YARNS

(PART 1)

YARNS FROM VEGETABLE FIBERS

INTRODUCTION

1. The word **yarn** is one of the best known in the textile trades of all English-speaking nations and is used to indicate a continuous strand, spun or otherwise produced from natural fibrous substances, whether vegetable, animal, or mineral; as, for instance, cotton yarn, woolen yarn, asbestos yarn, and so on. Though the term is applied commonly to all fibrous threads, it is more accurately applied to yarns in bulk, or to a quantity of strands or threads, than to small pieces or single lengths of thread. When threads are considered singly, each one is more frequently spoken of as an *end*, as, for example, the expressions *broken end, two ends in a dent;* but even in this case it is an end of yarn that is meant. One possible exception is that sewing, embroidery, and such threads, which consist of several ends of yarn twisted together, are usually spoken of as *thread* instead of yarn. The use of the word thread in the sewing-thread and kindred trades instead of the word yarn differs from the custom in many other branches of textile yarn manufacturing where the yarn, even when several ends are twisted together, is still spoken of as yarn. Still another exception is in the case of the various kinds of cordage, which, although technically are continuous strands of fibrous materials, cease to be

spoken of as yarn when made up into the form of twines, cords, and ropes owing to their thickness as compared with ordinary yarns. Aside from the exceptions named, the word yarn may be considered as applying to all strands or threads made from fibrous substances.

The word yarn is derived from the Anglo-Saxon word *gearn* and bears resemblance to *garn* in the German, Swedish, and Danish languages, which also has the same meaning. These words probably all came from the Teutonic name for yarn, or string, and are allied to the Greek χορδή (chordé), meaning a string, originally one made from the intestines (χολάδεξ—choládez) of animals, which was one of the earliest filaments used by man. It is from χορδή that we have the English word cord.

In its most perfect form, yarn is cylindrical, of the same diameter and evenly twisted, with the same number of turns per inch, throughout its length, and of a uniform strength at all points. Either from the nature of the fiber, from intentionally different construction, or from defective material or manufacture, some yarns do not attain this standard of perfection, but vary in evenness and in strength.

CLASSIFICATION OF YARN

2. Drawn and Condensed Yarns.—The subject of yarns, when dealt with generally, opens up a very wide field and various methods of classification so that the subject may be intelligently considered. Not only do the series of processes for preparing yarns vary according to the material that is to be operated on, but different series of machines or processes are often used even for the same material. Although each series of machines produces yarn different in some respect from yarns produced by other series of processes, all yarns, of whatever material, may be classified in two main divisions, according to their structure; namely, *drawn yarns* and *condensed yarns*. **Drawn yarns** are those in which all fibers are laid parallel, with the ends overlapping one another, which, since the yarn is twisted while in this

condition, produces a series of parallel spirals. This method of producing yarn depends on the principle of roll drawing, and such yarns may be described as *drafted* or *multidrafted* yarns. It is by far the larger class of yarn, including most cotton yarns, all worsted yarns, and many others.

The second class—**condensed yarns**—consists of those yarns in which the fibers do not all lie parallel, overlapping one another, but are crossed and laid without any regular order. These yarns are produced by arranging the fibers in loose ribbons at the carding process, rolling these ribbons into roving by a condenser, and completing the operation of spinning with a slight drafting operation between the rolls and spindles of the mule, at which time the twist is also inserted.

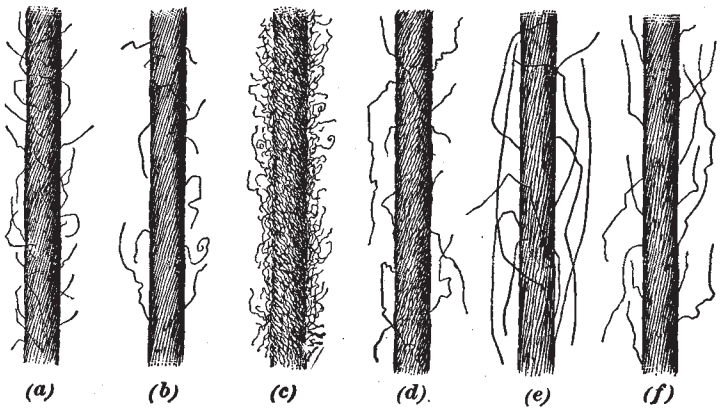


FIG. 1

As the fibers are laid in the thread without regard to their parallelism, such yarns have not the strength of drawn yarns of the same thickness; condensed yarns also have a rougher surface and a more oozy construction, owing to the fact that many of the fibers project from the surface of the yarn.

The appearance of several typical yarns, when magnified, is shown in Fig. 1, where (*a*) represents a single cotton yarn; (*b*), a single flax line yarn (linen); (*c*), a single woolen yarn; (*d*), a single worsted yarn; (*e*), a single mohair yarn; and (*f*), a single spun silk yarn. The parallel, spiral

formation is shown in (*a*), (*b*), (*d*), (*e*), (*f*), and the irregularly arranged, crossed formation of the fibers in (*c*). This means of classifying yarns into drawn or condensed yarns is a purely academic one, not obtaining to any large extent in practical mill work; but nevertheless it is an excellent theoretical division.

3. Classification According to Material.—One of the most common classifications of yarns, which is simple and easily made, is according to the material from which the yarns are manufactured. These may first be divided into the three divisions: (1) *vegetable*, (2) *animal*, and (3) *mineral substances*. If vegetable fibers, they may be subdivided according to the portion of the plant from which they are taken: (1) fibers from seeds, (2) fibers from the stem of the plant, (3) fibers from leaves, and (4) fibers from the fruit of the plant.

1. *Vegetable Fibers.*—Seed fibers are represented principally by cotton. Fibers from the stems of plants are flax, hemp, jute, and China grass, ramie, or rhea. Fibers from the leaves of plants are Manila hemp, sisal, and aloe fiber. Fiber from fruit is represented by coconut fiber, or coir. From all these substances yarn can be made, but there are other vegetable materials that are sometimes used for weaving and similar purposes, such as straw, cane, strips of wood or bark of trees, rubber, etc., from which yarn is not made and which will be ignored in this Section.

2. *Animal Fibers.*—Yarns are produced from animal fibers that form the natural covering of certain mammals and have been sheared or clipped from the bodies or pulled from the skins. These fibers consist of a large number of separate filaments varying in length, strength, fineness, waviness, pliability, softness, elasticity, and luster, and may be subdivided into wool and hair, although in some animals the division is difficult to determine, for wool is really a fine, wavy hair. Wool, however, is generally considered as referring exclusively to the fiber obtained from the sheep. The hair materials are mohair (the fleece of the Angora goat),

the fleece of the Cashmere goat, the alpaca, and the vicugna, which, although hair, have much resemblance to wool; also the strictly hair materials, free from waviness commonly considered a feature of true wool, such as goat hair, camel hair, horse hair, cow hair, and the various furs, including cat, rabbit, and hare. Both wool and hair lend themselves, especially in the case of wool, to the manufacture of yarn, which is not the case with the stiffer hairs known as bristles and spines.

A third class of animal fiber is known as silk, which is the exudation of the silk worm. This is divided into natural silk, of which there are two varieties—true and wild—and artificial silk, although this more naturally comes under the vegetable class, as it is produced from vegetable matter.

3. *Mineral fibers* is a small class of thread material, consisting principally of asbestos, glass, and metals.

It is not intended that the foregoing list should be considered complete, as for special purposes other materials are used in small quantities for yarns, and new fibrous substances are constantly being discovered and used for textile purposes. Many of the materials mentioned are of little importance to the ordinary textile student, but others, such as cotton, linen, wool, and silk, are of great importance and require careful study. Under the modern conditions of textile manufacturing, it is not sufficient for a student to have a knowledge of yarn manufactured from one material or one variety of material alone; there is a tendency for one branch of manufacture to merge into another. Designers are often called on to use yarns of more than one material, size, structure, or value in the fabric being designed; a manufacturer of cloth or knit goods is often required to utilize more than one size, structure, or value of yarns, or to incorporate into one fabric yarns made from different materials; a yarn-mill superintendent may be called on to imitate yarns made from some other material than the one from which he has to produce a yarn. The modern millman is therefore expected to have some knowledge of other yarns than those actually used or produced in the mill with which he is connected.

The widest knowledge of yarn is required by those engaged in preparing yarns for the market, in dealing in yarns—either selling or buying them—or in converting yarns by various processes so as to change their appearance or construction, or in combining threads to give special effects.

4. The largest proportion of the yarns produced in most of the textile industries is utilized for weaving purposes, usually by the firm that spins them. Another large percentage is intended for knitting mills. Other yarns are utilized for such purposes as sewing or embroidery thread, lace making, rope and twine making, and electric-wire covering.

Yarns for thread are usually spun by the firm making the thread, but for the other purposes the yarns are often purchased. In some cases, weaving mills buy their yarns; in most cases, knitting mills buy their yarns; and even knitting mills, weaving mills, or thread mills either buy a portion of the yarns they use or sell a portion of their yarn production according to the conditions of the market or for other reasons. Almost every mill making fancy goods at times requires to purchase novelty or special yarns, the production of which is a feature of certain yarn mills possessing the necessary machinery and employing help skilled in such work. Similarly, yarns that are put up in special form or that are dyed, bleached, printed, mercerized, polished, or otherwise prepared are sold to firms requiring the same. Often these processes are conducted in the mill in which the yarns are to be used. The uses found for yarns are increasing every year and it often requires some special method of preparation or handling to prepare them for the purposes for which they are intended. Thus, in the aggregate, the trade in yarns is of large proportions, and requires an expert knowledge on the part of those dealing in them—either as buyers, sellers, or agents.

5. A brief description will be given of the yarns that are produced from each of the principal materials, and some attention paid to their identification and the forms in which they are put up, the purposes for which they are intended,

and the effects of the processes through which they are passed after spinning, some of which change the appearance of the yarn, some of which combine threads, while others are intended to put up the yarn in various forms for convenience in transportation or to facilitate the operation of the next process. It is not intended to describe the manufacture of the yarn, but rather to refer to the leading types of yarns as they are placed on the market.

The great variety of yarns used for a large number of processes renders their classification and accurate description a matter of some difficulty. The correct word to use in their description is sometimes difficult to select owing to the fact that the same word may have a different meaning in different textile industries and even in the same industry as conducted in different districts or different countries; as far as practicable, however, these different meanings will be explained. When the counts, or numbers, of yarns are given, they refer to the standard numbering of yarns made from the material under description in each case.

