

Beaufort Scale of Wind Force

Force	Knots	Km/h	Description	Specifications for Use at Sea
0	< 1	< 1	CALM	Sea like a mirror
1	1–3	1–6	LIGHT AIR	Ripples with the appearance of scales formed but without foam crests
2	4–6	7–12	LIGHT BREEZE	Small wavelets, still short but more pronounced; crests have a glassy appearance and do not break
3	7–10	13–19	GENTLE BREEZE	Large wavelets; crests begin to break; foam of glassy appearance; perhaps scattered white horses
4	11–16	20–30	MODERATE BREEZE	Small waves, becoming longer; fairly frequent white horses
5	17–21	31–39	FRESH BREEZE	Moderate waves, taking a more pronounced long form; many white horses are formed; chance of some spray
6	22–27	40–50	STRONG BREEZE	Large waves begin to form; the white foam crests are more extensive everywhere; probably some spray
7	28–33	51–62	NEAR GALE	Sea heaps up and white foam from breaking waves begins to be blown in streaks along the direction of the wind
8	34–40	63–74	GALE	Moderately high waves of greater length; edges of crests begin to break in spindrift; the foam is blown in wellmarked streaks along the direction of the wind
9	41–47	75–87	STRONG GALE	High waves; dense streaks of foam along the direction of the wind; crests of waves begin to topple, tumble and roll over; spray may affect visibility
10	48–55	75–87	STORM	Very high waves with long overhanging crests; the resulting foam, in great patches, is blown in dense white streaks along the direction of the wind; on the whole, the surface of the sea takes a white appearance; the tumbling of the sea becomes heavy and shocklike; visibility affected
11	56–63	103–117	VIOLENT STORM	Exceptionally high waves (small and medium-sized ships might be for a time lost to view behind waves); the sea is completely covered with long white patches of foam lying along the direction of the wind; everywhere the edges of the wave crests are blown into froth; visibility affected
12	> 64	> 118	HURRICANE	The air is filled with foam and spray; sea completely white with driving spray; visibility very seriously affected

THE WORK OF WIND

Volume 2

The Work of Wind Sea

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& Etienne Turpin



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6 STRONG BREEZE Navigating in Turbulence

Christine Handte, Kathelin Gray, and
Claus Tober of *Heraclitus* in conversation
with Konstantina Koulouri

After forty years of sailing, *Research Vessel Heraclitus* docked in Roses Shipyard on the northern shores of Catalonia, Spain. The twenty-five-meter long Chinese junk has been standing inside a wooden cocoon for seven years undergoing a nearly complete restoration, with the original keel still in place. The ship has sailed a total of 270,000 nautical miles, circumnavigating the world three times, traveling 2,000 miles up the Amazon River and voyaging to Antarctica. After visiting the site to see the new ship under construction in 2019, Konstantina Koulouri conducted an email interview with Kathelin Gray, Director of Ecotechnics Maritime, *Heraclitus* Captain Claus Tober, and *Heraclitus* Expedition Leader Christine Handte. What follows is an edited version of their correspondence.





KONSTANTINA
KOULOURI

The Beaufort scale of wind force allows us to discern and express change. Our conversation is prompted by Force 6, which describes the impact of wind on the sea as forming large waves and white foam crests everywhere. Over the past few decades, an increasing number of scientists have also been trying to describe the scale of human impact on the oceans. Could we say that the *Heraclitus* was born out of the need to describe these environmental changes, as well as the various speed differentials between human life cycles and the cycles of the ocean?

KATHELIN GRAY

Understanding turbulence is fiendishly difficult. Chaotic systems and out of balance systems are everywhere. The award-winning Alaskan journalist, Steve Heimel, recently reported on observations of the Arctic ice mass and the Beaufort gyre, which drives ocean currents. The news was alarming: “I spoke with Eddy Carmack and with Hajo Eicken and Andy Mahoney, who are both in Barrow and headed out to the lead edges by helicopter today. Eddy says, ‘We must be prepared for a non-linear future.’” So, what now?

