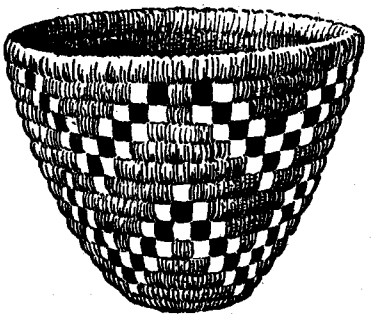
# The Tie That Binds



*This is the twenty-sixth in Nature Magazine's series of educational inserts.*

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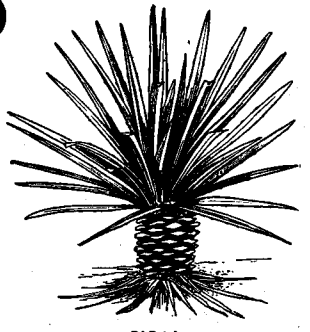
BOW-STRING HEMP



SISAL

JUTE

WE SPEAK these days of United Nations; of pulling together; of cooperative effort. It takes something in the nature of a bond. Nations need, to bind things together, race, religion, or, most important, conviction. And in any case we must also have material things to hold other material things together.

Even before Pearl Harbor we were told to conserve burlap sacks because we could not get all the raw materials needed to make them. The rubber bands we formerly carelessly used became precious. If we go mountain climbing, we are told that we should no longer depend on a three-eighth-inch rope because new ropes do not have enough manila fiber in them. Even the metal for wire with which to bale hay has gone to war.

Faced with these conditions, we must seek substitutes. We might first consider what primitive peoples used for fiber before we had rayon for socks, or cellophane ribbon to bind gift packages. It may pay us to know how to make a shoelace from Indian hemp, a garbage basket from willow withes, or a rope from basswood bark.

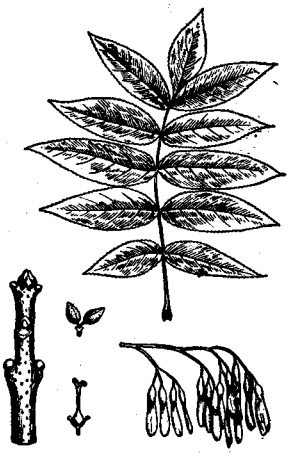
A few things are certain. The manila that was so useful in making ropes, particularly for marine use, came from the Philippines. Until Togo and Tojo are taught a lesson, we will have to do without new manila. The same goes for rubber, largely from the Malay area; for jute, from Burma and India; for silk from China and Japan, and for generous portions of our supply of other fibers from the regions now controlled by Asia's New Order. This insert seeks to help you know something of the fibers you have used and will use, how to identify them and how to recognize, process and use the various substitutes that must serve us for a while.

Roughly, the materials with which we bind things consist of raveled out plant fibers, split woods, sticks or roots, or such animal products as hair, hide or intestinal or glandular materials. Minerals that we make into wire, and the host of synthetic products the chemists are giving us are outside the scope of this article.

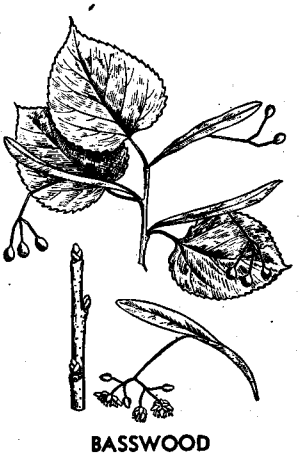
The common plant fibers include manila, jute, sisal, hemp, flax, nettle and cotton. In the various textiles and cordage we use, there is an increasing likelihood that cheaper, more abundant materials will be mixed with better, less common stuffs. Here are a few hints about identifying some of these. Other suggestions may be found in the chart section.

If you have a cord or rope in which there is a mixture of hemp, flax and jute these elements may be identified as follows: Untwist a piece of the cord or fabric to be studied so that the individual fibers stand out more or less distinctly. In a clean saucer, put a saturated solution of chloride of lime. Dip the fibers in this. Add a few drops of hydrochloric acid. There will

COTTON



BLACK ASH



BASSWOOD

FLAX

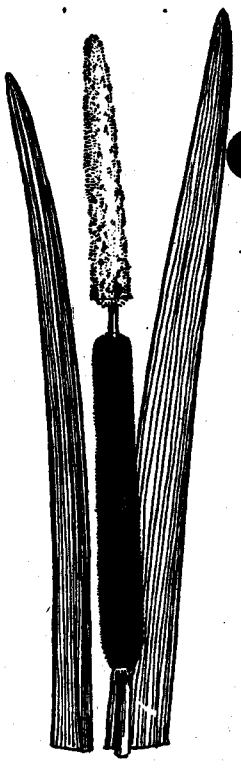
HEMP

be a slight disturbance; the liquid should become yellowish-green and the fibers should be bleached almost immediately. Now, wash the fibers and wring out the surplus liquid. Put the fibers in a clean dish and moisten them with a few drops of ammonia. Examine the fibers immediately. Jute fibers will take on a reddish-blue color; flax or hemp will be yellow, streaked with pink. If the same fibers are treated with a solution of iodine and water, the jute will assume a deep brown color, while the flax or hemp will become blue or violet. If treated with iodine and sulphuric acid, the jute will assume a yellow color.

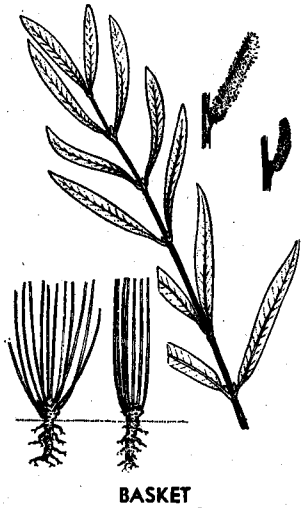
Probably, the easiest way to distinguish between a cotton and a linen cloth is to rub it on dark wool cloth. The cotton will leave plenty of lint, while the linen should leave none. This difference is reflected in the clean-cut pattern that shows through a linen handkerchief held to the light as contrasted with the confused pattern of the cotton cloth. This is largely because the cotton fibers are less stiff than those in the linen.