In the case of yarns made from the more important materials, the following general classification will be made, as nearly as possible, in the order given; but for yarns that are less frequently met with a briefer description will be considered sufficient: (1) the material; (2) the various classes of material and the numbers made from each, including the various qualities, growths, or varieties of the material and its suitability for various yarns; (3) the classification of the yarns according to the method of their preparation, which is occasionally found to vary even in yarns made from the same material; (4) the appearance of the thread, which may vary according to the kind of material used, the method of its preparation, or its treatment after spinning; (5) forms in which the yarn is put up for the market or for a succeeding process; (6) the general purposes for which the yarn is used.

COTTON YARNS

CLASSIFICATION ACCORDING TO VARIETIES OF RAW MATERIAL

6. Cotton yarns are those made from the seed fibers of the cotton plant, which belongs to the botanical genus *Gossypium*, of which there are a number of species. The genus Gossypium belongs to the order of *Malvaceæ*. The principal species cultivated for commercial purposes are the *Gossypium herbaceum*, *Gossypium Barbadense*, and the *Gossypium arboreum*. The species known as Gossypium herbaceum grows to a height of from 2 to 6 feet and, like most species of the cotton plant, is an annual, having to be planted each year. It is found largely in northern Africa, Asia, and in the United States of America. The Gossypium Barbadense is a shrub, but attains a height of from 5 to 10 feet; this is also an annual. It produces the longest cotton fiber known and is largely cultivated in the sea islands off the coast of South Carolina and Georgia. The Gossypium arboreum is not of much importance commercially, but is interesting from the fact that it grows to a height of from 15 to 20 feet; the fiber thus derives the name of *tree cotton*. It is a perennial, thus distinguishing it from other species of the cotton plant. While this plant is occasionally found in Asia, it is most largely met with in Central and South America.

Cotton fiber is known to commerce simply under the name of *cotton* in English-speaking countries, although by some people it is spoken of as *cotton wool*. Its German name is *baumwolle;* in French its name is *coton;* in Spanish, *algodon;* and in Italian, *cotóne*.

The botanical classification of cotton is not used commercially, but a geographical classification has been made, which has also been extended to cover the yarns made from such cotton—as, American cotton yarns, Egyptian yarns, Peruvian yarns, Surat yarns—with subdivisions derived either from the name of the seed from which the plant is grown, such as Allan-seed, which is a variety of American cotton, or local

names, such as Peelers, uplands, and boweds, which are also varieties of American cotton. It must be understood that the names given in this classification refer to the cotton from which the yarn is made and not the country in which the yarn is spun; thus, Egyptian yarn means yarn spun from cotton grown in Egypt, notwithstanding the fact that the yarn itself may be made in America, England, Japan, or other countries.

7. Yarns From American Cotton.—1. *American cotton yarns* are usually understood to be those produced from the more common varieties of cotton grown in the United States of America, of short and medium staple, and excluding yarns produced from sea-island, Peeler, and Allan-seed cottons, which although they are American, usually give a distinct trade name to the yarns produced from them. American cotton yarns are usually of low and medium numbers, not usually exceeding 40s for the warp or 70s for the filling, and generally spun in much lower numbers. They are almost white in color.

2. *Sea-island yarns* are produced from the long-staple sea-island cotton grown on the islands off the coast of South Carolina and Georgia and, to some extent, on the mainland in districts near the ocean, especially in Florida. Sea-island yarns are almost always fine yarns, from 100s to 400s, although they are sometimes spun for special purposes into low and medium numbers. They are white in appearance and smooth and silky.

3. *Peeler yarns* are produced from a long-staple cotton grown principally in districts near the Mississippi River. Peeler yarns are spun as high as 80s or 90s and from this downwards. They have a very white appearance.

4. *Allan-seed yarns* are produced from American cotton grown from Allan seed; the description of Peeler yarns applies largely to these.

8. Egyptian yarns are prepared from cotton grown in Egypt, and when examined in the natural state can be readily distinguished from most other yarns by their brownish color,

They are commonly spun as high as 100s, and even occasionally up to 150s, but are often made into lower numbers, especially for hosiery purposes; as the fibers are very strong in proportion to their size and are long and silky, they enable a solid, strong thread to be made. On the continent of Europe, Egyptian yarns are generally spoken of as Mako, or Maco, yarns, especially in Germany.

9. Peruvian cotton yarns are not spun to any large extent. They are found, however, in coarse numbers from 10s to 20s, although the staple of the cotton is long enough to enable finer numbers to be made. There is more than one variety of Peruvian cotton, but the one chiefly used is known as rough Peruvian and has a harsh feel; it is not so white as the American cotton nor so brown as some of the Egyptian cottons. The yarn made from this cotton exclusively is harsh, woolly feeling yarn, with a brownish appearance. The principal use of Peruvian cotton, on account of its length of staple and harsh feel, is as an adulterant for mixing with wool for the production of merino or similar yarns.

10. Surat yarns are those made from East Indian cotton. Its many varieties are of short staple, and much of it is dirty and of a brownish color, so that when used alone it is made into yarns coarser than 20s, which in most cases have a dirty-white appearance. It is not usually spun alone except in India, although some of it is still used in England and on the continent of Europe, either alone or mixed with short American cotton.

11. Chinese and Japanese yarns, when spun alone, are like Surat yarn, except that both the Chinese and Japanese cottons are cleaner and whiter than the Indian cotton and produce yarn of a better appearance.

12. Many other varieties of cotton yarns could be mentioned, such as those made from Brazilian cotton, Turkestan cotton, West Indian cotton, Smyrna cotton, Bourbon cotton; but with the exception of the Brazilian and Turkestan cottons, these are not of much commercial importance as

a rule, being spun only in the countries in which the cotton is grown or in the country of which the one in which it is grown is a dependency. When such cottons are exported to other countries they are as a rule not used alone, but are mixed with other cotton, principally with American, of about the same length of staple. The only yarns spun in the United States of America from imported cottons are Egyptian and Peruvian yarns.

This comprises the list of the principal varieties of cotton yarn as indicated by the name of the cotton from which it is spun. In some cases, however, yarn is produced from a mixing composed of two or more growths of cotton; in this case the yarn is usually named for the variety forming the larger proportion of the mixing; for instance, when a small proportion of Brazilian cotton is blended with American cotton in order to increase the strength of the yarn, the product is still called an American yarn; when American cotton is added to Egyptian for the sake of economy, the product is called an Egyptian yarn, or Maco; or when Indian cotton is used with American in order to cheapen the mixing, the yarn receives the name of American.

CLASSIFICATION OF COTTON YARNS ACCORDING TO THEIR PREPARATION AND APPEARANCE

13. Single Drawn Yarns.—1. Almost all cotton yarns belong to the class of drawn yarns, being produced by the sequence of processes comprising picking, carding, drawing frames, fly frames, and spinning, and any yarn described as cotton yarn without any other qualification, may be considered as being produced by these ordinary processes. Drawn cotton yarns, however, may be subdivided, according to the method of treatment of the stock before spinning, into two classes—*carded* and *combed yarns;* also, according to the methods of spinning, into *mule yarns*, *ring yarns*, or *throstle yarns*.

The processes required for making all cotton yarns up to and including carding are substantially the same, and when the stock is afterwards passed through drawing frames,

slubbing frames, and roving frames, and the spinning process, it is described as a **carded yarn.** If, however the combing process is inserted between the carding and the drawing, the yarn is described as a **combed yarn.** The combing process removes short fibers, neps, and small particles of foreign matter, and is ordinarily used in those cotton mills producing fine yarns, and sometimes for coarse and medium yarns that must be of exceptional strength or cleanliness. Combed yarns can usually be distinguished from carded yarns of the same number by their cleanliness and their smooth, silky appearance. To summarize, all cotton yarns are carded, but only a small proportion are combed.

Combing is being introduced to a greater extent every year, and the proportion of combed yarns produced is increasing. In yarn dealing, the word carded or combed is usually prefixed to the description of yarns being sold; as, for instance, carded Egyptian means yarn spun from Egyptian cotton that is not combed; combed Peeler yarn means yarn spun from Peeler cotton that has been both carded and combed.

Cotton yarn is the common name in all English-speaking nations for yarn produced from cotton. The German name is *baumwollengarn;* the French name is *fil de coton;* the Italian name is *filo di cotóne.* The German name for carded yarn is *streichgarn,* and for combed yarns is *kammgarn;* the French name for carded yarn is *fil cardé,* and for combed yarn, *fil peigné.*

2. *Mule-Spun, Ring-Spun, and Throstle Yarn.*—Either carded or combed cotton yarns may be spun in three different ways, giving the three classifications of mule-spun, ring-spun, and throstle yarns. **Mule-spun yarns** are those that have been spun on a mule, in the form of a cop. **Ring-spun yarns** are those that have been spun on a ring frame, ordinarily on a wooden, but sometimes on a paper, bobbin. **Throstle yarns,** according to the strict interpretation of the term, are now only found in Europe in a few districts; they comprise those spun on a throstle spinning frame on the flyer principle and are made on a bobbin with a double head. In England, owing to the fact that the ring frame is

supplanting the throstle frame, it is quite common to speak of ring-spun yarns as ring-throstle yarns or merely as throstle yarns. Strictly speaking, this is an erroneous term, but it is one that is largely in use; ring-spun yarn, or ring yarn, is the more accurate name.

When cotton yarns are examined in the form in which they leave the spinning machine, they can easily be identified, according to whether they are in the form of a cop, a ring bobbin, or a throstle bobbin, but it is more difficult to identify the class to which a cotton yarn belongs after it has been wound into some other form. Generally speaking, coarse and medium weaving yarns in America may be considered as being ring-spun. Fine weaving yarns, especially for filling, are generally mule-spun. Hosiery yarns are almost always mule-spun.

In determining the classification by an examination of the yarn itself, mule-spun yarn can sometimes be identified by its being more elastic and more even than ring-spun yarn, and if yarn is very soft and slackly twisted, it is almost certainly mule-spun. Ring yarn is usually harder twisted and not so even as mule-spun yarn. Throstle yarn has a more nearly round, and a very even, thread.

These descriptions of the differences between the yarns are not absolute, for other conditions occurring during the preparation of the roving may produce an effect that cannot be attributed to the mode of spinning.

3. *Waste-Cotton Yarns.*—The waste produced from the various cleaning processes in cotton-yarn preparation is frequently respun and the material again put through the picking, carding, fly frame, and spinning processes, the number of operations being reduced as compared with the ordinary list of processes. These yarns are usually spoken of as **waste yarns** and are always of coarse numbers, usually not exceeding 8s and often much coarser; they are readily identified by being dirty, weak, uneven, and composed of short-staple material. When the waste yarns are prepared in this way they still come under the class of drawn yarns.

