Island of the Blue Dolphins

Sailors' Knots

Grade Level
Middle School: Sixth Grade through Eighth Grade

Subject
Literacy and Language Art, Social Studies

Common Core Standards
6.RI.7, 6–8.RH.2, 6–8.RH.3, 6–8.RH.7

Background Information
To the untrained eye, rope (or cordage) does not seem complicated. However, it is a sophisticated maritime tool that requires skill both to manufacture and to manipulate on board ship.

To begin, the construction of rope is a complicated business involving numerous steps. Natural fibers from select plants are collected. Then, either by hand or machine, the fibers are stretched out and twisted together in a clockwise direction to form a yarn. Next, several yarns are twisted together in a counter-clockwise direction to form a strand. Finally, three strands are twisted together, in a clockwise direction, to form rope. Three-stranded rope made in this fashion is very strong; indeed, nineteenth-century ships even used this rope to support masts.

Rope plays an important role in a ship's "rig," which is all the spars and sails (see figure 1, below). Spars include the masts (vertical timbers that support everything aloft) and yards (horizontal timbers that support sails). Miles of rope tie all the components of the rig together. Additionally, rope is used to manipulate the sails from the deck.

On board a ship, you will hear sailors talk about "lines" rather than "ropes." Once a rope is designated for a particular task, it becomes a *line*. Lines are used to set sails, raise spars, lower boats, secure masts, set anchor, etc.

When a ship's rig is assembled for a voyage, some rope is used to secure items for the duration of the journey. For example, a thick piece of rope might be used to secure a mast. That line would be tightly tied to the top of the mast and then run down to the deck. Because this line "stands" (in other words, it remains in place) from the start of a voyage until the end, it is called "standing rigging."

Take a close look at the image on the next page and you will see standing rigging at work. On the right side, at the very front of the ship (called the *bow*), you can see a number of ropes that run upwards toward the masts. These lines are called "stays." They help support the masts and hold the sails up.

In the 1800s (nineteenth century), standing rigging was often made of hemp rope because it was readily available and very strong. But, hemp is also subject to rot. It is therefore necessary to cover hemp rope in a thick pine tar to protect it from the sun and salt water. Sailors became known as “Jack Tars” because they were often seen painting tar onto their ropes.