Plant fibers useful in tying things may be had in various forms. Such plants as basket willows, rattan, and the like, yield long sticks, which, with a little treatment, may be tied or woven as desired. Other plants, like basswood and elm, have bark that may be ripped off in long, coarse strips to serve as crude ropes. Still other plants, like ash and hickory, may yield tough sticks that may be twisted or woven into strong fabrics or ropes. Some plants, like cattails and bulrushes, have long, slender leaves that may be twisted into surprisingly strong ropes for seating rush-bottomed chairs. And then, of course, there is the multitude of plants that yield fine, strong fibers that may be spun into cords or threads and twisted or woven as desired. Sometimes, as in cotton, these fibers come from the seeds. In others, as in flax, hemp, nettle, sisal, manila or jute, the fibers are imbedded in the tissue of the stems or leaves and must be extracted and processed before they are used.

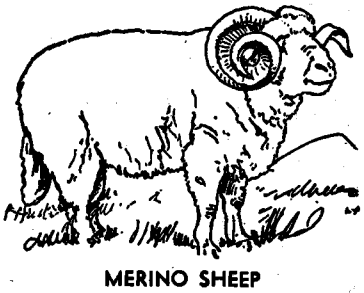
Only in an emergency, or where a tree is doomed or too badly deformed to be of use, should one attempt to make a rope from the bark of a standing tree. If you ever do need an emergency rope, an axe or hatchet may be driven at an angle into the bark of such a tree as a young slippery elm or basswood, and a rope substitute may be obtained by grasping the free end of the bark and pulling. The bark will come off in a long strip up the trunk and will yield a reasonably good rope. Leatherwood, *Dirca palustris,* has a rather wide range and can be used for emergency small cordage. In spite of the name, the wood is weak and rather useless, but the bark is tough and highly durable when twisted into a coarse cord. This plant is so beautiful when in bloom that I would not wish to make any suggestion that might lead to its wasteful use. The inner bark of many of the cedars yields an excellent, easily-processed fiber. Some of the baskets in our home, made of cedar bark by the Chehalis Indians of the Northwest, are woven so tightly that when well-soaked they will hold water almost as well as a bucket. Other trees whose inner bark makes good rope material include slippery elm, American elm, hickory, white oak, red cedar, osage orange, black locust, cypress and papaw.



CATTAIL



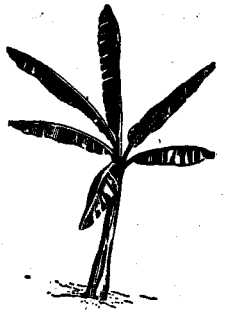
BASKET WILLOWS



MERINO SHEEP

In the sporting goods houses, we see beautiful pack baskets made of thin wooden splints. Sometimes, we buy "porch furniture" with woven splints for the seats or backs. Usually, these splints are of ash or hickory, black ash possibly being the most popular of all. These splints are not always easy to get, but they can still be obtained.

The best time of the year to get splints is in the spring when the "sap is in the wood." Cut a black ash tree, preferably one whose top has been so deformed that it never can be a superior timber tree. Lay the log on the ground and peel off the bark. Lay a board lengthwise on the wood. With the flat of an axe pound the board repeatedly, distributing the blows so that the ash wood is violently jarred but not struck directly. When at one end it seems evident that the wood in some of the annual rings has been jarred loose, make two knife slashes in the end about three-fourths of an inch apart. Grasp the free end and start to strip off the splint. If it comes off with difficulty in any spot, tap the area with the board and axe until it can be broken loose. Continue in this way to strip off the needed splints. The splints will follow the grain, so it is not possible to get splints by splitting them off a sawed board that



MANILA HEMP

MILKWEED

does not follow the grain. If a board is "split" out of the ash log, splints may be stripped off it but this is not always the best way to get them. The splints may be stored until needed for use, but the longer they are kept the more likely they are to split or break when bent unless they are thoroughly steamed or soaked beforehand. Good splints may be made from a piece of ash or elm at least four inches in diameter by beating it with a wooden club until the layers have broken loose. The pieces are then stripped off and stored for use. Hickory splints may be made by splitting them off a split hickory board. A surprising variety of practical furniture may be made by an ingenious person with a good supply of fresh ash, elm, or hickory splints.

Probably the plants in the United States most used as sources of sticks for making furniture, clothes baskets and the like are the willows. In America, the better willow species are the green willows, and the purple willows. One of the varieties of crack willow known as Küstermann's willow, *Salix fragilis triandra,* has been grown commercially in Wisconsin and Virginia, but does not compete in quality with the others mentioned. The true basket willow of Europe does not do well enough in America to compete with the species referred to. Some of the best willow withes in the world are produced in America but the labor costs are high and it is difficult to compete with the products produced where labor is not so well rewarded. Our willows can never produce woodenware with the strength of rattan and similar tropical woods. Rattan comes from a palm and probably will not be coming to America in any quantity while the war is on. Farmers' Bulletin 622, issued by the United States Department of Agriculture, will provide useful reading for anyone interested in raising willow withes for home use or for commercial reasons. Excellent withes may be had from hickory, white oak, black ash, birch, wild grape, witch hazel, chestnut or sweet gum, as well as from willow.

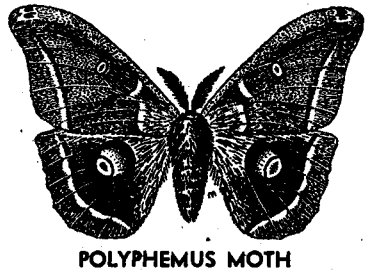
Most vines are flexible and many of them are strong enough to be used as cordage substitutes. Grapes probably offer the greatest promise of yielding a fair rope in a hurry in an emergency.

The underground parts of white spruce (split), cedar, hemlock, digger pine, fir, cottonwood, or long leaf pine, tamarack and brake fern yield a strong flexible material that, in an emergency, can be used directly as a rope or cord. These may be softened by steaming or by boiling wood ashes in water ten minutes with the roots.

A variety of plants produce the rushes used in rush-bottomed chairs. Possibly, the most common of these are the cattails, which are to be found in abundance in shallow fresh waters in north temperate regions around the world. The leaves are used, and these are usually more or less uniform in size and shape and usually free from any important diseases that might disfigure them. They are cut in late summer and dried on racks or by being hung in bundles. Usually, this is done by September. The dried leaves may be stored and when ready for use may be freshened so that no serious injury results from twisting them.