14. Condensed Yarns.—A small proportion of yarn made from cotton, cotton waste, or from a blend of waste and good cotton comes under the classification of condensed yarns. Up to and including the carding process their manufacture is similar to that of drawn cotton yarns, but the material is removed from the card in numerous small ribbons, or slivers, wound on a bobbin. These bobbins are taken to a specially constructed mule and the yarn spun directly from them, the required size being attained by drawing out the end between the rolls and the spindle at the same time that the stock is being twisted.

Condensed yarns are always carded and mule-spun yarns, and are never combed yarns, nor ring- nor throstle-spun. This class of yarn is sometimes spoken of as *wool-spun cotton yarn*, from the fact that the process of manufacture resembles woolen-yarn manufacture. It is also called *imitation yarn*, from the fact that it is produced in order to imitate woolen yarn, and occasionally is called vigogne (vigonia), or imitation vigogne, from the fact that it was first manufactured, in French-speaking countries, to imitate yarns spun from the wool of the vicugna, the French name for which is *vigogne*.

The statement that condensed cotton yarns are always mule-spun ought to be modified, because in Belgium and Germany a continuous-spinning machine is built and used to spin yarn from the card slivers or ribbons on a principle differing from that of the mule. This is used to so small an extent, however, that it is not of much commercial importance and can be ignored.

15. Ply Yarns.—**1.** All the yarns heretofore mentioned are single yarns; that is, one strand comprises the thread, which if untwisted, resolves itself into loose fibers. All cotton yarns leave the spinning process in the form of single yarn. For certain purposes, it is necessary to combine two or more of these single yarns into one thread, making what is called in the American cotton trade **ply yarn,** and in the English cotton trade **folded yarn, or,** more specifically, *two-fold yarn, three-fold yarn,* etc.

The uniting of these single yarns is performed in three different ways: (1) On a machine constructed on the ring-spinning principle, known as a *twister* in the United States or a *doubler* in Europe; (2) on a machine constructed on the flyer-throstle principle, known as a *flyer doubler*, used principally in Europe; (3) on a machine constructed on the mule principle, known as a *twiner*, used only in Europe. *Dry-twisted yarns* are combined without the application of moisture; *wet-twisted yarns* are moistened at the twisting process.

Ply yarn is composed of the necessary number of single yarns usually twisted together in the opposite direction to that in which the twist is inserted in the single yarn; that is, if the single yarn was twisted to the right, the ply yarn is twisted to the left, and vice versa. Two-ply and 3-ply yarns are the varieties most commonly used, although 4- and 6-ply are sometimes made. It is easy to identify ply yarns from single yarns by determining whether the yarn is composed of one strand or more than one.

The German name of ply yarn is *doublirtgarn* or *zwirngarn;* the French name is *fil plié.*

2. *Twist Yarns.*—When ply yarns are made from two colors of single yarns, they are usually spoken of as **twist;** thus, a black and a white thread when twisted together make a *black-and-white twist*, or a blue and a white thread twisted together make a *blue-and-white twist*, thus producing a mottled appearance. The English name for this yarn is *grandrelle.* The word twist in the English cotton trade has a different meaning from the same word as used in the United States; in England it is used to indicate cotton warp yarn in the same sense as the word warp in America.

3. *Cable Yarns.*—For a few purposes, two or more ply threads are cabled, or twisted, together in the opposite direction from the ply twist, making what is known as *cable yarn*, or *cable cord*, or more briefly, *cord.* For instance, suppose that 9-ply 60s were required to be made from single yarn spun with right-hand twist, 3 threads of 60s would be twisted to the left, making 3-ply yarn, and

3 of these yarns would again be twisted, this time to the right, making 9-ply-cable yarn, or 60s nine cord.

16. All the cotton yarns that have been mentioned are spun in their natural state, and when spun from American, sea-island, Chinese, Turkestan, or some kinds of Indian cottons, the yarn is almost white; when spun from Brazilian, some kinds of Peruvian, some kinds of Indian cottons, or from Egyptian, the yarn is of a brownish tint, varying from a yellowish brown to a light brown. Yarn that is spun from cotton in its natural state, unbleached or undyed, or cloth that is woven from such yarn, is usually spoken of, in America, as *brown* cotton yarn or cloth. In the Lancashire district of England, it is spoken of as *gray* cotton yarn or cloth; but in the Midland district of England, where knitting is conducted, it is spoken of as *brown* cotton yarn. The expression *white* cotton yarn or cloth is usually applied only to yarn or cloth that has been bleached.

The above description includes practically all cotton yarns that are produced in any quantity for commercial purposes, but ignores yarns that are composed wholly or in part of fibers that have been bleached or dyed before spinning, or those of special construction produced in what is known as the novelty-yarn trade; these comprise only a small proportion of cotton-yarn production. No attention has been given to the numerous processes through which yarn can be passed after the spinning and twisting to change its appearance, nor to the different forms into which yarn can be placed in readiness for the market.

CLASSIFICATION OF COTTON YARNS ACCORDING TO COUNTS

17. Yarns are frequently spoken of as *fine*, *medium*, or *coarse*, but it is difficult to give an exact definition of what should be comprised under each division, for they are relative terms and their meaning varies even in different branches of the same yarn industry. A manufacturer of combed sea-island yarns would consider 30s coarse, while a spinner of waste-cotton yarns or a manufacturer of cotton blankets

would consider it fine. In order that there may be some general definition given of these terms, it may be stated that, in general, cotton yarns are considered coarse up to 30s; from 30s to 60s they are referred to as medium numbers; and from 60s upwards, as fine yarns. Cotton yarns much finer than 200s are not in common use in the United States, but English cotton spinners are regularly making yarns from 200s to 400s, while for experimental purposes cotton has been spun very much finer than this.

Sometimes names of more or less local character are given to cotton yarns as a means of classifying them according to their numbers. Thus, for instance, the term *candle-wick yarns*, while it formerly had a different meaning, is now used to indicate waste yarns of very coarse numbers, so coarse that they are numbered by the yards to the ounce rather than by the hanks to the pound. The word *bump* is also applied to yarns of low counts in general, the name alluding to the rebound or concussion in the loom when these yarns are used for filling and the reed is beaten up against them. The word *rove* is used in the sense of rove yarns to indicate coarse yarns, usually made from a good quality of cotton and well carded, but which are of such low counts as to resemble roving, although rove yarns are sold in the cop or skein. *Lace yarn* is a term sometimes used to indicate fine numbers of ply yarns, even when they are not intended for use in the manufacture of lace.

These four terms are more particularly used in Great Britain, the names candle wick and bump being used in Lancashire, while rove yarns and lace yarns are Scotch expressions.

CLASSIFICATION OF COTTON YARNS ACCORDING TO THE FORMS IN WHICH THEY ARE PUT UP

18. Cops.—Single yarn as it leaves the spinning machine is in the form of a *cop* or *bobbin*, and in very many cases must have this form changed, either in order to continue the process of manufacture or to be put into suitable form for transportation. A cop is a cylindrical coil of yarn with

cone-shaped ends, the lower end being called the *cop bottom* and the upper end the *cop nose;* it is produced on the various forms of cotton mules and is sometimes spoken of as a *mule cop*, but more often simply as a cop. It can be made self-contained by means of the method of winding, which builds up the yarn on the bare spindle of the mule sufficiently firm to be handled after removal without requiring any central support. In this case the cop bottom is formed by covering a few closely wound layers of yarn with other open layers used as a binding thread, and covering this portion with paste. More commonly, especially in America, the cop is built on a tube of paper, which may be a *short tube*, slightly over 1 inch in length; a *long tube*, 2 or 3 inches long; or a *through tube*, which is longer than the cop itself. About $\frac{3}{8}$ inch of the tube, in all cases, projects below the bottom of the cop, the remainder being covered with yarn, except in the case of through tubes, which project beyond both top and bottom. The tube, of course, is placed on the spindle before the cop is spun, and the yarn wound on it.

Views of various styles of mule cops and tubes are shown in Fig. 2; (*a*) is a filling cop, often called a *pin cop*, spun without a tube; (*b*) is a mule warp cop without tube; (*c*) is a knitting-yarn cop on a long tube; (*d*) is a larger size of filling cop on a short tube, often called a *bastard cop*, as it is neither the size of a pin cop nor a warp cop; (*e*) is a large filling cop on a through tube, a size used for condensed yarns. Various styles of short tubes are shown in (*f*), long tubes in (*g*), and through tubes in (*h*). Sometimes tubes are perforated, as shown in (*i*), a long tube, and (*j*), a through tube, in order to facilitate cop dyeing and bleaching; (*k*) is a cop skewer, which may be made of hardwood or steel, and is used for holding cops for safe handling or unwinding. Pin cops are about $\frac{3}{4}$ inch in diameter and 5 inches long; bastard cops, 1 inch in diameter and $6\frac{1}{2}$ inches long; warp cops, $1\frac{1}{4}$ inches in diameter and 7 inches long; hosiery cops, $1\frac{3}{4}$ inches in diameter and 8 inches long; cotton-waste yarns are spun into cops occasionally as large as $2\frac{1}{2}$ inches in diameter and 11 inches long. These are

