@Home @Sea

by Dwight Howse

In April 1895, at age 51, after a 35-year career in various capacities sailing primarily on freighters, Captain Joshua Slocum left Boston in an 11.2 m gaff-rigged sloop named *Spray*. He embarked on a busman's holiday that would see him sail single-handed more than 46,000 nautical miles to become the first person to circumnavigate the globe alone. He recounted his adventures over the three year period in his book entitled *Sailing Alone Around the World*. Having no business driver to undertake this voyage, it might be said that Captain Slocum set the bar for a new class of recreational sailors. Driven by a thirst for adventure or escape, a desire to see new cultures and destinations, or simply the romance and lure of the sea, cruisers set out for extended periods of time living on board sailing yachts, travelling to various destinations around the globe.

Captain Slocum spent a career around boats as cabin boy, mate, captain, and boatbuilder. As such, he developed the navigation and other complementary seamanship skills that enabled him to sail safely and confidently. On the other hand, I would suggest that most modern recreational cruisers contribute significantly less than 35 years to "learning the ropes."

They are young people, families, and retirees with varying degrees of skill and relatively little infrastructure support, yet the vast majority sail safely, confidently, and in comfort along their chosen tracks. The key factor that enables today's recreational cruisers to undertake these long voyages is the development and adoption of a suite of ocean technologies that greatly eases the burden of knowledge and experience required to safely enjoy recreational cruising. The challenges of navigation, communication, boat-handling, and even provisioning have been successfully parried by technology. Technology has enabled a broad cross-section to participate in the exciting and satisfying world of recreational cruising.

Navigation

An old Breton prayer reads, "Oh God, thy sea is so great and my boat is so small." Those few words exemplify the mindset of sailors who must constantly respond to the question "Where am I"? Without fail, that question is followed up by part b: "How do I get from here to where I want to be"? The Designer provided great oceans to travel but, apparently, signposts were in short supply.

No doubt, incredible feats of navigation have been accomplished with little or no technology. Polynesians populated the remote islands of the Pacific and later sailed regularly from the leeward islands of Tahiti to Hawaii and back based on an intimate knowledge of winds, ocean swells, sea animal behaviour, cloud formations and of course the rise and fall of the stars. The Phoenicians, Chinese, Norsemen and Arabs each ventured on long distance trade and raid routes with little instrumentation. In their time, the marine compass, the astrolabe, the backstaff and sextant each made significant technological contributions to answering the perennial "Where am I?" question. Nonetheless, it wasn't until John Harrison invented the marine chronometer in the 1700s that longitude could be accurately determined. Even our Captain Slocum circumnavigated the world with only a log, a compass, chronometer, and sextant as navigation instruments. These instruments, however, require knowledge, practice, mathematics, and a certain degree of luck to use since inclement weather and a rolling boat often limit the precision that can be obtained.

Two technologies developed early in the twentieth century have contributed immensely to the safe navigation of recreational yachts. They are both similar in that they rely on echolocation; however, one uses radio waves while the other uses acoustic waves. Here, I refer to radar and sonar, respectively. By constantly monitoring the returns from radio pulses sent sequentially in a circle around a yacht, the master can see land, traffic, and weather patterns in the local area using a radar system. Similarly, an acoustic pulse reflected off the bottom informs the master whether or not there is sufficient depth and enables the sailor to recognize when depth contour lines are crossed. With reference to a chart, the knowledge of landforms and depths provide the sailor with valuable location cues.

Ocean navigation signposts were not broadly available to the common person until the twentieth century with the installation of long range radio positioning systems such as Loran and the early attempts at satellite positioning. The breakthrough navigation technology of our time is of course the Global Positioning System (GPS). Sailors have crossed oceans for thousands of years but it was less than twenty years ago, in 1994, that the GPS became fully operational. Through altruism or other motivation, with the launching of 24 active satellites, the United States effectively gifted the world with a signpost every 10 m or so around the globe. Three other systems to augment this capability are in various stages of development and deployment: GLONASS (Russia), Galileo (European Union), and COMPASS (China). Suddenly, practically anyone with a GPS receiver can rattle off latitude and longitude. The perennial "Where am I?" question has been perennially answered.