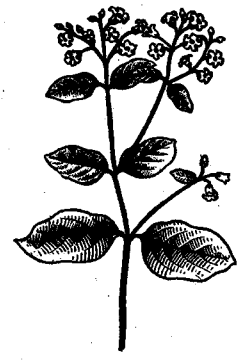
There is not space here to go into the commercial uses and processes of cotton. What we do want to give help on are the means of getting fibers from plants. For the most part, plant fibers to be found in stems or leaves are surrounded by softer tissue that must be removed. This soft tissue generally rots before the harder fibrous material. The simplest procedure, then, is to permit rotting to take place just long enough to destroy or weaken the soft tissue and not long enough to injure the desired fibers. This "rotting" is sometimes done by bundling the plant material and submerging it in water in such a way that it is not exposed to the air or forced into the mud at the bottom. At other times, the plant material is merely spread out flat on the ground and the dew and ground moisture are allowed to do their work.

WHITE CEDAR



POLYPHEMUS MOTH

NETTLE



INDIAN HEMP

After the tissues containing fiber have been rotted, the fibers must be removed. Sometimes this is done by running the plant between the fingers, forcing the soft tissue aside. At other times it is done by machines. Indian jute fiber is extracted from its tissue by native women, one of whom can strip about forty pounds of fiber a day. Once the fibers are free, they must be arranged so that they can be worked into a continuous thread, cord or rope.

In some of our native fiber plants such as milkweed and Indian hemp, the fibers must be separated from close-lying semi-woody material, which does not rot easily. Usually, this re- (Continued on page 424)

| COMMON NAME<br>SCIENTIFIC NAME | BASSWOOD<br>*Tilia americana* | WHITE CEDAR (1).<br>ALASKA CYPRESS (2).<br>*Chamaecyparis thyoides (1).*<br>*C. nootkatensis (2).* | BASKET ASH<br>BLACK ASH<br>*Fraxinus nigra* | PURPLE WILLOW (1).<br>GREEN WILLOW (2).<br>*Salix purpurea (1).*<br>*S. amygdalina (2).* |
|---|---|---|---|---|
| GENERAL DESCRIPTION | Tree, to 80 feet high, with trunk to 4 feet in diameter. Crown, dense and rounded; trunk, straight and slightly tapering, with dark gray, somewhat scaly, and deeply and regularly-fissured bark. Leaves: alternate, simple, unequally heart-shaped, with incurved, marginal teeth, and texture, firm. Roots, lateral, deep, spreading, without taproot. | (1) Tree, to 80 feet high; with reddish brown bark, fissured into flat, connected ridges; and with inner bark that may be torn into long, strong strips. Branchlets flattened. Leaves with gland on back. (2) Tree, to 120 feet high; with gray, brown bark, separated on surface into large, loose scales, and irregular fissures. Branchlets not flattened, but squarish. Leaf-backs glandless. | Tree, to 100 feet high, relatively slender, with a straight trunk, rather coarse twigs and branches. Bark: close, ash gray, without deep ridges but with thin scales. Rubbed bark breaks into fine powder. Twigs: smooth, dull, black-budded, with circular or semi-circular leaf-scars. Leaves: opposite, compounded of 7 to 11 stalkless, rounded-based leaflets, with shallow-toothed margins. | (1) Shrub, or small tree, with long, erect, uniformly diametered twigs. Leaves to 3 inches long, smooth, paler beneath, sometimes nearly opposite, and with short stalks, or none. (2) Shrub or small tree, to 30 feet high, with bark in flakes. Twigs long, and slender, but coarser than in (1). Leaves to 4 inches long, tapering pointed, light- or blue-green beneath. |
| RANGE AND HABITAT | Family Tiliaceae. A close relative of the linden. The family has about 370 species. This species is found from New Brunswick to Manitoba and south to Georgia and eastern Texas and is usually rather abundant within its range, though it does not occur in pure stands. It favors rich woods and loamy bottomlands. | Family Pinaceae. Six species of the genus in North America and eastern Asia. (1) Ranges from Maine to Florida, and west to Mississippi, being found mostly in swamps. (2) Ranges from Alaska to northern California, and in cultivation, in California and through the East; from sea-level to 3000 foot elevations, at the higher elevations appearing like a low shrub. | Family Oleaceae. Related to the olives, syringas and privets. This species rather uncommon in wet woods and swamps from Newfoundland to Manitoba, and south to Virginia and Arkansas. It does best in the cooler part of its range, seldom thriving on dry lands or on warm exposures. It will grow well mixed with spruce, fir and larch, in land too wet to support other forest trees. | (1) Native of Europe, but escaped and wild in North America, commonly planted for basketry in western New York. The true basket willow, *S. viminalis* is grown in the Northwest, but is useless in the East and South. (2) Popular in Europe and in America, particularly along the Mississippi where it withstands heavier soil and more water than does (1). |
