W. J. Johnson

yARn wORks

How to Spin, Dye, and Knit Your Own Yarn

Includes knitting patterns exclusively designed to complement the beauty, texture, and unique qualities of your handmade yarn

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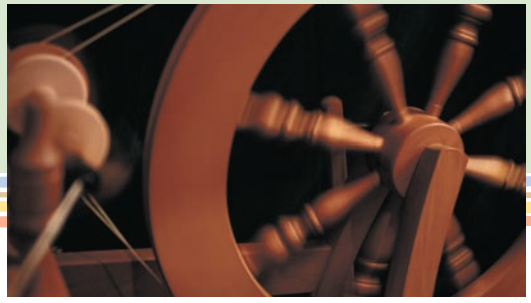
DEDICATION

I dedicate this book to my Swedish ancestors,
who spun for necessity so I may spin for joy.

Contents



Introduction

Why spin and dye our own yarn? The most obvious answer is, to make the yarn we want in the fiber and colors we desire. The less obvious answer is, to give balance to life. If we value our time as much as materials, it's not a cost savings to create yarn by spinning and dyeing it ourselves. But it can be a "life" savings. For some, it's a way to connect our modern lives with a far-off past that seems simpler and more balanced. Spinning, and all the activities associated with making yarn, force us to slow down and consider the act of creating. To actually make something completely from the original source is so rare. I equate it to gardening in an age of warehouse supermarkets. We may not need to grow our own food to survive, but we may want to do it to feel closer to the source of life. Being a spinner, dyer, and knitter of your own yarn is like growing a garden from seeds—you will be growing your knitted project from its true beginnings. Best of all, the fruits of your labor contain the story of your experience.

Knitting from yarn that was spun and dyed by your own hands is the ultimate experience for fiber lovers. The memories of how the fiber was acquired, where you did the spinning and dyeing—all of these thoughts and emotions unfold as the knitting proceeds. It's impossible to knit anonymously when the fiber carries such strong memories. The spinning and dyeing experience becomes part of your history. The only danger in creating your own yarn from scratch is that you may wish to work only with the yarns you've spun and dyed from now on. Never fear. Continuing to spin, dye, and knit your own yarn will bring you full circle in your love of fibers and yarn.

WHY THIS BOOK?

Yarn Works is indeed a guide for knitters who wish to try spinning and dyeing. But this book will also appeal to current spinners and dyers who want to gain further background and increase creative inspiration in their work. I've written this book from the perspective of the "why" or the science behind the subject, since I believe that a more

fulfilling and freeing experience results when someone knows why something does or doesn't work. This book will help answer questions such as these:

- What is the best spin method for a chunky yarn?
- How can I dye this fiber to the color I want?
- Why doesn't this yarn hold its shape when knit?

HOW TO USE THIS BOOK

Yarn Works can be read from front to back, or by individual section. The book is divided into four main sections—Fiber Workshop, Spin Workshop, Dye Workshop, and Knit Workshop—and each main workshop section includes a brief history of the subject. The workshop sections are structured with short, informational workshops that take you through the most essential learning activities for spinning, dyeing, and knitting.

In Fiber Workshop, you learn the specific attributes of various fibers; Spin Workshop examines how to spin them; Dye Workshop discusses how to dye the spun yarn with natural and synthetic dyes; and Knit Workshop continues the exploration of fiber with actual knitted projects from each of the fiber groups (protein, cellulose, synthetic blends), using the actual yarn created and dyed with techniques from the preceding workshops. At the end of each pattern, be sure to read the "Details from Spinning and Dyeing" section. It's here that you'll find the specifics on how the yarn for each project was made. Each of the main workshop sections has a separate appendix containing supporting material for that section. At the very end of the Fiber and Dye Workshop sections is a Creative Workshop in which experimentation is the rule!