A GPS receiver is practically ubiquitous now as the fundamental geo-referencing instrument for navigation. The integration of GPS with a database enabled a Geographical Information System (GIS). A GIS is able to effectively maintain and present geo-referenced nautical information and, therefore, an electronic chart and pilot book has become possible. Instead of plotting courses with dividers and parallel rules on paper charts, today's navigator can plan routes with a series of waypoints and calculate headings, distances, and estimated times of arrival with the press of a few buttons or a few touches on the screen. While I would not suggest that paper charts have become redundant, I would suggest that their use has been relegated to more of a backup role. An electronic chart can provide automatic warnings of fixed hazards such as rocks, reefs, and wrecks. It can also provide calculated and real time information such as tides, currents, and even weather. Why stop there? Why not overlay radar information on the same display? Now, with a radar overlay, even local traffic appears in the same display as the chart and there is an additional level of confidence in position when the radar returns register well with the electronic chart shorelines.

An autopilot contributes to the ability of a short-handed cruising crew to maintain watch on long passages. By relieving the burden of a hand on the wheel or tiller, a single individual can maintain watch, plot locations, and make any necessary adjustments to sails while another crew member or two are off duty. A good autopilot will enhance the stamina of the crew by relieving the relative drudgery of playing the wheelsman. Cruiser's experience with autopilots has varied significantly. Slocum reported that he was able to go several thousand miles by just lashing his tiller – a very crude autopilot. Meanwhile, Sir Francis Chichester reported considerable frustration with the autopilot used during his 1966 circumnavigation. Today's autopilots are able to be integrated with the electronic chart to follow a series of waypoints rather than being restricted to just maintaining a heading. However, for now at least, the crew will still have to make necessary sail adjustments.

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bathymetric surveys are quite dated and may sometimes have significant inaccuracies. Secondly, it is critical that the datum used for the chart and the GPS position match. Be sure to check your manual for datum selection options.

Communication

For weather information, traffic updates, safety, business transactions, friend and family contact, and entertainment, communications are now considered essential on board any vessel. Captain Slocum and other sailors before him may have circumnavigated the globe with their communication systems limited to a visual range of a very few miles. Nonetheless, few modern cruisers would be satisfied with such isolation. Fortunately, in December 1901, Guglielmo Marconi demonstrated the capability of transoceanic radio communication from Poldhu in Cornwall, England, to St. John's, NL, Canada. Technology can now overcome the isolation of being incommunicado.

Today's cruisers have multiple modes of communication available. Very High Frequency (VHF) radio provides local line-of-sight connections within about a 30 nm radius. For longer range, Single Side Band (SSB) Medium Frequency (MF) and High Frequency (HF) radio provide voice and data communications over hundreds or even thousands of miles depending on the propagation characteristics. For the ever-thrifty cruiser, these services are essentially free once the radio has been purchased.

Cellular telephones are now commonly used while coastal cruising around populated areas; however, long range cruisers and even gunkholers [those who cruise from place to place, spending the nights in coves] will often find themselves out of range or attempting to use the bosun's chair to go up the mast in search of a better signal. For the long range cruiser, recent technology has enabled access to the global (or nearly so) satellite communications offered by Inmarsat, Iridium, and Globalstar systems. Inmarsat relies on a network of geostationary satellites and, therefore, does not cover the poles, although this is of little concern to most cruisers. For mariners, Inmarsat C (text only) has the advantage of being recognized as part of the Global Maritime Distress Safety System (GMDSS). Inmarsat Mini-M provides both voice and text services. Inmarsat is the only system of the three that is designed specifically for mariners. However, only Iridium, with