| REPRODUCTION | Stamens and pistils, in fragrant, yellowish-white flowers borne in flat, drooping clusters in June and July. Pollination by insects, particularly bees, results in woody, spherical, pea-sized fruits, attached singly or in groups, on a wing, and distributed in October or fall by the wind. Seedlings: 1 to 2 inches high first year, with two, 4- to 5-lobed, palmate cotyledons. | Cones; of (1) about ¼ inch across, bluish purple; of (2), nearly ½ inch across, and dark, reddish-brown. There are 1 or 2, winged seeds under each fertile scale, each with wings as broad as the dark, red-brown body; and the whole, about ⅛ inch long. The seeds are wind-borne, shed over a relatively long period of time, and produce 2-cotyledoned seedlings. | Pistils and stamens borne in separate flowers on the same or different trees. Stamens purple, and appear, with the pistils, before the leaves in spring (May). Pollination is probably by wind, and results in broadly winged fruits each with the seed-enclosing portion at one end, which are carried by the wind when shed in fall. Seedlings develop in spring. | Staminate flowers of (1) have 2 stamens; of (2), 3 stamens. Bracts of the pistillate flowers dark at the tip in (1) and light in (2). Leaf stalks of (1) without glands; of (2), with glands. Pollination is by wind or insects, and the seeds are distributed by wind when the fruits burst. Normal reproduction is by cuttings, which root freely. |
| CULTURE AND ENEMIES | Rarely attacked by fungi, although sometimes by a canker of the bark and a leaf spot; and by an insect pest, the basswood leaf-roller. The tree grows better in a mixed forest than alone, and does not resist wind injury well, or severe ice storms. | (1) Favors wet areas; produces a light, soft, weak, close-grained, light-brown to reddish, fragrant, uniform wood. (2) Produces a hard, close-grained, brittle, durable, bright yellow, fragrant wood with resinous quality, with a very thin, white sap-wood. This tree lends itself well to cultivation and is commonly grown as an ornamental. | Wood soft, tough, but not strong; dark brown, weighing 39 pounds to cubic foot; elastic, rather than brittle. If wood is steamed, it may be bent to desirable positions, which it holds. Tree is attacked by fungi and a few insects, including ash wood-borer, which destroys much valuable lumber, and spring canker-worm, which eats leaves, and lowers tree's vitality. | Cuttings, made 2 weeks after leaves fall, may be planted in spring, the shoots being about 1 year old and a foot long, or larger and older, for poorer ground. They are usually spaced about 18 inches or a yard apart, are cultivated the first 2 critical years; twigs are harvested in December or January, and yield may continue 25 years. |
| ECONOMIC IMPORTANCE | Inner bark yields a cordage fiber; whole bark, used by farmers for tying logs together. Inner bark has some edible qualities, and the buds are good to eat. Wood, valuable as "whitewood," is light, soft, moderately strong, fine-grained, white, weighs 28 pounds per cubic foot. Flowers, with help of bees, yield a superior honey. | (1) Wood is used in boat building, shingles, interior finish, fence-posts, railway ties, cabinet work, and woodware. (2) Wood is used in furniture, shipbuilding and in interior finish. Inner bark, of either, may be used as fiber of a primitive nature, particularly in making baskets that will hold water, as do some made by the Indians in the Northwest. See cut, p. 417. | Wood used in making skis, barrel hoops, baskets, splint-bottom furniture and for interior finish. Logs are cut in winter or spring, pounded with a board until the years' growths become separated, and then stripped through knives to make strips for weaving into baskets or for furniture seats. Also popular as a street tree. | Harvested rods are peeled, dried, packed and bundled. Profit of the yield of an acre may be around $100 for the better years, although this implies that labor costs are low and that the land is not worth more than $35 an acre for other purposes. Willow is grown locally or imported, but the centers in America are near the larger cities. |

