

The Classic Yacht Symposium 2006



The History of Rope

by **Bill Fronzaglia**

New England Ropes

Introduction

When I took my family to see the Tall Ships sail through the Cape Cod Canal, I was impressed by the majestic rigging on these sailing ships from around the world. These ships conjured up a sense of history that prompted me to do a little research into the history of rope and rope making.

When I had the opportunity to tour some of the Tall Ships I was surprised by the wide variety of cordage in evidence. It ranged from authentic looking antique rope to modern braided synthetic lines. It was evident that differing amounts of research and fidelity went into the rigging efforts. I will attempt to present a brief summary of significant milestones in the development of rope technology, and will conclude with some alternative options for the classic yacht restorer.

Origins of Rope

The true origins of the ropemaker's craft are lost in antiquity, but there are fossil evidences of rope usage as early

as 17,000 BC. These early ropes were either twisted by hand or braided. It was in early Egyptian times that simple hand tools were used to improve the hand twisting method. In this method, a stick with a rock tied to it would be swung around by the early rope maker, to assist in the twisting of the strand. This method, called a "Spinner", worked well as long as you didn't want to make a very long rope. The "Spinner" method was also used by American Indians around 1,000 years ago.

Pictures from Egyptian tombs c. 1500 BC show men walking while making rope. The first walks were outdoor level spaces, often having posts at intervals to support long work as it was extended. Later walks were roofed or completely enclosed. A mechanized method based on the ropewalk is used extensively throughout the world.

References to the use of rope in the Bible can be found as early as the book of Exodus. Ecclesiastes 4:12 states "Though one may be overpowered, two can defend themselves. A cord of

three strands is not quickly broken.” Although this statement is used as a metaphor, it illustrates the efficiency advantage of 3-strand cord over its 2-strand predecessor. This passage was written in approximately 950 B.C.



3500-year-old Egyptian Rope On Display in a Museum (All Figures for this Paper Provided by the Author)

Ropewalks and Machines

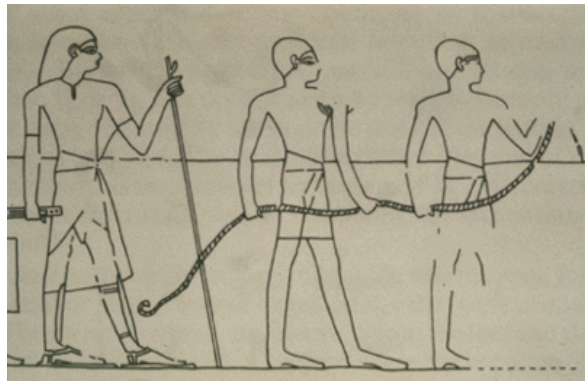
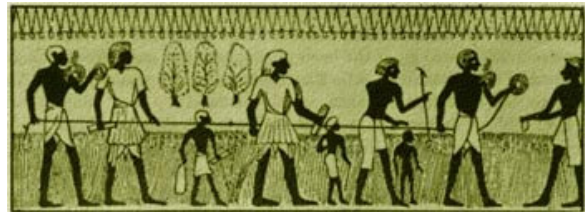
Throughout the Middle Ages, rope in Europe was made using a mechanically assisted ropewalk method. The machine, which is called a rope jack, consists of three hooks connected mechanically with a gear or chain at one end, and a free spinning swivel at the other. The three swivels spin together to put twist in the strand. When the strands have enough twist, the rope is laid by allowing the swivel to spin freely. The length of the walk limits the length of rope that can be made without splicing; yarns spun in the longest walk (about 1,200 feet) form, when fully twisted, a 700-foot rope. In 1834 a ropewalk was established at the Boston Naval Shipyard, and remained in operation until the mid 1900s. There is an original ropewalk from the Plymouth cordage company in the museum at Mystic Seaport. It was moved there in the 1950s when it became commer-

cially unviable, but ropewalk technology is still used to this day in many parts of the world.

Not much is known about the details of the trade during medieval times. Beginning in Bridport, England, the ropemaking craft was protected by a Guild (the predecessor of modern unions). Master craftsmen taught apprentice ropemakers their skills, and trade knowledge was kept very secret. Inventions and innovations were not shared between rival ropewalks.