66 Low Earth Orbit (LEO) satellites and inter-satellite communication links, is truly a global satellite system offering connections anywhere at any time. Globalstar employs 48 LEO satellites for its system; however, it uses a "bent pipe" technology rather than inter-satellite links and therefore its coverage is limited by the location of ground stations. Globalstar covers most continental areas and even extends quite a way offshore. It may be used for coastal cruising in most areas; however, it should not be relied upon for transoceanic passages. The frugal cruiser will of course be concerned that satellite services charge not only for the equipment but also for each call that is made with fees that vary depending upon the data volume. Nonetheless, one relatively inexpensive technology based upon the Globalstar network is the Spot GPS messenger. By integrating a GPS with a satellite radio and a few buttons, the Spot GPS messenger enables cruisers to check in with friends and family to let them know where they are and that either 1) Everything is fine; 2) I'm done, come get me; or 3) This is an emergency, call for help. Often, that is sufficient for peace of mind ashore. Note that this system is limited to the Globalstar coverage areas.

One of the most satisfying aspects of sailing is being at one with nature; feeling the boat surging through the waves powered only by the wind. Nonetheless, long-term cruisers will likely encounter times when they might feel just a little too close to nature; when sails are reefed and waves are crashing over the deck. Fortunately, cruisers do have the ability to minimize this probability. Today, global weather patterns are reasonably well known by season and region. Route planning involves choosing times when the expectation of good sailing weather is maximized. Before setting out, broad weather forecasts complete with satellite imagery and pressure systems are accessible over the Internet. Even so, such planning only accommodates broad weather patterns. Daily conditions can vary considerably.

Radio communications allow today's cruiser to obtain marine forecasts for the next few days even while at sea. Weather forecast information can be accessed via SSB radio weather fax and Navtex. Additional routing services are available to cruisers for a fee to guide them around major storm events; however, it must be emphasized that with cruising yachts averaging 5-7 knots, the probability of outrunning storms is practically nil. Cruisers still need to be capable of dealing with heavy weather conditions since it is virtually certain that, at some point, the skills of the long-term cruiser will be tested.

One more word with respect to communication is the proliferation of the Internet. While high speed Internet is not the norm offshore, today's cruiser can generally expect to make Internet connections at libraries or Internet cafés in most ports of call, often wirelessly from the yacht while tied up at a marina. The Internet enables connections for socializing, for business, personal banking, and ordering parts for repairs. In fact, with access to e-mail, Skype, and other services, perhaps you will be more connected than you want.

Mechanical Systems

Much of the discussion so far has focused on the electronic technology that now empowers cruisers. It is nonetheless important to also recognize the impact of mechanical technology developments on enabling the cruising lifestyle. Materials technology advancements have seen transitions from wooden boats and masts to steel, aluminum, and various fibre-reinforced compounds used throughout the vessel to optimize strength, durability, resistance to corrosion, and aesthetics. By far, the materials of choice for most modern cruisers are glass reinforced plastic (fibreglass) for the hull, aluminum for the mast, stainless steel for the stays and shrouds. The choice of materials for each component has led to yacht designs that provide for a safe passage for the crew and longevity for the yacht with relatively little maintenance required compared to the days of "wooden ships and iron men." Even so, newer, lighter, stronger material compositions are still being designed and tested for their applicability on yachts. Kevlar and carbon fibre both offer material characteristics that are

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beneficial for some yacht components and are therefore finding their way into modern yacht designs, albeit with some additional expense.

Materials technology is not limited to the structural components of the yacht. Consider the variety of ropes that are now available. It used to be that every rope on a ship was manila. Now, we find nylon, polyester, polypropylene, and Spectra used for different applications depending upon the strength, wear, and elasticity characteristics desired for halyards, sheets, anchor rode, painters and mooring. In fact, you would be hard pressed to find any manila on a modern yacht.