So, roll up your sleeves and enter the creative and limitless world of *Yarn Works*. Once you've tried the techniques shown on these pages, I encourage you to go on and create your own workshops based on the knowledge you've gained.

part 1 Fiber Workshop

This section gives an overview of the various fibers available to spinners and knitters today, with an emphasis on the fibers used in the *Yarn Works* projects. Fiber Workshop provides a strong foundation in the fundamentals of appropriate fiber selection so spinners, dyers, and knitters may progress in their work, confident that they've picked the right fiber for the project.

Gandhi saw the rich culture of Indian fiber spinning as a means to celebrate the peasant class and bring India away from British industrial oppression. In the 1920s, he founded a spinning movement in India that raised money to give peasants spinning wheels so they could make yarn for cloth that they could sell to help support their families and raise them up from squalor. Saying, "The act of spinning is the symbol of nonviolence," Gandhi even placed the wheel of a spinning wheel at the center of his party's flag—where it remains part of the national flag of India to this day. But beyond the political and economic applications of spinning, Gandhi also spun every evening for its "rhythm, music, poetry, romance ... and spiritual solace."
Pictorial Press Ltd/Alamy

"There is no yajna (sacrifice) greater than spinning calculated to bring peace to the troubled spirit ..."

—Gandhi

A BRIEF HISTORY OF FIBER

Since fiber is a material that disintegrates relatively quickly, little is known of the earliest fibers used by people. We assume that these early fibers were derived from local plants and animals. Wool is known as one of the first spun fibers, along with plants such as flax and nettle.

The origin of silk (before 2600 BC) is linked to a Chinese legend about an empress who, while sitting under a mulberry tree, had a silkworm cocoon unexpectedly drop into her cup of tea. She noticed how the fiber that floated from the dissolving cocoon made a very fine thread—and so began the silk industry. Although it's uncertain whether this tale is true, we do know that silk was a greatly guarded secret in China for centuries before it was carried along the Silk Road (a trading route that reached from Asia to Europe and Africa from 200 BC to AD 200) and subsequently spread around the world.

Flax is an ancient plant with a history that stretches back before recorded time. Flax has had a tremendous impact on human life, not only as a fiber source for sturdy clothing, but also as a food source that is extraordinarily nutritious. Every garden of preindustrial times contained a patch of flax just for household use—the seeds for food and the stalks as fiber to spin. It is because of flax that flyer spinning wheels (sometimes called "flax" wheels) exist. These wheels were developed just for spinning flax more efficiently.

Cotton has also been in our spinning baskets since before written history. Archaeological evidence shows that cotton was grown in the Middle East and Americas since about 5000 BC, but there is no clear historical record of its origin. It may have been indigenous to the Americas, India, Asia, and Africa. Nevertheless, prior to 1793, flax remained the most sought-after fiber for warm-weather clothing

because, even with flax's multiple processing steps, it was still produced for less cost than handpicked and teased cotton. When the cotton gin was patented in 1794 as a means to expediently gin (remove the seeds of) the North American variety of upland cotton, flax was quickly shown the back door and cotton came raging in, making comfortable clothing more affordable for the average person.

Sheep's wool was also a part of the prehistorical fiber record, but it became more common during the Roman era, when the wool industry was born. As the Roman Empire spread into today's Europe, more sheep became domesticated and bred, further advancing the influence of wool. The popularity of wool continued beyond the age of the Romans until today—as wool arguably has become the most sought-after fiber in the world. As the demand for wool grows, more is learned every day about breeding for the best wool fiber qualities. It's fairly certain that we haven't seen the end of how this fiber can enrich our lives.

By the 1900s, test tubes became the incubators for new fibers. From nylon to polyester, modern-day fibers bear the mark of the scientist, sometimes with their very own trademark—the modern attempt to guard our new fiber "silks." But in the end, these new fibers are mostly mimics and wannabe's of the real thing—natural protein and cellulose fibers.

SELECTING THE BEST FIBER FOR A PROJECT

We live in a time of phenomenal worldwide fiber access. With such access comes wonderful opportunities—and challenges. This section walks you through what you need to know to pick the perfect fiber for your project.

