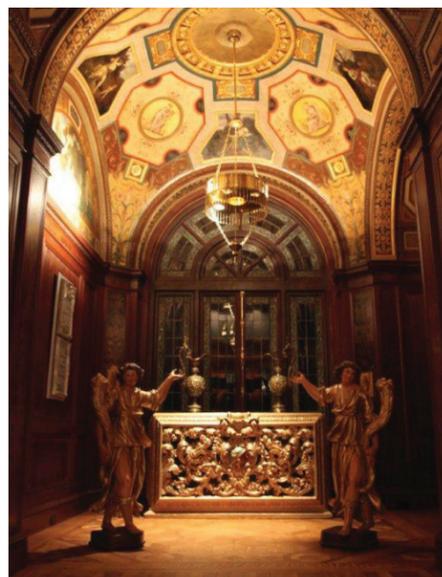


from Smith College she began sculpting, which resulted in many years of study with noted Swedish sculptor Carl Milles. I was honored that an artist whose works include the marble Army-Navy Nurse at Arlington National Cemetery, and busts of Hepburn, Diego Rivera, and opera legend Lotte Lehmann was creating a bronze bust of me for the Bodrum Museum.

I fondly recall her tales of Monument Valley, where John Ford shot so many westerns; her insistence on being called "Miss Rich," never "Ms. Rich"; her insistence on making reservations in even the humblest Payson restaurants; and her enjoyment at meeting the INA folks in College Station."



From left: Soprano Lotte Lehmann poses for Rich in her California studio in 1952; Rich working on the bust of INA founder George Bass, now on display at the Bodrum Museum of Underwater Archaeology.



INA TURNS 40

The Institute of Nautical Archaeology is pleased to celebrate its 40th year with everyone who has contributed to the growth and success of the organization. “It began modestly,” recalls Founder Dr. George Bass. “An institute devoted to nautical archaeology was created simply to provide the means for three former University of Pennsylvania graduate students – Frederick van Doorninck, Jr., Michael Katzev, and myself – to work more efficiently on ancient shipwrecks in the eastern Mediterranean. We had no idea that within a few decades our new institute would be excavating or surveying on four continents, with projects in Albania, the Bahamas, Bahrain, Bulgaria, Canada,

the Caymans, Cyprus, the Dominican Republic, Egypt, Eritrea, France, Georgia, Greece, Israel, Italy, Jamaica, Japan, Kenya, Lebanon, Malta, Mexico, Morocco, the Netherlands, Panama, Portugal, Spain, Turkey, the Turks and Caicos, and in the United States from the Great Lakes to the Gulf of Mexico – nor that it would create an academic discipline with a university graduate program and several publication series.” Coming issues of the *INA Quarterly* will focus on the people and projects that are part of INA’s first four decades.

NEH BRIDGES CULTURES

On January 16, 2013, INA officers and Texas A&M University (TAMU) faculty



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Find the latest news, excavation blogs, photos and more at www.nauticalarch.org. Like our Facebook page, too!

members Dr. Deborah Carlson and Dr. Cemal Pulak traveled to Washington, DC to participate in a lovely evening gala event at the stunning residence of the Turkish Ambassador to the U.S., Namik Tan. The ambassador’s residence was designed and commissioned by industrialist Edward Everett (inventor of the crimped bottle cap, among other things) in the early 20th century and is a masterpiece of Neoclassical architecture, Renaissance design, and rococo refinement.

Carlson and Pulak were joined by Dr. Brian Rose, a professor of archaeology at the University of Pennsylvania and former president of the Archaeological Institute of America. Moderating the three speakers was Dr. Joseph Schwarzer, a member of early INA excavations at Serçe Limani, Turkey and current Director of the North Carolina Maritime Museums. The event entitled “Bridging Cultures through Archaeology: Exploring Ancient Turkey” was the first in a series of programs designed to highlight the far-reaching impact and long-lasting results of research funded by the National Endowment for the Humanities (NEH).

Following warm words of welcome from Ambassador Tan and NEH chairman Dr. James Leach, Rose provided a breathtaking overview of important recent

archaeological work at sites such as Troy, Gordion, Çatalhöyük, and Göbekli Tepe. Pulak spoke about major recent INA projects at Uluburun and Yenikapı, and Carlson discussed NEH’s pivotal role in supporting the work of INA Founder Dr. George Bass at a time when the field of nautical archaeology was in its infancy. In the years that followed NEH supported four different INA research or excavation projects in Turkish waters, and sponsored a Challenge Grant that helped bring to life INA’s research center in Bodrum, which is home to the world-famous Museum of Underwater Archaeology.

The NEH gala was a profound tribute to the synergistic, international, and collaborative nature of archaeological research – INA thanks all of our many friends, old and new, at NEH and in Turkey!

RENOVATION IN COLLEGE STATION

In 1991, together with Nautical Archaeology Program, INA moved its main administrative offices and archives to our present location on the first floor of the Anthropology Building on the Texas A&M University campus in College Station. More than two decades later, during the summer of 2012, INA staff moved all of the office contents into temporary storage

owing to the installation of a heating and cooling (HVAC) system in the 60-year-old building. On-campus historians recall that when the Anthropology building was constructed in the early 1950s (as the home of Aerospace Engineering), it was considered luxurious for state employees to work in air conditioning. But at the beginning of 2013, INA staff moved back into our renovated and now climate-controlled office space and we have been extremely busy reorganizing the archives and maximizing our new space. Furthermore, the staff of INA headquarters in College Station continues to grow with the addition of Nautical Archaeology Program (NAP) graduate students Laura White as Assistant Dive Safety Officer and Stephanie Koenig as Assistant Editor of the *INA Quarterly*. Watch for staff profiles of these two talented young ladies, and please come visit our newly updated offices next time you are on the Texas A&M University campus!

Clockwise from top left: Turkish Ambassador’s residence in Washington, D.C.; Deborah Carlson presents Ambassador Tan with a signed copy of George Bass’ new autobiography *Archaeologist Beneath the Sea*; renovated INA office space in College Station; NEH event celebrating underwater archaeology in Turkey.

EXPLORING THE OLDEST SHIPWRECK IN THE INDIAN OCEAN

Excavating the **oldest known shipwreck in the Indian Ocean**, which sank some 2,000 years ago, answers questions about the role of Sri Lanka in transferring technology and goods to the Indian Ocean and beyond.

BY DEBORAH N. CARLSON AND KEN TRETHEWEY

For almost six weeks from early December 2012 until the middle of January 2013, a multinational team of archaeologists and students from the United States, France, Sri Lanka, and Turkey launched the excavation of what is presently the oldest known shipwreck in the Indian Ocean, at Godavaya, Sri Lanka. The collaborative project is spearheaded by principal investigators Osmund Boparachchi (CNRS – Paris), Deborah Carlson (INA / Texas A&M University), and Sanjot Mehendale (University of California at Berkeley) and made possible by funding from the National Endowment for the Humanities. Our 2012–2013 team of more than 20 included INA staff from the U.S. and Turkey, graduate students from the Nautical Archaeology Program at Texas A&M University, and numerous Sri Lankan archaeologists and interns representing both the Maritime Research Unit of the Department of Archaeology and the Maritime Archaeology Unit of the Central Cultural Fund. The project benefited immensely from the support and assistance of Senarath Disanayake, Director General of the

Laura White examines a large globular jar from the Godavaya shipwreck.

Department of Archaeology, Palitha Weerasinghe, and Amalka Wijesuriya, our principal local collaborators.

The ship was transporting a cargo of raw materials, including what appear to be ingots of iron and others of glass, as well as finished stone querns (hand-operated mills) and ceramic bowls, when it sank some time before the first century A.D. The wreck was discovered in 2003 by local fishermen B.G. Preminda and Sunil Ratnaweerapatabandige at a depth of about 100 feet, and has been explored and mapped by local archaeologists intermittently since 2008. In 2010, Carlson and INA archaeologist Sheila Matthews dived on the site for the first time and collected several wood samples for radiocarbon analysis, which has provided a working date for the wreck in the last two centuries B.C. or the first century A.D. In 2011 Matthews returned to the site with Ken Trethewey, a member of three previous INA shipwreck excavations in Turkey and now an INA Associate Director. In 2012 we launched the first season of full-scale excavation of the Godavaya shipwreck with a team of two dozen enthusiastic volunteers working under the guidance of Matthews and Trethewey as field directors and Laura White as Dive Safety Officer.