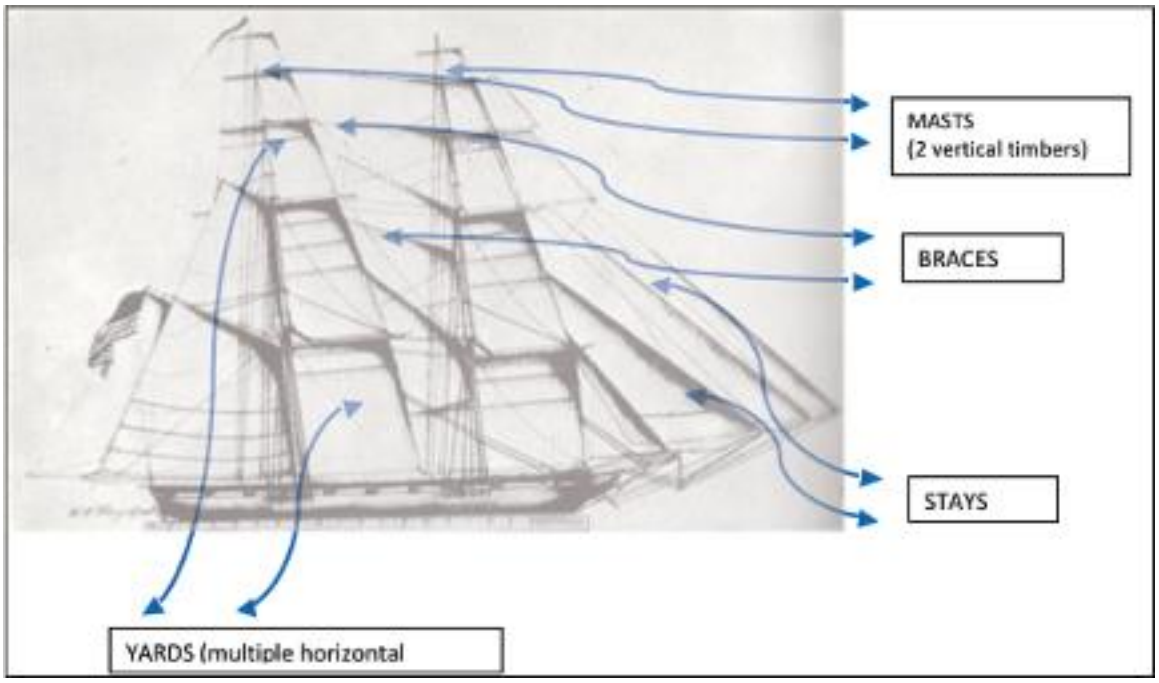

Image: Sail Plan for the Brig USS *Spark*. Drawing attributed to Charles Ware. U.S. National Archives (NARA) Record Group 45.

While standing rigging remains in place, other ropes are moved about daily. These ropes are called “running rigging.” Running rigging is meant to “run” freely through blocks (or pulleys) as sailors “haul on” (or pull) lines to raise sails, lower sails, or simply reposition sails to power the ship or change its direction. If you look closely at the image above, you will see ropes that run horizontally between masts; these are called “braces.” Braces are lines that when manipulated, change the position of the sails.

Because the rope that makes up the running rigging is constantly handled by sailors, it needs to remain flexible. Therefore, it is not covered with tar, which makes rope stiff. Running rigging was often made of the plant fiber *manila* because this fiber has a natural coating of protective oil.

Sailors were responsible for knowing what work all the ropes on a ship could perform—that is, what happened when each rope was pulled. This was called “learning the lines,” and it sometimes required sailors to memorize what more than 200 different pieces of

rope did, often within the first week or so on the job! Sailors' lives depended on knowing their lines. Sailors also needed to know how to *manipulate* each of the lines, which meant knowing how to make knots, hitches, and splices that kept all the ropes working together.

The following activities provide an opportunity to closely examine rope to see how it is made, and also to practice tying some of the knots used by sailors, in the 1800s (nineteenth century) and today. As students learn basic ropework, including knot tying and the associated maritime vocabulary, they can better appreciate sailors' work and better interpret primary source documents such as ship journals and logbooks.

Materials

- Five pieces of 3-strand twisted manila rope (1' in length); unlabeled
- Five pieces of 3-strand twisted manila rope (2' in length, ½" or greater in diameter); labeled
- Five pieces of 3-strand twisted hemp rope (2' in length, ½" or greater in diameter); labeled
- Five pieces of twisted sisal (2' in length, ½" or greater in diameter); labeled
- Five pieces of tarred hemp (2' in length); labeled
- Synthetic line for each student (any kind will do; this will be used for tying knots; one 2'–3' length per student)

    Note to teachers: *Much of this rope can be found at a hardware store and others at a boating store or marina. Tarred hemp may prove more difficult to find. We recommend contacting a seaport museum or shipyard, if possible.*
- Five wooden bars or sticks to tie knots around
- Copy of Rope Observation activity sheet for each student (provided)
- Copy of Selected Reading for each student (provided)
- Five copies of Knot-Tying Instructions; one for each group and knot-tying station (provided)

Rope Preparation

- Cut pieces of rope to suggested lengths (see above). Wrap a piece of electrical tape around each end to prevent the strands from separating.
- Label each piece of rope. Make sure that there are enough labeled pieces for each group.
- Leave at least five pieces of manila rope unlabeled. This will be used for student groups to take apart and record observations.

Procedure

1. Divide the class into five groups of three or four students each.
2. Introduce the hook: Do you have what it takes to be a sailor? Could you learn your lines, tie secure knots, and contribute to a ship's crew?
3. Pass out the Selected Reading and allow students time to read. Once students complete their reading, they can quietly work on the discussion questions.
4. Pass out the Rope Observation activity sheet and the five unlabeled pieces of manila, one for each group. Ask students to slowly pull apart the strands, yarns, and fibers at one end of the rope. As they do so, they should compare the construction to that described in the introductory material above. Students should record their observations on their activity sheet.
5. Pass out the pieces of labeled sisal, hemp, tarred hemp, and manila rope. Ask students to observe the samples closely and record their findings on their activity sheet.
6. Set up knot-tying workstations. Each station should have one copy of Knot-Tying Instructions, one wooden bar, and enough pieces of synthetic rope for each student. Allow students fifteen minutes to attempt the knots shown in the pictures.
7. Once students have completed their group work, teachers can organize knot-tying races.
8. End group work and ask students to come together as a class. Open a discussion by asking students to share some of their findings with the class.