Step One: Choose a Project

Of course, you may jump right in and start working with any fiber that suits your fancy, but if you want to have the most success in your spinning, dyeing, and knitting, it's smart to decide what you want to make before you select the fiber. For instance, garments that are worn next to the skin are best created with fibers that are gentle to the skin. And those meant for hard use are best created with fibers that can stand up to the rigors of their final purpose.

Detail of yarn, showing twist

Can Your Fiber Do the Twist?

To be spun, a fiber needs to be able to retain a twist when the force that has been turning it (the wheel or whorl pulley) has been removed. For some fibers, like wool, the twist is naturally held. Other fibers, such as flax and hemp, hold their twist best when moistened. The twist in cotton needs to be set under tension or it won't stay in the yarn. Synthetic fibers have been scientifically designed to enhance the twist for a particular yarn or end use, so their twist qualities vary depending on the fiber.

Hint for Beginning Spinners: Try Wool!

The best fiber for beginning spinners is wool. It's the most forgiving of novice pulling and tearing, and the least cantankerous to control. Of all the wool options for beginners, a medium wool (such as Corriedale) is the best since it's easily spun into soft, balanced yarn. After a medium wool, move on to a fine wool like Merino. After Merino, consider a blend of silk and wool, followed by silk alone. At this point, try short fibers, as your ability to control the spin will be well tested. Start with short protein fibers, like angora and cashmere. Then experience even shorter cellulose fibers, like cotton. Before you know it, you'll be ready for the unique spin process of flax and hemp (which is often spun wet), and you'll be spinning like a master!

Consider the Staple Length

It is important to consider the staple length when selecting the appropriate fiber for a particular project, since staple length affects the spin method, and that influences the final quality of the yarn.

1. **Natural staple** fibers have a defined length based on natural genetics. Examples are sheep's wool, alpaca, llama, yak, angora, cashmere, silk, dog, cotton, flax, hemp, and bamboo (bast type—meaning that the fiber is the natural stalk and not a manufactured extrusion of the plant material).
2. **Extruded** fibers have a manufactured staple length that may be (1) cellulosic—consisting of a natural fiber–content base, but manufactured in a lab through a chemically enhanced process (such as corn, milk, soy, and bamboo (extruded type); or (2) synthetic—mostly consisting of bases of nylon, acrylic, or polyester and extruded in a chemical process involving synthesized polymers not found directly in nature.

Step Two: Determine What You're After in a Yarn

First determine the characteristics you're looking for in a yarn (softness, durability, dyeability, etc.), then determine which fibers most closely match the characteristics you've listed and will spin, dye, and knit to the qualities you want in the yarn.

CHARACTERISTICS TO CONSIDER IN FIBER SELECTION

- staple length—the total measurement of a fully grown lock of fiber when stretched.
- crimp—the natural wave formation of the fiber. In a sheep's wool, the crimp helps to determine the best way to spin a fiber. Not all fibers have crimp.
- fiber diameter—the width of any given strand of fiber. This is measured as a micron count or a Bradford count. The finer the diameter of a fiber, the shorter the staple length tends to be.
- strength—the tensile strength of a fiber. A fiber's strength determines the ability of a fiber to hold together when being pulled in different directions.
- elasticity—the ability of a fiber (and knitted material) to return to its original state after being stretched.
- durability—the ability of a fiber to resist abrasion.
- comfort—whether a given fiber produces a warming effect (heat retaining) or cooling effect (heat/moisture wicking).
- natural color—a fiber with a light natural color like white or cream can be dyed to a truer color than a fiber with a darker natural color like gray or brown.
- dyeability—ability of the fiber to accept dye particles, mainly determined by the molecular structure of the particular fiber.
- stability—the ability of a fiber to hold a twist. A stable yarn is less likely to stretch out and "grow" between washings than an unstable yarn.

MEET THE FIBERS

Now that you have guidelines for what to look for in selecting a fiber, it's time to explore the specific fiber choices.