We all knew, however, that the logistical challenges were numerous and the time afforded us, limited both by historically-favorable sea conditions and by the winter break between university semesters, was short. We also knew that the nearest accessible and operational recompression chamber was in Trincomalee, so we availed ourselves of the generous assistance of Mr. Ariyaseela Wickramanayake (aka Mr. Wicky), who owns the island's largest marine maintenance and salvage company, called Master Divers. Mr. Wicky agreed to supply us with a barge from which to work, SCUBA cylinders, a compressor and a recompression chamber, all at no cost to the project, in order to help us uncover the history of this exciting wreck. Following the 40-hour trip to Southeast Asia, we spent the first few days purchasing supplies and provisioning our



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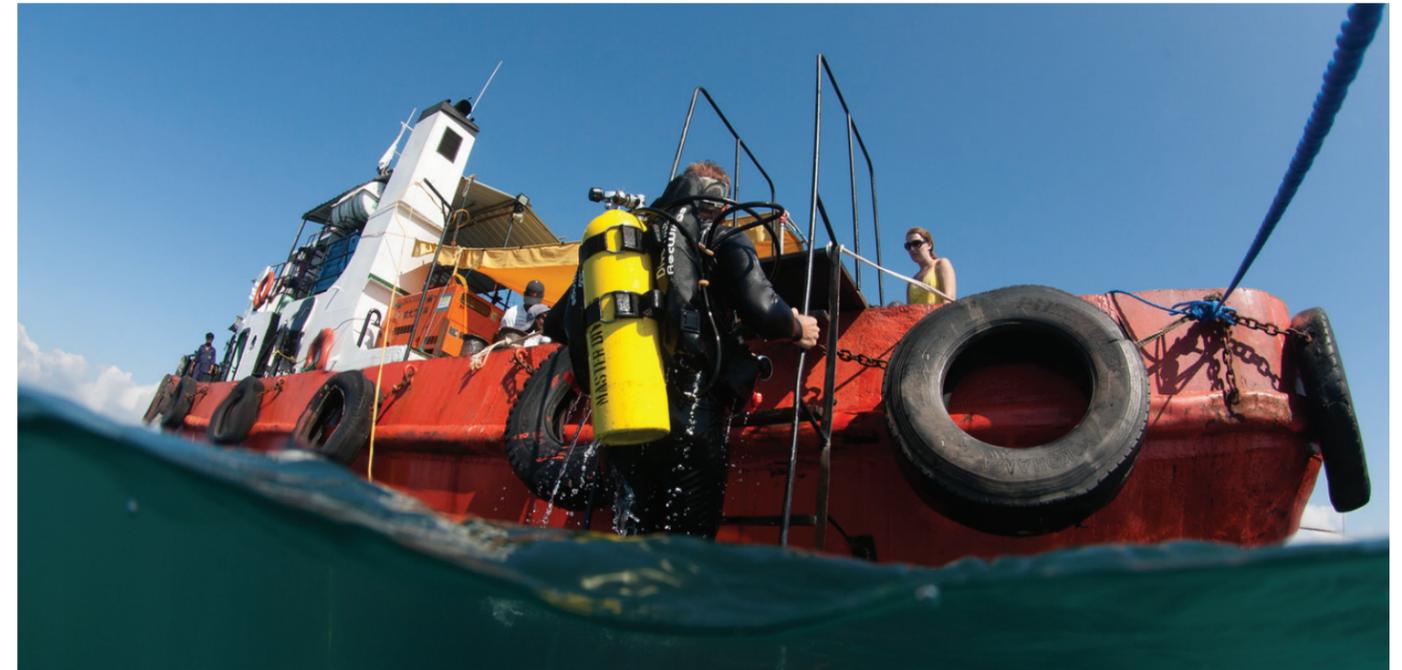
lovely five-bedroom rental house outside Ambalantota, just a 10-minute walk from the ancient site of Godavaya, which was excavated by a team from the German Archaeological Institute and the University of Bonn 15 years before.

While we awaited the arrival from Colombo of the ship and equipment provided by Mr. Wicky, we set about building an underwater trapeze for decompression and procuring oxygen to breathe while decompressing. The first was fairly simple to accomplish, as we have used similar constructs on INA projects in Turkey; it was merely a matter of purchasing the chain, shackles and piping we would need, sketching out the design, and taking it to a local welding shop. At first, it was a little difficult for some divers new to INA to conceptualize what purpose the trapeze would serve, but later, when it was in the water and the currents were ripping, everyone appreciated having a place to clip off cameras and hang on tight during decompression. For oxygen, we considered two sources: hospitals, where it is used for oxygen therapy, and welding shops, where it is burned as fuel. After exploring both options, it turned out that our neighborhood welder was the most feasible source, as he proved to be many more times during our stay in Ambalantota.

With decompression matters in hand, we eagerly awaited the ship, to see firsthand what other projects might be necessitated by its particulars. When it finally arrived on a soggy, gray morning in mid-December, it was immediately apparent that we had plenty more work to do. The ship was a 70-foot tug boat named *Puffin XI*, with a small foredeck, high off the water, surrounded by a tall rail, and filled with mooring tackle; it would not serve our diving operations. The stern deck was better in every way – wider, flatter, closer

Clockwise from top left: Rain in Godavaya; field director Ken Trethewey climbs the dive ladder of *Puffin XI* toward team member Staci Willis; the team loads supplies onto *Puffin XI*.

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to the waterline and surrounded by a low rail – but it was almost completely covered by an enormous low pressure compressor, leaving us no place to work. Master Divers had provided the massive compressor in case we wanted to use it for dredging, but it was much too powerful for archaeological work, and there was no way we could accommodate it, and all of us, and *Puffin XI*'s crew of 10, on board the ship, so it had to come off. Since Ambalantota's har-

Logistical challenges were numerous and the time afforded us, limited by sea conditions and the winter break between semesters, was short.

bor has no cranes, we had to wait for Mr. Wicky to send a truck with a boom crane from Colombo to remove the massive machine. Once it was gone, the deck was clear, but searing hot in the tropical sun.

A smaller high pressure compressor for filling SCUBA cylinders was also located on *Puffin XI*, but it required 370 V power, and the ship generated only 220 V, so we had to arrange for a separate source of power, or another way to fill dive tanks.

There was no means of getting into and out of the water safely, so we would have to build a dive ladder. Lastly, the diving cylinders provided were standard aluminum 80s, holding 80 cubic feet or 12 liters of air, which is not enough for most divers working at 110 feet to stay for more than 15 minutes with a reasonable margin of safety, so we would need bigger tanks, or a reasonable way to wear two. Finally, it became clear upon inspection that the

recompression chamber needed to be replumbed before it could be pressurized for a safety drill. In other words, we had our work cut out for us!

In an effort to get the diving under way as soon as possible, we tackled everything at once. INA staff member Orkan Köyağasıoğlu designed the dive ladder, and our local welder brought it to life. After trips to every hardware store in Ambalantota and nearby Hambantota, and then to

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a machine shop for a custom part, Orkan and Zafer Gül, Turkish captain of INA's research vessel *Virazon*, succeeded in rendering the chamber operational. Ken found a dive shop that would lease 18-liter SCUBA tanks, but when they arrived by truck over night from Colombo, they were also 12-liter tanks, so we sent them back and determined ultimately that there are no larger cylinders on the island. The local welder fabricated supports for an awning to shade the stern of *Puffin XI* and after much effort, our Sri Lankan partners found a 440 V generator we could lease, so we hired a local boom truck to load it onto the ship in order to fill tanks during the work day. The alternative was to fill tanks at night by means of a small Bauer compressor in a corrugated metal shack used as a perch by several chickens, which would not have been convenient for us or them.