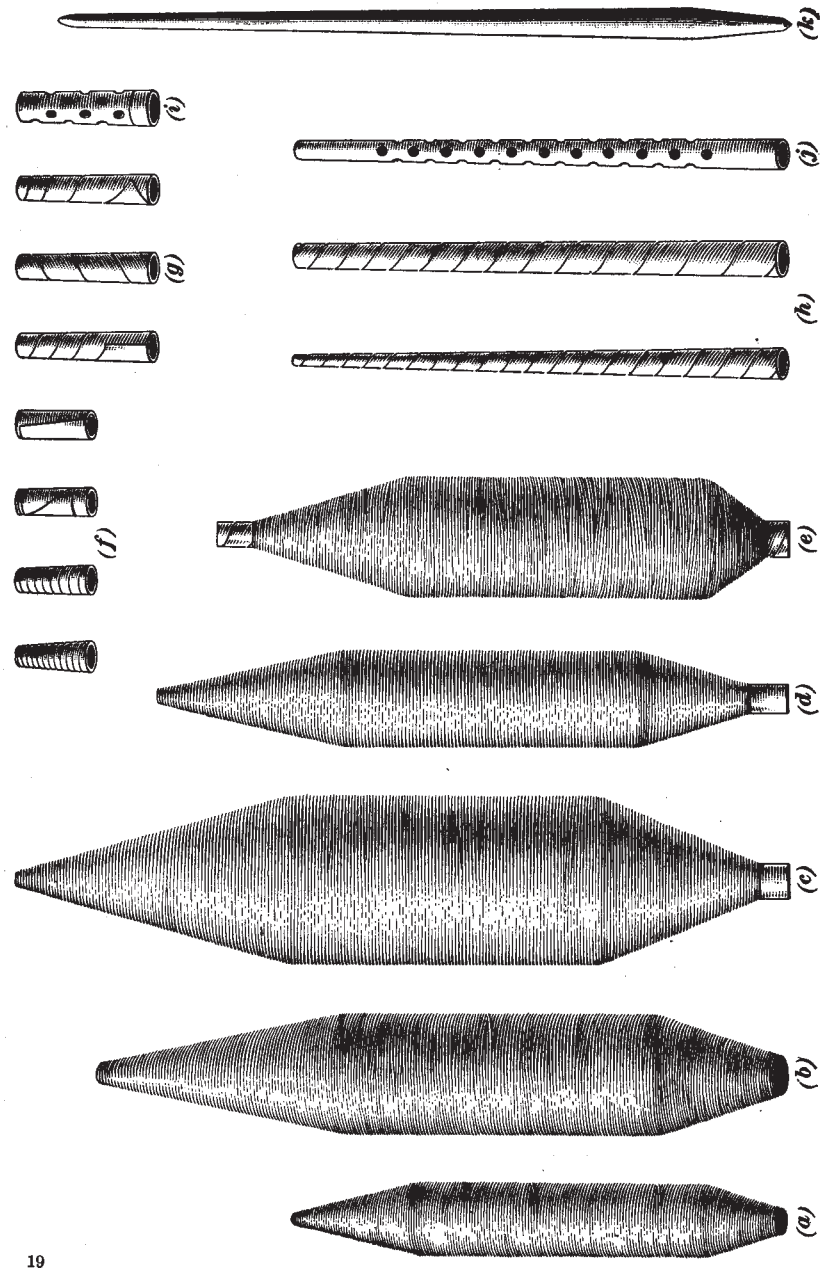


FIG. 2

customary sizes, although other sizes can be made, the maximum diameter depending on the space between the spindles in the mule, and the length depending on the length of that part of the spindle available for building the cop.

In using mule cops, the thread is taken from the nose and unwound until the bottom is reached; these cops are, of course, always single yarn and consist of but one continuous thread.

Another style of cop is a *twiner cop* of ply yarn, which in all other respects resembles a mule warp cop. The name cop is also given to forms of yarn built up for special purposes, among which are cops for carpet- or quilt-loom

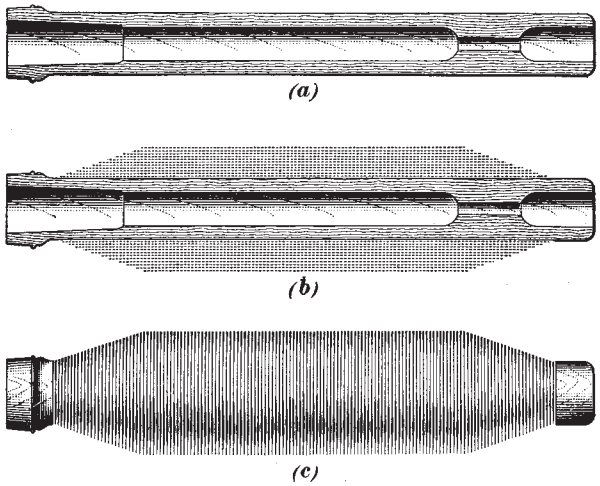


FIG. 3

shuttles. Yarn is sometimes wound into cops on a special machine, called a *cop-winding machine;* this, however, must not be confused with another machine, also called a cop-winding machine, that winds the yarn from cops.

The *carpet cop* is produced on this cop-winding machine, which winds yarn on a spindle in the form of a large cop, larger than the regular mule cop. A peculiarity of this cop is that when placed in the shuttle, the filling thread is taken out from the inside of the cop, starting at the bottom, while the cop is held in place in the shuttle by means of an elastic

band with an eye at the end, which is drawn over a hook in the shuttle. When carpet-filling yarns, rug-filling yarns, and quilt-filling yarns are spoken of as being sold in cop, a carpet cop is usually referred to.

19. Bobbins.—The word *bobbin* is applied to so many forms of wooden contrivances on which yarn is wound, or built up, that it is almost meaningless without a distinguishing word used with it. In the cotton trade, **bobbins** are

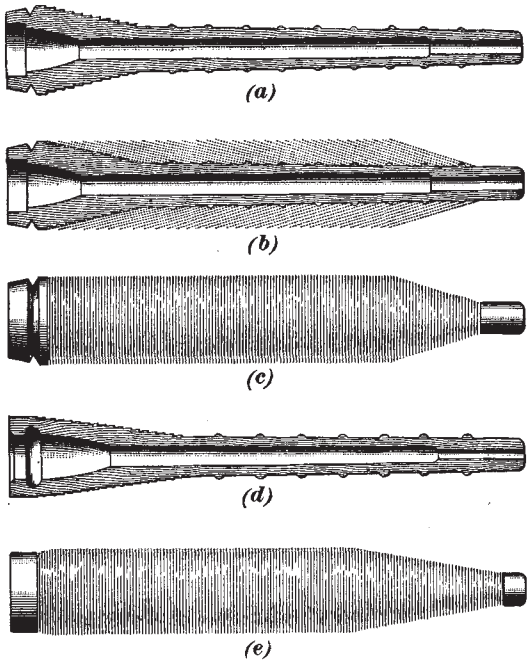


FIG. 4

classified as ring-frame bobbins, throstle bobbins, spinning bobbins, shuttle bobbins, filling bobbins, twister bobbins, etc.

1. *Ring-frame bobbins* are those used on the ring spinning frame, on which the single yarn is wound during spinning. They are usually constructed of wood, although sometimes of paper, and are of two distinct types, known as the *warp bobbin*, shown in Fig. 3, and the *filling bobbin*, shown in Fig. 4. In

each figure, (*a*) is a section through the empty bobbin, (*b*) a section through the full bobbin, and (*c*) a view of the full bobbin. The warp bobbin is arranged to contain coils of yarn wound on it in layers having a long traverse, the first layer extending almost the length of the bobbin, and the traverse being reduced as the yarn is wound on until it ultimately forms a cone at each end; this is called a *warp wind.* The yarn from this bobbin is generally drawn from the side.

In filling bobbins, the traverse is rather short and commences on a cone-shaped projection near the base of the bobbin, so as to wind at an angle. At each traverse, winding occurs a little higher up, with the same angle maintained throughout the winding of the yarn on the bobbin. When it

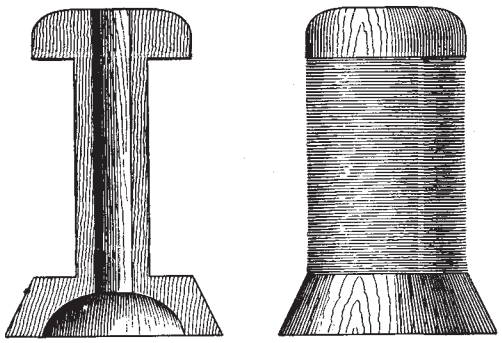


FIG. 5

is completed a cone formation is found only at one end—near the top; this is called a *filling wind.* Another style of ring-filling bobbin used for cotton yarn is shown in Fig. 4, in section in view (*d*), and filled with yarn in (*e*). The yarn from a filling bobbin is drawn over the nose.

2. *Throstle bobbins* are small spools, as shown in Fig. 5, in which (*a*) represents the section of an empty bobbin, and (*b*) a full bobbin. They are used on the throstle spinning frame, the traverse of which is such that it winds the yarn in even layers corresponding to the distance between the heads, and parallel to the barrel of the bobbin.

3. *Twister Bobbins.*—The bobbins on which ply yarn is wound at the twister are of different shapes, depending on the method of twisting that is employed or, in the case of

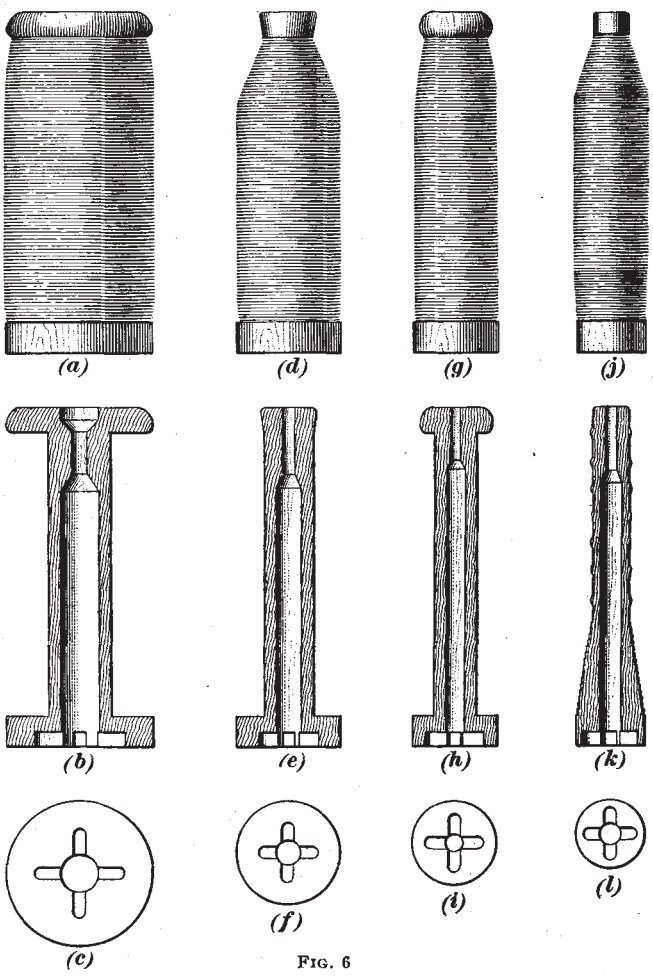


FIG. 6

ring twisting, on whether the frame is intended to build with the warp wind or the filling wind, according to whether it is desired to unwind the yarn from the side or from the top of the bobbin.

The flyer-twister bobbin somewhat resembles the throstle bobbin shown in Fig. 5. Ring-twister bobbins are made in various styles, four of which are shown in Fig. 6; (*b*) and (*h*) are double-headed bobbins, and (*e*) and (*k*) single-headed bobbins, all shown empty and in section; (*b*) is chiefly used for coarse numbers in dry twisting, with a long traverse; (*e*) and (*k*) are commonly used in dry twisting, with a short traverse, so that the yarn can be unwound from the nose of the bobbin; the construction shown in (*k*) is a filling bobbin intended for use in the shuttle of the loom; (*h*) is a style generally used for wet twisting, although (*e*) is also used for this purpose. The full bobbins are shown at (*a*), (*d*), (*g*), (*j*) and the bases of the bobbins at (*c*), (*f*), (*i*), (*l*).