| CATTAIL<br>*Typha angustifolia* | COTTON<br>*Gossypium hirsutum* | MANILA ABACÁ NE'E<br>*Musa textilis* | INDIAN JUTE<br>*Corchorus capsularis* | SISAL HEMP<br>*Agave rigida (sisalana)* |
|---|---|---|---|---|
| Height, to 6 feet. Leaves, erect, flat, smooth, green ribbons, about ½ inch broad as contrasted with the inch-wide leaves of the broad-leaved cattail, considered in the second insert of this series. Underground, there is a stout, horizontal, perennial rootstock well stocked with starch, branching and giving rise to the leaves and flower-stalks. | Height, to 8 feet, much branched, but with one more or less central stem. General shape of plant like a cone. Leaves, variable, to 6 inches long and to 5 inches wide, heart-shaped, 3- to 7-lobed, and coarse-veined. Roots, a main tap root, and finely-divided, lateral roots that fill the soil. Sometimes described as "herbaceous shrubs." Annual. | Height, to 20 feet. General appearance almost identical with banana. Leaves often spotted, with the fiber found in the sheathing leaf-bases that form the 20-foot trunks. Like the banana, the plant is not a tree, nor is it a woody plant. Inner leaves the more valuable. A cut stem weighs from 20 to 80 pounds. Perennial. | Height, 15 feet. Stems straight, branching only near the top. Diameter, ½ inch. Leaves shaped somewhat like an arrowhead, to 4 inches long, and with basal teeth, sharp-pointed. In *C. capsularis,* leaves are bitter and seed-pods, spherical; in related *C. olitorius,* Desi or Nalta jute, the leaves are not bitter and the seed-pods are cylindrical. | Leaves, 8 to 10 feet long, average 6 feet by 4½ inches wide, by ½ inch thick, with a tough, green skin, and pulpy interior mixed with fibers; about 3½ to 5 percent of the leaf, fiber. Weight of leaf, 1 to 2 pounds. Stem erect, coarse, and, in cultivation, conspicuous, with diamond-shaped leaf-scars, cylindrical, barrel-shaped. |
| Class Monocotyledonae. Family Typhaceae. This species is native of Eurasia and other north temperate parts of the world and is found in America from southern Maine to North Carolina and west to the coast, but is most abundant near the coast. It has a more restricted range than the broad-leaved cattail and is rarely so abundant. Both grow in shallow waters or marsh lands. | Family Malvaceae. Related to the mallows. American cottons include: Upland cotton, *G. hirsutum;* Sea-island cotton, *G. barbadense;* Peruvian cotton, *G. peruvianum.* Asiatic cottons include: Indian cotton, *G. herbaceum;* Bengal cotton, *G. neglectum.* Upland cotton constitutes about 99% of cotton grown in United States. Leading crop in Southern States. | Family Musaceae. Close relative to the banana and to many ornamentals. Grows best in the Philippines, especially on Luzon and to the south, where there is a warm, moist climate and a deep, rich, well-drained soil and 60 inches or more of annual rainfall. Attempts to introduce abacá into American tropics have failed, partly because of diseases. | Family Malvaceae. There are more than 20 races of Indian jute. Requires a rich, loose, sandy soil, with good drainage and climatic conditions such as are to be found in Burma, Bengal, southern China, northeastern India; and the southern islands of Japan. It does best on high lands, but is grown on lands that are flooded in the late summer season. | Family Amaryllidaceae. About 300 other species in the genus including the century plant or blue aloe, *A. americana;* the small-leaved aloe, *A. angustifolia* and others. Sisal hemp also comes from *A. morrisi* and *A. vivipara.* Mauritius hemp comes from *Furcroya gigantea. A. rigida* is cultivated in the Bahamas, Cuba, Mexico, Florida and Northeast India. It is native of Yucatan. |
| Flowers appear in early summer and are either pistillate or staminate. The two are borne on the same erect stalk with the staminate at the top and separated slightly from the pistillate, a character which helps distinguish the two species. The pollen is wind-carried. The fruits are wind-carried when the spikes break during the winter or following spring. Seedlings grasslike. | Flowers on short stems, creamy white at opening, changing to red by second day. Sea-island cotton has yellow flowers. The "bolls", which develop from the flowers, may be 2½ inches across and a good plant may bear to 50 bolls. Seeds planted 2 weeks after last killing frost produce plants that in September to November yield mature cotton. | Fruits inedible, with seeds the size of BB shot and borne on drooping spikes. Reproduces largely by sucker shoots. Field is cleared and burned, suckers planted and competitive weeds removed. Plants mature in about 3 years when they should be cut. Young leaves give weak fiber; older leaves, harsh, brittle fiber. | Annual. Flowers small, yellow, often solitary, mallow-like, with 5 petals, 5 sepals, and 10 or more stamens, which are free of each other. Seeds sown by hand, 10 to 15 pounds per acre, March to May; cultivated when plants are 6 inches high, and hoed thereafter; harvested from flowering to seed maturity, the earlier being the better. | Shoots are planted 4 feet apart, in rows 12 feet apart. In 4 or 5 years, or when leaves assume horizontal, first leaves may be cut. Plants allowed to bear 25 to 27 leaves and yield 12 to 15 a year cut at intervals. If leaves are not cut when mature, plant may send up 8- to 10-foot flower stalk and die. Properly handled, a plant may yield for 14 years in rocky soil, sometimes 1500 leaves. |
| Erect leaves expose a maximum surface to the sun when it is at an angle; a minimum surface when it is at its strongest or directly above. Creeping rootstocks submerged for a considerable portion of the year particularly when fire may sweep the exposed upper portions. Underground parts provide good food for muskrats, and the upper parts summer protection. | Require about 200 days with a mean summer temperature around 77° F., and rainfall after harvest of about 10 to 22 inches. May and June are critical months, and a rainy fall may ruin the harvest. The seed-hairs vary in length, strength and fineness in different cottons. Cotton-boll weevil principal insect pest. | Leaf-bases contain 90% water. Requires 5 acres of plants to yield 1 ton of fiber. The shoots cut are replaced by developing suckers. Around a million acres of land in Philippines yield annually 150,000 tons of manila fiber. Grades of manila fiber include, "current", "fair", "brown." Knotted abacá is hand-sorted and tied fiber. | Plants are cut, then held under water but off bottom at about 80° F. for 10 to 20 days when the fiber is extracted by running to 3 stalks at a time between the fingers, a woman being able to strip 40 pounds a day, for which wage has been the waste fiber to be used as fuel. Yield per acre about 1300 to 1800 pounds. Exported in 400 pound bales. | A bed of semi-decomposed coral rock, with hot, dry air, is best environment. In native Yucatan, a plant may yield twenty crops over a span of 25 years. If one plant in an area is allowed to produce its flower-stalk, nearby plants may, strangely enough, do the same and die, so a plantation requires care to have yield continued. 600 to 1200 plants to an acre. |
| Leaves of this and of the broad-leaved cattail may be cut in late summer, dried either on racks or in shooks, and twisted or braided into cords, which may be used in making rush-bottomed furniture. Staminate heads, harvested at their prime, yield a flour-like nutritious powder, the submerged rootstocks, a starchy food, and the plants, flood control. | The world's most important fiber crop, having been used since 1000 B.C. Next in importance as agricultural crop in United States to wheat, potatoes and corn, but leads in areas between 30° and 40° north or south of equator. Cottonseed valuable in industry for food and oil. In U. S. in 1941. two million acres yielded ten million bales worth nearly a billion dollars. | One of most valuable Philippine exports. Knotted abacá is twisted into skeins and then braided by hand or by simple machines in Japan. A piece 250 feet long and ⅛ inch wide brings, after all labor, only about 50 cents. Adding 15 minutes on an American machine it becomes a hemp hat, which a milliner sells Mrs. America for $10. | India grows 3,000,000 acres of jute. Normal world yield, 1 to 2 million tons. Used in making burlap sacks, coarse cordage, twines, and some coarse papers. War disrupted export of jute to America and requires use of substitutes and wise use of remaining supplies. | Leaves are worked when green and fiber is removed by machines, but juice attacks wrought iron. Yellow leaves yield inferior fiber. Fiber is whiter, flatter and less pliable than manila. It is used in making ropes, nets, hammocks and cordage. Some sisal is extracted by steeping leaves in water 10 days after a 4-day drying and then beating fiber out. |

