BILL LOCKINGTON

SPARKS *of* Inspiration

A modern take on a vintage launch

by Greg Rössel

Ted Moores's early-morning preparations for leaving the dock at the Antique Boat Museum in Clayton, New York, were routine. The docks were dew-covered, quiet, and, other than his 30′ fantail launch, SPARKS, they were largely deserted. Just the day before, the museum had been alive with boats gathered for the annual Antique Boat Show, many of them vintage speedboats with a rain forest's worth of highly polished mahogany. Powerful, throaty gasoline engines with their chortling exhausts had been tinkered to audio and performance perfection. Glistening varnish, brass, and nickel bespoke countless hours of flawless maintenance. But after a few glorious days in the sun, the boats were now back on their trailers, heading to their boathouses and storage buildings, leaving but a skeleton crew at the pier.

A few moments before casting off his own mooring lines to head across the St. Lawrence River to Kingston, Ontario, to begin the journey up the Rideau Canal to Ottawa, Moores checked his instruments and hit the starter. And there was...silence. Which was exactly what he expected, since this particular classic boat's "engine" is totally electric.

SPARKS, which Moores built at his Bear Mountain Boat Shop, might be best described as a hybrid both for its propulsion system—electric drive supplied by photovoltaic panels backed up by a diesel generator—and for its blend of 19th- and 21st-century technologies. The 19th century inspires the launch's understated elegance and easily driven, efficient hull. The 21st century's contribution, meanwhile, comes not only in the high-efficiency electric motor and solar panels but also in the computer used to design the boat's hull and electrical systems, in its composite construction using epoxy-encapsulated strip-planking, and more: computer analysis and display of all onboard systems, bow thruster, and GPS navigation. In many ways, the boat seems to bypass the excesses of the petrolcentric 20th century.

***Above*—For freshwater cruising in Ontario, Ted Moores conceived a fantail launch that calls to mind the best of the area's heritage but is thoroughly modern in its use of wood-and-epoxy construction and a solar-powered electric motor, with a diesel generator for backup.**

Past Performance

During most of that 20th century, powerboat and automobile designers followed parallel tracks in pursuing bigger engines and more speed. In their early days, autos with diminutive engines merrily puttered over the nation's byways. Their counterparts on the water had long, lean, and easily driven displacement hulls. These boats were designed to take advantage of the marine engines then available, which were heavy and low-powered, and to minimize the use of fuel, which was expensive. Builders like Owens and Richardson touted not only the seaworthiness and beauty of their boats but also their sensible economics. Propeller manufacturers promoted economy. Even outboard motor companies touted models capable of running "a full hour and a half on a single quart of fuel."

After World War II, the high horsepower that had helped win the war carried over into autos and boats alike. Speed was king, and there was no turning back. Early innovations in electric power faded into the past. The upheaval of oil embargoes in the 1970s eventually brought minimum mileage mandates for automobiles, but boats had no similar benchmarks, and on the water the macho horsepower arms race went on undeterred for most of the 20th century. Decades later, as the 21st century dawned, nasty fuel price spikes made gas-and-electric hybrid autos like the Toyota Prius cool, and the all-electric Tesla roadster most definitely cool. For powerboats, even normally bullish trade magazines had to acknowledge that $1,000 fill-ups at the gas dock were a turn-off for customers. With advances in electric motors and batteries, meanwhile, some boatbuilders began to reconsider those easily driven hulls of a century earlier.