Enrichment Activities

For further reading:

Clifford W. Ashley, *The Ashley Book of Knots* (New York: Doubleday, 1944).

Hervey Garrett Smith, *The Marlinspike Sailor* (New York: International Marine, 1960).

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Sailors' Knots—Rope Observation

Directions: With your group, slowly pull apart your piece of manila rope. See if you can identify the strands, yarns, and fibers, as described by A. Hyatt Verrill in the Selected Reading. Next, draw and label what you observe in the space below. Add additional notes where necessary.

Record your observations about each of the rope samples listed below.

Type of Rope	**Oily or Dry?**	**Soft or Hard?**	**Additional observations**
Sisal			
Hemp			
Tarred hemp			
Manila			

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Sailors' Knots—Knot-Tying Instructions

Directions: This provides diagrams explaining how to make six different knots. How many knots can you successfully tie? You'll find that some knots are more difficult than others; sailors certainly found that to be true. Once you master a knot, can you help your classmates tie theirs?

Note: the text below is adapted from A. Hyatt Verrill, *Knots, Splices and Rope Work: A Practical Treatise* (1917).[1] Annotations provided by Jason Hine.

Knot #1

This is a variation of the figure-eight knot … and it is used where there is too much rope, or when a simple knot is desired to prevent the rope from running through an eye, ring, or tackle-block.

FIG. 24.—Double figure-eight knot (complete).

This knot is made by forming a regular figure eight and then "following round" with the other rope, as in Fig. 25. The rope is then drawn taut…

[1] A. Hyatt Verrill, Knots, Splices, and Ropework: A Practical Treatise, 2nd Revised Edition. 1917. Digitized copy of full text available through Project Gutenberg, https://www.gutenberg.org/files/13510/13510-h/13510-h.htm

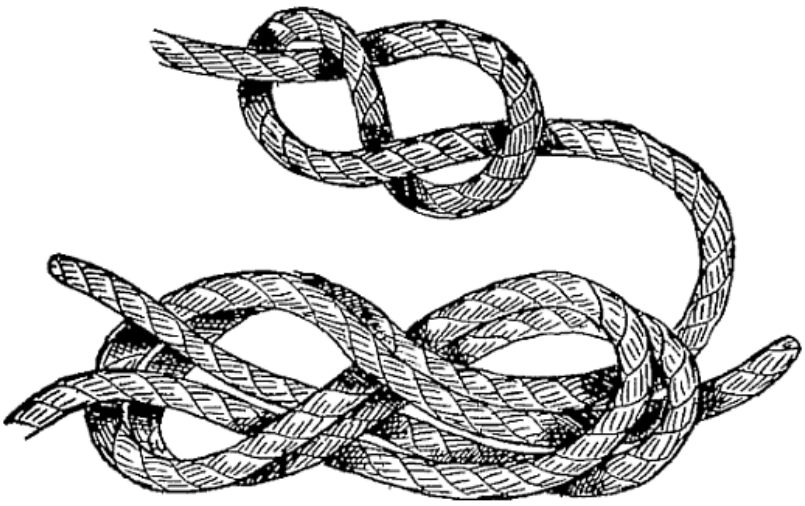

FIG. 25.—Double figure-eight knot (tying).

[Note to students: Use the picture to help you tie this knot. You may find it easier to pin one end of your rope down and then "snake" the other end of the line around it to form the knot. As you study the illustration above, you'll notice that the two knots are actually the same: the knot pictured on top is a *single* figure-eight knot and the one on the bottom is a *double* figure-eight knot. Start by making the single figure-eight knot.]

Knot #2

This [Fig. 36 A] is a more secure knot used for the same purpose as the "Clove Hitch" (Fig. 36 [B]). It is sometimes known as the "Builders' Hitch."