We named our ship after the pre-Socratic philosopher, Heraclitus, whose most well-known aphorism is: “Change is the only constant.” Living with change, foreseeing, adapting, creating a forwardly organizing future, is a huge challenge. The future is unknown, and if humanity survives, it will be through drastic change and adaptation and the cultivation of fluid intelligence. Observing and classifying turbulence, plotting the pattern in chaos is a practice, the major lesson, and the key transmission of the crew of the *Heraclitus*.

Humans evolved to notice change. This vigilance is effective on a certain scale: our peripheral vision picks up movement. Slower movement, change, turbulence, is harder for us to notice; we need tools to assist us. The change that the biosphere has undergone in recent history has now become obvious to nearly everyone. But mass extinction and the climate crisis didn’t happen suddenly. It’s as if we were watching water slowly

heating, then finally coming to a boil. It is then that we notice a phase change to steam.

The Beaufort scale is tied to the ability of humans to view ever-increasing markers of turbulence in water, which help sailors easily gauge wind speed. Understanding the nature of turbulence itself is fiendishly difficult, even for a physicist like Richard Feynman, but that doesn't mean we are not able to observe it.

We live in an air-water ocean, sailing through the cosmos, upon a geosphere and amidst a biosphere which endure various “weather” of their own. The 2020s are visibly a time of extreme turbulence on almost every level globally: economic, political, cultural, natural, meteorological. We are amidst migrations, hellish fires, toxic air, toxic water, avalanches of plastics, red tides, flora and fauna death—most shockingly, an estimated one billion animals perished in the recent Australian bush fires.

Biologist and author Rachel Carson wrote her landmark treatise, *Silent Spring*, in 1962. Movements arose, hopeful ones, in the belief that positive change is possible. Movements arose to try to find ways to heal global post-traumatic shocks from the world wars and the atomic bomb, continuous wars, exploitative economics and power politics, wielding weapons of mass destruction, and cultural degradation from colonialism and degradation of the land. *Heraclitus* was constructed in response to the societal turbulence of the 1960s and '70s. Living responsibly on the Water Planet was the ship's mission. We would create a modest subculture of Sea People, humans committed to living on the sea, practicing a way of life that enhances the biosphere, instead of damaging it.

κ κ But before you initiated the *Heraclitus* there was the Institute of Ecotechnics, yes?

κ G We began as an eight-member group who came together in the late 1960s in San Francisco. Three of those still remain:

metallurgist, entrepreneur, and poet, John Allen; artist and manager Marie Harding; and me. A fourth, William “Freddy” Dempster, arrived within months; as a computer scientist, he brought physics and engineering into our talent pool. I was a student, interested in cutting-edge art, performance, and collaboration with science. We called our entrepreneurial line “Enterprise for Developing Possibilities.” John prompted the rest of us to undertake long-term initiatives, demonstrations of ecologically oriented projects. Our view of ecology always included humans, who were typically ignored in the environmental thinking of those days. The extent of the influence of humans in the biospheric equilibrium, the notion of Anthropocene, was not publicly acknowledged.

In 1969, Marie found a deal on a ranch in New Mexico, where we established a base and began to work in earnest on understanding life systems. Our numbers grew. Future Ecotechnics chairman Mark Nelson joined John to lead the planting of one thousand trees on the property. We all made compost to help restore the overgrazed land. In the early 1970s, we formed the Institute of Ecotechnics, and began a series of annual conferences, inviting top scientists, explorers, and artists to join us in thinking about the state of the planet. We built dwellings and workspaces from adobe mud. We integrated the arts into everything we did. We constructed a geodesic dome for a theatre and began a touring company, Theatre of All Possibilities, which expanded the concept of drama to the world stage, to scenarios we would enact in history.

The Ecotechnics group, now greatly expanded in size, has, since the 1970s, created other projects around the world, one in each of the major biomes. October Gallery in London, founded in the late seventies, was one of the first galleries to show contemporary artists from different cultures *as artists*, as opposed to ethnic artisans. Las Casas de la Selva in Puerto Rico carries out sustainable forestry. Caravan of Dreams was our nightclub and arts center in Texas, reminiscent in terms of

glamor and excitement, music and sophistication of Rick's Café Américain in the film *Casablanca*.