During this same time in Venice, Italy, the Venetian government owned the ropemaking factory called the Tana. Because the product was so vital to their economy and security, the government wouldn't allow private enterprise to engage in ropemaking. The biggest problem for the Tana was obtaining enough hemp to keep the factory operating.

The Guild in Bridport escaped this problem since the hills surrounding the



“Rope Stretchers” - Egyptian Predecessors to Modern Day Surveyors (and Tax Collectors)

city were excellent for growing the plant when the supply from southeast Europe was interrupted. During the advent of the Crimean War, the hemp supply was interrupted and ropemakers in Britain turned to manila, long proven in the Far East as a reliable rope fiber. Sisal, another fiber more readily available through the West African trade route, was not as strong as manila, and did not stand up to salt water.

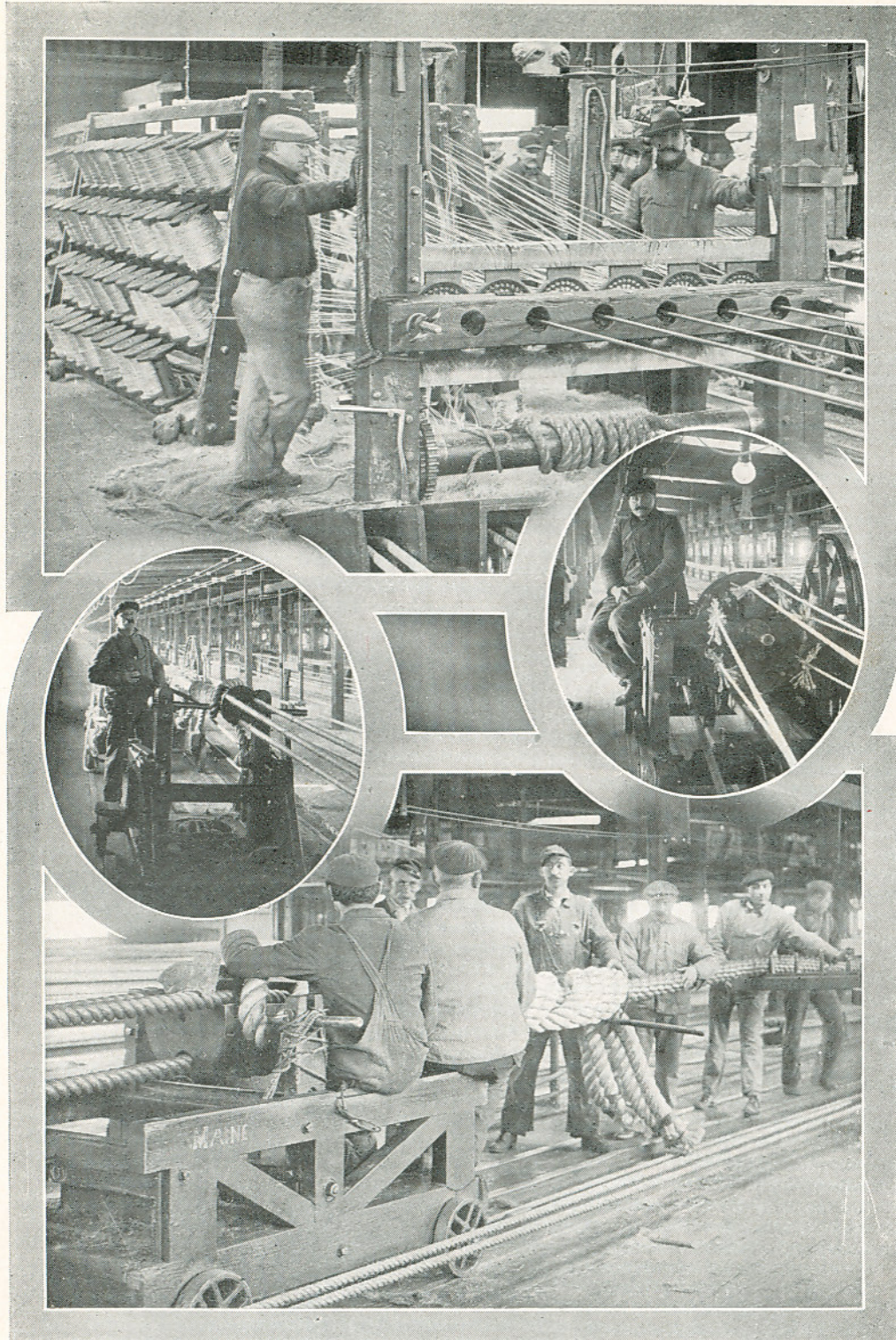
The use of a colored tracer was made mandatory by the British government in 1664 to identify rope made in government yards. This tracer was called a "Rogue's Yarn" and a different color was used by each ropery. Even the standardization of the Right Hand Lay rope dates back to the early days of rope production, when it was known

