

Letter from the Desk of David Challinor
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I grew up on the Connecticut shore of Long Island Sound with boats and sailing as part of my everyday life. It is hard to remember a time when I did not know how to sail. The daily changes of wind and tide are still so ingrained in my mind that they have become part of my psyche. Recently, I climbed the stairs to the high-pitched sail loft (attic) of our local yacht club, built about 1930. In those days, sails were made of cotton duck, and when my sails became wet from rain or spray, I hung them in that loft to dry. Had I not taken these precautions, mildew soon would have invaded the cloth, discoloring and weakening the fabric. Today, no sails are hung there because sail cloth is now made of mildew-resistant synthetic fabric. Musing on this change in sail fabric led me to wonder about the evolution of sail material. This month's letter, therefore, is written with a bias towards those who sail. It will consider the development of sail fabric from ancient Egyptians to the synthetics of today.

Boats themselves evolved from logs to timbered rafts, or where trees were few, to rafts made of inflated animal hides or bundled dry reeds. Propulsion initially was by poles in shallow water, then by paddles, then oars. The first sails were likely large palm fronds held up by hand to travel down wind in a dugout. By 3500 BC, the Egyptians took advantage of the prevailing north winds to move boats south against the Nile's current, all the way to the first cataracts at Aswan, about 500 miles from the delta. Their first sails were probably made from papyrus or other woven reeds. Over the next two millennia, tomb drawings graphically illustrated all kinds of river craft. Not only did artists depict boats, but they also made models of them. Later, an actual ship was buried adjacent to the tomb of Pharaoh Cheops. By this time (2550 BC), not only were mummies wrapped in linen, but large square sails were assembled by stitching together long strips of linen cloth much as we do today. The Egyptians also used various preservatives both to stiffen their sails and to protect the fabric. They secured their rectangular sail not only from the top yard but also to a bottom spar parallel to the top one. This arrangement put considerable strain on the sail cloth to carry the bottom spar; therefore, they connected the two spars with vertical lines (ropes) to reduce tension on the sail itself. These vertical lines were true brails, also used today for furling the sail. The early Greeks used horizontal as well as vertical lines for their loose-footed linen sails, which gave them a checkerboard pattern.

The Greeks and Phoenicians, unlike the Egyptians, had no rivers of importance and their ships sailed the open Mediterranean. Greek warships relied primarily on oars for propulsion, because of their advantage in maneuvering. Merchant's ships depended on sails, and gradually about the time of Christ, the triangular-shaped lateen sails developed. Lateen rigs are often attributed to Arab seafarers, but it seems to have originated in two places: the eastern Mediterranean and, at about the same time, India.

They are not as efficient as square sails when going down wind, but they more than offset this disadvantage when beating to windward. When possible, early sailors took advantage of the prevailing breezes. Thus, Columbus and his successors, traveling westward to the new world, generally went south to about latitude 15° N to take advantage of the southeasterly trade winds. To return to Europe, ships sailed farther north (latitude 45° N) to gain the prevailing westerlies. For centuries, with the yearly arrival of the northeast monsoon that carried a quartering (blowing over the starboard/right stern) breeze, sailing dhows left the Arabian peninsula and the west coast of India each year and sailed to Africa's east coast. The dhows remained there for at least four months until the northwest monsoon arrived to carry them back. In the 13th century, enormous Chinese junks estimated to be 300 feet long sailed from what is now Burma and Malaysia to the east coast of Africa. Their size was extrapolated from the proportions of the rudder posts washed out of the sand on east African beaches in the 20th century. By the 14th century, the Chinese abruptly called their ocean fleet home and it was never again dispatched. The long sojourn of Arab traders waiting for favorable wind accounts for the large number of Arab words in Swahili, the *lingua franca* of east coast Africa.

The ancient dhows, many believe, used sails made from cotton, then a common crop in India. The cloth may have contained hemp, another local crop, for added strength. Ancient cotton cloth shrouds, thousands of years old, have been found in southern Arabian tombs, but archeologists have yet to discover a piece of medieval dhow sail cloth.

The Polynesians, also an ancient sailing culture, successfully navigated catamarans throughout the mid and south Pacific. These vessels had parallel hulls lashed together with transverse beams on top of which was a platform for people and cargo. Although many south Pacific cultures produced tapa cloth by pounding the inner bark of paper mulberry or similar trees, the cloth so produced was not rugged enough for sails; they made them from woven pandanus leaves. Pandanus or screw pine is an odd looking but common tree in Southeast Asia and Pacific Ocean islands. I have not seen one much taller than about 15 feet. The crown is full of long narrow leaves and from about three feet above ground level, multiple stilt roots emerge to hold the tree erect. The narrow leaves, a foot or more long, are woven into mats for house siding, floor coverings, sails and many other uses. The Smithsonian's Natural History Museum has an early 19th century pandanus sail in its collection.

One of the great historical "visuals" is that of a Viking long boat plying the North Atlantic on the hunt for conquest and booty. Amazingly, Viking sail cloth was made from wool. Like the Polynesians, the Vikings were also intrepid seafarers, but they lived too far north for hemp, flax or cotton to grow. In 1990, two researchers found a scrap of cloth stuffed in a hole between the roof and the walls of a 12th century church. A full

account of this discovery is in the 24 July 2004 issue of *New Scientist**. The small piece of cloth had an eyelet sewn into one corner that clearly identified it as part of a sail. The big problem was that no one had made woolen sails since the early 1800's, so the knowledge of how to weave such sails had been lost. Through careful research on the sail remnant, a medieval woolen sail was reproduced to power a replica of a 19th century coastal boat. Through microscopic analysis, the researchers learned that the sail's strength was drawn from the long guardhairs of an ancient hardy breed of short-tailed sheep still raised in Iceland and Scandinavia. The sheep forage outside all year long so their wool is high in lanoline—a water repellent and fabric strengthener. Just collecting enough wool from the sheep was labor intensive because it had to be pulled—not cut—from the sheep in the summer. Spinners separated the thick outer guardhairs by hand from the softer, curly inner wool. For this reconstruction project, four people took six months to separate the wool and guardhairs and another two and a half years to spin the yarn and weave the sail. The cost of producing sails for the vast Viking fleets must have been enormous. King Knut II, the Viking who planned to oust William the Conqueror from England in 1085, is alleged to have had a fleet of 1,700 ships. Just think of the resources needed to produce so many sails, to say nothing of the advanced sheep husbandry required to produce enough wool to make them.

The age of sail survives, but now in the developed world mostly as recreational activity. Nonetheless, a vast amount of coastal commerce is still sail-powered in parts of Africa, Southeast Asia and even in the Caribbean. Wind is a cheap source of energy, but it can be fickle and either blow too hard or not at all. For those of us who like to sail, the perpetual need to keep your sails “full and by” for maximum efficiency is a rewarding challenge, well appreciated by all sailors.

David Challinor
Phone: 202-673-4705
Fax: 202-673-4686
E-mail: ChallinorD@aol.com

* Bazilchuk, Nancy “The Sheep that Launched 1,000 Ships” *New Scientist* 24 July 2004, 52-3