With a working chamber, a dive ladder, full SCUBA cylinders, shade and room on the ship's stern deck, we were at last ready to get in the water, at least for 15 minutes at a time. The next round of challenges,

however, came from the sea. Though sea conditions off Sri Lanka's southern coast are normally advantageous by late December, we experienced days with strong currents, rough seas, poor visibility, and heavy rains leading on one occasion to a massive flood. Some days were reasonably calm in the morning, then very rough in the afternoon. The current changed direction with the tides, so a mooring that served in the morning might become untenable a few hours later. On some days, after the rains had washed mud into the river and out to sea, one could barely see six inches, meaning divers could not find their work areas, or the ascent line, and opportunities for photogrammetric mapping were few. Rolling seas also made it impossible to secure the SCUBA cylinders on the deck without a rack, so back we went once again to the welding shop.

The biggest challenge was mooring. We tried locating suitable rocks on the seabed and wrapping heavy chains around them, then attaching an anchor line, but any tackle left on the surface to facilitate moor-



ing the next day vanished overnight. In response, we asked our welder in Ambalantota to build barrel buoys out of 55 gallon drums, heavy pipe, and steel cable. These were not stolen overnight, but when *Puffin XI* tied up to a barrel buoy in a strong current, the barrel was forced under water by the resulting angle of the mooring line, and it imploded, flooded and sank. On one occasion, the currents were so strong that the rocks on the seabed broke, and we drifted away, engines off, dragging our mooring chain, with four divers down. On yet another occasion, the windlass broke and we were unable to raise the anchor. Adding to the complexity of all this was our need to deliver surface supplied oxygen to a stationary decompression stop. Needless to say, our boatmen in the two dinghies were very busy and indispensable to our operations and safety.

Despite numerous logistical challenges, which were compounded by the ele-

Top: Cylindrical grinding stone recovered from the Godavaya wreck during the 2012–13 season. Left: INA staff member Orkan Köyağasıoğlu sketches the design of the decompression stop trapeze built in nearby Ambalantota.

Our Sri Lankan partners experienced some of the proven methods that INA archaeologists pioneered for safe and productive excavation under water.



ments, our small team made progress. With the decompression stop secured by a barrel buoy at the surface and anchored to some rocks beside the wreck, we were soon able to set up a baseline and grid squares. Datum points were driven in and measured, and artifact provenience was recorded the old-fashioned way, with tape measures. Since time was short, and the currents served to sweep away our silt clouds, we settled for hand-fanning in place of airlifts. We moved significant amounts of sand in limited areas, and uncovered dense fields of artifacts beneath, suggesting that there is much more to this shipwreck than those objects visible on the surface of the seabed.

Among the handful of artifacts raised during the brief 2012–2013 campaign were a black glass ingot that parallels green and blue glass ingots recovered from earlier explorations, a globular ceramic pot, another bench-shaped stone quern, and a cylindrical hand-held grinding

stone. There was also a less tangible but significant outcome of this first season at Godavaya. Our new Sri Lankan partners experienced for the first time some of the proven methods that INA archaeologists pioneered for safe and productive excavation under water. In challenging and adverse weather conditions, our efforts to set up an infrastructure that seemed to compound the complexity of our task were no doubt mystifying to our colleagues. But as problems were resolved and they could see how all the pieces fit together to permit two reasonably long and very safe dives per day into deep water by a sizable group of archaeologists, they eagerly joined in the tasks of time keeping, barge chiefing, chamber drills, and all the rest. It was interesting to observe the gradual, and then sudden and quite complete acceptance of our alien ways.

How many times did we collectively reflect on the fact that many of the same frustrations, setbacks, and miscommu-

nications that we experienced launching an INA fieldwork project in Southeast Asia were encountered five decades earlier by a small, brave group of pioneers in Turkey launching a discipline, and in due course, INA? Of course the delays of this first short season in Sri Lanka were disappointing but time was rarely wasted; when horrendous visibility made diving impossible on Christmas Day, the team visited the Udawalawe elephant orphan-

The 2012–13 Godavaya excavation team. Front row, left to right: Arianna Dimucci, Ariane de Saxcé, Kalpa Asanga, R.P. Sunil, Laura White, Staci Willis, I.P.S. Nishantha, Sanjyot Mehendale. Back row, left to right: Zafer Gül, Ken Trethewey, Orkan Köyağasıoğlu, Ajith Athukorala, Kevin Melia-Teevan, Deborah Carlson, R.P. Sunil, Karunajeewa Dangamuwage, L.D. Sunil Jayaratne, A.M.A. Dayananda, Deepthi Suranga, S.M. Nandadasa, Anuruddha Wanninayaka, Sheila Matthews, Palitha Weerasinghe, Susannah Snowden, Sanath Karunaratna, Peminda Kumara.



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age and enjoyed refreshments overlooking the manmade lake that served the ancient capital city of Tissamaharama. On another occasion we took a fabulous evening boat trip up the Walawe River where we saw peacocks, eagles, monkeys, water buffalo, owls, and giant bats. The possibility

Osmund Boppearachchi inspects a stone quern raised from the Godavaya wreck.



that the very ship we were excavating had once sailed the Walawe River is suggested by the presence of iron-smelting furnaces farther upriver at Samanalawewa, where British archaeo-metallurgist Gillian Juleff posits that locals were harnessing the power of the monsoon winds to stoke furnaces like these as early as the fourth century B.C. This means that the Godavaya shipwreck is poised to answer major,

meaningful questions about the role that Sri Lanka played in the transfer of both commodities and technology within the Indian Ocean and beyond.

At present, our indefatigable team plans to spend the entire spring semester 2014 at Godavaya, with the hopes that the island of Sarandib (the Persian word for Sri Lanka and the etymological source of serendipity) will live up to its name!

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THE FINISTERRE PROJECT

On the west coast of Galicia, Spain, archaeologists are studying **16th century Spanish shipwrecks** and shedding new light on shipbuilding techniques, ship outfitting, and life onboard these vessels.

BY JOSÉ LUIS CASABÁN, MIGUEL SAN CLAUDIO, FILIPE CASTRO AND RAÚL GONZÁLEZ

Cape Finisterre, from the Latin *finis terrae* or "end of the earth," is a fitting name for the sacred place on Spain's northwest coast in the Galicia region. Early pagan societies worshipped the sun here, and Christians have been making the pilgrimage known as *El Camino de Santiago* (The Way of St. James) to this location since medieval times. The ancients celebrated Finisterre (*Fisterra* in Galician) as the final place on earth to see the sun before it sank into the ocean depths.

The cape itself extends from the mainland into the North Atlantic, threatening navigation between the south and north of Europe, along one of the most important maritime routes in the region. With its rocky coastline and reefs, brutal winter

storms, dangerous currents, and dense fogs this dangerous coastline is known in Spain as *La Costa de la Muerte* (Coast of Death) and has become the final resting place for many ships, along with their passengers and crew.

One of the worst maritime disasters to occur in this area took place on the night of October 28, 1596, when a storm took an armed Spanish fleet by surprise off Cape Finisterre. Written sources reveal that 25 ships were lost and more than 2000 men drowned. The fleet had de-

parted from Lisbon under the command of Martin de Padilla, and was composed of about 80 large ships including galleons from Ragusa, northern hulks, *naos*, *galizabras*, and other types of vessels. The fleet was heading to Ireland to disembark an expeditionary army to support the insurrection of the Count of Tyrone against the English.

In the last decades of the 20th century

A bronze pedrero found at Punta Restelos.

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the remains of what seemed to be one of the 1596 shipwrecks were discovered by seafood harvesters at Punta Restelos. In 2007, looting of this shipwreck was detected and communicated to the authorities. The Regional Government of Galicia supported a preliminary archaeological survey of the Punta Restelos shipwreck to document the archaeological remains. The survey was conducted by the Spanish archaeologist Miguel San Claudio and his Cultural Resource Management (CRM) firm Archeonauta S.L. The initial archaeological assessment allowed the team to record the visible remains of the shipwreck as well as recover artifacts in danger of disappearing.

Claudio and Raúl González conducted underwater and geophysical surveys of a large portion of the Finisterre area. During the surveys, six more shipwrecks, thought to be part of the fleet of 1596, were located together with shipwrecks from later periods. These included the French corvette *Bayonnaise*, scuttled by its crew in 1803 to avoid capture by superior English forces, and the remains of the British steamer *SS Great Liverpool*, which sank in 1846 after hitting a reef near Cape Finisterre en route from Alexandria, Egypt to Britain.