Selecting a Design

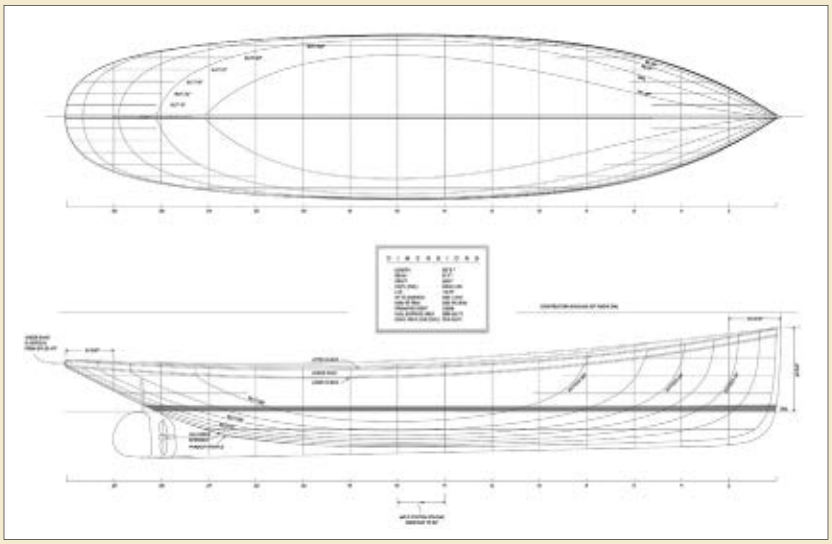
In 2006, Moores and his partner, Joan Barrett, began experimenting with ideas for an electric-powered boat for their own use as well as a prototype of a boat whose time they thought might have come. To be practical, it would have to be easy to maintain, have a cruising range at least as good as its fossil-fuel competitors, look good, and be fun to run—in short, a viable custom powerboat for builders in the petroleum-challenged future. Would customers be open to an alternative?

One could say that for decades Bear Mountain Boat Shop (see sidebar, page 54) has been in the business of producing low-impact, composite, energy-efficient boats—strip-built canoes and kayaks. So making the leap to a family-sized powerboat wasn't all that much of a stretch. Cedar strip planking encased with epoxy and fabric allows versatile design choices for light yet strong hulls. "I asked myself what kind of hull I wanted to get old with and what skills my grandchildren will have to put into maintaining it," Moores said, "and strip-plank/epoxy was the only contender. Also, I have a barn full of clear local white cedar, and the building method suits the complex shape of the fantail hull."

Electric propulsion, although not currently the first choice among today's pleasure boaters, seemed natural to Moores. In the early 1900s, electric boats, especially those built by the Electric Launch Company, better known as Elco, competed head-to-head with those powered by steam and gasoline engines. A fleet of 54 Elcos

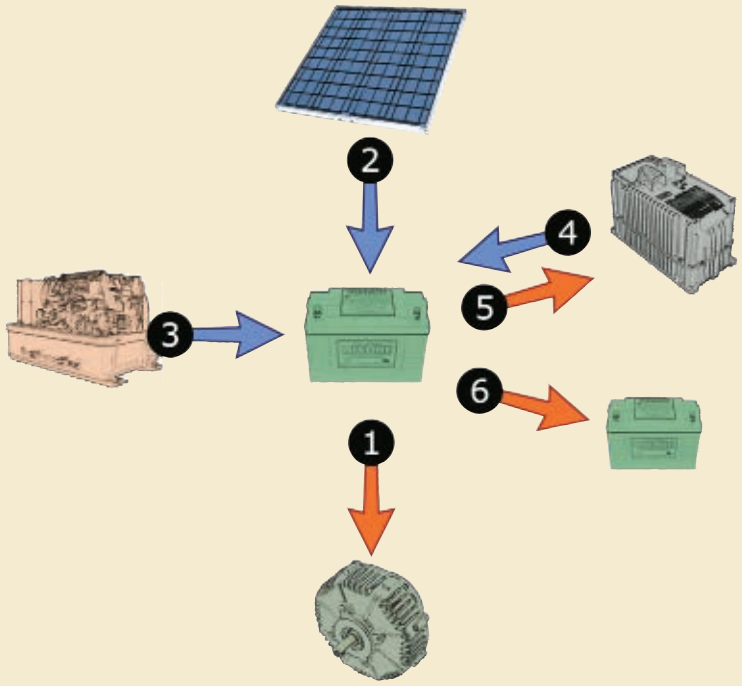
With fenders out for passing through one of many locks, SPARKS is in her element in Ontario's interconnected network of waterways. Her cruising speed is about 5 knots.

BILL LOCKINGTON



SPARKS
Particulars

LOA	30′3″ (9.22 meters)
Beam	6′11″ (2.11 meters)
Draft	2′ (0.61 meters)
Displacement	6,800 lbs (3,084.42 kilograms)
Top speed	6 knots (1.2 hours on batteries alone)
Cruising speed	5 to 5.5 knots, at about 1,200 watts
Solar-only speed	3 knots in full sun



Power flows: **1—The electric motor draws power from the main battery bank. 2—Solar panels charge the main batteries. 3—A diesel generator supplements solar power when necessary. 4—A charger/inverter draws from shore power, when available, to recharge main batteries. 5—The charger/inverter also supplies 120-volt AC power when the boat is away from shore power. 6—Two additional batteries are charged by the main batteries, one running low-voltage "house" power, the other powering the bow thruster and the generator starter.**

Motor: PermMotor PMG 132, 4.7 kW at 48 volts, operating through a 3:1 reduction gear bolted directly to the electric motor.