that Hemp retains more strength when the yarn is twisted to the right. This resulted in a left hand strand, and a right hand rope. It wasn't until modern times that microscopic examination of the plant illustrated that the structure of the plant has a natural twist that causes this effect.

There are reports in the journals from the original Pilgrims that the Indians used fishing lines and nets made with ropes twisted from local barks, animal sinew and rawhide. Early Mexican vaqueros braided rawhide together to form ropes used in their ranching activities. They called these creations "La Reata"; they were the predecessor of the cowboy's lariat. The knot that modern cowboys tie in the end of their lariats, called a *Honda* or *Hondo*, was



Register Plate and Forming Tubes in Ropewalk at Mystic Seaport



CORDAGE MANUFACTURE BY THE ROPEWALK METHOD

YARNS PASSING FROM BOBBINS THROUGH PERFORATED PLATES

“TOP TRUCK”—LAYING PROCESS

FORMING MACHINE—MAKING STRANDS

CLOSING TARRED RUSSIAN HEMP CABLE 15 $\frac{3}{4}$ ” CIRCUMFERENCE
FOR ARGENTINE BATTLESHIP “RIVADAVIA”

originally used to secure bow strings in medieval longbows. One of the requirements of the Boy Scouts Pioneering Merit Badge is to make a piece of rope by hand from sisal twine.

In the 1780s Joseph Huddart made the most revolutionary inventions of register plates and forming tubes. These inventions allowed the ropemaker to position each yarn within each strand as the strands are formed. This allowed the yarns in the outer layer of the strand to be longer than the ones in the inner layer, due to the increased length of the helix. Before register plates and forming tubes were used, all of the yarns in each rope strand were the same length. This meant that the yarns on the outside of the strand were under more tension than the yarns in the center. For ropes with more than 7 yarns per strand the increase in strength could be considerable.

Types of Rope and Rope Materials

It has only been in recent years, relatively speaking, that wire (metal) ropes were created. In 1834, the first wire ropes, then called Albert ropes, were made in Germany for use in mining.

It is certain that prior to 1939 natural fibers, both vegetable and animal, were the only materials (other than metal) that were available to cordage manufacturers. It was then that the laboratories of E. I. DuPont de Nemours developed nylon, a discovery that revolutionized the cordage and textile industries. The discovery of polyester followed in the 1940s, and polypropylene in the 1950s.

David Himmelfarb, the U.S Navy's Mas-

ter Ropemaker from 1945 to 1970, published *THE TECHNOLOGY OF CORDAGE FIBERS AND ROPES* in 1957. Mr. Himmelfarb is responsible for many of the standards to which are ropes are currently produced.

Braided cords have also been around for centuries, but all had been braided by hand, until the 1800s when automatic braiding machines were invented in Germany. Braiding machines were initially used for small cords and laces. Larger braiding machines suitable for braiding rope weren't in widespread use until the middle of the 20th century.

Double Braided rope was patented by Kenneth L. Fogden in 1961. This innovation made possible many of the ropes we use and take for granted today

Today, Kevlar, Technora, Twaron, Spectra, Dyneema, Vectran and PBO Zylon are but a blink of an eye in the long history of ropemaking. Right now we are involved in one of the most revolutionary times in a craft that has been around since before recorded history.

Rope Selection for a Classic Yacht

Line selection for the restoration of a classic yacht will depend on the amount of information available from the original construction of the vessel. Obviously, the best circumstance would be to have possession of the original rigger's specifications. Historical supply manifests, original hardware, sheaves, cleats, fairleads, etc, may provide additional clues to the size and type of the originally specified lines.