Our most famous project is Biosphere 2 in Arizona, originally an airtight structure enclosing a miniature world and inhabited for two years by eight humans, the Biospherians. But that is a tale for another time. The history of Ecotechnics, the theatre, and our entrepreneurial projects span five continents and six seas.

К К In the summer of 1974, you cancelled the theatre season, drove the tour bus to Oakland, California, squatted on a marina and started building a twenty-five-meter junk—a style of Chinese sailing ship developed during the Song dynasty. This would become the first ecological-cultural project pursued by the Institute of Ecotechnics and it would develop into a truly daunting task that would distinguish the Institute from other ambitious groups of the 1970s.

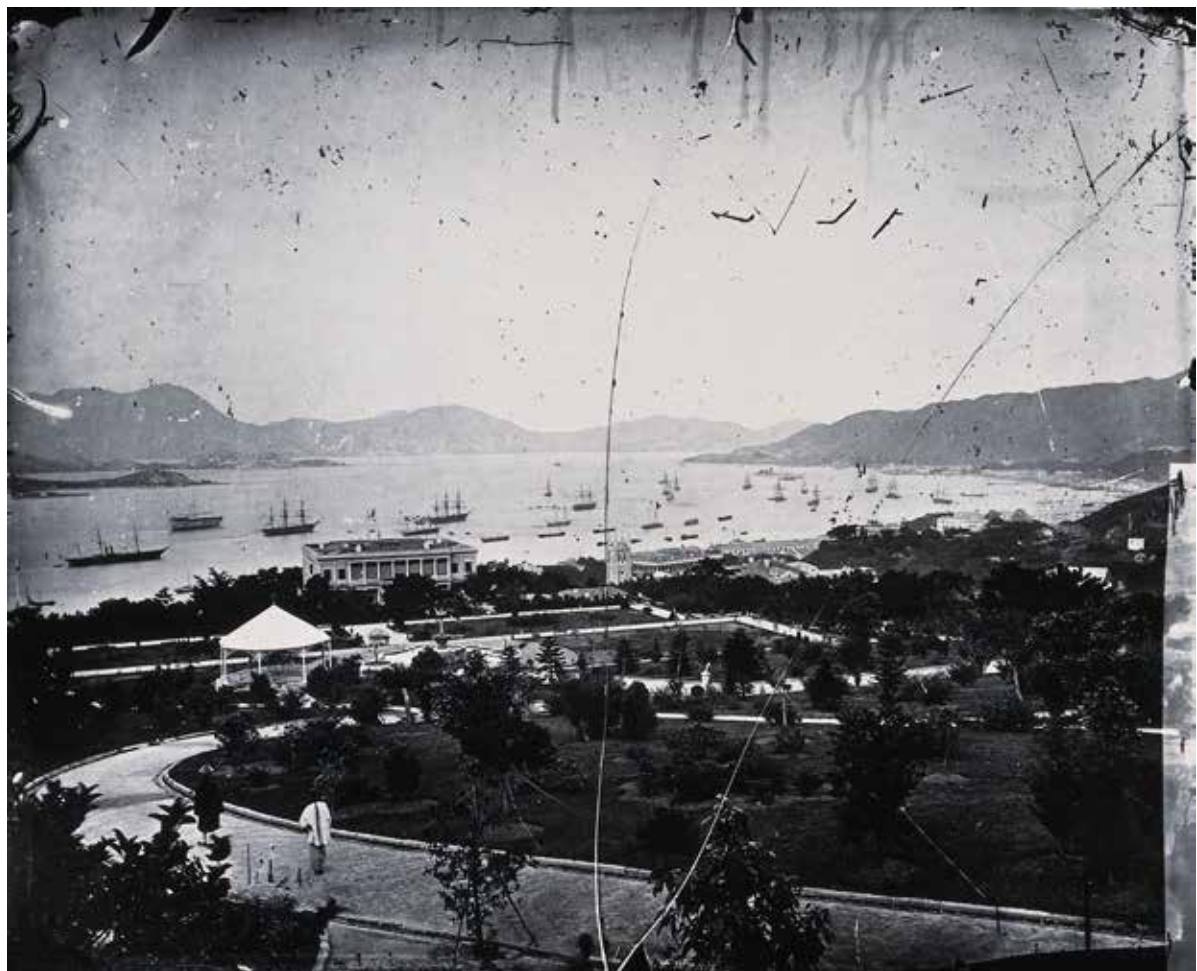


K G John had contemplated the picturesque junks sailing in the Hong Kong harbor, and proposed the design and construction of an ocean-going Chinese junk, creating a contemporary version of age-old maritime cultures. All of us became enamored with this vision, playing out as a series of epic films in our dreams. We thought, if we can build a ship and sail the seven seas, then maybe we can do anything. In the high desert of Santa Fe, we educated ourselves in maritime skills. A crew was sent to the North Sea for a seamanship program on a tall ship. Research in shipbuilding was done under kerosene lamps. Freddy did engineering calculations and drew plans in an unheated adobe studio. Ensemble members learned celestial navigation while being pushed through arroyos in a wheelbarrow, sextant in hand, attempting to take fixes on stars in the night sky.

In the summer of 1974, we drove our tour bus to Oakland, California, where we built the project that would redefine us. About fifteen people moved into a house in the Berkeley Hills, opened a cafe called The Junkman's Palace, and began construction on a nearby marina that was deserted except for a motley array of sculptors, hippies, and wannabe boat builders. We basically squatted. We expanded our ranks by driving our tour bus along Telegraph Avenue in Berkeley, inviting street people to get in on our self-administered course, Shipbuilding 101. "Would you like to help us build our ship today? We serve macaroni salad for lunch!"