Batteries: Concord-Lifeline GPL 31T, sealed deep-cycle absorbed glass mat lead-acid 12-volt batteries. Four in series compose one bank, producing 48 volts. Four such banks are hooked up in parallel. To preserve battery life, they remain charged above 60 percent. A separate heavy-duty battery powers the starter for the generator and runs the bow thruster, and another serves as a house battery, though 120-volt loads for the refrigerator and the essential electric coffee maker, for example, are run from the main 48-volt battery bank through an inverter.

Generator: Fischer-Panda, 48 volts DC; 4 kW. Electric and generator systems can be isolated if necessary. The generator automatically engages when batteries drop to 60 percent charge.

Solar panels: Kyocera KC50T (eight panels, producing 400 watts at 48 volts).

Battery charger/Inverter: Outback FX3048t (charges 48-volt battery bank from 120-volt input and can produce 120 volts for onboard outlets).

Propeller: 17x15 (cruising speed of 5.5 knots at 400 rpm shaft speed; 6-knot boat speed at 800 rpm shaft speed).

Console monitor: Touch-screen user interface shows current status of power consumption and state of charge. In full sunlight, the motor's power consumption can be matched to solar input to maintain the battery charge level.

STEVE KILLING (THIS PAGE)

COURTESY TED MOORES

When SPARKS was moored to a lock wall in the Tay Canal during her 2010 voyage, a 1920s-vintage Elco Cruisette locked through at the same time, making the canal reminiscent of a different age. Late in the 19th century, the Electric Launch Company—which had switched to gasoline engines for the Cruisettes—gave electric-powered boats their highest-profile sucess until modern times.

carried more than a million passengers around Chicago during the 1893 World's Columbian Exposition. Even back then, as today, electric propulsion was simple, quiet-running, low-maintenance, odor-free, and never needed to be winterized. Moores reasoned that modern technology could overcome most of the earlier boats' shortcomings, dependent as they were on heavy motors and low-capacity batteries that limited their range and took a long time to recharge. From the outset, the Bear Mountain wish list included the use of an advanced DC electric motor engineered for a demanding marine environment.

In the early stages, most of the design work took the form of ideas jotted on Post-It notes. The batteries in the bank would be of the absorbed glass mat type, (which don't spill or produce gases) capable of running four hours at half speed without deep discharge. There would be a solar panel array to produce at least a quarter of the batteries' power, augmented by a highly efficient diesel generator that could "refuel" the batteries even while the boat was under way. Plus, a shore-power connection would permit the batteries to be topped-up at the dock. They envisioned a high-tech management system that would seamlessly harmonize all the power sources in a reliable, user-friendly, low-maintenance way. Behind the scenes, a computer would record all of the electrical functions, along with other digital information, such as GPS navigation. And the whole deal had to be done without being totally geeky.

COURTESY TED MOORES

Using computer-generated shapes, Moores laminated the backbone in layers set up vertically—similar to the "lift" method of half-model making—then sculpted the keel to its final shape.

Curiously, perhaps the easiest decision was selecting the hull design. The lake district of Ontario has long been known for elegant small powerboats of all sorts, intended for its well-protected waterways. For Moores, the answer was obvious: "I've always liked the fantail launch style," especially one he knew from an 1880 photo. "Our launch is very similar to the steamboats built in Peterborough in that era," he said. "The design, then, was function-driven—today's conditions are much the same as 100 years ago." There were other practical considerations as well. For starters, a narrow hull is easier to haul down the road on a trailer, although its elegant shape isn't as stable as a broader hull. Long, narrow hulls are tender—a price paid for being easily driven. Then, there is the matter of acceptance. A displacement hull will only go as fast as its waterline length will allow. "If you build a hull that goes slow," Moores said, "it has to look slower so you are not disappointed."