| COMMON NAME<br>SCIENTIFIC NAME | BOW-STRING HEMP<br>*Sansevieria zelanica* | NETTLE<br>*Urtica dioica* | SOFT HEMP. MARIJUANA<br>*Cannabis sativa* | MILKWEED<br>*Asclepias syriaca* |
|---|---|---|---|---|
| GENERAL DESCRIPTION | Leaves, to 8 feet long, to 3 inches wide, springing directly from the foot, since the plant has no stem above-ground. Leaves rounded on the back, with dark green, longitudinal lines on back and lighter green, transverse lines on inner face. A number of varieties differ by color, and banding of the leaves. | Height, to 1 foot; related *U. gracilis*, to 10 feet. Covered with bristling, stinging hairs. Leaves on short stalks, less than half the leaf-width, with coarsely-cut margins, and downy undersurface; heart-shaped at the base. Stinging nettle of the Southern States is *Jatropha stimulosa*, an entirely different plant. | Height, to 12 feet, with stalks ½ inch or less in diameter, if grown crowded; or 20 feet high and 2 inches through, if grown in hills. Leaves opposite near the base, and alternate near the top, and composed of 7 to 11 dark green, 2- to 6-inch, roughish leaflets, with notched margins. Stamens and pistils borne in flowers on separate plants. | Height, to 4 or 5 feet. Stout, covered with fine fuzz. Leaves broad, rather thick, dark green above, with slightly incurved margins, to 8 inches long. Young shoots succulent, relatively brittle and rapidly developing into tall stems. Juice milky and profuse. Flower stalks set at an angle to the main supporting stems. |
| RANGE AND HABITAT | Family Liliaceae. Some 50 species, for the most part native of Africa and Asia, although many are suitable for cultivation in North America and are to be found as house plants, since they survive abuse and lend themselves to limited floor space and exposure to the sun. Named after a Prince of Sanseviero who was born in Naples in 1710. | Family Urticaceae. Related to hemp, hops, and mulberries. Naturalized from Europe where it has enjoyed some cultivation for fiber since the days of the early Egyptians. The common stinging nettle of the North ranges through southern Canada and from North Carolina to Missouri. | Family Urticaceae. A close relative of hops, nettles, mulberries and similar plants. Has been cultivated since the 28th century B.C., when Emperor Shen Nung taught its cultivation in China. It came to the Europeans about 1500 B.C., and to America with the arrival of the earliest pioneers. It was grown primarily for cordage. It does best in rich river-bottoms. | Family Asclepiadaceae. Some 2000 species in the family, found widely distributed over the world. This species erroneously thought to have come from Syria. Native of America, where it is found on rich ground from New Brunswick to Saskatchewan and to the south. |
| REPRODUCTION | Flowers whitish to yellow, in an open cluster. Tubes swollen at the base, with the 6 stamens attached to the throat. Fruit, a berry, with 1 to 3 seeds. Occasionally, the plant will flower as a household plant, in which case its fragrance is most welcome. Closely related species include the cylindrical leaved *S. cylindrica* and the flat-leaved *S. thyrsiflora.* | Flowers clustered in loose formations near the bases of the leaves, greenish, and, in some nettles, staminate or pistillate on one plant or on separate plants. Since the plant will thrive on lands that will support few other crop plants, its culture is relatively simple. | Seeds sown in March more thickly on rich than on poor soil, 35 to 50 pounds per acre, usually in drills. Mature, yellow-stemmed, staminate plants are more abundant than the pistillate, whose stems pale at maturity. Harvesting is possible 4 months after planting. Seed weighs 44 pounds per bushel, and has commercial value. Yield of fiber may reach one ton to acre. | Flowers borne in loose, ball-like clusters, about the size of a baseball, the individual flowers being around ½ inch through; white to pinkish, with stamens united below. Pollination by insects, particularly bees, which break parts of the stamens free, carrying them to other flowers. Fruits broadly spindle-shaped, and bursting to free the flat, brown, parachuted seeds. |
| CULTURE AND ENEMIES | In India, Queensland, Java and South China, the plant is grown for its fiber, which is soft, pliant, silky, very strong, and easily extracted by machines. It is uniformly good through the length of the leaves. A ton of leaves will yield 50 pounds of fiber, with one acre of land yielding 13½ tons of fresh leaves. Propagation is simple and by roots. | The stinging hairs on nettles may cause severe injury. A species in California, *U. holoserica*, is reputed to have a sting sufficiently severe to kill horses, and the stings of some Asiatic nettles are reputed to be strong enough to kill human beings. As weeds, the plants may be kept in control by cutting twice a year, grubbing with gloved hands or salting. | Hemp fiber is 4 to 8 feet long; gray, if "retted" by dew; and white, if water retted, and is found in flat ribbons made of smaller fibers. The plant requires soils higher in phosphoric acid than corn, wheat, oats or cotton. Retting or rotting is done in fields where plants grew, the process requiring 2 to 10 weeks, then stalks are gathered, stacked and dried. | Grows on wasteland and pasture land or along roadsides, where, in part because of its milky juice, it is avoided by grazing animals. Is the host plant for the monarch butterfly, which hangs its gold-studded, green chrysalids beneath the leaves. Stem survives the winter. Flowers appear June to August. Seeds shed in the fall. |
| ECONOMIC IMPORTANCE | This plant is known in many homes as "Snake Plant." It is also known as "Murta" or "Moorva." It is probably the commonest potted plant in the hotel lobbies of the United States, and, next to the geranium, ranks high as a house plant. It is most commonly cultivated in the Bahamas, and is slightly more difficult to handle as a commercial crop than is sisal. | In World War I, the fiber was cultivated for making fabrics for tents, wagon covers, clothing. It is capable of producing a good, strong, white linen. A yellow dye is obtainable from the roots and the young shoots boiled make an excellent spinach substitute. In a machine age, it may again become a valuable source of fiber. | Hemp is used in twines, oakum and packing and endures friction, heat and moisture. It dyes blue or violet with an aqueous iodine solution and is high in cellulose. Marijuana comes from the dried leaves, is smoked as tobacco, and is a dangerous habit-forming drug which stimulates unreasonable, and often more or less insane, activities. | Stems produce, in inner bark, a good fiber, which may be twisted into cord or woven into mats. Juice yields some proportion of basic rubber materials and is being experimented with as a rubber substitute source. Down of the seeds is used as insulating material, for filling cheap life preservers, and in art. Young shoots excellent asparagus substitutes. |