New material technology has also had an impact on the sails. Captain Slocum was limited in his choice of material for sails. Since the 1800s, woven cotton canvas had been practically the only material used for sails. By comparison, very few sails are now constructed of canvas. Instead, a variety of man-made materials are employed. The most common these days is woven polyester but other options include woven and laminate sails of nylon, Kevlar, Spectra, carbon fibre, Mylar, Pentex, and/or Vectran, among others. Different fibres have different characteristics of weight, strength, elasticity, and resistance to abrasion and ultraviolet light as well as cost. No matter what the choice, in general, modern sails are typically lighter, stronger, and less elastic. The result of these technological advances for the cruiser is that modern sails are more efficient, allowing better conversion of wind energy to propulsion and also enabling yachts to point higher into the wind. A further advantage is that the lighter sails, particularly when coupled with electric winches, are easier to handle by a short-handed crew.

Roller reefing offers another significant advance in sail handling technology. It is self-evident that sailors are safer in the cockpit than walking

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around the deck. Nonetheless, sailors are required to respond with sail changes or reefing exactly when the weather starts getting heavier and conditions worsen. Kneeling on the foredeck, wrestling with a sail as winds and seas are rising is a most precarious position. The introduction of roller reefing around the forestay eliminated that requirement and yielded the dubious honour of most precarious position to reefing the mainsail. Recently, however, roller reefing for the mainsail, either in-mast or in-boom, has also become available. In fact, with lines leading to the cockpit, if the equipment is working well, virtually all sail control can be handled without requiring a sailor to go on deck.

One final point in terms of mechanical systems is with regard to ground tackle. Today's cruiser is presented with an array of options for ground tackle. For centuries, the admiralty pattern or fisherman's anchor with two flukes and an orthogonal stock was the standard. Now, cruisers can select from Danforth, CQR, Bruce, and Northill, among others. Each has different characteristics for holding in mud, sand, weed, or rock. They have different weights and stowing characteristics as well as different retrieval characteristics. The cruiser is faced with a decision as to which anchors to carry for the cruising grounds and size of vessel anticipated. No matter which choice is made, the cruiser can take advantage of technology not only to set but also to retrieve the ground tackle with a relatively small electric windlass.

Safety

The primary concern of sailors, whether for work or pleasure, should be safety. Here again is an area where technology has contributed to enhancing the opportunities for cruisers. It could be argued that the advances in navigation, communication, and mechanical systems all contribute to enabling a safer experience. Indeed, it is better by far to avoid accidents no matter how effective the available response. Nonetheless, somewhere, somehow, accidents will happen; therefore, this section will focus on technology that allows a sailor on a big ocean to respond effectively when things go wrong.

Safety of life at sea is the driving force behind the GMDSS. One of the technologies cited within this international standard is an Emergency Position Indicating Radio Beacon (EPIRB). EPIRBs are a carriage requirement for a broad class of vessels; however, even pleasure boats are encouraged to carry one. An EPIRB may be manually activated or activated automatically when it floats free of its holder. When an EPIRB is activated, a series of events is initiated. The newer EPIRB with a built-in GPS will determine where it is and communicate that position along with a unique identifier to a Cospas-SarSat satellite. The nearest Coast Guard will be placed on alert to respond to the distress signal and, after some preliminary checks to minimize false alarms, will be tasked with responding to the distress. This no doubt gives a great deal

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of comfort to the crew of a stricken vessel but it should be noted that there is no way to communicate additional information over this system. Therefore, the response will be the same whether the emergency is fire, sinking, medical, or loss of propulsion. The full brunt of the international search and rescue effort will be activated. In addition to an EPIRB for the yacht, Personal Locator Beacons (PLB) are now available that operate using the same satellite system and will activate the same resources in the event of an emergency. In this case, the beacon is worn by each individual on the boat and may be activated in case of a man overboard or other emergency event. EPIRBs have contributed to the rescue of over 30,000 people since 1982 and over half of the incidents were maritime-related.