For the specifics, Moores went to yacht designer Steve Killing and his son, Jonathan, with whom they had worked before. "The process of selecting the desired low-horsepower motor has a lot of variables that you have to get right. The hull and propulsion system were designed at the same time so as to optimize one another. Steve designed the hull, Jonathan designed the propulsion, and they worked together." Hull shapes that were originally conceived for steam engines work well for electric motors, too. "Instead of looking to the future, you look to the past for efficient, low-speed hull shapes," Moores said. "Steve was looking to perhaps increase overall efficiency by 5 percent, which suggests that the old-timers got pretty close designing by the seat of their pants."

For a boat of this size and its need for accommodations and systems, Bear Mountain plainly couldn't use the no-bulkhead construction technique that had proven itself over time in their canoes. However, the bulk of the hull's strength still remains in her planking and sheathing, with judicious support from bulkheads

Adapting a proven boatbuilding technique

At first blush, the notion of a cutting-edge alternative-energy powerboat seems a bit of an anomaly for Bear Mountain Boat Shop. Ted Moores and Joan Barrett's shop has been closely associated with kayaks and canoes; they've written books about them, built them, taught students how to build them, and they've sold plans, books, videos, and kits. Look a bit closer, though, and their work seems to have a longer association with freshwater craft—the bulk of their business, in addition to canoes and kayaks, in recent years has involved restoring mahogany runabouts and building sprint-canoe racing shells.

For Moores, like many of today's builders, boatbuilding is a second career. In 1972, he was a graphic designer looking to get out of the big city of Toronto. The road to his summer cottage went right past the Trout Creek shop of Ross Ellery, Canada's first builder of "stripper" canoes. "I was familiar with cedar-canvas canoes, but these were all bright wood and light as a feather. A quick look around the shop suggested that it couldn't be hard to do. After renting one for the week and taking it back to the studio, I was convinced that I could build a better one and that everyone in 'cottage country' would want one. The smart part of the decision to start Sundance Canoes was to locate in Gravenhurst, in the heart of old cottage country and the home of Greavette Boats."

What followed for Moores was a crash course in boats, wood, and tools, out of which came a 16′ canoe that sold for $325 (Canadian). After two frustrating years of dealing with the incompatibility of wood and polyester resin along with the usual problems of surviving in the wooden boat business, he sold the business to Greavette, one of Canada's premier mahogany runabout builders. "We had been renting space from Greavette's and using their stationary power tools and washroom, so every trip to the head was an education. After the sale, I continued working for a time in their shop and had the privilege of working alongside some extremely talented wooden boat builders." This exposure to high-quality construction and the history of wooden recreational boats in the well-heeled cottage country around the Muskoka Lakes would set a direction for his future.

After the Gougeon Brothers introduced their epoxy boatbuilding products, Moores was convinced that epoxy would solve the earlier polyester problems. He and Joan returned to independent boatbuilding, this time as Bear Mountain Boat Shop, specializing in strip-built canoes and kayaks. Soon, they began offering kits. Requests for instructions led to the Moores's book *CanoeCraft* (Firefly Books Ltd., 1983), which to date has sold more than 200,000 copies and was follwed by *KayakCraft* (WoodenBoat Books, 1999).

"The problem we were having was that the quality of work we wanted to do was not justified in a canoe but was demanded in show-quality restorations," Moores said. "Publishing a book would capitalize on what we had invested in canoes and composite construction and put them behind us. Fortunately, our association with canoes and our building technique just never went away. It has been the thread that has held us together on our 38-year roller-coaster ride in the wooden boat business."

And like many small-boat builders, Moores also taught boatbuilding classes, from the Canadian north to WoodenBoat School in the east to San Francisco in the west to Coconut Grove and Belize in the south. At every region, he took note of local historical craft and why they worked. In Belize, as in Canada, efficient small craft opened efficient and economical access to the interior. Belize also offered another lesson, this one for the future—much higher fuel prices.

By 2000, Bear Mountain had moved to a century-old farm outside of Peterborough. Finally there was room and time to build something big. "When the economy started heading toward a reality check suggesting a slowdown in business," Moores said, "it seemed to be the ideal window for building a boat that would be right for us and perhaps make a difference in the direction of responsible boating.