The bobbin (*a*) is sometimes made as large as 4 inches in diameter; the others are from $1\frac{1}{2}$ to 2 inches in diameter at the base. That part of the bobbin that is covered with yarn is usually 6 inches in length, while the bobbin itself is somewhat longer. These dimensions, of course, are varied for different frames and for different kinds of work.

4. *Shuttle Bobbins, or Quills.*—The term shuttle bobbin is frequently used to designate a bobbin of suitable construction to fit inside the loom shuttle, so that the yarn may be unwound from it through the eye of the shuttle and be woven into the cloth as filling. The most common style of shuttle bobbin for cotton yarns is the ring-frame filling bobbin, shown in Fig. 4. This bobbin is so constructed that it will fit either the spindle of the ring spinning filling frame or the shuttle, so that the yarn may be spun directly on to the bobbin from which it is woven in the shuttle. Another form of shuttle bobbin is shown in Fig. 7 (*a*) and (*b*); (*a*) is a section through an empty bobbin and (*b*), a view of a full bobbin; this represents the type commonly used for colored cotton yarns for ginghams and other fabrics. The more common name for this bobbin in the United States is *quill*, or *quiller bobbin;* the name *quill* is used in some parts of Europe, but in Great Britain it is more commonly called a *pirn*. Strictly speaking, the quiller bobbin is used only in connection with long-chain quilling, while the pirn is the bobbin used to

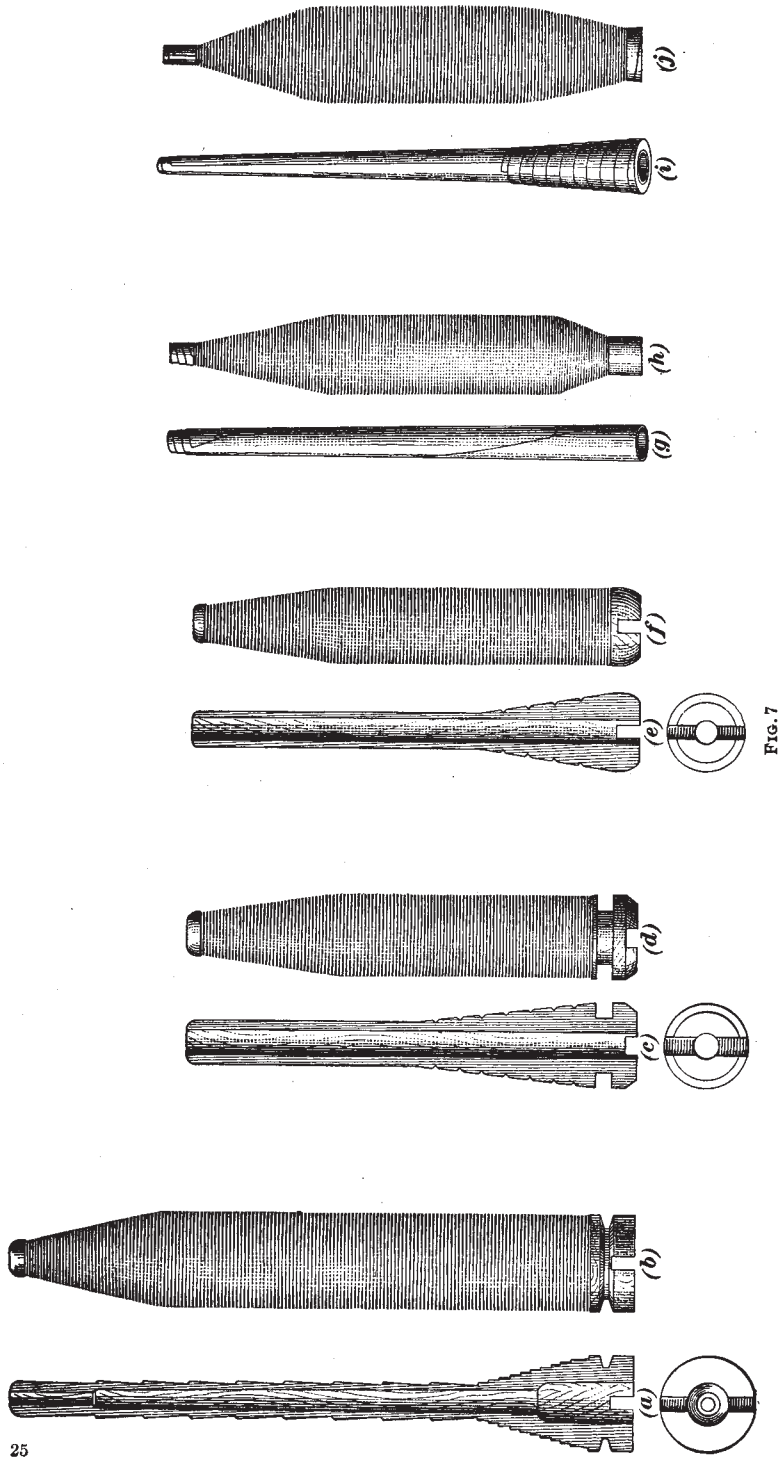


FIG. 7

contain filling yarn that has been unwound from a skein; but much confusion exists in different districts and the names filling bobbins, quills, and pirns are applied indiscriminately. Fig. 7 (*c*) and (*e*) shows sections of empty wooden pirns, while views (*d*) and (*f*) show the pirns when full; (*g*) and (*i*) represent paper tubes used for the same purpose, while (*h*) and (*j*) represent these tubes filled with yarn. After yarns intended for filling have been dyed, bleached, or otherwise dealt with, they are always wound on some style of quill or pirn, ready for use in the shuttle. Quills for cotton are

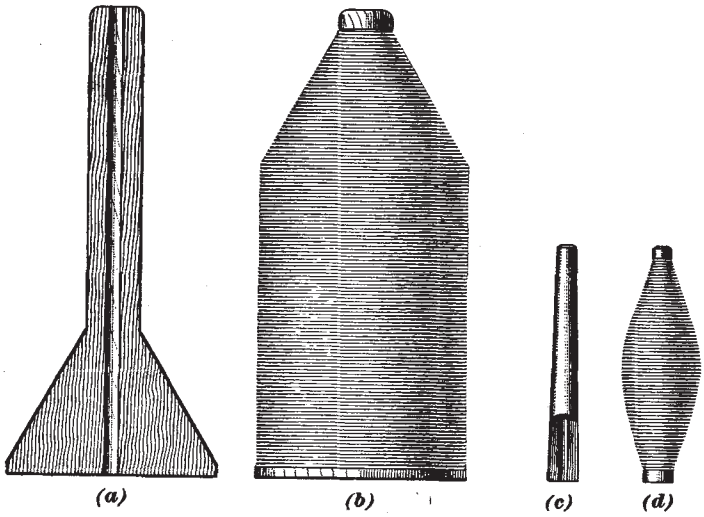


FIG. 8

generally $6\frac{1}{2}$ inches long; pirns and paper tubes are from 4 to 7 inches long. Many other shapes and sizes are used in addition to those shown.

5. *Knitting-Yarn Bobbins.*—On various knitting machines, it is necessary to have a large quantity of yarn that can be unwound from the top of the bobbin, and for this purpose wooden bobbins of various shapes are used. One style is shown empty in Fig. 8 (*a*) and filled in view (*b*); this is the kind generally used in the United States, and is 18 or 20 inches long. The tapered part is covered with cloth, as

shown by the heavy outline. Another style, which is used in Europe, sometimes called a hosiery spool, is shown partly in section and empty in view (*c*) and filled in view (*d*).

6. *Taper Bobbins.*—Another style of bobbin, known as the taper bobbin, sometimes called a *taper spool*, since it is made on a spooler, is shown empty in Fig. 9 (*a*) and full in view (*b*). It is used when desired to wind a large quantity of yarn on a bobbin in such a way that it can be wound off at the end, and is filled on the same machine as the double-headed spool by changing the winding arrangement. Such bobbins vary from 3 to 4 inches in diameter and from 6 to 9 inches in length; they are generally used for yarn that has to be gassed—that is, yarn that has to have projecting fibers singed off—or reeled, which is the process of forming skeins.

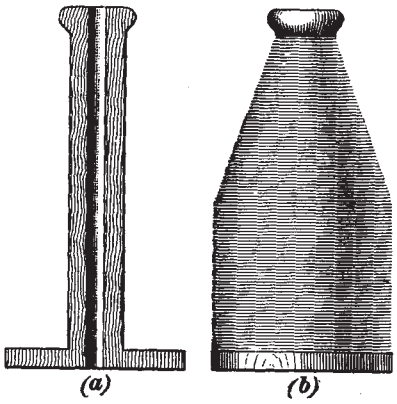


FIG. 9

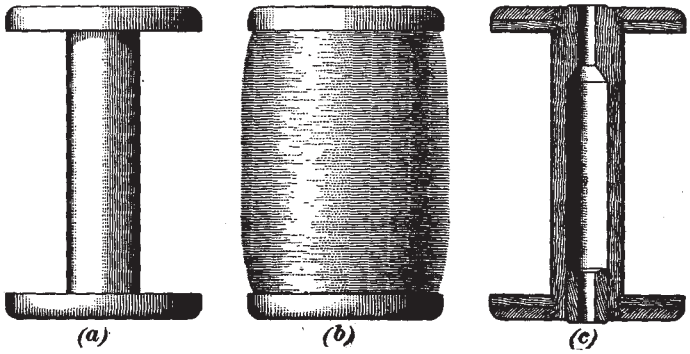


FIG. 10

20. Spools.—The word *spool*, when used alone, is almost as ambiguous as the word bobbin, since so many kinds of spools are used in almost all branches of the yarn industry.