| FLAX<br>*Linum usitatissimum* | INDIAN HEMP<br>*Apocynum cannabinum* | MERINO SHEEP<br>*Ovis aries* | SILKWORM<br>*Bombyx mori* | NATIVE SILKWORM POLYPHEMUS MOTH<br>*Telea polyphemus* |
|---|---|---|---|---|
| Stems, to 40 inches high, and under 1/8 inch in diameter, often divided at or near base into 2 or more nearly equal branches, which themselves remain unbranched until near the top. Leaves narrow, simple, to 1½ inches long. The best fiber comes from long, slender stalks, which are unbranched, and comes from the inner bark of the unbranched portion of the stem. | Height, to 9 feet. Stems relatively slender, branching, wide-spreading. Leaves smooth, or sparingly fuzzy beneath; the lower ones, on short petioles; the upper, without these; darker green above; much longer than wide. Juice, milky, abundant. Underground parts branch profusely near ground surface, sending shoots upward. | Ram weighs about 140 pounds; ewe about 100 pounds. Heavy fold over the body but not on the back. Wool covers the head obscuring the eyes. Ears and muzzle without wool. Skin pink. Neck long. Withers thin. Wool fine, 2 to 3 inches long. This breed raised for quality and quantity of wool. See seventh insert, for Shropshire breed. | Wing-spread about 1¾ inches. Wings placed roof-like. Antennae in each sex, broadly feathered. Male cream-colored, with 2 or 3, more or less distinct, brownish lines across the forewings, and half an eyespot on the inner half of the hind wings. Head small and obscured by mat of whitish hairs which extends from front of head to between the wings. Male rarely flies Female never. | Wing-spread, 5 to 6 inches. Wings held over back. Male fore-wing, buff, olive, or gray-brown, with transparent, yellow-bordered "eyespot"; hind-wing, with dark border, and black eyespot, deeply black-bordered. Female much like male, but with antennae not broadly feathered, and with a heavier body. Night-flying moth, commonly found away from wooded areas. |
| Family Linaceae, close to the peas. Flax cultivation goes back to the early Egyptians and the earlier Chinese, while a closely-related species, *L. perene,* was used in Europe in the Stone Age. It is now cultivated throughout Europe except in the Balkans, and in Siberia, China, Japan, Australia, East Africa, Chile, Canada, and the United States. | Family Apocynaceae. Perennial. Closely related to the milkweeds, but has the stamens distinct. Favors relatively poor gravelly soil or sandy areas near streams or waterways. Often, over sand beaches, where it may be low and spreading. Found in various varieties, from British Columbia to California and east to Virginia and Maine. Also in Eurasia. | Order Artiodactyla. Family Bovidae. This breed developed in Spain, nearly 2000 years ago. Introduced into the United States in 1793 and later. Reached peak of popularity 1812 and in the 1860s. Saxon and French Merinos were also imported. Now most popular in England and used to improve other breeds by cross breeding. | Order Lepidoptera. Family Bombycidae. Related to our Cecropia moth. The silkworm has been under domestication in China since 3000 B.C. Later, raised in India; then in Persia; and, about 555 A.D., was introduced into Europe. As a big industry, this was developed in Greece, Italy, France and Spain in about that order. It has never thrived in North America. | Order Lepidoptera. Family Saturniidae. Related to silkworms and tent caterpillars. This species common all over the United States and in northern Mexico. Must be dependent on trees, which constitute its food naturally, even though the adults are active away from the woods. Shade trees of villages and towns often provide ideal environment. |
| Flaxseed, weighing 56 pounds per bushel, is sowed for fiber 1½ to 2 bushels per acre; for seed, 2 to 3 pecks per acre preferably on clay loam which is fertile. Seed broadcast or drilled and soil is then rolled. Roots too shallow for ordinary cultivation, and weeding is by hand. Harvesting is 75 to 90 days after planting, when seeds are brown and hard. | Flowers small, somewhat bell-shaped to tubular, greenish white, 1/8 inch long, erect, and in loose clusters with those in the center flowering first. Blossoms June to August. Insect-pollination and wind-distribution of the seeds. Fruit slender, curved cylinders, pointed at ends and bursting to free many small, parachuted seeds much smaller than those of milkweed. | One ram, more than a year old, is bred to 35 to 50 ewes at least 1½ years old. In 146 days, ewes bear 1 to 2 lambs. Ewes need 16 square feet of floor space. Lambs nurse in 2 hours, nibble hay at 2 weeks and are marketable at 4 to 6 months. Tails are cut when lambs are 2 weeks old. Castrated rams are known as wethers. All teeth in by 4 years. | About 300 to 400 eggs, resembling turnip seeds, hatch in 8 to 10 days into caterpillars, which, in 6 to 8 weeks, develop, growing from ½ inch to 3 inches in length, shedding skin 4 times; usually white-humped behind small head, and with short, rear spine. The 1½-inch cocoon has about 1000 feet of silk, which is cut if moth emerges normally after 2 weeks. Egg to egg, 2 months. | One annual generation arises from female's 300 cream-colored, brown-banded, disk-like eggs, which hatch in 10 to 12 days into caterpillars, which eventually have green bodies, reddish heads, conspicuous body-segments, and when nearly mature, rose-red or pale prickles and silvery tubercles, with 7 oblique, yellow side bands, and red breathing spiracles. |
| Fineness depends on thickness of stand and uniformity of growth so drought or other weather conditions may affect quality. Fiber flax pulled by hand, an acre being one man's work for a day. Seeds are threshed out. Stems are "retted" in water 10 to 20 days or on the ground 3 to 6 weeks, then wood is broken and fiber is "scutched", baled and marketed. | Fruits remain on through the winter, bursting to free seeds over a long period. The bark, in the green state, or on seasoned plants in winter, yields a good fiber that may be twisted into a strong cord with little difficulty. Host to a beautiful beetle. If the plant were not a weed, it might well be grown as an ornamental. | Food, vegetation cropped close to the ground; best includes clover. Bluegrass pasture does not provide adequate food during warm summer months. Sheep stampede blindly in the face of danger and are killed by dogs. Where there is dog-danger, sheep should be pastured with aggressive breeds of cattle like Angus, which will drive away most dogs. | Food, leaves of mulberry, Osage orange or lettuce. The silk from the silk glands hardens in contact with the air. Pupae in the cocoons are killed by dipping them in hot water, which also softens the gum that binds them. This permits unrolling of the silk and its spinning into thread that has various uses. About 1000 miles of silk in one pound. | Caterpillars may snap jaws hard enough to be heard. They feed on leaves of oak, elm, birch and maple, and make a thick, strong, oval, light to nearly white cocoon, which winters on trees or on ground, and the silk of which can be unwound. There are many parasites of larvae and pupae; birds and bats destroy the adults. |
| Yield may vary up to 700 pounds fiber per acre. Used in making linen. Flax grown for seed matures in about 100 days. In United States, about 3 million acres yielded about 31 million bushels of flaxseed worth about 58 million dollars, approximately the value of peanuts, barley, potatoes, buckwheat, sugar beets, or grapes. Used as food and for extracted oils. | The bark has been woven into crude mats or twisted into primitive cordage. The underground parts provide a superior anchorage for loose sands and gravels on beaches, along streams, or on steep banks where sufficient water is available. Juice now being experimented with as a source of rubber. | A ram's pelt weighs to 30 pounds; an ewe's, to 20 pounds. They yield a fiber that is spun into cloth that is durable, warm and attractive in appearance. The intestines of sheep, particularly of lambs, yield a high-quality gut of value in surgery, in the production of musical strings, in tennis racket strings, and in other ways. | Silk supports great industries throughout the world, but depends basically on availability of abundant cheap labor for initial steps. In a new order, it may be supplanted by synthetic materials produced by the chemists, and this may have far-reaching social significance particularly in the Orient. Silk is used in fabrics for parachutes, clothing, balloons, etc. | Excellent fishing "leaders" may be made by pickling mature larvae in saturated solution of salt and vinegar, cutting larvae to let solution enter, then drawing silk glands out with pins and allowing them to dry in the air, suspended from some support. These gut leaders are longer and better than those from the commercial silkworm whose silk glands are smaller. |