Protein Fibers

Protein fibers are chemically composed of protein compounds. Most originate from animals, such as wool, alpaca, silk (worm), and cashmere (goat), but some manufactured fibers are also composed of protein compounds such as soy and casein (milk).

Note: See Beginning to Spin (page 51), Spin Methods (page 57) and The Finishing Act: Wrapping Up the Spin (page 65) for more on the prep, spinning, and finishing techniques mentioned in this section.

WOOL

Wool is sheep fiber. It's not rabbit, yak, alpaca, or goat. It's just the fiber from sheep. Despite all of the advancements in textile science over the past century, there isn't a fiber that can compare to wool—the fiber of the gods.

Wool Qualities

Let's break down the wool fiber to see how it's truly unique. First of all, wool is a protein fiber with growth scales. That alone is not unique. All fibers grown by animals are protein fibers, and some of these also have scales on their hair shaft. But sheep have the most—literally thousands of epithelial cells (scales) that swell and open when exposed to water and heat. If these scaly hair shafts are agitated while wet and hot, the scales grab each other, and felting results. Felting qualities vary among different sheep breeds because of differences in hair shaft/scale structures.

Wool also has a high grease factor compared with other protein fibers. The grease is caused by sebaceous glands, which secrete a greasy substance onto the hair follicles as they grow. This substance protects the sheep's skin and hair, giving it waterproofing qualities and protection from the environment. Chemically, the substance is a wax.

1. **Softness.** The feeling of softness is mainly due to scales on the hair shaft of the particular sheep breed. Fine wool sheep, like Merino, have many very small scales. Coarse wool sheep, like Lincoln, have fewer scales that are much larger.

   The softness or coarseness of the wool from different breeds is not only related to the number and size of the scales, but also to the structure of the hair shaft itself. In coarse wool fleece, a canal called the medulla runs the length of the fiber within the hair shaft. While this canal is common in sheep with coarse fleece, Merino sheep have been bred to eliminate the medulla. The lack of this stiff, structural piece is one of the reasons why Merino wool is so soft and delicate.

2. **Elasticity.** When dry, a wool fiber can stretch up to 30 percent of its length, and when wet it can stretch up to 70 percent, yet it returns to its original shape when dry. This same elasticity can be seen when wool is compressed. The property of crimp in the fiber and the structure of the hair shaft are the reasons wool has great elasticity. This quality gives resiliency to garments, allowing them to stretch or be packed tightly and yet hold their shape well when normal conditions return.
3. **Absorbency.** The chemical structure of wool attracts water molecules that the wool cells subsequently absorb.
4. **Warmth.** Air pockets formed within the crimps of wool help to create a feeling of warmth. Another factor of warmth is due to the prickly hair shafts that stick up out of the wool mass. When a wool garment is worn, the shafts poke us and create action in our nerve endings, resulting in more blood flow and a warming sensation. In addition, wool can actually *create* heat when it's wet, due to the heat that's produced when water molecules and the wool fiber microscopically collide.

A sheep, source of the most popular fiber among spinners and knitters alike.

Allergic to wool?

Maybe not. You may just have skin or nerve sensitivity from the prickly wool hair shafts. Some people have allergic reactions to the vegetation and/or pesticides that may be in the wool but an actual allergy to wool is quite rare.

Angora

5. **Fire resistance.** Wool only smolders, it doesn't burn. Again, water is the reason. Because water molecules are continuously held to the cellular structure of the fiber, when exposed to an open flame, wool responds by producing steam.
6. **Dyeability.** Wool accepts dyes very well, partially due to its exceptional absorbency. Dyes that best respond to wool are the high pH acid dyes. Natural dyes, which use mordants that raise the pH of the dye bath, also work well on wool.
7. **Spinnability.** Spinners favor wool due to its crimp, fiber length, and all of the factors listed above. It's just so darn easy to spin! Plus, with the great variety just within the 200-plus wool breeds, you can sample nearly every type of spinning method without ever leaving the sheep.