In general, the word means a bobbin having a head, or flange, at each end. In the cotton trade, spools vary in size from what is known as a warper spool down to the diminutive spool on which sewing thread is sold in a dry-goods store

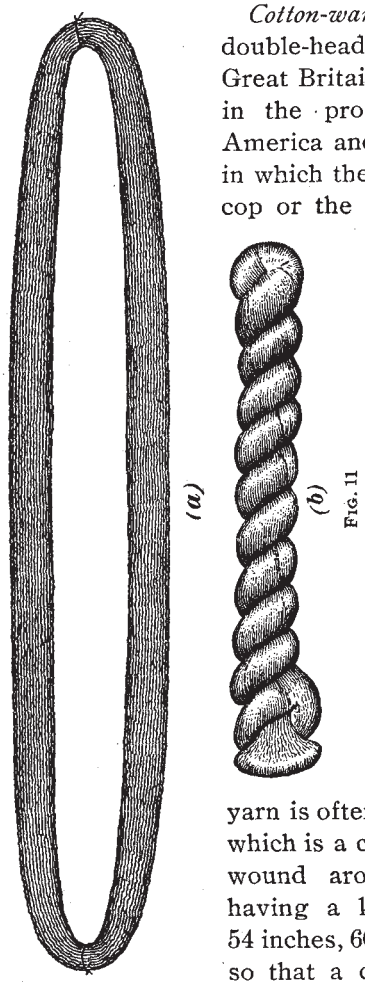


Fig. 11

Cotton-warp spools, shown in Fig. 10, are double-headed bobbins that are known in Great Britain as bobbins. They are used in the process known as spooling in America and as winding in Great Britain, in which the yarn is wound from the mule cop or the ring-spinning-frame bobbin to the spool in barrel-shaped form, as shown in Fig. 10 (*b*), ready for warping. These spools vary in size from $2\frac{3}{4}$ to $5\frac{3}{4}$ inches in diameter, measured at the head of the spool, and from $3\frac{1}{2}$ to 6 inches between the heads; (*a*) is a view of an empty spool and (*c*), a section through same. This same style of spool is also used on some kinds of drum-winding machines for winding dyed or bleached warp yarns from the skein to the spool.

21. Skeins.—Cotton yarn is often put up in the form of a skein, which is a continuous thread that has been wound around a revolving framework having a known circumference—such as 54 inches, 60 inches, 72 inches, or 1 meter—so that a certain number of revolutions will give a known length of yarn. The skein when removed from this frame is a continuous coil of yarn, as shown in Fig. 11 (*a*). In the cotton trade, for certain purposes this

skein contains a hank of 840 yards. For other purposes, the skein is made of a definite weight, such as 8 ounces, 2 ounces, 1 ounce, $\frac{1}{2}$ ounce, etc.; more frequently, in America, it is made up without regard to any special length or weight. In some methods of skeining, the complete coil consists of seven distinct sections separated by small pieces of thread so that the skeins can be separated without entangling the yarn. The name *hank* is generally given in England to the entire skein when it contains 840 yards in cotton or 560 in worsted, shorter lengths being called skeins. After the skeins have been made, they are twisted by hand and doubled on themselves for convenience in handling and transportation, as in Fig. 11 (*b*). Strictly speaking, a skein of 840 yards is the only kind that should be spoken of as a hank; a number of these hanks twisted together are called a *knot*.

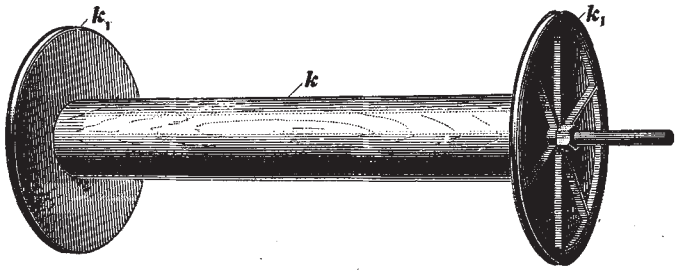


FIG. 12

22. Beam Warps.—A warp may be defined as a number of ends of yarn of equal length, parallel to one another, that go to form the lengthwise series of threads in cloth. Owing to the variations in the processes through which warps pass before being ready for the loom, they are put up in either of two forms—*beam warps* and *chains*. **Beam warps** are subdivided into *section beams*, or *warper beams*, and *loom beams*, sometimes called *slasher beams*, or *weavers' beams*.

When a warp for the loom is formed in a simple manner without having to pass through any bleaching, dyeing, weighting, or other process, it is prepared by winding the ends on a beam so as to form an even sheet between the heads. Beams are of various constructions, generally consisting of

a wooden barrel with iron heads, as shown in Fig. 12, which represents a section beam. The yarn is warped from spools to this section beam on a machine known as a *warper*. Afterwards the yarn from several of these section beams is combined and wound on to a loom beam, Fig. 13, at a machine known as a *slasher*. This form of preparing warps is commonly used in mills where the yarn is woven by the same firm that spins it.

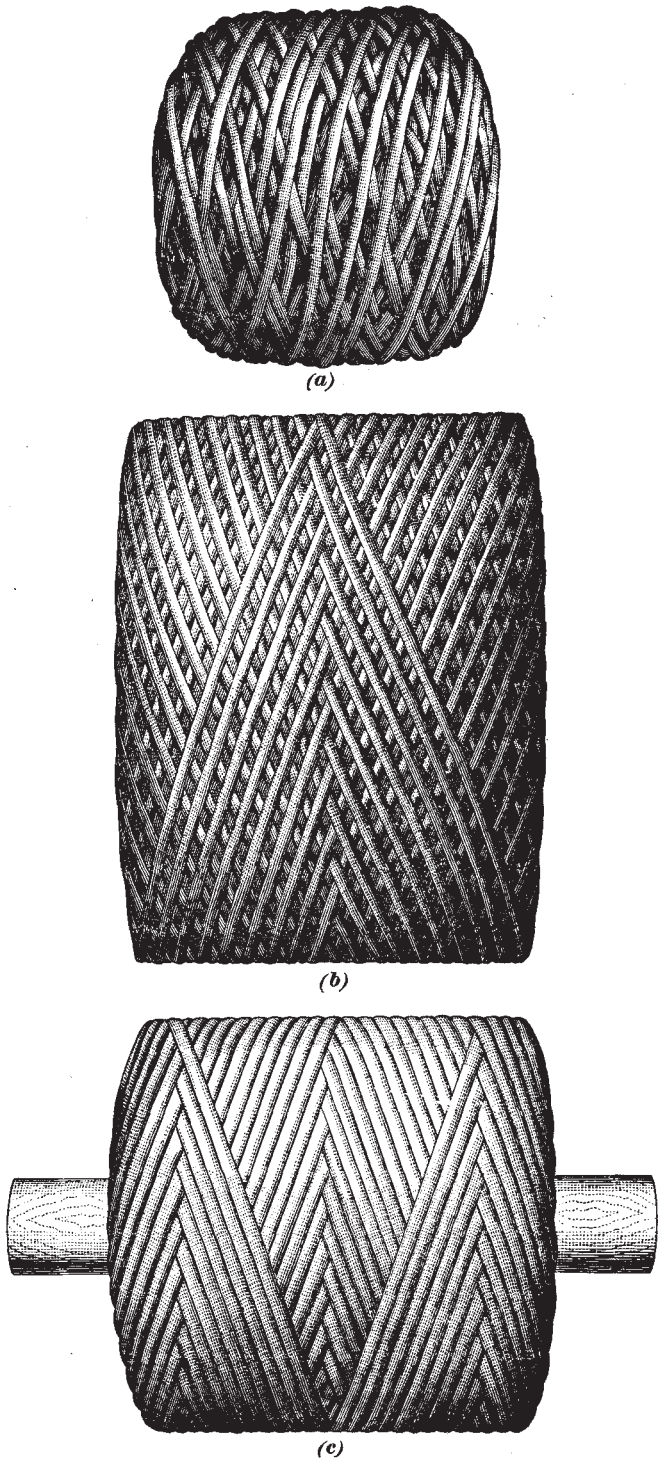
FIG. 13

23. Chains.—When yarn has to be bleached, dyed, printed, mercerized, or otherwise treated and afterwards used for the warp of a fabric, and sometimes when it has to be used as filling, it is put up in the form of a **chain.** For this purpose a large number of ends of yarn, usually several hundred, are gathered together so as to form a loose strand. The ends forming one warp are all of the same length, but the length of warps may vary from a few hundred yards up to several thousand. At each end, and sometimes at intervals throughout its length, a certain method of tying up the ends is adopted, so that they can be suitably separated without entanglement when the yarn is used. These chains can be packed without much risk of damage during transit, and as the mills where the yarn is to be used are generally located a considerable distance from where the yarn is spun, this is an important consideration and gives an advantage over the transportation of yarn on bobbins, spools, or beams. The chain form of warp is also a very convenient one in which to pass the yarn through the bleaching, dyeing, or similar processes before putting it on the loom beam or the filling quiller.

1. *Balled Chains.*—For convenience in transportation chains are coiled in two different ways, resulting in their

delivery in either the *balled* form or the *linked* form, often spoken of as *balled warps* and *linked warps*, although the yarn may be either warp or filling yarn. The loose strand of ends that forms the chain is warped in the same way for either balled or linked chains, the process differing at the final stage, in which the yarn is coiled. Balled chains are of three kinds—hand-made round balls, machine-made round balls, and machine-made cylindrical balls. The hand-made round-ball form, shown in Fig. 14 (*a*), is the oldest style and is now passing into disuse. It resembles a huge ball of twine and is formed on the arm of an operative, who first winds around his hand a small ball, which he gradually increases in size, by coiling other layers around it, until a large ball is formed. If the length is too great for one ball, the warp is sometimes made into two, which are connected by a short length of warp near the middle of its length. A more perfect ball can be made by a round-balling machine, the strands lying more evenly, as shown in Fig. 14 (*b*), and the ball in this case can be made larger than it is possible to do by hand. From the old style of round-ball warp has been derived the cylindrical form of warp, which still has the name of ball warp given to it, although this to some extent is misleading. A cylindrical-ball warp is formed on a balling machine by means of layers built up one on top of another until a large cylindrical form is reached, as shown in Fig. 14 (*c*). The round ball is used principally for short warps made on what is known as the short-chain system on the older form of circular warping mills or reels. The newer form of cylindrical-ball warps is generally used for warps made on the long-chain system and warped on a Denn warper or a common warper with a balling attachment.

2. *Linked Chains.*—The loose strand of ends to form a linked chain is prepared in the same way as for a ball warp, but instead of being coiled in a ball, the strand is linked, or looped, so as to form a continuous chain, so constructed that it can be pulled in one direction through the dyeing, bleaching, or other process to which it has to be subjected, but when it has been so treated, can be pulled from the other end so



(a)

(b)

(c)

FIG. 14

as to destroy the linked arrangement and allow the warp to assume its original form of a loose strand of ends. By linking a warp in this manner, a 300-yard warp will measure

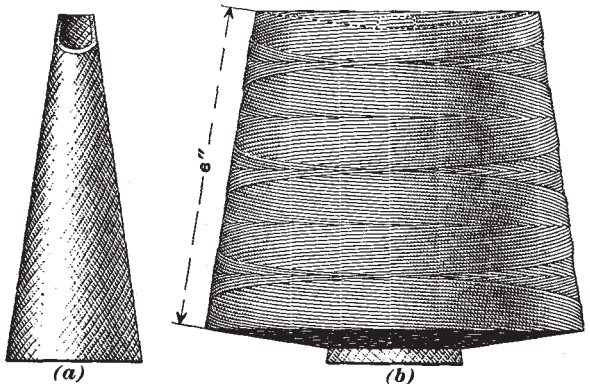


FIG. 15

less than 100 yards when linked, thus shortening the length of time necessary to pass it through any process of bleaching, dyeing, or drying. Chain warps, or linked warps, as they are sometimes called, are usually packed in bags for shipment.