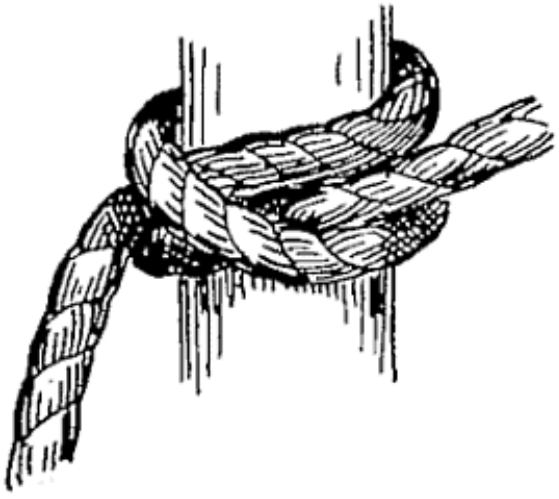

FIG. 36 *B*.—Clove hitch (complete).

To make this knot, pass the end of the rope around the spar or timber, then over itself; over and around the spar, and pass the end under itself and between rope and spar, as shown in the illustration.

FIG. 36 *A*.—Clove hitch or builder's hitch (tying).

[Note to students: One way to complete the "Clove Hitch" or "Builder's Hitch" is to have one person hold the stick while the other works one end of the line around it.]

Knot #3

For this purpose, the "Timber Hitch" (Fig. 38) is even better than the "Clove Hitch." It is easily made by passing the end of a rope around the spar or log, round the standing part of the rope and then twist it three or more times around, under and over itself.

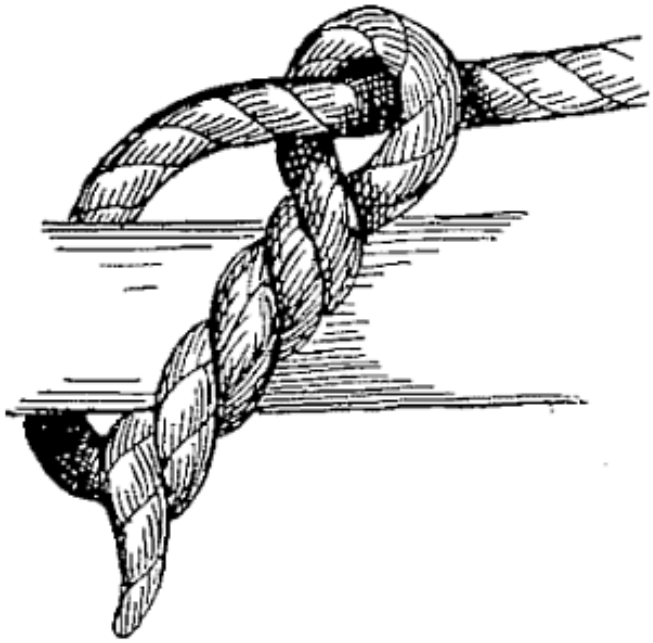

FIG. 38.—Timber hitch.

If you wish this still more secure, a single half-hitch may be taken with the line a couple of feet further along the spar (Fig. 39).

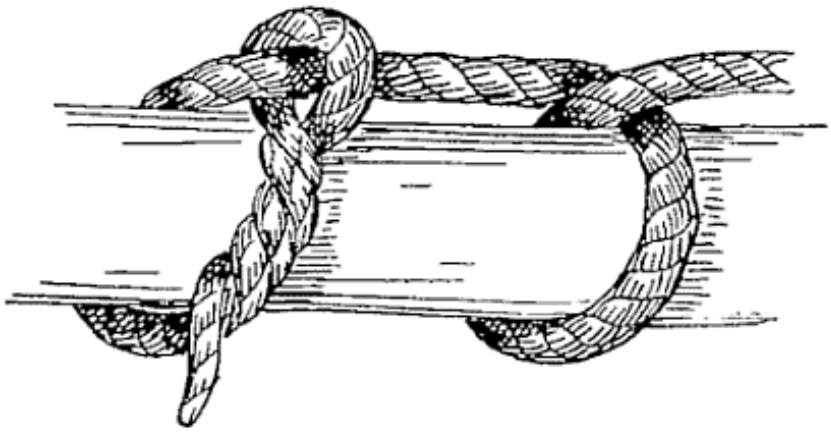

FIG. 39.—Timber hitch and half-hitch.

[Note to students: One way to complete this knot is to take a loop of rope and twist it four or five times. This will leave a small loop at one end. Lay your loop in front of your stick as shown, while wrapping one of the ends of the line around the stick and through the loop.]