In 2011, Ph.D. student José Luis Casabán and Associate Professor Filipe Castro of the Nautical Archaeology Program at Texas A&M University joined Miguel San Claudio to conduct further research on the 1596 shipwreck remains documented at Punta Restelos and the other 16th century shipwrecks discovered in the Finisterre area. The archaeological project was officially named Finisterre Project in 2012 when the Institute of Nautical Archaeology, the Ship Lab of the Center for Maritime Archaeology and Conservation, and the Anthropology Department at Texas A&M University lent their support. The official directors of the Finisterre Project are Miguel San Claudio, José Luis Casabán, and Filipe Castro.

The original objective of the Finisterre Project was to study the 16th century shipwrecks located in this area. However, the initial project objectives expanded with the discovery of exceptionally well preserved hull remains of another shipwreck provisionally dated to the 16th century in the Ribadeo inlet.

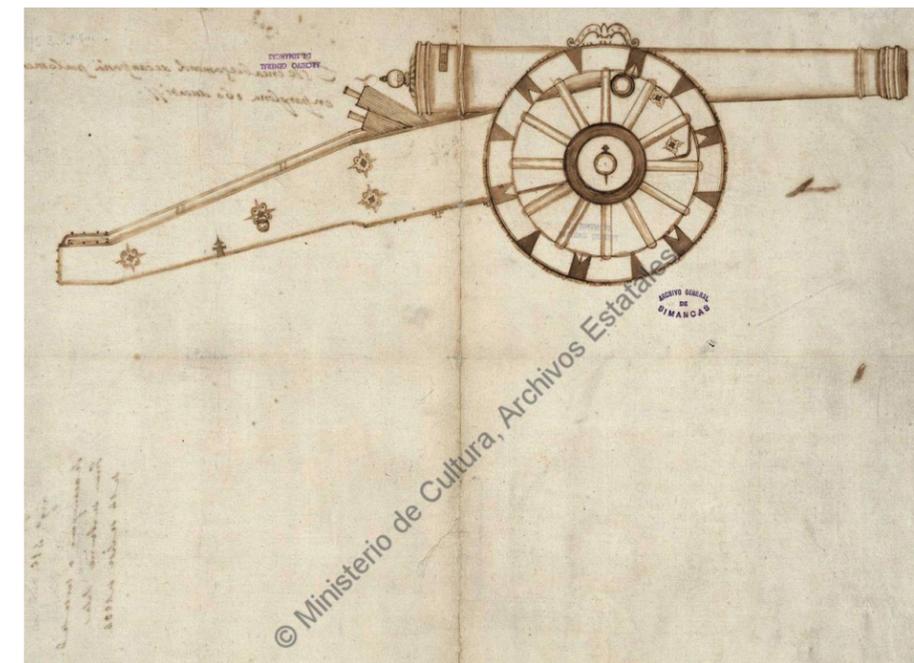
The Punta Restelos shipwreck is one of the most important archaeological sites included in the Finisterre Project. The shipwreck is located in the Sardifheiro inlet near Cape Finisterre, and the archaeologi-

cal investigation conducted here since 2007 has yielded materials that can be dated to the late 16th century, supporting the hypothesis that this ship was part of Padilla's armed fleet of 1596.

The archaeological research carried out during 2012 involved study of the materials recovered from the site since 2007, which are displayed at the Museo do Mar de Galicia. These include two carriage wheels for a siege gun, boat-shaped lead ingots, medical syringes, a bronze mortar, and a linstock. Once the preliminary study of the materials was complete, the team continued fieldwork research on site. A new area of the Punta Restelos shipwreck was surveyed and mapped using photogrammetry and traditional drawing techniques as permitted by the underwater visibility.

As mentioned above, during the archaeological survey carried out in 2007 on the Punta Restelos shipwreck, two carriage wheels for a siege gun were documented and recovered. Wheel 01 was exceptionally well preserved, while wheel 02 only consisted of the outer wooden rim. Both wheels have a diameter of 1.6 m. Wheel 01 was preserved with 12 spokes intact and it was possible to observe the metal concretions produced by the iron strakes that reinforced the rim of the wheel. The wheels documented at Punta Restelos are almost identical to those recovered during the excavation of the remains of the Venetian ship *La Trinidad Valencera*, one of the ships of the 1588 Spanish Armada. During the excavation of that shipwreck, Colin Martin documented the remains of three dismantled siege gun carriages which included five large 12-spoked wooden wheels with a diameter of 1.5 m. They were transported in the hold of the ship to be used by the expeditionary army after landing in England. The

Top: Illustration of a late 16th century siege gun carriage (Archivo General de Simancas, Spain). Bottom: Roman numeral marks on a boat-shaped ingot.



The archaeological research carried out during 2012 involved study of two carriage wheels for a siege gun, boat-shaped lead ingots, medical syringes, a bronze mortar and a linstock.



presence of the same type of wheels in the Punta Restelos shipwreck suggests that the same concept can be applied in this case since the objective of the 1596 Armada of Martin de Padilla was to deliver an expeditionary army to Ireland. This type of 12-spoked gun carriage wheel can be observed in a contemporary drawing in the *Archivo General de Simancas*.

Boat-shaped lead ingots have also been recovered from the Punta Restelos shipwreck. These ingots are similar to those documented in the shipwrecks of the Spanish Armada of 1588 such as *Santa Maria de la Rosa*, *El Gran Grifon*, and *La Girona*. Seven ingots, weighing a total of

440 kg, were recovered from Punta Restelos. These ingots were likely used by the soldiers of the expeditionary army to cast bullets for their muskets and arquebuses. All the ingots, except one, have a similar weight between 1–1.3 *quintales* (47–61 kg or 103–134 lbs), while the heaviest ingot weighs 2.3 *quintales* (109 kg or 240 lbs). Five ingots have different marks and stamps on their flat surfaces. The marks include Roman numerals presumably related to the weight of the ingots although the correlation is still under study. These marks have also been documented on other ingots recovered from the Gran Armada shipwrecks. The stamps have

Seven lead ingots were recovered from the Punta Restelos shipwreck. Ingots were used by the soldiers of the expeditionary army to cast bullets for their muskets and arquebuses.



been interpreted as trademarks of the Welser family, one of the most important European bankers of the 16th century. The Welsers were represented by the letter W which has also been found on copper and lead ingots recovered from the early 16th century shipwreck *Oranjemund*. The archaeological team intends to conduct isotopic analysis of the ingots to determine their origin and to correlate this information with historical data provided by the study of the ingots' weights, marks, and stamps.

The Punta Restelos shipwreck has also provided three examples of two types of medical syringes made of brass shows one of the syringes before and after conservation). The largest syringes were probably used in the treatment of constipation or flux while the small one was used to irrigate wounds and treat sexually transmitted diseases such as gonorrhea. They were an important part of the medical equipment of the ship's surgeon and they appear in the list of medical equipment loaded on two hulks of the 1588 Gran Armada. Similar syringes have been found in other shipwrecks such as the *Oranjemund* shipwreck (ca. 1530), *Mary Rose* (1545), and *Sea Venture* (1609). Their study can yield important information about medical treatments on board late 16th century Spanish ships. The recovered syringes were treated by Victoria Folgueira, the Finisterre Project conservator, to ensure their preservation.

In 2011, two pewter dishes were documented and recovered to prevent their being looted from the site. Pewter is an alloy of zinc, lead and tin that was used in the 16th century to produce dishes, jars, tankards, and other objects such as syringes. Pewter dishes on ships are generally associated with officers since this material was used exclusively by the

This page: Welser family stamp on a boat-shaped ingot. Opposite page, clockwise from top left: medical syringe; pewter dish; siege gun carriage wheel 01.





range weapons used against enemy crews before boarding. They shot stone balls that exploded against the ships' wooden structures forming deadly grapeshot that could wipe out everyone on the deck of enemy vessels.

A bronze linstock was also recovered during the 2007 field season. This bronze object was placed at the top of a long pole and held a match used to fire the cannon. It was an unreliable and slow firing system that had a negative effect on the accuracy of the shot and was used until the end of the 18th century when it was replaced by the gunlock.