"At some point every boatbuilder deserves the chance to put some of the tricks he has tried in his career together and see if he has learned anything." —*GR*

and built-in structure, to achieve a lightweight but strong hull that broadly disperses stresses and loads. For example, much of the weight of the 1,400 lbs of batteries is transferred to the keel, with support from longitudinal plywood laminations, which double as structure in the cockpit and raised pilothouse. This structure distributes the batteries' weight over as large an area as possible, which is especially important when the boat is hauled out.

They also wanted the bright-finished interior to be well lighted and ventilated, and large enough to carry six people on day trips, with overnight accommodations for two to include a head and a galley. The cabintop had to be designed to make the solar array nearly invisible, so that it would not distract from the boat's classic appearance. "We really tried to find a way that new technology didn't compete with old technology," Moores said.

Building the Boat

Early on, they favored native Canadian woods over expensive imported exotic species. Her planking strips are white cedar. The keel, deadwood, and sheer clamp are Douglas-fir. The deck is built of alternating cherry planks and basswood splines over plywood, with white oak margin boards. Basswood and cedar were

With the hull's strip-planking completed, sheathed in fiberglass and epoxy, and painted, the boat was ready for rollover (a technique included in a WB No. 203 article).

also used extensively in constructing the cabin. Her half-round rubrails are ash. "Traditionally, boatbuilders would use the best they could find locally," Moores said.

To make her as stable as possible, they strove to keep the heavy weights low in the hull. The bare hull's weight at the conclusion of planking, estimated from test panels and extrapolated by computer, was only about 800 lbs (362.87 kg)—even with the extra reinforcing fiberglass and paint—before it was rolled upright for fitting out. The cabintop is hollow—built like an airplane wing—with lightening holes in its frame-like beams. Its sheathing, like a kayak deck, consists of ¼″-thick strips sheathed on both sides with fiberglass. To preserve the lines of the cabintop, the solar panels were let in flush with the top and the wires were kept inside.

Molds were made of two layers of ¾″-thick particle board cut by a computer numerically controlled (CNC) router. Straightforward stuff—molds cut on a Friday night were set up by Sunday, bypassing lofting entirely. "I did miss the traditional process and the ability to pick up details throughout the construction process,"

Jonathan Killing, who designed the propulsion system, installed solar panels set flush with the top of SPARKS's canopy-style cabintop to minimize any distraction from the boat's lines. With solar power, an electric motor, a generator, a charger/inverter, shore power, house power, an onboard computer to monitor systems, a bow thruster, refrigeration, and other electrical components, SPARKS's electrical panels (inset) were complicated but cleanly assembled.

COURTESY TED MOORES (THIS PAGE)

BILL LOCKINGTON

For exploring the scenic beauty of Ontario, the silent running of an electric boat only accentuates the experience.

Moores said. However, "the big advantage in setting up was that if something was not fairing the way it should, the accuracy of the mold eliminated going all the way back to the lofting to trace a problem."

Moores found himself studying strip-planking from a fresh perspective. "Since this was a 'science project,' we wanted to re-examine what we knew about strip-planking at this scale. The questions I wanted to answer were: Using planks that are square in section has been the accepted way, but perhaps this goes back to edge-nailing and to spread expansion and contraction over the largest area. If we look at the planking as a core that is expected to remain stable, does the width matter? We know a fair bit about boats of this displacement [6,800 lbs] being built with a strip-planked first layer then followed by diagonal layers of veneer. If the hull is to be painted, is it necessary to apply and fair these additional layers? The logic was that if the 'glass fibers were going in the same direction as the grain in the veneer, it had to work." Moores also said that in the case of the hull receiving an external blow—for example, from a hard landing against a canal wall—then the flexing hull would compress the layers outside while putting the inside layers in tension; therefore, the strongest layer of a core-composite hull should be on the inside. This notion, he said, has been supported by testing at Gougeon Brothers: "Failure seemed to happen first with the outside 'glass cracking as the core compresses, then tearing from tension on the inside, then total failure of the core."

Moores settled on ¾″-thick × 2⅞″-wide white-cedar strips. Next, he looked closely at the fiberglass-and-epoxy sheathing, experimenting with various configurations to determine how much reinforcement would be needed for the hull. He sent test panels—lots of them, involving the use of 200 yards of 50″-wide 6-oz fabric in all—to the Gougeon Brothers lab for deflection and fracture testing. The results showed that a laminate of three diagonal layers of epoxy-saturated 'glass cloth would suffice. But considering that the boat would be bumping against lock walls, Moores chose to add two more. The elegance of the 19th century and the technology of the 21st met again in, for example, the Victorian-themed cabin doors, which are built over a 4mm plywood core, with a layer of 'glass cloth and veneer on each side set in epoxy—all in a thoroughly modern, single-step vacuum-bagging session.