Knot #4

The sailor's knot par excellence, however, is the "Bow-line" (Fig. 58), and wherever we find sailors, or seamen, we will find this knot in one or another of its various forms. When you can readily and surely tie this knot every time, you may feel yourself on the road to "Marline-spike Seamanship," for it is a true sailor's knot and never slips, jams, or fails; is easily and quickly untied; and is useful in a hundred places around boats or, in fact, in any walk of life.

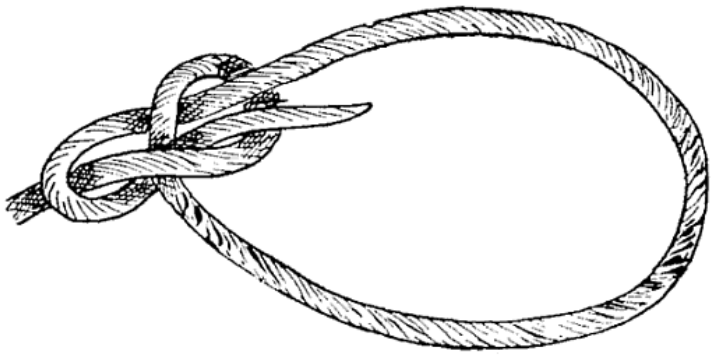

FIG. 58.—Bow-line.

The knot in its various stages is well shown in Fig. 59 and by following these illustrations you will understand it much better than by a description alone. In *A* the rope is shown with a bight or cuckold's neck formed with the end over the standing part. Pass *A* back through the bight, under, then over, then under, as shown in *B*, then over and down through the bight, as shown in *C* and *D*, and draw taut, as in *E*.

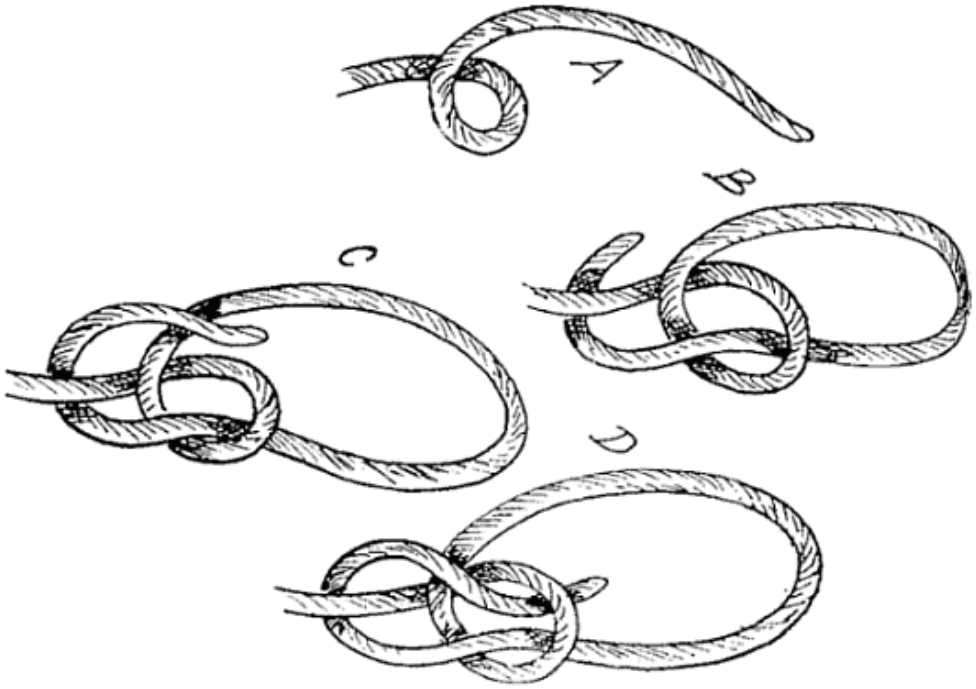

FIG. 59.—Tying bow-line.

[Note to students: You may find Fig. 59 the most useful.]

Knots #5 and #6

Only a step beyond the figure-eight and the overhand knots are the “Square” and “Reefing” knots (Figs. 11 and 12). The square knot is probably the most useful and widely used of any common knot and is the best all-around knot known. It is very strong, never slips or becomes jammed, and is readily untied. To make a square knot, take the ends of the rope and pass the left end over and under the right end, then the right over and under the left.