During the underwater survey conducted at Punta Restelos, various planks of the ship's hull were recorded. These planks are 5 cm wide and do not show any traces of nails or other metal fasteners. However, several treenails, or their holes, were recorded. Each has a diameter of 3.5 cm but no distribution pattern was observed. One of the planks was badly damaged by marine microorganisms and they all have edges that are rounded by erosion.

upper class. Sailors normally used wooden dishes and glasses for their meals. Pewter dishes were documented during the excavation of *Santa Maria de la Rosa*, another shipwreck of the Gran Armada of 1588, and the ship tentatively identified as *Nossa Senhora dos Martires*, lost in 1606 near Lisbon. In both of these cases, the pewter dishes featured marks on the rim with the name or initials of their owners; in the *Santa Maria de la Rosa*, the marks indicated ownership by Captain Matute, an officer of the infantry troops on board of the ship.

The underwater survey conducted at Punta Restelos has allowed archaeologists to document two cast iron cannon and a bronze *pedrero*. One of the cast iron cannons has been identified as an English gun dated to the last decades of the 16th century (Pers. Comm. Renato Ridella). On the other hand, the bronze *pedrero* is similar to a Sicilian gun found during the excavation of *La Juliana*, an Italian vessel of the 1588 Armada. *Pedreiros* were short

archaeological study of this shipwreck, including those identified as part of Padilla's 1596 armada, can help us gain a better understanding of shipbuilding techniques, ships' outfitting, and life on board the vessels used by the Spanish crown during this period. Moreover, these data complement the results of excavations carried out on shipwrecks of the 1588 Armada. Thus, we hope it will be possible to achieve a more objective knowledge about these vessels, and to overcome some of the nationalistic views and interpretations that are still prevalent in various articles and books.

During the 2013 season, the Finisterre team intends to carry out further archaeological survey, artifact analysis and archival research of the Punta Restelos shipwreck. The objective is to identify the name of the ship that sank at Punta Restelos on that fateful night in October, 1596.

Follow the Finisterre Project blog at www.nauticalarch.org/blogs/finisterrel.

This page, left to right: Cast iron cannon; bronze linstock. Opposite: Wooden planks.



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A VIEW FROM BELOW

From limited dives times to a lack of light, **shooting underwater archaeological sites** takes a unique set of photographic skills.

BY SUSANNAH H. SNOWDEN

I am 60 feet beneath the surface of the Mediterranean Sea off the coast of Spain, balancing prone on a small rock, my body and SCUBA gear floating against the curve of a dim overhang. All around me are ceramics from a 7th–6th century B.C. Phoenician shipwreck, the Bajo de la Campana excavation. My toes grip the craggy ceiling above me, and I steady myself so I can take the photograph. I check my aperture and shutter speed, dial in the settings on my strobes, peer through the viewfinder to frame my shot and slowly depress the shutter.

When I was in 6th grade, we read a chapter on underwater archaeology, and I declared, *that's what I'm going to do with my life!* To achieve the goal, I earned a degree in anthropology with an emphasis in archaeology, a minor in classical art history, and excavated at the Athenian Agora. My passion for photography developed during this time and I knew I wanted to

combine the two. My dream was realized in 1998 when I flew to the Red Sea to work on my first INA excavation, at Sadana Island. Since then I have had the great pleasure of working on other INA projects at Kızılburun, Cape Gelidonya, Bajo de la Campana, and Godavaya.

This past March I was awarded a scholarship by the Women Divers Hall Of

Fame for my photography. The awards ceremony was held at the "Beneath the Sea" annual event. It was an honor and a thrill to meet other women doing exciting underwater work!

I used the scholarship to sharpen my photography skills at an underwater photo course — The Digital Shootout — on Little Cayman. I was in the company of dozens of underwater photographers, the singular goal being to improve our underwater images. In my photography I strive to capture a novel view of the world. I seek out the unique angle, the



Opposite: Neil Puckett excavates ceramics at the Bajo de la Campana excavation. This page: Snowden prepares to dive.

unexpected take on a subject, the moment that tells the story in one image. Underwater photography presents different challenges from those on land. An underwater archaeology photographer must work while looking through a hole the size of a paper towel roll — a camera's viewfinder.

Some of the lessons I've learned over the years, and skills I continue to improve are:

- First, while concentrating on getting that precise shot, situational awareness is crucial to prevent losing track of body position, time and air consumption. Safe diving and the importance of fragile ar-

From left: Project Director Mark Polzer ascends following his dive at the Bajo de la Campana excavation in Spain; divers hand a crate of wooden hull timbers from the Kizilburun shipwreck to teammates waiting on the platform of the catamaran *Millawanda*.

tifacts and cannot be overstated. I like to have bare feet, using just my toes on the sand so that I am attentive to where my body is at all times. I also stick to a strict system: check air, check bottom time, check exposure, set the strobes, shoot, do it all again.

- Bottom time is often extremely limited, so getting the perfect photo is particularly tricky. At Kizilburun, we had 20 minutes of bottom time at 150 feet. Subtract 2 minutes for descent, a 2 minute warning for gear at the end of the dive, and only 16 minutes were left to shoot. A surface meeting before the dive will help things go smoothly. Plan the photos to be taken, talk with the divers who will be featured and discuss the hand signals that will be used.

- Debris floating or kicked up into the

water column can ruin a photo. When illuminated with strobes, these specks appear as snow-like blobs called backscatter. Some backscatter may be unavoidable, but moving gingerly and scheduling photographs for the first dive will ensure the cleanest water.

- Light is obviously crucial in photography, but even more so under water. As we descend, reds, oranges, yellows, and greens quickly disappear. Our brains compensate to a certain degree, replacing color. However, the camera is unforgiving: without artificial light at depth, everything is blue. Moody, dramatic, documentary, silhouetted: proper lighting creates the effect.

Susannah H. Snowden is founder of Omnia-Photo (www.OmniaPhoto.com). When not on an excavation, she hones her eye working as a photojournalist and travel photographer.



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RECONSTRUCTING THE IRON ARTIFACTS

FROM THE KIZILBURUN COLUMN WRECK



Using a procedure pioneered by INA in the 1960s, concretions raised from **the Kizilburun Column Wreck** yield the shapes of 20 iron artifacts, including an intact anchor and stock.

BY KIMBERLY RASH KENYON

Conservation is of fundamental importance following the excavation of material from any archaeological site, but correct technique becomes critical when artifacts are waterlogged, because water can be extremely detrimental to the preservation of ancient objects. Seawater breaks down the cellulose in wood, causing ship timbers to decay and

become spongy, and it plays host to marine life, such as the ship worm, which also feasts upon the delicate wooden timbers.

Iron in seawater corrodes more readily than in dry conditions, forming a thick outer layer of concretion composed of carbonates, iron salts, and marine life deposits. This concretion not only obscures the identity of the artifact but also makes it difficult

for divers to distinguish between an iron object and a lump of rock. For this reason, assessment is only possible once all objects are raised and brought to the laboratory, where work begins with radiography. An x-ray can determine if the concretion holds an object, evidenced by a clear outline of a once-metallic void, or if it is simply rock, in which case the x-ray appears hazy with no distinct features. A trained conservator can

Kim Kenyon reassembles the iron anchor concretion on the floor of INA's Bodrum laboratory, as it appeared on the seabed at Kizilburun.

recover an iron artifact from its encrustation and restore what has been lost. For most concretions, the iron has long since corroded, leaving behind a void lined with a thin wall of metal. This hollow is used as a natural mold to reproduce the object. Following radiography, the concretion is broken apart, cleaned of all remaining iron corrosion dust and sediment, and filled with epoxy resin. When the epoxy hardens, the concretion is chiseled away, and an accurate replica of the iron artifact is revealed.

these, conservation involved desalinating the friable metal in deionized water. Since water is corrosive to iron, sodium hydroxide was added to inhibit further corrosion while the water worked to rid the metal of damaging soluble salts. Following desalination, the iron was boiled to remove any remaining sodium hydroxide, painted with tannic acid to prevent future corrosion, and sealed with Paraloid B72 to protect the iron from environmental elements. Since the beginning of the excavation at

the anchor and its stock intact, but the fact that at least two additional wooden anchors were found on the same ship has even greater significance. It is likely that the presence of the iron anchor alongside wooden anchors not only signifies the gradual replacement of wooden anchors by those made of iron but also the necessity of having different types of anchor on hand for varying bottom conditions as well as the practicality of carrying multiples in case of an emergency.

adze are both common tools and have been found among the wreckage of many other ancient ships. They were both useful for everyday tasks such as collecting firewood, as well as a necessity for repairing damages to the hull or rigging during a voyage.