Follow the processing and spinning of Hanna's fleece—a part Corriedale, Romney, Lincoln, and Border Leicester sheep—our subject in the Knit Workshop projects: Vallkulla, Hanna, and Sami (pages 120–134); and follow the processing and spinning of wool roving in the Gabriel Knit Workshop (pages 135–138). Learn how to dye wool in the Natural Dye Workshops and Acid Dye Workshop (pages 92–102).

OTHER PROTEIN FIBERS

This book could have easily been just about spinning, dyeing, and knitting wool, but then you would miss out on the rest of the vast menu of protein fiber options. So let's see what else is out there and explore their unique qualities for spinning, dyeing, and knitting.

Note: Protein fibers dye best with either acid synthetic dyes or natural dyes using an acid pH mordant and dye bath.

Angora

Angora is the fiber from Angora rabbits. Plucked angora is considered premium for hand spinning since it is the complete long fiber, from base to tip. Angora fiber has three components: bristles (long and stiff guard hairs), down (fine, lightweight, and the highest percentage of the coat hairs), and awn (another guard hair that is between the bristles and down in size).

The fibers have a core consisting of hollow chambers that enhance warmth, making angora eight times warmer than wool. The hair surface has a tight scale pattern, creating softness and a slippery surface that produces a halo effect when the fiber is spun and knit.

Angora doesn't have good elasticity or memory (memory is a fiber's ability to return to its original shape after being stretched or compressed), so choose knitting projects that won't suffer from stretching or sagging—or blend angora with an elastic fiber such as wool to encourage more elasticity. It dyes well, but because of the variety of fiber types in the coat, angora doesn't take dye evenly. Angora blends well with other fine fibers and felts well. It often doesn't need cleaning or carding and is best spun as an even yarn with a high twist that is softened and strengthened by fulling after spinning. (See page 67 for fulling process.)

ABOVE It's really no wonder that the Swedish Bohus garments were so popular in northern regions during the 1940s–1960s, since many were knit with angora. The lightweight fiber was a welcome and elegant alternative to traditional heavy Nordic wools. We are rediscovering the beauty of angora fiber today, with the resurgence of interest in Bohus knitting.

Bison/Buffalo

This fiber is sheared from slaughtered buffalo or plucked from fence lines and bushes. (Shearing a live buffalo is not advised!) Often it's not necessary to wash the fiber, but if you do, wash it gently. The fiber used for spinning is the downy undercoat—strong, soft, elastic, and warm. Because of its great elasticity, this fiber is harder to block in knitting. It has a dark natural color (rarely white) that can be overdyed to rich tones. Buffalo blends well with other fine fibers. The down, being a short fiber, is often spun with a high-twist woolen technique. It should be fulled after spinning to strengthen the yarn.

Camelid Family

All camelids have a number of nonmedullated (hollow) fibers, providing lightweight warmth. If purchased as a raw fleece, these fibers have no grease but may have vegetative matter that needs to be shaken or perhaps washed out.

Alpaca. There are two types of alpaca: Huacaya (a dense fiber with a wave crimp and elasticity) and Suri (no crimp, long, soft, and lustrous with a beautiful drape). Alpaca fiber is strong and durable, and it creates a warm garment—warmer than wool. It blends well with other fibers and is bred in a wide variety of natural colors—some of which overdye beautifully. Although Huacaya is often spun with a woolen technique and Suri with a worsted technique, the fiber preparation determines the best spin method. Follow the processing and spinning of alpaca in the Knit Workshop Project Róisín (page 139).

Camel. The Bactrian (two-humped) camel is the one that provides fiber for spinning. The best spinning fibers are found in the undercoat, which is soft and fine, with great thermal properties. The camel's coat is shed in the spring in large tufts, and the fibers are hand gathered. The fiber has little elasticity. Camel overdyes to rich hues and blends well with other fine fibers, including wool. Card it with fine cotton carders, but instead of making a typical rolag (a rolag is a carded fiber preparation, see page 28) for spinning, roll the fiber across the horizontal width of the carder so the fibers remain more parallel for a semi-worsted spin.