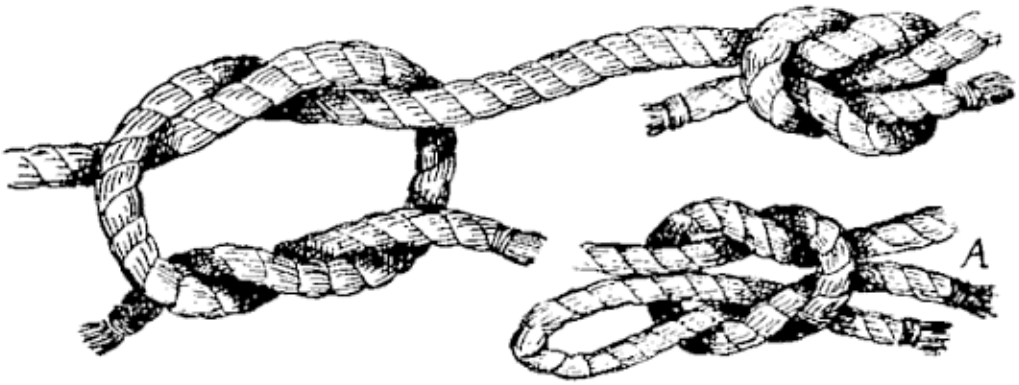

FIG. 11 FIG. 12

FIGS. 11 and 12.—Square knots.

If you once learn the simple formula of “Left over,” “Right over,” you will never make a mistake and form the despised “Granny,” a most useless, bothersome, and deceptive makeshift for any purpose (Fig. 13). The true “Reef Knot” is merely the square knot with the bight of the left or right end used instead of the end itself. This enables the knot to be “cast off” more readily than the regular square knot (*A*, Fig. 12).

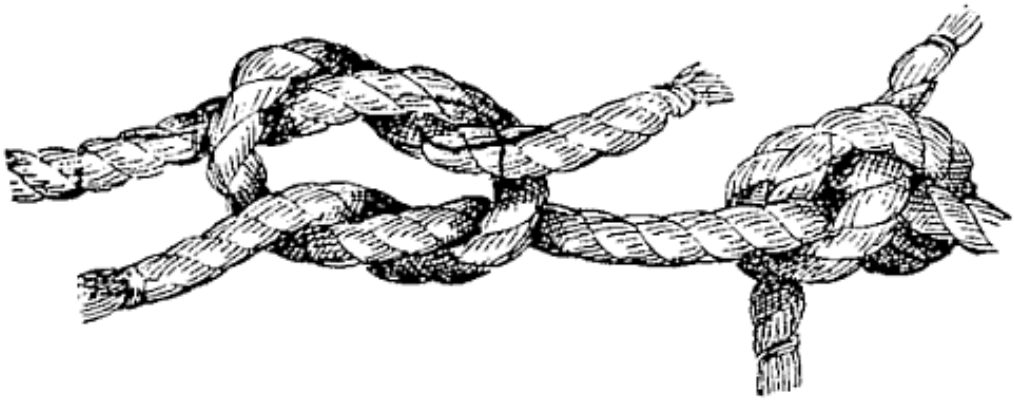

FIG. 13.—Granny knot.

[Note to students: You have tied the first half of this knot every time you’ve tied your shoes. For the second half, just do the opposite. For example, if you tied right over left the first time, tie left over right the second time!]

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Island of the Blue Dolphins
Sailors' Knots—Selected Reading

KNOTS, SPLICES, and ROPE WORK

A PRACTICAL TREATISE[i]

Giving Complete and Simple Directions for Making All the Most Useful and Ornamental Knots in Common Use, with Chapters on Splicing, Pointing, Seizing, Serving, etc. Adapted for the Use of Travellers, Campers, Yachtsmen, Boy Scouts, and All Others Having to Use or Handle Ropes for Any Purpose.

By

A. HYATT VERRILL

Editor Popular Science Dept., "American Boy Magazine."

SECOND REVISED EDITION

Illustrated with 156 Original Cuts Showing How Each Knot, Tie or Splice is Formed and Its Appearance When Complete.