Thanks to the innovations of Katzev and van Doorninck, we can now faithfully recreate artifacts that at one time may have been overlooked or mistaken for rocks. Compared to the years or decades required to preserve and stabilize the delicate

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AUTHOR



KIMBERLY RASH KENYON
Former Interim Head
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This procedure was pioneered in the 1960s by INA's own Michael Katzev and Frederick van Doorninck with concreted iron artifacts from the 7th century A.D. Yassiada shipwreck, and even though the material used to produce the cast replica has evolved — from silicone rubber in the early days to the current standard of epoxy resin — the process has remained essentially the same.

Occasionally, an x-ray will reveal that a concretion is not hollow but still contains a metallic object. This was the case for two artifacts recovered from the late Hellenistic shipwreck at Kizilburun, Turkey excavated by INA between 2005 and 2011. For

Kizilburun in 2005, divers were recording and raising concretions from all over the site. Of the 51 separate concretions found, more than a dozen artifacts were identifiable following casting. These include: (a) an intact iron anchor, along with its associated stock and one of its cable rings, (b) an anchor tooth for one of the ship's other wooden anchors, (c) a flat chisel, (d) a bar chisel, (e) a nail remover, (f) an axe-adze, (g) two double axes (one of which is probably intrusive), (h) three ship's fasteners, and (i) an iron bar.

The iron anchor in itself is an exciting find, given the rarity of finding both

Although the types of tools available in the Late Hellenistic Period were plentiful, only a handful were chosen for their importance on this specific voyage. On a ship, an isolated environment where space is valuable, each implement must be useful enough to warrant bringing it on board. The flat chisel, made of solid metal, has a documented use in the stoneworking trade and might have been especially useful to the crew of a ship carrying marble. Additionally, while the nail remover had a primary use short crowbar, a useful implement when positioning the smaller blocks and grave stele in the hold. The double axe and the axe-

wooden remains of the ship itself, casting a concretion can take as little as a day to complete, which is a small investment in both time and money when considering what information can be learned. These implements, specifically chosen by the crew for their usefulness, not only offer insight into activities on board the Kizilburun vessel but also can be compared to assemblages from other shipwrecks in order to draw conclusions about which tools fell out of favor, such as the nail remover, and which, like the axe-adze, continued to be preferred due to their versatility and utility over the course of many centuries.

Kim Kenyon spent three seasons as a team member of the Kizilburun excavation and graduated with an M.A. from the Nautical Archaeology Program in 2012. In 2013 she was hired by the North Carolina Department of Cultural Resources as a conservator on the Queen Anne's Revenge Project in Greenville, N.C.

Opposite: The clear outline of a once-metallic void in an x-ray scan. This page, clockwise from left: An intact iron anchor and its stock; a nail remover; an axe-adze; a double axe.

THE DIVING ARCHAEOLOGIST

INA has long believed that **any archaeologist can be trained as a diver**. The institute has also been a leader in diving techniques and technologies.

BY LAURA WHITE



technique meant that the practice has become standard on deep archaeological sites and indeed, for underwater archaeological work in general. Oxygen decompression is an ideal solution because it is cheap, allowing archaeologists to continue to use basic air on deep sites rather than resorting to more expensive mixed gas to extend bottom times and decrease surface intervals. INA also experimented with the use of enriched air nitrox during excavations at Bozburun (1995–1998), again proving that minor changes in diving efficiency can make major changes in the success of a field expedition. INA continues to correspond with leading diving organizations when preparing the plans and profiles to maximize diver safety and bottom time, and provides valuable diving data to organizations such as DAN that study the long-term effects of working at depth.

Perhaps the primary reason that INA has historically been so wise in its approach to diving is that diving has traditionally been considered ancillary to the completion of high-quality archaeological work. INA has never required excessive diving certifications from participants in its excavations, and it has dictated that advances in diving technologies were sensible and reasonable when they were necessary. It means, however, that INA's rather remarkable innovations in the field of diving are difficult to track in perpetuity. Diving is the tool rather than the primary focus of the endeavor.

Laura White is a Ph.D. student in the Nautical Archaeology Program at Texas A&M University and INA's Assistant Dive Safety Officer.

AUTHOR



LAURA WHITE, M.Sc.
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In ways that are different from other sorts of archaeology, the exploration of underwater sites is intrinsically tied to the technology that allow access to that site, which, for nautical archaeologists, generally means diving technologies. Few other archaeologists experience the same degree of difficulty in reaching their sites, the same physical dangers and disorienting or debilitating physiological effects, or the same feeling of being in an utterly alien environment. Few other types of archaeology are so dependent on an external technology, not only for the success and quality of work, but also for

the preservation of life. While underwater work is only a tiny part of what is done by nautical and maritime archaeologists, and indeed, it is certainly not a requirement of the discipline, it is this medium that in many ways makes what they do so remarkable.

It is well known that INA has been a leader in developing standards of archaeological practice for shipwreck sites. The techniques pioneered by INA have been studied and practiced by other institutions and research groups, and many successful archaeologists joined INA projects to learn the underwater excavation and

survey techniques that would thereafter be used on their projects around the world. What is less well known is that INA's success under water is partially attributable to its sensible approach to the diving technologies that have continually provided access to archaeological sites.

In its long history, INA has managed to maintain a careful balance. Where simple, effective, and even archaic technologies were deemed useful, they have been retained rather than resorting to the unnecessary gadgetry that is so appealing to many diving scientists. On the other hand, where it is necessary and appropriate, INA has been an innovator in diving and decompression technologies, offering contributions that have improved SCUBA and other technologies for archaeological projects, and for diving as a whole.

INA has historically maintained a close relationship with decompression scien-

tists and doctors, and continues to do so. Hyperbaric physicians consistently work in the field alongside archaeologists, prepared not only to offer recompression treatment in case of accidents but also to monitor the diving records and suggest improvements to the profiles used in the field. During excavation of the Bronze Age shipwreck at Uluburun (1984–1994), oxygen was used as a decompression gas for the first time on an archaeological site, following tables designed by Dr. Richard Vann of the Divers Alert Network (DAN). Oxygen allows more effective decompression and in turn, safer dives and longer bottom times. Not only was this a major advance for archaeological divers, it was also one of the first times that civilian divers had used oxygen for decompression. Prior to this, the physiological effects of multiple, long-term exposures were uncertain, but the overwhelming success of the

Opposite, from left: Divers at the Cape Gelidonya site in 2010, from left to right: John Littlefield, Matthew Dames, Susannah Snowden and George Bass; late director Claude Duthuit at Cape Gelidonya in 1960. This page: Excavation Director Deborah Carlson at Kizilburun.

INA PROFILES

We are pleased to welcome two new members to the Board of Directors

REBECCA MARTIN is the founding director of National Geographic's Expeditions Council, an editorially driven grant program that supports exploration and adventure in little-known areas, as well as in regions undergoing significant environmental and cultural change. Launched by her in 1998, the Council's key objective is to support compelling projects that fulfill National Geographic's mission of inspiring people to care about the planet. In her role as director of the Expeditions Council, Rebecca works closely with world-renowned explorers and collaborates with editorial leaders on magazine articles and web content, television programs, books, lectures, exhibits, radio programs, and news. Her work has taken her to Turkey and the Black Sea, Mongolia, Gabon, Peru, China, Poland, and Tibet, among other regions of the world. Ms. Martin is also founding director of the Young

Explorers Grants at National Geographic, a program she developed in order to provide talented young individuals with some of their first opportunities to carry out field-based research, conservation, and exploration. Prior to her current position, Rebecca served on the Editorial Staff of National Geographic magazine, where she was a member of the exploration story development team, and where she also managed submissions for exploration-based projects. She holds an M.A. in International Education from the George Washington University. Rebecca lives in Washington, D.C.