Llama. Llamas have a hair that is similar to alpaca, but weaker. The llama has a dual coat of soft down and long guard hair. The overall coat lacks crimp and elasticity, but has a beautiful drape. The down is a warm, lustrous fiber and has the best dyeability of all the hairs in the llama's coat. Llama blends well with other fine fibers. The two types of fibers in the coat are often separated and the woolen down is spun with a woolen spin and the guard hairs as worsted.

Guanaco and Vicuña. The guanaco is an ancestor of the llama, and the vicuña is an ancestor of the alpaca. Both have soft, lightweight, warm fibers with great strength. Vicuña has been measured as the softest fiber on earth. Both guanaco and vicuña are wild animals and are classified as endangered species, as a result of being killed for their fiber. Recently, an ancient Incan method of vicuña fiber harvesting has been encouraged, in which the harvesters round up the animals and shear them, releasing them again to the wild. Since these animals are endangered, the fibers are not readily available to spinners, although this is changing as vicuña are starting to be bred in the United States. Guanaco and vicuña

Alpaca

Camel

Llama

Guanaco

Vicuña

Cashmere

don't have natural white coats, but their fiber can be overdyed to create rich colors. Both fibers blend well with other fine fibers, and because of their high cost, they are often spun in a blend. The fiber preparation (carded or combed) determines the spin method for both of these fibers, but they are most often spun from a puni preparation (see page 166) with a high-twist, woolen spin.

Cashmere (Cashmere Goat)

This is a luxuriously soft, fine fiber with a matte appearance that comes from the downy undercoat of the cashmere goat, which originates from the Kashmir region. The best cashmere comes from combings made during the spring molting season. The nonmedullated (hollow) hairs in cashmere provide air pockets that add to its lightweight warmth. The raw fleece should be cleaned very gently. Cashmere blends well with other fibers and dyes well, although dyeing it can affect the softness. It should be fulled after spinning to strengthen the yarn. The fiber preparation determines the spin method. It's most often spun woolen to enhance the softness and warmth.

There are two main blends of cashmere. Protein fiber blends created by cross-breeding have fiber characteristics corresponding to the animals from which they were bred:

- Cashgora—from the cashmere and angora goats, cashgora is typically a longer fiber and not as fine as pure cashmere.
- Pygora—from a pygmy and angora goat cross-breeding, pygora has a fine, cashmerelike down from the pygmy goat and long locks from the angora goat.

Mohair

Mohair comes from the angora goat, named after the province of Ankara, Turkey. Mohair grows quickly, so goats are sheared twice a year. The wool is lustrous, strong, and elastic, with the youngest fibers (also called "kid mohair") being the softest. Mohair has some nonmedullated fibers that add to its fineness. The raw fleece has grease, so it's advisable to wash it prior to spinning. Mohair is notable for its great dyeability. It blends well with wool. Mohair may be spun woolen or worsted, but its fiber qualities are enhanced by a worsted spin.

Mohair

Qiviut

Yak

Qiviut (Muskox)

Qiviut is a seasonal shedder, blowing its coat in large pieces in the spring. The downy undercoat of domesticated qiviut is harvested by combing during the shedding season. It often doesn't need washing prior to spinning, but needs to be well prepared to separate the coarse guard hairs from the favored down. Qiviut is elastic, eight times warmer than wool, and softer than cashmere. It blends well with other fibers. Fulling after spinning is recommended. The natural coat is typically dark in color and often not dyed, but it does take dye well and overdyes to dark, rich colors—although dyeing may affect the softness of the fiber. The fiber preparation determines the spin method, but the down, being a short fiber, it is often spun with a high-twist, woolen technique.