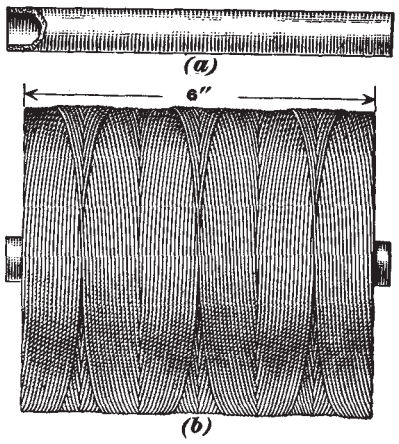


FIG. 16

24. Conical and Parallel Tubes.—The practice of putting up yarns in what are called **cones,** or **tubes,** is very common, and the method is gradually being adopted for many different purposes, but principally for knitting yarns. A full conical tube is shown in Fig. 15 (*b*), while (*a*) is the paper framework on which it is formed. The cone is made on what is known as a quick-traverse cross-winder, the cone tube fitting on the conical arbor, which revolves on a

revolving drum in some types of machines. By a suitable construction, the end of yarn being wound on the paper cone is given a horizontal traverse along the surface of the cone, and this being repeated many times builds up the yarn in the cone-shaped formation shown in the illustration. When a straight tube, as in Fig. 16 (*a*), is used as a foundation, the yarn is built up in cylindrical form, as shown in (*b*), commonly called a *cheese*, *parallel tube*, or merely a *tube*.

Two or more threads are wound together on cones when necessary; these, of course, are simply converted into one strand without being twisted. This is commonly done for such purposes as winding yarns for covering electric wires.

One type of machine by which the yarn is wound on the conical or parallel paper tube without coming in contact with the revolving drum is known as the Universal winder, and the name sometimes given to conical or parallel tubes made on such machines is that of Universal cones or tubes.

CLASSIFICATION OF COTTON YARNS ACCORDING TO PURPOSES FOR WHICH THEY ARE INTENDED

25. Weaving Yarns.—Cotton yarns are produced for a great variety of purposes, but principally for weaving into fabrics. Two distinct classes of yarns are made for weaving; namely, the warp and the filling, the warp being used lengthwise in the fabric and the filling crosswise, or from side to side. The English name for cotton warp is *twist*, and for cotton filling *weft*. The German name for warp is *kette*, and for filling *schuss;* while the French name for warp is *chaîne*, and for filling *remplisage*.

Warp yarn, as compared with filling yarn of the same number, is usually spun from longer-staple cotton, is harder-twisted, and possesses greater strength, as it must withstand the bulk of the strain in the loom and the chafing and wear of certain parts of the weaving mechanism. Filling yarn does not require so good a quality of cotton as does warp yarn of the same numbers. In American cotton weaving, yarns for both warp and filling are spun mostly

on the ring frame, although fine numbers are frequently spun on the mule, especially when for filling. In England, both warp and filling are usually spun on the mule, although the ring frame is being more widely used now, principally for warp.

No limit as to the numbers of yarn suitable for weaving can be given, as almost all numbers are used for this purpose, the warp usually being of lower counts than the filling. In the cotton trade, it is customary to use single yarn for both warp and filling, although ply yarns are sometimes used, principally for warp but occasionally for filling. In the former case they are mainly 2-ply when used for the side selvages, and usually 2-, 3-, 4-, or 5-ply when forming extra threads, such as leno threads, lappet threads, center selvages, and others used to produce special effects in the fabric. Two-ply cotton warps are largely used in mixed fabrics, the coarser ones being used for fabrics woven with woolen and worsted filling, and the finer ones for those used with silk filling.

26. Knitting Yarns.—Cotton knitting yarns are made in large quantities, are almost always mule-spun with less twist than weaving yarns, and in order to free them as far as possible from all impurities, ought to be well carded, and in some cases combed. They are usually made from longer-staple cotton than would be used for the same numbers of weaving yarns. The thread of the knitting yarn should be distinguished by its fineness, cleanness, and its slack twist, and should be full, round, and even.

Cotton yarns are used by knitters for a large variety of purposes, varying from the low numbers required for coarse miners' socks to the fine yarns for light Balbriggan underwear, and consequently are made in a wide range of numbers, principally, in both carded and combed yarns, from 6s to 30s, although finer numbers than these are made in many cases. Knitting yarns are almost always supplied in single yarns, although a quantity of 2-ply and even 3-ply is used for certain kinds of goods, especially in

fabrics that must have what is known as a lisle finish, and for the reenforcing threads that are inserted at the heels of stockings and other parts of knitted garments where extra wear takes place. Knitting yarns are usually supplied in an undyed state, although such mixes as jaegers, silvers, steels, as well as light shades in solid colors spun from cotton dyed in the raw state, form a large percentage of the knitting-yarn trade for underwear in numbers from 22s to 60s.

Many varieties of cotton are used for knitting yarns, including Peeler and Egyptian for the better qualities, American uplands for the medium qualities, and short American mixed with waste or with East Indian cotton for the low qualities; the latter, however, is not spun in the United States.

27. Yarns for Converting.—Cotton yarns are spun in a large variety of numbers for bleaching, dyeing, mercerizing, printing, dressing, and polishing; they are usually ring-spun, and when intended for processes that involve considerable tension or strain, such as mercerizing and polishing, are made from long-staple cottons of extra good quality.

28. Yarns for Export.—Relatively very little yarn is exported from the United States, but the export trade is a very important branch of the yarn business in the European manufacturing countries. This yarn is usually spun from as low a variety of cotton as can be used for the numbers of yarn required, and is in most cases reeled and made into bundles of 10 pounds each. A small quantity, however, is exported in the form of mule cops, packed in casks of about 560 pounds each.

29. Carpet yarns are used for the warp of carpets, particularly for the cheaper classes of floor coverings. They are among the cheapest cotton yarns made, and a low quality of cotton, usually short-stapled American, is used in their manufacture. They are spun on the ring frame and are afterwards twisted into ply yarns, either 3-ply, 4-ply, or 5-ply as a rule. Number 8s is the most common number that is made, thus giving the three standards of 8/3, 8/4, and 8/5, although in some cases they are made coarser or

finer as required. As it is customary to dye the warp yarns for carpets, carpet yarns are generally reeled into 72-inch skeins, cross-reel. In the carpet mills, as several of the ply threads are used together, it is found more economical for those mills that make a cheap grade of carpet and do not dye the warps to buy their carpet yarns on tubes containing three ends of either the 3-ply, the 4-ply, or the 5-ply wound together without being twisted.

30. Upholstery Yarns.—In the upholstery trade, a large quantity of slack-reel skein yarn is used. The two standard numbers are 9s and 16s; each of these is put up either in 3-ply or 4-ply, thus giving four standard numbers—9/3, 9/4, 16/3, and 16/4. As these yarns have to be dyed, they are put up in skeins, 54-inch skeins being the standard. One peculiarity of these yarns is that, in making the ply thread, it is very slackly twisted, with a few turns to the foot, while ordinary ply yarns usually have many turns to the inch. Upholstery yarns are made from short-staple American cotton.

31. Cotton Yarns for Rugs.—A line of yarns somewhat similar to the upholstery yarns is made for fringes for rugs, often in 14s, 2-ply.

32. Thread is made from ply yarns in a large variety of numbers, qualities, colors, and forms, comprising sewing thread, seaming thread, covering thread, embroidery thread, mending thread, etc., but is not included within the scope of this Section.

33. Yarns for Cordage.—Cotton yarns are largely used for making twine, cord, and rope, but as such yarns are usually spun by firms that make the cordage, their manufacture is not of much general interest. Cotton yarns for twines are usually coarse numbers of ring-spun yarns that are twisted into either 2-, 3-, 4-, or more, ply, and wound into balls or put on cones or tubes. They are usually sold without being dyed or otherwise treated, the general run being a 2-ply, dry-twisted twine.

Various better classes of twines are made under the name of druggists' twines, macramé twines, cable twines, ply twines, hawser twines, or under other names, which are sometimes private trade names of a particular manufacturer. These are made from finer yarns with a larger number of plies, so as to make a level, smooth, and strong twine. They are often wet-twisted, to further insure the fibers lying close and thus producing a smooth, hard surface. In some cases, for the better classes of twine, they are cabled, and frequently are dyed or polished. As they are used for almost every conceivable purpose, it is almost impossible to state the numbers of yarn that are used, but as a rule the single yarns from which they are made are not finer than 30s.

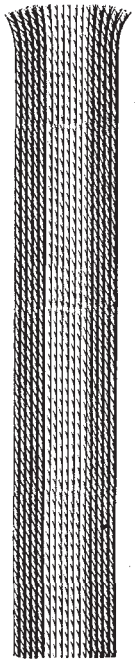


FIG. 17

Cotton cords are usually referred to as *sash cord*, although there are other varieties of cords and rope. They are made from $\frac{3}{16}$ to $\frac{1}{2}$ inch in diameter and are built up of coarse cotton yarns made from low-grade, short-staple cotton or combinations of cotton and waste, usually about number 8s, which are afterwards made into 2-, or more, ply. The central core of the better-class cords or rope, such as sash cord, consists of a number of these ply threads, around which others are braided.

Other ropes are made by twisting heavy strands of cotton together. Cords and ropes of this character are spoken of as *all-thread* ropes, to distinguish them from cheaper grades, such as clothes lines, which are made by twisting yarn around a central core of roving.

34. Cotton Banding and Driving Ropes. In making cotton banding, such as mule banding and power-transmission ropes, sometimes as large as 2 inches in diameter, a large number of threads is formed into a strand and a number of these strands taken to form the rope. The threads are usually not over

30s in fineness, but, especially for the best grades of ropes, good American, or even Egyptian, cotton is used.

35. Parallel ply tapes, as shown in Fig. 17, are a form of yarn that has the appearance, to some extent, of a woven tape, although it has not been woven, but has been made up by arranging several threads of yarn side by side and attaching them with an adhesive paste. It is now used for some purposes for which woven ribbon and woven tape were formerly used. As it is composed of a number of ends, usually of ply yarn, laid side by side, it might be classed as a variety of folded yarn, although it is an imitation tape. It is used for tying parcels, cigars, and for similar purposes where it is only to be used once, as it easily frays and the threads separate if handled. By arranging different colors of thread side by side, ornamental effects can be produced and the names, trade marks, and descriptions of goods printed on it.