LYNN BAIRD SHAW received her B.A. in Geography from Middlebury College before obtaining her M.A. in Sociology and Secondary Education from Boston College. She also performed graduate work in Urban Social and Environmental Policy at Tufts University. She has had great success in business over the years, turning a four-investor start-up company into a 50-person establishment achieving \$5.5 million in sales in just 10 years. She has worked as Assistant Director of the British-American Chamber of Commerce in Cleveland, coordinating membership development and event planning, and as an Execu-



tive Director of the Business Advisers of Cleveland, a position from which she retired in 2009. Lynn is an active member of her community, serving as a Trustee and Vice President of the Horses and Human Research Foundation, and is an avid fan of curling, participating in administrative duties for the Mayfield Curling Club and Great Lakes Curling Association. She has been a member of the National Association of Female Executives and the National Society of Fund Raising Executives, and performed administrative roles for the Alex Nason Foundation, Blossom Women's committee of the Cleveland Orchestra, United Way of America, and the Beech Brook for Children in Ohio. Despite her many community and professional obligations Lynn still finds time to be an active member of INA's Board, a legacy begun by her father John Baird, who was a fiery, fervent, and generous supporter of INA and the first chairman of the INA Foundation.

REVIEWS

MISADVENTURES OF A CIVIL WAR SUBMARINE: IRON, GUNS AND PEARLS

By James P. Delgado

Texas A&M University Press. 2012
ISBN 978-1-60344-472-9
REVIEWED BY JOHN D. LITTLEFIELD

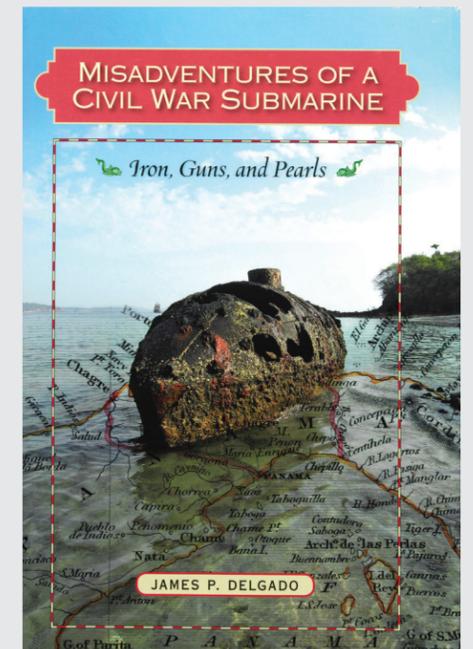
Many readers often gloss over the preface of a new book. However, one should not do this with Jim Delgado's newest release as it engages one from the first phrase with stories of adventurous, if not romanticized and humorous discovery, exploration, and background of the submarine Explorer. In keeping with his past works, Delgado presents excellent research in an easy-to-read narrative, foraging effortlessly from designer/builder Julius Kroehl's family background, to a brief history of diving apparatuses; from humanistic stories of Kroehl's personal failure, success, and controversy to archaeological examination of a rare surviving artifact of naval ingenuity.

The first of nine chapters traces Kroehl's genealogy and ultimately follows the entrepreneur from his geographic Prussian homeland to Industrial-Age New York. Chapters Two and Three provide a brief overview of this period of rapid technological change with a cursory survey of early diving equipment. The reader gets a glimpse into the world of Kroehl's rival business man Benjamin Maillefert and his claim to fame, the diving bell — an early branch of submarine technology and immediate technological predecessor to Explorer. Chapter Four chronicles Kroehl's arguably shaky career as a contracted civilian of the Union Navy and his continued rivalry with Maillefert. The next two chapters describe the design and

construction of the submarine Explorer and the formation of the Pacific Pearl Company. Designed for war, but utilized in commerce, Explorer was briefly employed for pearl harvesting in Panama in 1869 before failure of the financial venture and abandonment of the vessel.

Chapter Seven, aptly titled Requiem, spins a humanistic tale of Kroehl's widow after his death, followed by a brief discussion of Explorer's technological cousin, Intelligent Whale. The penultimate chapter outlines documentation of the physical remains of Explorer that took place between 2004 and 2008 over three one week field seasons. Delgado describes not only the documentation process, but also a survey of the vessel's presumed working environment. The final chapter places the Pacific Pearl Company in historical context and suggests reasons for the failure of the company and ultimate abandonment of Explorer.

Delgado's experience as historian, archaeologist, and lecturer, although of great quality, is eclipsed by his prowess as a storyteller. He weaves an intricate tale from the well-researched historical record. The book achieves the often elusive goal of making historical/archaeological examination both engaging and interesting for non-specialists and experts alike. However, the work is not without shortcomings; gaps in the written record are often filled with speculation, conjecture, or supposition. While this enhances narrative quality, it detracts from otherwise solid and impressive research. Furthermore, the book could have benefitted



from more stringent editing, particularly Chapters Seven and Eight, which were internally repetitive and suffered from nearly identical phrasing in several places. Minor shortcomings aside, Delgado has produced yet another quality historical work. This book is recommended for anyone interested in those often ill-fated technological advances of the industrial age, early diving apparatuses and submarine technology, or a nice narrative excursion of a maritime nature.

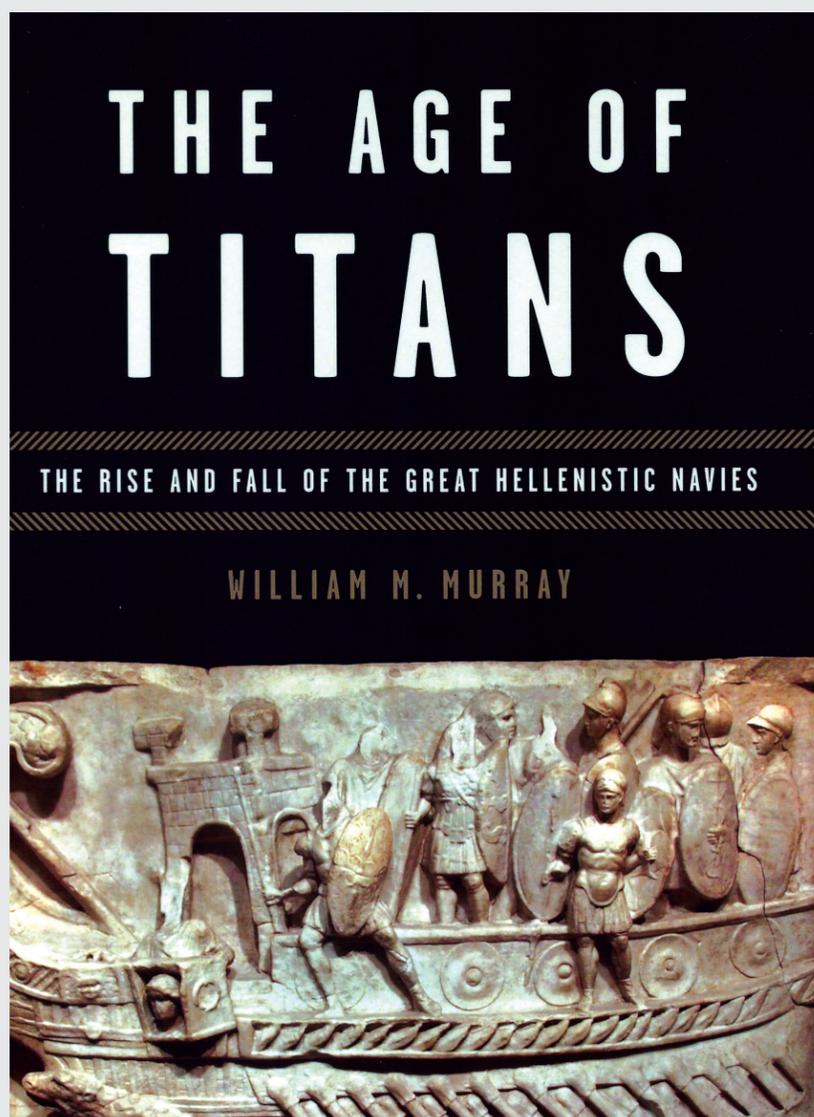
John D. Littlefield, M.A. is a Ph.D. student in the Nautical Archaeology Program at Texas A&M University and an INA staff member.