INTRODUCTION

The history of ropes and knots is so dim and ancient that really little is known of their origin. That earliest man used cordage of some kind and by his ingenuity succeeded in tying the material together is indisputable, for the most ancient carvings and decorations of prehistoric man show knots in several forms. Doubtless the trailing vines and plants first suggested ropes to human beings; and it is quite probable that these same vines, in their various twistings and twinings, gave man his first idea of knots…

…As to the utility of knots and rope work there can be no question. A little knowledge of knots has saved many a life in storm and wreck, and if every one knew how to quickly and securely tie a knot there would be far fewer casualties in hotel and similar fires. In a thousand ways and times a knowledge of rope and knots is useful and many times necessary. Many an accident has occurred through a knot or splice being improperly formed, and even in tying an ordinary bundle or "roping" a trunk or box few people tie a

knot that is secure and yet readily undone and quickly made. In a life of travel and adventure in out-of-the-way places, in yachting or boating, in hunting or fishing, and even in motoring, to command a number of good knots and splices is to make life safer, easier, and more enjoyable, aside from the real pleasure one may find in learning the interesting art of knot-tying.

Through countless ages the various forms of knots and fastenings for rope, cable, or cord have been developed; the best kinds being steadily improved and handed down from generation to generation, while the poor or inferior fastenings have been discarded by those whose callings required the use of cordage.

Gradually, too, each profession or trade has adopted the knots best suited to its requirements, and thus we find the Sailor's Knot; the Weaver's Knot; Fishermen's knots; Builders' knots; Butchers' knots; and many others which have taken their names from the use to which they are especially adapted.

In addition to these useful knots, there are many kinds of ornamental or fancy knots used in ornamenting the ends of ropes, decorating shrouds of vessels, railings, and similar objects; while certain braids or plaits, formed by a series of knots, are widely used aboard ship and on land.

In many cases ropes or cable must be joined in such a way that they present a smooth and even surface and for such purposes splices are used, while knots used merely as temporary fastenings and which must be readily and quickly tied and untied are commonly known as "bends" or "hitches." Oddly enough, it is far easier to tie a poor knot than a good one, and in ninety-nine cases out of a hundred the tyro,[ii] when attempting to join two ropes together, will tie either a "slippery" or a "jamming" knot and will seldom succeed in making a recognized and "ship-shape" knot of any sort…

THE AUTHOR.

JANUARY, 1917.

CHAPTER I

CORDAGE

Before taking up the matter of knots and splices in detail it may be well to give attention to cordage in general. Cordage, in its broadest sense, includes all forms and kinds of rope, string, twine, cable, etc., formed of braided or twisted strands.