Back on the Water

After the Antique Boat Show in Clayton, SPARKS set out to cross the St. Lawrence River on her way to Ottawa via Kingston. On the crossing, a stiff breeze came up, and with it a steep chop. This transit can be sporty for any small boat, and this day was a prime example. SPARKS took to it like a duck to water, even though it is clear that this boat is in its element when cruising in well-protected waters—lakes, gentle rivers, and canals. All three are combined beautifully in her perfect usual cruising grounds of Ontario's stunning, 125.5-mile Rideau Canal, completed in 1832 and now a UNESCO World Heritage Site.

The Rideau Canal is the place to see her at her best. The first thing I noticed was how easily, just by opening the throttle, the boat climbs steadily to cruising speed. With a displacement hull, there is no concern about whether the boat will get up and plane—it won't. The

GREG RÖSSEL

SPARKS neatly matches the stately pace encouraged by the numerous locks on the Rideau Canal, and campgrounds alongshore permit a fairly large group to voyage together without feeling shoehorned into the accommodations.

second observation was the silence as the boat sliced through the water. There was no engine vibration, no rumble of exhaust, and almost no wake. We could hear the waterfowl, what was going on ashore, and even each other. The birds seem as unperturbed by the boat's passing as they would have been if we had been in a large canoe.

The flat water of the canal presented a great opportunity for Moores to test the battery and solar power. SPARKS cruises at about 5½ knots, a good speed in the canal, where there is no great hurry. The locks act like traffic lights on a boulevard; some may open the throttle more than others, but everyone ends up waiting at the next lock. At this speed, SPARKS cruises on about 1,200 watts, or the equivalent of about 1½ hp. Under way, the computer monitors speed and all the electrical components, providing a continuous energy audit. "Last night, the fridge and coffee maker consumed as much power as the entire day of cruising," Moores told me one morning.

Running the low-speed diesel generator for two hours, ideally while cruising, brings the batteries to full charge for "a good day's worth of cruising." Housed in a sound-dampening enclosure, the generator is not intrusive. Originally, Moores thought he wouldn't even use shore power, but he had concerns about developing "battery memory," a pattern of use that can reduce battery capacity over time. Besides, "there is something quite smug about tanking up at shore-power outlets while you sleep when the big cruiser beside you has to drop another $300 at the gas dock before casting off."

On one particular day, with sunny skies and light winds, running at 5 to 5½ knots during a five-hour trip (including locking) the motor was drawing 1,200 watts. A quarter to a third of that was supplied by the solar panels, and the batteries were drawn down only about 10 percent. There was never even a consideration of kicking on the generator.

DICK BOLHISE

During their extensive cruising in SPARKS's first season in 2010, Ted Moores and Joan Barrett found her ideally suited to Ontario's canals.

"I have thought a lot about the sort of places where electric boats could be the ideal boat," Moores said, back at the shop at the conclusion of the Rideau run. "One of them is the canals. The Rideau has shore power at many locks, but there are none on the Trent," meaning the also-popular Trent-Severn Waterway. "Some of their problems are that their systems are underutilized and there is excessive speed in no-wake zones. Electric boats could help to solve both of these problems. The Rideau charges $9.50 a day [Canadian] for power; we use less than a dollar's worth of power for a day's cruising—I am happy to pay ten bucks for a day cruising. Overall, I think we got it right. My philosophy of 'Happy Boat'—happy first, boat second—really does work. We may have a few dings, but we know how to fix them. We didn't baby the boat and leave the dogs at home—SPARKS is built tough and still looks great. I am assuming that electric boats will play a significant part in the future of recreational boating."

Although SPARKS may have a difficult time winning over the go-fast cigarette and bass boat crowd with her sedate cruising style, her high-tech power and construction should be right up their alley. And all things considered, there is much to be said for a family-friendly powerboat that can cruise 674 miles and only use 14 gallons (53 liters) of fuel to run the generator only 46 hours—and do it with fun, quiet, understated elegance and style.

Greg Rössel is a contributing editor to WoodenBoat.