REVIEWS

THE AGE OF TITANS: THE RISE AND FALL OF THE GREAT HELLENISTIC NAVIES

By William M. Murray

Oxford University Press. 2012
ISBN 978-0-19-538864-0
REVIEWED BY NICOLLE HIRSCHFELD



William Murray titled his book in homage to Lionel Casson, whose impeccable scholarship and lucid, lively writing are still the gold standard for historical analyses of ancient Mediterranean seafaring. “The Age of Titans” is among Casson’s most compelling essays, a narrative of the Hellenistic naval arms race, an era characterized by monstrous ships and giant fleets. Casson got it right: these gargantuans were possible only in an era of big kingdoms, big budgets, big egos. But, Murray argues, Casson (and Tarn in the first place) also got it wrong: the catalyst for building bigger ships was not new sea-battle tactics (grappling and boarding) but a new strategy altogether (besieging coastal cities); even the largest of the monster ships was built for use, not just for show.

The first step in the transition from building for sea-battle to designing for siege was, according to Murray, the great battle in the harbor of Syracuse (414/3 BC) where the efficacy of frontal ramming was made plain. Continued Syracusan-Carthaginian hostilities over the harbor-cities of Sicily then catalyzed the development of heavier ships better able to deliver and withstand the forces of frontal ramming. Fours and fives supplanted triremes (threes). Alexander’s brilliance at the siege of Tyre (332 BC) was to coordinate the men who sailed these bigger ships with military engineers to develop the naval siege unit. Not everyone jumped on this bandwagon but Antigonos the One-Eyed, his son Demetrius the Besieger of Cities, and their enemy Lysimachos did, build-

ing ever bigger ships to serve as floating platforms for siege machinery, protected by escorts of smaller warships. The beehive fleets assembled and actually used effectively by Ptolemy II Philadelphus and Ptolemy III Euergetes (mid third century BC) marked the culmination of the Big Ship phenomenon, the battle at Actium (31 BC) its last hurrah. Thus Murray outlines Hellenistic naval history in his Conclusion, where the reader should start.

Then the Introduction, which presents a clear exposition of the history of scholarship on the topic, the discoveries (Athlit ram and Augustus’ victory monument at Actium) that triggered the author’s re-thinking, and the essential question: why was the development of big ships, whose increasing size, weight, and beam at the same time decreased their speed and maneuverability, seen as a positive?

The devil is in the details, the chapters in-between. Murray presents his thesis for the most part in a chronologically ordered narrative. In this review there is space only to comment briefly on the primary categories of evidence:

TEXTUAL

Murray has collected every reference to Big Ships (fours through forty) in Appendices A-D. These alone automatically make this book an essential addition to any library of (ancient) naval history. Appendix E is Murray’s original contribution, a translation of all the naval sections in the single ancient text that describes how Big Ships might be used in action, Philo of Byzantium’s *Poliorketika*.

ARTEFACTUAL

The Athlit ram is the crux of Murray’s thesis and I will assign his clear, concise but full presentation of its wood and casting (pp. 31–38) as the basic reading on the subject to my classes. Continuing archaeological research at Augustus’ victory monument (p. 44 fn. 19 and <http://networkedblogs.com/DM9ya>) will probably change only details of Murray’s current understanding of the rams once displayed here. But the recent and ongoing discoveries of rams by the RPM Nautical Foundation off the coast of Sicily more than double the catalogue presented in chapter 2 and may cause Murray to revise his proposed ram-categories and their identifying features.

REPRESENTATIONAL

This is the weakest leg of Murray’s triad, partly due to the inherent nature of the evidence (images and monuments carry no labels to clarify what class of ship they represent). Murray must base his identifications on (1) what is likely, given the historical context of the representation, (2) the proportions and features of the pictured or sculpted rams (a shaky enterprise in light of the artistic objectives of the rendering), and (3) the assumption that one can correlate ship classes with ram depictions; given the admitted variation of types within even a single class, this is a tough sell.

The challenge is to tie all these disparate bits together into a cohesive narrative. Murray’s methodology (and his strength) is historical analysis, i.e. to study historical contexts to determine why particular

ship classes developed at particular times and places. His honesty with the historical texts is commendable: he is scrupulous about presenting the sources for his sources and the immediate context of passages he cites. This reviewer has only the small quibble that occasionally Murray overlooks the literary context. So, for example, Thucydides’ description of the battle in Syracuse harbor is not simply a battle narrative, but also the bookend of a story arc that brackets Salamis (a de facto harbor battle) and Perikles as illustrations of the height of Athenian democratic ideals with the dark mirrors — Hermocrates and Syracuse — that signal its end. Without doubt the author’s literary objectives color his description of the events on the water.

Despite these critiques, this reviewer is convinced that Murray has come up with a better explanation for the Big Ship phenomenon of the Hellenistic Age: they were invented to capture coastal cities and maintain control of their harbors. The arguments are for the most part clearly presented. They are scrupulously referenced, both in terms of ancient texts and secondary literature. As a result, this is a book useful to both informed enthusiasts and as a think-piece and essential resource for scholars of ancient Mediterranean maritime history.

Casson would have been fascinated.

Nicolle Hirschfeld is a Bronze Age scholar and Associate Professor in the Department of Classical Studies at Trinity University in San Antonio, Texas.

INA REMEMBERS:
HENRI DELAUZE (1929–2012)

We bid farewell to one of the world's greatest underwater explorers

Delauze founded COMEX, a company that specializes in engineering and deep diving operations, and pioneered deep saturation diving.

Henri Delauze, who passed away at the age of 82, was a diving legend and considered one of the world's greatest underwater explorers. "When I tried on my first pair of diving goggles, I realized that I was hooked. From then onwards I went diving whenever I could." What followed was a lifetime devoted to his passion for diving and underwater exploration. Delauze met Jacques Cousteau in the mid-1950s becoming part of his team. In 1956 his experience as a diver plus his degree in engineering led to a job offer as site manager for the construction of a tunnel under the port of Havana. He was then offered a scholarship to study geology at the University of California at Berkeley and also worked briefly doing underwater research for the US Navy. In 1961 he returned to Marseille and founded Compagnie Maritime d'Expertises (COMEX), a company that specializes in engineering and deep diving operations and was responsible for pioneering the science of deep saturation diving. COMEX developed systems for countless underwater construction projects including offshore deep-sea oil rigs and pipelines for water, gas, and telecommunications. Idefix was the first lock-out diving bell developed, followed by further innovations such as the Total Sub in 1970, the Marco in 1974, and the Seabex One — the largest industrial system in the world in 1981 with 8 chambers to accommodate up to 12 divers working at depths of up to 450 meters.

In addition to his technological pursuits, Delauze was no stranger to underwater archaeology — he was responsible for the discovery and exploration of the Grand Ribaud F site, an ancient shipwreck

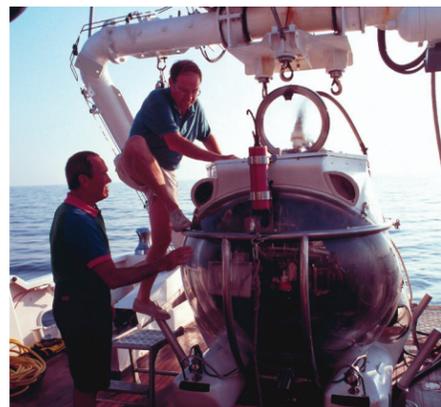
loaded with more than 700 Etruscan amphoras, black-figure ceramics, bronze basins and bronze bossed discs.

Delauze worked with INA and Dr. George Bass in 1990 to locate the shipwreck that may have been carrying the famous bronze statue of a tunic-dad African youth that was pulled from the sea near Yalıkavak, Turkey by sponge draggers in 1963. Thirty years later, Delauze provided the vessel *Minibex* and tethered submersible *Remora*, with which the INA-COMEX team located a scatter of late Hellenistic East Greek amphoras and other ceramics that suggested the remains of a cargo that likely included the African Youth statue.

Dr. Bass had this to say after his dive in *Remora*:

"At 280 feet, then my deepest dive ever, I thought I would be apprehensive. Instead it was the most magical dive I have made in my thirty years of examining ancient wrecks."

The achievements and legacy of Henri Delauze will not soon be surpassed, or forgotten.



PHOTOS: INA ARCHIVES





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