A young woman from a family of Philippine boat builders bent structural metal with her feet. A septuagenarian engineer schooled crew in installing the engine and propeller. An inspired Hindu inventor mixed a new substance for us called epoxy glue. Another young woman, Margaret Augustine, took charge of the construction coordination.

While building the ship and running the cafe, Theatre of All Possibilities performed *Metamorphics in Theatre: Brecht and Artaud*, a play about the imaginary meeting of two influential theatre theorists of the twentieth century. We created a palimpsest



called *Shakespeare and Fitton*, about the bard and his mysterious muse, the Dark Lady of the Sonnets. We toured with our *Carneval of the Seven Sins*. We held Tuesday salons where everyone had to speak exclusively in bon mots.

Artists and old salts inhabiting the docks made bets that we'd never launch the ship, and that its skeleton would join other abandoned, half-built hulks lining the marina. But we were entranced with the inspiring project unfolding before our eyes and at the tips of our fingers. The spirit of this ship, like a benevolent alien goddess, seemed to be building herself despite all odds. We were her devotees working night and day to get her launched.

Our schedule lagged behind the aim of a March full moon and high tide, and we went into overdrive to push through to completion. We moved to the sand dunes of the marina, sleeping in ramshackle sheds, shacks, and on construction piles, working eighteen to twenty hours a day to meet our deadline. Then, just after sunrise, on 22 March 1975, a tugboat pulled our new twenty-five-meter ferrocement Chinese junk into the San Francisco Bay. I was on deck during the launch. It was exhilarating to ride her momentum into the sea. We unfurled our Panamanian flag. According to maritime law, we were legally in Panama even though we were floating in the coastal waters of California.

KK Since the launch of *Heraclitus* there have been a number of captains, experienced or self-trained, that have taken the helm. Can you explain some of the practices of navigating and captaining the ship in coastal territories and communities?