Yak

As a member of the bovine (cattle) family, yak fibers are rather short, but yaks have longer hair than most bovine, averaging 1.2 in. (3 cm). The spinning fiber is the downy undercoat that is shed in the spring and collected by combing. It doesn't need to be washed before spinning, but it should be fulled after spinning. Natural white/cream yak fibers dye well, and other natural colors overdye to rich tones. Yak combines well with other fine fibers. The fiber preparation (carded or combed) determines the spin method, but because it is a short fiber, a high-twist, woolen technique is often used.

Cat/Dog (Chatgora and Chiengora)

Now we're talking about local fiber—maybe right in your own house. Certain breeds of cat and dog have a downy undercoat that is wonderful for spinning. The fiber can be gathered by plucking or combing while the animal is shedding. It can be washed prior to spinning, but often spins best if not washed. (The dog/cat smell should come out of the fiber/yarn after a thorough washing.) The fibers dye fairly well, depending on the breed and natural color. They're often blended with wool and make a fabric with a fiber bloom similar to angora. The fiber preparation determines the spin method, but a woolen spin is usually the most appropriate.

Silk cocoons, before degumming process

SILK: THE OTHER NATURAL PROTEIN FIBER

Silk doesn't come from a coat that's sheared or combed off an animal, but it is instead spun by a silkworm and boiled to release the fiber from the silkworm's cocoon. The silkworm is created by one of two primary types of silk moths:

The Bombyx Mori produces silk that is called "bombyx" or "cultivated." This moth is fed only mulberry leaves, which give its silk a bright white color and a fine micron count. The Tussah moth produces what is called is called "wild" silk, since it's fed a diet of oak, mulberry, and other tree leaves from the wild. This moth creates a fiber that ranges from off-white to brown, depending on the amount of tannin in its leaf diet. Tussah silk is about twice the diameter of bombyx/cultivated silk.

Silk fiber is actually a construction of two silk filaments in a fibroin solution encased by a protein called sericin. The silkworm shoots the fibroin solution from two glands on either side of its mouth and simultaneously twists its head in a figure eight formation, to create a single, continuous strand of fiber from the two filaments. The strands of fiber eventually encase the silkworm and form a silk cocoon. Silk fiber is extremely fine and translucent, triangular in cross section and slightly twisted, enhancing the reflection of light on its surface.

Silk Qualities

1. **Strength.** Silk is the strongest natural protein fiber, rivaling steel in tensile strength. But water is to silk like Kryptonite is to Superman. Silk loses its strength when wet because of weakened hydrogen bonds in the filaments. Although it has great tensile strength when dry, the smooth-sided fibers don't have a very strong abrasion resistance.

2. **Elasticity/plasticity.** Silk is more plastic than elastic. This is felt when spinning with silk. The fibers slide and stretch past each other like a crazy elastic silly putty.
3. **Absorbency.** Silk can absorb 30 percent of its weight in water before it feels wet, making it a very comfortable fiber to wear in all seasons.
4. **Durable.** Even though silk has a very delicate feel, it's resistant to mold and mildew, and it's usually not bothered by clothes moths.
5. **Resilience.** When silk fiber is forced into a tight wad, it will quickly spring open. Parachutes have been made out of silk due to this resilience and great tensile strength.
6. **Warm/cool.** Silk is a poor conductor of heat, making it more comfortable in both summer and winter. It repells heat in the summer and contains heat to the body in the winter.
7. **Dyeability.** Silk is a fantastic fiber to dye, but it is easily damaged by acids, so care must be taken when working with acid dyes to be sure the acid fixer (vinegar or citric acid) doesn't sit on the fiber for very long. It also dyes well with natural dyes and is the only protein fiber that can be effectively dyed in an alkaline fiber-reactive dye bath.

Silk is a good fiber for spinners who have learned some control of the wheel and their spin. Tussah is the best silk to start spinning since it has a larger diameter and a less slippery surface than cultivated silk. Spinning with a hard twist brings out the luster of silk. The wheel tension needs to be lightened and a smaller whorl used. Learn more about spinning different silk preparations in FA-5 (page 165). Follow the preparation and spinning of silk hankies (a bundle of silk cocoons stretched into a square formation) in the Knitting Workshop project Sylph (page 146). Follow the process of dyeing silk in the Acid Dye Workshop (page 100).