Another relatively new technology that contributes to safe operations is the Automatic Identification System (AIS). [Ed. Note: read more about AIS in this issue's *Inside Out* column.] This system uses VHF radio channels to continuously broadcast information such as vessel name, speed, heading, etc. Other AIS units in the vicinity are able to receive these broadcasts and either present the information on an integrated display or send this information to an electronic chart where ship information can be presented to the ship's master and also registered with radar returns. The focus of AIS is collision avoidance; however, AIS technology may also be installed on buoys and other navigational aids to automatically broadcast their identification, location, and any other pertinent data, such as weather information. This technology is becoming smaller and less expensive to the extent that personal AIS devices are now available to broadcast the location and identification of individual crew. The benefit of this technology is immediately apparent if you consider a man overboard situation at night. Instead of hunting for the victim using search patterns and lights, the electronic chart automatically displays the location of the victim provided they are in radio range.

Technology has contributed to safety in many other ways. Global communication itself enables access to search and rescue but also to expertise from mechanics or medical personnel, when needed. Who could count the improvement in safety that GPS has enabled through more accurate navigation? Refrigeration has contributed to safety through the preservation of food against spoilage while reverse osmosis watermakers enable access to clean fresh water practically anywhere a yacht may be travelling. For that matter, the technology that created the Suez and Panama canals contributes to safety by mitigating the need to round the Cape of Good Hope or Cape Horn and brave the Southern Ocean. In the words of Kim Stanley Robinson, referring to Antarctica, "Below the 40th latitude, there is no law; below the 50th, no god; below the 60th, no common sense; and below the 70th, no intelligence whatsoever."

For the aspiring cruiser, technology broadens the opportunity for participation. With a little training and experience, couples, families, and retirees are able to take on a cruising excursion.

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Hotel Power

All of this technology, of course, places an extra burden on the requirement for hotel power. Navigation, communications, refrigeration, and entertainment all require electric power to operate. This presents a need for reliable and preferably redundant sources of electricity. Here again, technology comes to the rescue with compact diesel generators, solar panels and wind generators coupled with high capacity batteries all readily available to provide electricity when the "iron jib" (engine) is not running.

Conclusion

For the aspiring cruiser, technology broadens the opportunity for participation. With a little training and experience, couples, families, and retirees are able to take on a cruising excursion. They can make long passages to new countries or spend a few weeks gunkholing in company with other yachts or on their own. Even a relatively small yacht is capable of carrying the technologies mentioned above. Not only are the sizes appropriate for cruising yachts, but these technologies are also quite affordable, even for yachters.

Before closing, it is appropriate to issue a warning that, no matter how good the technology may be, there is still no substitute for common sense. Do not abandon it in the face of technology. Cruising should be a safe, enjoyable and rewarding experience. Watch the waves, listen to the wind, feel the pull on the wheel, and fully engage your mind in the reality of the moment.

What's holding you back? In the words of Mark Twain: "Twenty years from now you will be more disappointed by the things that you didn't do than by the ones you did do. So throw off the bowlines. Sail away from the safe harbour. Catch the trade winds in your sails. Explore. Dream. Discover."

Dwight Howse serves as the Head of the School of Ocean Technology at Memorial University's Marine Institute. His interest in encouraging young people to consider careers in the ocean environment has led him to become involved in promoting underwater robotics teams in schools around the province of Newfoundland and Labrador and in Nunavut. Mr. Howse is also a mentor for Memorial University's Eastern Edge Robotics team, which has distinguished itself through multiple first-place wins in international competition. He is engaged in a variety of outdoor sporting activities including sailing. He has cruised the waters around Newfoundland and in the Caribbean with his wife Diane, friends, and family and is now looking forward to his next sailing excursion in the South Pacific. Dwight and Diane are actively preparing for a cruising retirement.