CLAUS TOBER Dropping the anchor in a new place for the first time, or leaving from somewhere that has just begun to feel like home, are some of the most intriguing moments in the life of a sailor. To experience what it feels like to approach a new shore or continent by boat, to hear the anchor chain racing down the hawser pipes, and to literally “drop your hook” is a forceful commitment to

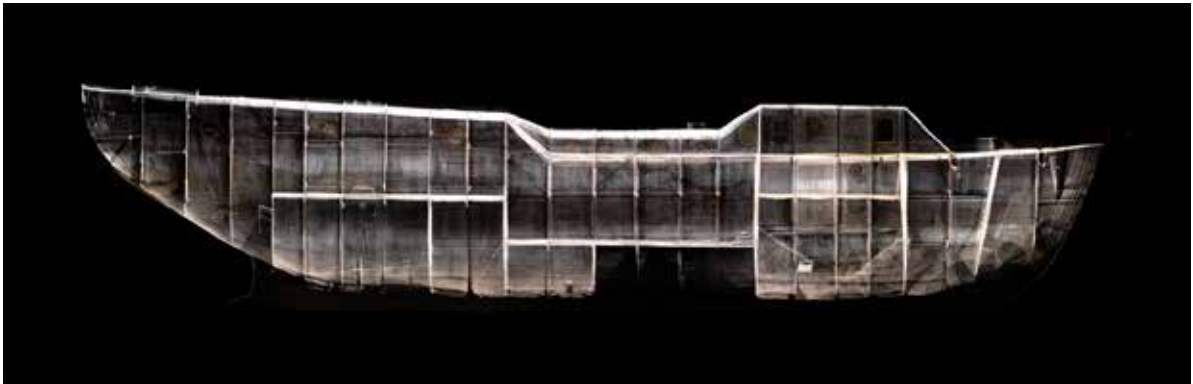
greet and embrace whatever there is, to welcome the new. There is also a deep meaning in raising your anchor, in taking your mooring lines off the harbor wall, disconnecting from what there was. It stands for completion, for facing the unknown again, and embarking toward a new beginning.

Crossing an ocean there is always time to reflect and digest the past. There is always time to prepare and contemplate where one is going. That might be the reason why my feet feel so very welcome when walking on a new shore. That is why many sailors experience a great sense of belonging, even on the other side of the planet. For my part, many decades ago I had a girlfriend from Berlin whose sister was sailing to Antarctica. That is when I first heard about this very special sailing vessel called *Heraclitus*. I was intrigued and had to join. In April 1992 *Heraclitus* was moored off Belize City in the Caribbean—my very first port of call.

Heraclitus has sailed around the world several times, made it to Antarctica, and up the Amazon river all the way to Iquitos. She has not only endured the relentless wear and tear of the challenging ocean environment, she has also been battered on a reef in Samoa, been sunk in 160 knot winds during Hurricane Hugo in Puerto Rico harbor in 1989, and has suffered several broken masts. Many moments on *Heraclitus* have left a strong impression on my mind. Sailing through the straits of Gibraltar, leaving Africa to starboard and Europe to port, while being accompanied by a large pod of pilot whales was an unforgettable entrance into the Mediterranean. A remarkable friend once told me that the Suez Canal was a true gateway to the East. And it truly was. Approaching Port Said and finally meeting its people in their happy, mad, and wonderful difference. The new smells, tastes, and dress, accompanied by the enchanting calls to prayer from the many minarets that adorned the skyline, is a favorite memory.

К К 270,000 nautical miles and many expeditions later, you pulled the ship in Spain, between Barcelona and the French border, to assess whether to build or buy a new ship, or to rebuild the original structure. Against all odds, the team decided to rebuild the ship from the keel up.

С Т *Heracitus* is not a “stay at home” vessel. By the time we arrived at the shipyard in Roses, Catalonia, in 2012, she had lived a lifetime and a half and had suffered several broken masts and many broken hearts. But somehow she had survived all of those challenges, hardships, and disasters. How or why exactly *Heracitus* managed to stay alive all those years, I cannot really fully explain. What I know is that, for some reason, there was always a large enough group of passionate people attracted to *Heracitus*—courageous and foolish enough to never let go of her, to never give up. I guess I joined those ranks many years ago. We are romantic lovers of an ancient lifestyle, an ancient idea of liberty and exploration.



What we are doing today—almost completely rebuilding the ship—does not make much sense from an economic point of view. Many times I’ve heard people say: “Why don’t you just buy another one?” Time, though, is an interesting concept, and so is identity. I believe that what we have been doing over the past few years is not only resurrecting the body of a very spirited ship, but remembering what got us here in the first place. We





have been rebuilding our ship's crew whilst recovering our common dream of a free and independent life at sea.