For boats built prior to WWII the original rigging was certainly a 3-strand natural fiber rope and was likely to have been tarred or otherwise treated to prolong the life in a wet environment.

Tarred hemp was the preferred fiber for marine use from pre-colonial times to the 1940s. So for a truly authentic restoration project, spending time to source this rope will ensure that the rigging would be recognizable to the original crew.

There are many vegetable plants that yield fiber suitable for rope making. Scarce supplies (and hemp prohibitions) have resulted in other fibers being used, such as manila, sisal, flax, jute, etc. These fibers will function, but with a much shorter life than hemp. Since the popularity of natural fiber rope has diminished, some products are available, bearing names like "Manila Hemp", which make it difficult to determine from which plant fiber the rope was made.

However, it must be noted: pre-WWII natural fiber ropes bear little resemblance to the natural fiber ropes one is likely to be able to purchase today. Today, these ropes are considered low cost ropes, and the quality of the product is far below what was sold in chandleries in days gone by. In addition, rather than pine tar, the rope today is more likely to be preserved with a chemical preservative and biocide. In some cases, chemicals containing arsenic or cuprinol are used (avoid green rope). The fiber preparation of today is also done much more crudely, which gives the rope a rougher feel, and may result in painful chemical laced splinters.

There are several modern options available that provide an authentic look, but will have a longer life and a less rough hand.

Three-strand polyester ropes will provide the longest life in running rigging. Polyester is sometimes known as Dacron, which is Dupont Chemical's brand of polyester. Available polyester ropes are made from continuous filament fiber, or from chopped and spun fiber to provide a more natural look and feel. Replacing a 1/2" hemp line with a 1/2" polyester line will provide over twice the breaking strength (2,400 lbs. vs. over 5,000 lbs.). This will provide a very large margin of safety and long life within the existing hardware. However, the load bearing strength of the other hardware being used will limit the load the rig can handle. These products are sold as "Classic" polyester or as "Spun Classic". They are generally sold as a white rope, but for many applications they can be dyed with over-the-counter dyes, such as RIT, or by using a strong solution of brewed tea.



3-Strand Spun Polyester

Modern 3-strand nylon ropes can also be dyed to approximate the look of original natural fiber rope. The application of these should be limited to docking, mooring, and anchoring. The higher stretch of nylon makes it ill-suited to rigging.

Three-strand fibrillated polypropylene ropes are manufactured by several companies in styles designed to simulate the look and feel of hemp rope.

These are very common in theme park decoration, theater dressing, and in any other use where an authentic antique look is desired. In spite of modern UV protection additives these ropes will degrade with long term exposure to direct sunlight. However, they should last at least as long as any natural fiber in a similar application, and are also impervious to rot, marine growth, and rodent gnawing. This product is sold under several commercial names, such as "Hempex", "Un-manila", or "Roblon" to name a few.

Some braided or plaited rope may be found on classic vessels. Usually these

were braided by hand during long voyages. They are mostly employed in bell pulls, handrails, or in other ornamental ways.

Whatever rope you select for your project, be sure to make routine inspections of the rigging, even when new. Repair or replace any excessively worn, abraded, and cut sections, and take corrective action to reduce or eliminate the cause of the damage. Properly cared for, your lines will provide years of service and sailing enjoyment.

About the Author:



Bill Fronzaglia started with New England Ropes in 1998 as a Market Manager. In 2000 he was named Director of Engineering. In this role he has designed innovative cordage products to meet the needs of performance racers, cruisers, and dinghy sailors.

Bill is also involved in many professional standards setting bodies. He is the current Chairman of the Cordage Institute Technical Committee, and is a former chairman of the Cordage Institute Life safety Rope Subcommittee. He is also the current Treasurer of the Marine Technology Society Ropes and Tension member committee. As a member of the UIAA Safety Commission, (UIAA - Union Internationale Des Associations D'Alpinisme), he helps set international standards for personal fall protection equipment (Ropes) used in mountaineering and rock climbing, and has authored and presented "Effectiveness of dry coating on water absorption" Italian Alpine Club Nylon and Ropes Conference Tourino, ITALY.