AZLON FIBERS

Azlon fibers are manufactured fibers derived from regenerated, naturally occurring protein, casein (milk) or soy. Like silk, both casein and soy can be dyed with acid, natural, or fiber-reactive dyes, but the colors will be not as rich as they are on silk.

Casein (Milk)

Casein, sometimes called "milk fiber," is chemically processed from milk protein and extruded through spinnerets into fiber form. It may seem to be part of the recent eco movement, but casein was first created in the 1930s as an alternative fiber to wool. It has many properties similar to wool and has the feel of silk, but it mildews easily. Care must be taken when dyeing casein since it is quite weak when wet. The fiber preparation determines the spin method, although its qualities lend themselves to a semi-worsted spin.

Soy

Developed in the 1930s as an alternative fiber to silk, soy fiber is made with oil from the processed protein of the soy cake. The oil is combined with other solutions to make a material that is extruded through spinnerets into fiber. It contains the softness and luster of silk and blends nicely with silk. Soy is often blended with more elastic fibers to create lightweight knits with elasticity. The fiber preparation determines the spin method, but the fiber qualities suggest it be spun worsted.

Cellulose (Plant) Fibers

Cellulose fibers are usually not the first fiber choice for beginning spinners, since their structure and fiber length can be a challenge to spin. But they are great fibers to help develop spinning expertise. When you have the command of a cellulose fiber, you will truly be awarded the title of Spinster! There are two main types of cellulose fibers: seed hair and bast.

CELLULOSE/SEED HAIR FIBER

Cotton

Cotton grows on 3- to 6-ft-high (1 m to 2 m) bushes. The spinning fiber comes from hairs in the seedpod of the plant's flower. When the flower dies back and the seed pod (also called "cotton boll") ripens, the pod splits open to reveal the cotton fibers attached to between five and eleven seeds, depending on the cotton variety. When safe inside the cotton boll, the fiber structure is essentially a tube filled with a sap material. When the cotton boll bursts open from the growing pressure of the fibers, the walls of the tubes collapse and become ribbonlike and twisted as the seed hairs dry out. It's this convoluted shape of the fiber that gives friction and spinnability to cotton.

Note: Pima (long-staple) cotton is more easily removed from the seeds than upland (short, hairy) cotton. Being able to more easily remove the seeds was one reason the cotton gin was a wonderful invention for the U.S. cotton industry. The United States was (and still is) a primary grower of the upland variety.

Depending on the variety of cotton, the fiber varies in staple length from about ½ in. (1.3 cm) to as much as 2½ in. (6.3 cm), and is fine with little variation in diameter. There are three major types of cotton for hand spinners to choose between: Pima, with the longest staple, up to 2½ in. (6.3 cm), is also called Egyptian cotton, although there is an American variety, too. Upland, with medium staples of 7/8 to 1 5/16 in. (2 cm to 3 cm), is considered to be American cotton. Colored cotton (available in brown/red, green, and cream) has a short staple of ½ in. (1.3 cm). (A recently created organic colored cotton [FoxFiber®] has a longer staple and comes in a wide range of colors.)

Note: Colored cotton isn't a new fiber. It's been in the Americas (Peru, Central America, Mexico) since at least 5000 BC. Before the Civil War, slaves in the United States could only grow brown and green cotton in their gardens because the plantation owners feared the slaves might sell white cotton if they grew it. The last laugh is on the plantation owners, since colored cotton has become a highly sought-after variety!

ABOVE Cotton boll, detail. Cotton has been called "white gold" in the southeastern United States, where cotton was an important part of the economy beginning in the late 1700s. And like the flax seed, cotton seed is of note for more than just textile reasons. It's also greatly valued for its significant nutritional qualities.