Much of modern life is driven by commerce and mediated by technology. A life spent at sea is a very different affair. It has a different rhythm; it teaches different values. It is a life well spent. Remember that *Heraclitus* was built in the early seventies in Oakland, California. The hull was made of ferrocement, a composite material that combines the compressive strength of concrete with the tensile strength and flexibility of steel. Ferrocement boatbuilding was a fashion of that time, comparatively cheap, but very labor intense. This method was very soon overtaken by another promising, much quicker and simpler, but also much more environmentally burdensome technology: fiberglass. However, the union of steel and concrete remains, until today, the most successful synthesis of materials used in nearly all modern architectural structures, from bridges, tunnels and opera houses, to the highest high-rises on this planet.

The base structure is composed of a series of strong equidistant steel frames and girders on which three layers of six-millimeter high-tensile strength steel rods are placed. This very strong steel cage in the shape of a boat is then covered by a further six blankets of welded galvanized wire mesh. All of this has been meticulously tied together, over tens of thousands of hours, by the many hands of our enthusiastic crew.

We are building our own ship with our own hands. A ship that will soon carry us again around our blue planet. It is quite a feat these days, when hardly anything, not even a meal or a chair, is made by oneself. For now, the next crucial step in the process will be the cementing itself, when we will be literally setting things into stone—another hugely exciting process taking place in only a few weeks from now, and one that will require great skill, precision, patience, and attention to detail.

KK Contemporary oceanography practices are based on remote-sensing satellites, drifting floats, and remotely operated underwater vehicles. Under a proliferation of oceanic data, *Heraclitus* subsists as a voyager, collecting observations on socio-scientific encounters with the oceans. Can you talk about the distinct archive of 270,000 miles and the records it holds?

CHRISTINE
HANDTE

The *Heraclitus*' extensive archives are located at Synergia Ranch in Santa Fe, New Mexico, where, forty-five years ago, the ship was imagined and designed. There are 16mm film reels, logbooks of the ship's operation, captains' logs, video footage, slides, photographs, files, letters, reports, recordings of interviews, handwritten notebooks. One striking object is a traditional "Tumbuwan" costume from Papua New Guinea which was especially made and hand carried to the ship for our theatre performance in Bali in 2000. Field research data and collected samples such as coral cores, water, whale skin, and ethnobotanical plant specimens were sent to various research institutions, including live fish and corals that were gathered for the Biosphere 2 project in Arizona.

The search for experience-based knowledge was given a new focus upon arrival in the Mediterranean in 2010 when the expedition team began interviewing fishermen, market women, sea captains, and all kinds of people who live on and by the sea; we called this the "Lives and Legends of the Mediterranean Sea." To date, hundreds of hours of voices from around the Mediterranean have been recorded narrating stories of their lives and offering acute observations about fish decline, changing weather patterns, impending poverty, and the industrialization of the sea.

During our next expedition we will continue this line of research and document the "Lives and Legends of the Atlantic Ocean." We are now in the process of developing routes, as the vectors that have to be taken into account are complex. The Atlantic has strong seasonal winds and dangerous tropical

storms. The North Atlantic's main current turns clockwise, the South Atlantic's counterclockwise.

The people who live at sea or the coast are strongly affected by rising sea levels and changes in temperature, ocean currents and abundance of fishing grounds. We will explore a range of issues including traditional and industrial fishing practices, modern and historical voyages of exploration, commercial sailing, smuggling, and the history of the slave trade. The Atlantic touches three continents: Europe, Africa, and the Americas; during this voyage we will also be re-tracing transatlantic cultural diasporas and collaborating with artists. We will engage in environmental education and solutions to the plastics crises in local ports, build partnerships, and create presentations with students and local initiatives.



K K Expeditions aboard the *Heraclitus* do not have as their primary concern the development of a scientific archive. The crew is attentive to the practices surrounding the expedition: training volunteers to take part in real-time science, leading educational and cultural programs in ports, assembling conferences, performing onboard theatre productions. Can you describe some of the practices you developed in more than forty years of sailing on the ship?