(Continued from page 419) quires splitting of the stem and then bending the halves outward so that the fractured hard material does not cut the more delicate fiber.

In some cases, the fibers may be released more quickly if the tissue is boiled in a weak lye solution. This may be made by boiling wood ashes for about ten minutes in water.

Some of the most effective binding material comes from animals. The hair, hide, sinews and glandular secretions of a great variety of animals figure in this and their treatment varies as greatly as do the sources.

Rawhide rope has long made a name for itself. For some uses, no satisfactory substitute seems available. We still use it for the webs of snow shoes, for shoelaces that must stand special usage, for harness and for other purposes. Rawhide has the disadvantage of varying greatly in length with the amount of water in it, shrinking when dry. To prevent this, the hide is waterproofed with oils, greases and other substances.

If you happen to have a spare piece of leather that is soft and flexible, or a hide that has been reasonably well cured, you can make a leather thong relatively easily. Cut from your leather a circle as large as possible. Now, begin cutting from the outer circumference a piece of leather as wide as the thong you wish. Continue in this way to the inner part of the circle and you will have a continuous thong.

In the packing industry, strings for musical instruments and for tennis rackets are made from intestines. The best of this material comes from the small intestines of lambs, where about twenty-four feet are suitable for a superior product. It requires this portion of the intestines of eleven lambs to string a tennis racket. Those who have occasion to handle carcasses, and who are seeking material for tying things should not overlook the intestines of the animals as a source of supply. A tennis string must stand a strain of one hundred pounds to come up to the standard set.

Most fishermen have noticed that the average "gut" leader is made of a number of sections tied together. For the most part, these sections have been made from the silk glands of the commercial silkworm. Much longer gut leaders may be made in one piece from the native silkworms, which are to be found wild in most parts of our own United States. Among these moths are the cecropia, luna, promethea and polyphemus. Anyone can make an excellent gut leader from the caterpillars of these moths. Any good entomology will show pictures of these caterpillars, or they may be had from a twenty-five-cent bulletin called *The Moth Number,* published by the Slingerland-Comstock Company of Ithaca, New York.

When these caterpillars cease eating and begin to wander about preparatory to making their cocoons, they are ready to be used in the making of gut leaders. They are killed by immersing them in a saturated solution of salt and vinegar. To be sure that the killing solution enters the body of the caterpillars, shallow slits are made in the side of the body. In a day or so after the caterpillars have been killed in this way, they should be opened carefully. The two silk glands will appear plainly as silvery bodies. If a needle is thrust into one end of a gland and another needle into the other end, the glands may be drawn out through the solution and if this is done steadily and carefully the resulting gut will be uniform in diameter. A single caterpillar has two silk glands so may produce four of these leaders. If one needle is thrust in a support high enough to hold the other needle off the floor, and the glands left hanging, they will lengthen somewhat and will become most slender at the upper end. After a few hours it would be well to reverse the two needles, and a few hours later reverse them again. In this way a long, spindle-shaped gut will develop, which, of course, will be thickest in the middle. If the gut is cut in two in the middle, you will have two perfectly-tapered gut leaders that may be four or five feet long.

The story of the silkworm has been told so many times that we will merely summarize it in the chart section. But the animals' service must be recognized in peace or war. However, rayon, nylon and similar developments are, no doubt, only the first steps toward synthetic fibers or fabrics of superior quality, the social implication of which, centering around the products of the silk glands of one insect, staggers the imagination.

Animals that have long-haired tails can provide materials for reasonably satisfactory ropes or cords. Several short-haired animals produce in their pelts excellent wool, which may be spun into yarn and woven or twisted to form fabrics or cordage. These fibers are usually reserved for the making of blankets or clothing, their value lying in their beauty and warmth rather than in their strength and flexibility.

Primitive folk the world over have found in animal sinew a material that has wide uses. The better of these sinews are those of the backs of the larger animals. When these have been soaked, they are split into finer portions—some as fine as thread —which, twisted, provide a strong slender string for beads, bead-work, or sewing moccasins or garments.

Having suitable fibers with which to work, you may so combine them that they may make a cord with maximum strength and a minimum of diameter and weight.

Take a mass of fiber such as you can get from milkweed, nettle, hemp or flax. Make a rough cord somewhat larger than you wish your final cord or rope to be. Loop this over a stub of a tree or a nail, holding the opposite ends in your two hands. It may be more convenient for two to work on the job at the same time, in which case each person will work on one of the free ends. Give each end one or more twists in the direction taken by the hands of a clock. After each complete twist, shift the right hand end over the left one. If you wish a tighter-twisted cord, give it two twists, or more, before shifting the ends, but if you want a uniform bit of cordage always continue to give the same number of twists before a shift is made. New fiber may be added at the loose ends so that a uniform amount is constantly twisted into the rope or cord.

Rushes may be twisted into loose ropes for making mats or for providing seats for chairs. Once they are in place, they should be shellacked or varnished, and to give long service should be regularly varnished to avoid wear and general deterioration.

There is a rich literature on the making of baskets, mats, rugs and fabrics. One thing is certain, however, and this is that in spite of what the war may do to the silk, manila, sisal and rubber that we had come to accept as necessary to our way of life, the present emergency may prove to us that we can get along without them. We have the raw materials and the ingenuity. Should it develop that, when the war is over, we no longer need much that we imported, the aggressor nations may find that they made a grave mistake when they started puffing out their chests and talking of writing a peace of their own choosing in Washington.