YARNS FROM STEM FIBERS

LINEN YARNS

36. Among the fibers spun into yarn are those obtained from the stems of plants, such as flax, hemp, jute, and china grass, ramie, or rhea.

Linen yarns are those procured from fibers obtained from an inner layer of bast in the stem of the flax plant, which belongs to the order *Linaceæ* and is botanically termed *Linum;* strictly speaking, the name *flax yarns* would be more accurate, but the term linen has always been so commonly used that it is generally accepted. The plant is an annual, that is, the seed is sown for it each year, and is cultivated in Holland, Russia, the United States, Ireland, Germany, Austria, and Belgium. The best flax is produced in Ireland and Belgium. Linen yarns are not classified according to the geographical source of supply of the flax, as is common with cotton yarns, but rather according to the methods of spinning and the whiteness of the yarn. When

linen yarns are classified according to the origin of the material, the Irish linen and Belgian linen are placed first.

37. Linen Yarns Classified According to the Methods of Preparation.—The flax is obtained from the stem of the plant by means of a retting process, which partly decays the constituent parts of the stem, so that the valuable fiber may be removed, after which, by means of breaking, scutching, and hackling processes, the fiber is obtained and separated into long bunches, varying from 12 to 30 inches in length, known as *line flax*, and also a shorter, tangled mass, containing woody particles and impurities, known as *tow*. Linen yarns may be made either from the line flax or the tow, which gives the two distinct varieties—**line** and **tow**. These may be distinguished by the fact that line yarns are very much finer in number than tow yarns, and have a smoother and more even construction. Common numbers of line yarns are from 10s to 30s, although they are spun both finer and coarser than this. Line yarn is the variety most used for weaving purposes, lace making, thread making, etc. The better qualities of flax have a light yellow, gray, or greenish appearance, while poorer qualities are darker gray or brownish in shade. Tow yarns are made from 10s to 15s dry-spun and from 18s to 30s wet-spun, and coarser. They are used for weaving, twine making, etc.

The division of both line and tow yarns into *wet-spun* and *dry-spun* yarns depends on whether the fibers immediately before spinning are moistened in the spinning machine or not. The wet-spun yarns are spun after the application of cold, warm, or hot water; the fine yarns having a smooth, even thread are made by this process. Ply and sometimes even cable yarns are made both from line and tow yarns. When linen yarn is manufactured into twine, especially of the better qualities, line yarns in either ply or cable form are generally used.

38. Linen Yarns Classified According to the Forms in Which Put Up.—Linen yarns are not put up

in so many forms as cotton yarns because the fiber is unsuitable to be spun in so many different ways or to be passed through many after processes.

1. *Bobbins.*—The chief forms in which linen yarn is put up are bobbins, which somewhat resemble the cotton bobbin shown in Fig. 6 (*a*), having a head at each end. Wet-spun linen yarns have to be removed from the bobbin immediately after spinning, in order to dry the yarn, so that these bobbins are only found in the mill in which the yarn is spun and do not form a subject of commercial dealing.

2. *Skeins.*—A common form in which linen yarn is put up is in that of a skein. Skeins are formed in the same way as cotton yarns, but are larger, being made 90 inches in circumference. In countries using the metric system, where yarns are reeled, they are made into slightly larger skeins, running about 91 inches in English measurement.

3. *Cops.*—Linen yarns are not put up in cop form, as the fiber does not lend itself to mule spinning.

4. *Beams.*—Linen yarns are, of course, wound on loom beams when they are intended for weaving purposes.

5. *Pirns.*—When linen yarn has to be used for filling, it is wound on pirns or shuttle bobbins somewhat resembling the larger one in Fig. 7.

6. *Cones and Tubes.*—Linen yarns are sometimes coned or tubed for sale, as the structure of the thread does not render this form of putting up linen yarns impossible.

7. *Spools.*—Linen yarns are found on either large or small spools when in the form of sewing thread; the smaller spools are commonly sold in dry-goods stores, while the larger ones are used in factories where linen thread is used in quantity for power sewing machines.

8. *Balls.*—Linen yarn is sometimes put up in small round balls weighing $\frac{1}{2}$ or 1 pound each.

Neither line nor tow yarns are spun to any large extent in the United States, but are made mostly in Ireland, Scotland, and Belgium. Large quantities of linen yarns are imported into the United States in the form of skeins packed in bales weighing 600 or 700 pounds.

39. Linen Yarns Classified According to Purposes for Which Intended.—Line yarns are used chiefly for weaving, either warp or filling, for which purpose the numbers vary along the whole range of linen numbers; for lace making, which requires the finer yarns; for thread making, which also requires the fine line yarns; and for twine that has to be of considerable strength, such as jacquard-harness twine. Yarns for cordage are almost always tow yarns, although sometimes line yarns are used for this purpose; but as a rule, only the smaller sizes of cords, which are classified as twines, come under the head of flax, and tow yarn is used for this purpose.

HEMP YARNS

40. Hemp yarns are procured from fibers obtained from the bast portion of the stem of the hemp plant—the *Cannabis sativa* of the nettle family (*Urticaceæ*). Hemp is obtained principally from Europe, the better qualities being found in Southern Europe, including Italy and Spain, and the inferior grades in Russia and Germany. Italian hemp is the best and has a long silky fiber, while the Russian crop is one of the most important as to quantity.

Hemp yarns are not usually classified according to the geographical production of the material, excepting that Italian hemp yarns are sometimes so indicated in order to draw attention to their high quality. What has been said with regard to the classification of linen yarns according to their method of production, the forms in which they are put up, their division into line and tow yarns, and the division of the line yarns into wet- and dry-spun applies almost equally well to hemp yarns.

Hemp yarn is found in bobbins, skeins, and beams. The weaving yarns are divided into warp and filling, and are used for weaving coarse bagging, canvas, and other fabrics requiring strength and bulk. It is also used for the warp of certain kinds of carpets. The hemp that is described here should not be confused with what is known as *Manila hemp*, which is really not a hemp fiber, being a leaf fiber, while the true hemp is a stem fiber.

JUTE

41. Jute yarns are made from the bast of the jute plant, sometimes called the Jews' mallow, the scientific name of which is *Corchorus capsularis*, and which is an annual belonging to the *Tiliaceæ* order.

As almost the entire supply of jute comes from the East Indies, being shipped principally from Calcutta, from which it derives the name sometimes given to it of Calcutta hemp, no special geographical division of jute yarns can be made. They are classified, as are linen and hemp yarns, according to whether they are line yarns or tow yarns, but are almost always dry-spun.

Like linen and hemp yarns, jute is found on bobbins, in skeins, and in warps. It is also found in cops, which, however, are not mule cops, but carpet cops made on a cop-winding machine.

RAMIE YARNS

42. Ramie yarns are produced from the fibers obtained from the bast of the stems of certain Asiatic members of the nettle family (*Urticaceæ*), which are now cultivated to some extent in other countries, including the United States. The botanical name for the species from which this fiber is derived is *Bœhmeria nivea*, sometimes called the Chinese nettle, or snow nettle, or, as given by some authorities, *Bœhmeria tenacissima*. The fiber is spoken of variously as *china grass*, *ramie*, or *rhea*. No definite geographical classification of ramie yarns, nor in fact a classification of the form in which they are put up, their appearance, or their method of production, can be satisfactorily given, as the ramie-yarn industry is not yet of much commercial importance, although considerable attention is being given to it, and there are a few ramie-yarn mills in England and Germany.

YARNS FROM LEAF FIBERS

43. Among the yarns made from fibers derived from the leaves of plants are those produced from **Manila hemp, sisal, New Zealand hemp,** and **pineapple fiber.**

As leaf fibers are usually coarser and less suitable for spinning into yarns and weaving into fabrics than either seed or stem fibers, they are more commonly used for rope making, as, for instance, for driving ropes, cordage for vessels, cables, etc., although in a few cases they are used for weaving into coarse mattings and carpets, and in the case of Manila hemp and sisal, for filling in upholstery fabrics. This is done to so small an extent that they are not of much commercial importance in the yarn industry.

FRUIT FIBERS

44. The only fruit fiber of much commercial importance is the **coconut fiber,** sometimes spoken of as *coir*, or *coconut bast*, which is obtained from the covering of the coconut, being used principally for mats, carpets, etc. The remarks that have been made regarding leaf fibers in general apply to the coir fiber.

YARNS

(PART 1)

EXAMINATION QUESTIONS

(1) How would you distinguish between sea-island cotton yarn and Egyptian cotton yarn?

(2) In what direction is the twist usually inserted in ply yarn as compared with that of the single yarn from which it is made?

(3) Give a definition of a warp.

(4) Name three kinds of tubes for cops.

(5) Name some of the characteristics required in knitting yarns.

(6) What is ramie yarn?

(7) What are the characteristics and chief features of: (*a*) warp yarn as made from cotton? (*b*) filling yarn?

(8) (*a*) What is a chain? (*b*) Describe a linked chain. (*c*) Describe a balled chain.

(9) State what is meant by the word yarn.

(10) What yarns are spun in the United States of America from foreign cottons?

(11) What is the difference between an ordinary ply yarn and a cable yarn?

(12) Is filling yarn ever put up in chain form?

(13) Describe the difference between a ring-spinning-frame bobbin intended for warp wind and one intended for filling wind.

(14) What is the difference between the two kinds of yarn made from flax known as line and tow?

(15) (*a*) What is the difference between the through tube used for spinning cops and the parallel tube used for winding yarn? (*b*) Of what material is each made?

(16) What is the difference, in construction, between a yarn made by a roll-drawing series of processes and yarn made by a condensing and a mule-spinning process?

(17) When a geographical name is applied to cotton yarn, does it refer to the country in which the yarn is spun or to the country where the cotton of which the yarn is made has been grown?

(18) Name a representative yarn made from each of the following: (*a*) animal fiber; (*b*) mineral fiber; (*c*) vegetable fiber.

(19) What is the difference between what are commercially known as carded cotton yarns and combed cotton yarns?

(20) (*a*) What is the name of the machine where two or more ends of yarn are twisted together? (*b*) What is the name of the machine where two or more ends of yarn are laid together without twisting?

(21) What is a cone of cotton yarn?

(22) Name and briefly describe, mentioning their different characteristics, three kinds of cotton yarn produced on different spinning machines.

(23) What is meant by the expression ply yarn?

(24) Describe the structure of a cop and give the usual dimensions of warp and filling cops of cotton yarn.

(25) In case of a ply yarn being composed of three ends of 40s yarn, how would it be designated: (*a*) in America? (*b*) in England?