K G Understanding requires direct experience. We have shortcut phrases for processes: air moving from one place to another is “wind”; adaptation of species to shifting habitat (countering the second law of thermodynamics, by the way) is called “evolution.” Consistent with our aim in the late 1960s, our group has built projects which offer experiences to understand cycles and total systems from the inside out, with dirt under the fingernails. Living with change, adapting, forming a fluid intelligence, is fundamental to those experiences.

C H The world seems excessively accessible now, we can look nearly everywhere with Google Earth and, pixel by pixel, the world is digitized and even made printable. Records are no longer static, data is constantly updating and refreshing. But a digital map can often convey the illusion of knowledge; experience gives a whole-body understanding. *Heraclitus* engages and manifests directly and uniquely in the material world.

K K How do you find the right crew for *Heraclitus*?

C H Becoming a crew member on *Heraclitus* is a rite of passage. Those who rise to the challenge become part of the ship’s four decades of expedition history, and thousands of years of global seafaring history. The practice and technology of sailing has evolved since its invention but there have always been sails, ropes, anchors, the need for a watch system, some kind of

hierarchy, a captain, attention to port politics, and a knowledge system of navigational skills, charts, currents, and seasonal winds. All onboard participate in the practices necessary to operate the ship. All cooperate and coordinate to raise sails, raise anchors, and steer the ship twenty-four hours a day. Onboard, people learn and experience together, working side by side, in the wilderness of the ocean. Fieldwork and data collection in remote areas such as tidal marshes and on the high seas require field workers to have the skills to “get there and back,” which can be difficult. This gives the data real time context and meaning and a rich sensorial experience.

When the ship docks, it becomes part of that land for a limited time. When stepping off the vessel, we might be stepping onto the streets of Tangiers, Bombay, Darwin, or Barcelona. At this point our lives become highly visible and accessible to the public. Cooks might be watched through a porthole by dozens of strangers as they prepare a meal in the galley.

Life at sea, usually off the grid, can mean months without the distractions of land. The “Blue Planet Ensemble” practices theatre onboard, even under sail, rehearsing performances for the next port. Dinners are elaborate and each feast is completed by a distinct theatrical interlude by the chefs. On long voyages, theatre and art provide creative challenges. In port, a performance is a way of gifting our experience, a way of communicating, interacting, and creating meaningful encounters with local people.

Twenty years ago in the Maldives, *Heraclitus* was anchored offshore and locals came in a dozen small boats, boarding to see one of our onboard performances acted out beneath the stars. A storm blew up drenching our show and we lost power, so we continued performing below deck in the light of kerosene lamps. Nature became a character in our play and made us a more fervent ensemble, bringing the performers and audience together.

The sail is a powerful projection surface. I never get tired of observing that tall white canvas, as it is the surface the wind

catches to propel us forward, and it indicates direction. To represent *Heraclitus* in a play, we either use theatrical sails, our bodies, or a mask of the bow, as the bows of Chinese junks are traditionally painted with eyes so that the ship can “see.” During long voyages, sometimes we project movies onto the main sail, and in port, a mockup sail becomes a projection screen to host presentations in the docks. At night, on the high seas, when we are at risk of a close encounter with another ship we shine powerful beams onto the sails to be seen if we aren’t able to communicate by radio, ensuring safe passing.

К К In 2025, when you will complete “Lives and Legends of the Atlantic Ocean,” *Heraclitus* will have existed for fifty years. At this moment, when the ship is looking for a new generation and a new crew, what is your outlook?

С Н The ship *Heraclitus* can be recreated again and again; it is a timeless space and welcomes the flux of human beings. People come and go and some stay and carry on. A few years ago I picked up a couple who were hitchhiking and they are now very engaged with the project and part of the next generation who will sail *Heraclitus* into the future. It has been a continuous evolution and revolution.

С Т I know that *Heraclitus* has already found her next generation crew. During recent years, quite a fantastic and remarkable group of fine ladies and gentlemen of many nationalities and ages have come to work on the *Heraclitus* in drydock. Although *Heraclitus* is a ship most suited for the young and adventurous, we are happy to enjoy the company and experience of some older tough cookies in our midst. And then of course there is my young marvelous daughter, turning three-years-old this year, who, within no time, will be a fantastic sailor and have mastered the ancient art of celestial navigation.