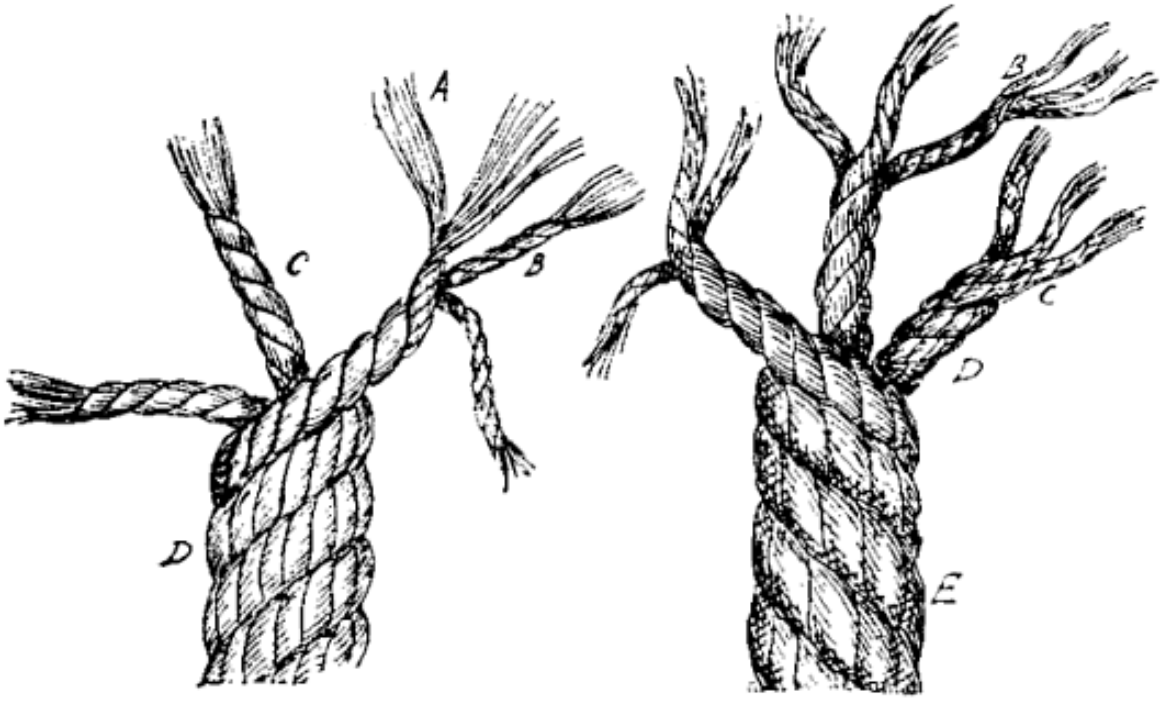

FIG. 1.—Construction of rope.

In making a rope or line the fibres (*A*, Fig. 1) of hemp, jute, cotton, or other material are loosely twisted together to form what is technically known as a "yarn" (*B*, Fig. 1). When two or more yarns are twisted together they form a "strand" (*C*, Fig. 1). Three or more strands form a rope (*D*, Fig. 1), and three ropes form a cable (*E*, Fig. 1). To form a strand the yarns are twisted together in the opposite direction from that in which the original fibres were twisted; to form a rope the strands are twisted in the opposite direction from the yarns of the strands, and to form a cable each rope is twisted opposite from the twist of the strands. In this way the natural tendency for each yarn, strand, or rope to untwist serves to bind or hold the whole firmly together (Fig. 1).

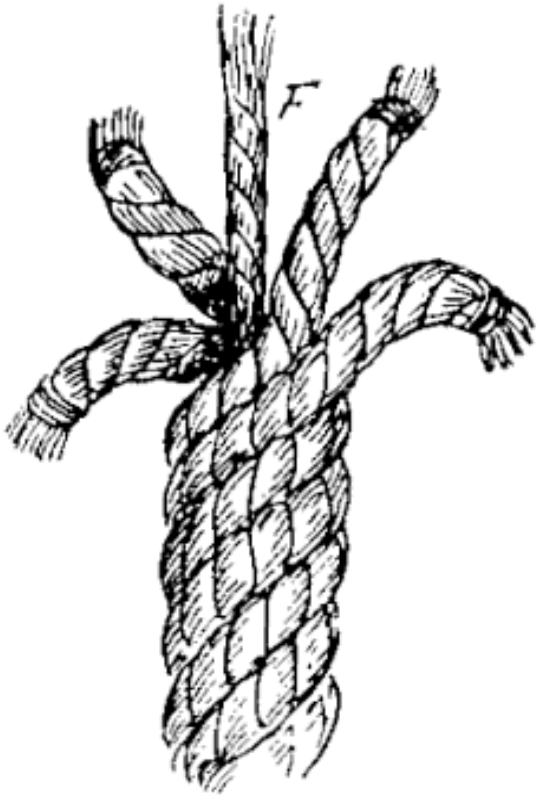

FIG. 2.—Bolt-rope.

Rope is usually three-stranded and the strands turn from left to right or “with the sun,” while cable is left-handed or twisted “against the sun” (*E*, Fig. 1). Certain ropes, such as “bolt-rope” and most cables, are laid around a “core” (*F*, Fig. 2) or central strand and in many cases are four-stranded (Fig. 2).

The strength of a rope depends largely upon the strength and length of the fibres from which it is made, but the amount each yarn and strand is twisted, as well as the method used in bleaching or preparing the fibres, has much to do with the strength of the finished line.

Discussion questions:

1. According to the author, why should everyone know how to tie knots?

2. What professions have developed their own knots? Can you add some of your own examples to his list?

3. To construct rope, what kinds of fibers should one begin with?

4. What three steps are involved in making rope?

[i] A. Hyatt Verrill, *Knots, Splices, and Ropework: A Practical Treatise*, 2nd Revised Edition. 1917. Digitized copy of full text available through Project Gutenberg, https://www.gutenberg.org/files/13510/13510-h/13510-h.htm

[ii] A beginner, a novice.