Personally, I will be happy to continue voyaging on *Heraclitus* for the first few years after her launch. During this time I hope to pass on my knowledge of how to operate this exceptional vessel and my love of the sea—together with the desire to support a new crew that will cherish and protect our world’s oceans. I will then embark upon a new chapter in the mountains of the Brazilian Mata Atlantica, where I will follow with great passion and curiosity the new stories and adventures of *Heraclitus* as she sails around the world. Of course, I’ll be visiting often, to offer my companionship and advice during difficult passages or daring ocean crossings that are just too exciting to miss.

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pp. 234–35	Isolde Drosch

The Institute of Ecotechnic's *Research Vessel Heraclitus* is a floating platform for ecological education, scientific studies, and cultural projects. Built in 1975, the ship has undertaken eleven expeditions including studies of coral reefs, ethnobotanical collections, whale genetics and now, documentation of communities living on and by the sea. Generations of endangered ecological knowledge and cultural practices are crucial to document and reinvigorate. The unusual vessel, a twenty-five-meter, three-masted ferrocement Chinese junk, with its multicultural crew is at home in ports throughout the world from the Red Sea to the Antarctic, from the Upper Amazon to Melanesian island cultures.

KATHELIN GRAY is a director, writer and producer of cultural, artistic and ecological projects worldwide. She is a founding director of the Institute of Ecotechnics USA and UK, and Managing Director of Ecotechnics Maritime, Ltd. She was on the Board of Directors of Space Biospheres Ventures, Inc., which designed and built the Biosphere 2 ecological laboratory in Arizona. She has founded cultural and ecological projects worldwide, including a gallery and cultural center in London, a sustainable forestry project, a research vessel, hotel and cultural center in Kathmandu, and many others. Gray produces music and film, and consults in the arts and ecology.

CHRISTINE HANDTE has lived for thirty-five years on the sea, leading marine expeditions in every sea but the Arctic. She is Expedition Leader for *Research Vessel Heraclitus*, Director of Ecotechnics Maritime Ltd. and the Institute of Ecotechnics UK. The work she has been engaged in includes: studying coral reefs, release of captive dolphins into the wild, conducting genetic sampling of whales in the Antarctic, studying wetlands and mangroves, and most recently the oral history expedition "Lives and Legends of the Mediterranean Sea." She is a Fellow of the Explorers Club since 1997. She is currently co-managing the rebuild of the *Heraclitus* in Spain and coordinating the development of the next expedition to the Atlantic Ocean.

CLAUS TOBER is the captain of the *Research Vessel Heraclitus*. He has engaged in several expeditions worldwide; since 1995, he is a Director of the Institute of Ecotechnics UK, and of Ecotechnics Maritime, Ltd. Claus grew up at the shores of the Baltic Sea in the north of Germany. On board the *Heraclitus* he has collected data for coral reef and climatological studies in conjunction with the Scripps Research Institute (USA) and the Lamont-Doherty Earth Observatory (USA). Claus has spent several years at *Heraclitus*' sister projects. He worked as construction operations manager and Assistant to the Artistic Director at October Gallery in London, UK, and he tremendously enjoyed his time as the assistant to the station manager of Birdwood Downs, a horse and cattle station in the Kimberly, Western Australia. He is currently the project manager for the rebuild of *Heraclitus* in Roses, Spain.

KONSTANTINA KOULOURI is a designer working between urban research and strategic design. Her practice focuses on integrating new conceptual and technical approaches for city planning at the intersection of technology, ecology, and finance. Currently, she is a research and analysis lead at Dark Matter Labs, where she is working on a variety of projects, including the development of a city-wide model to demonstrate how urban trees act as public infrastructure. Her Bachelor's and Master's degrees are from the Architectural Association, and she has a postgraduate diploma from the Strelka Institute for Media, Architecture, and Design. She has been a guest lecturer at the Royal College of Art, the Harvard University's Graduate School of Design, and the Strelka Institute in Moscow.





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