Plants that Produce Oil

By E. LAURENCE PALMER

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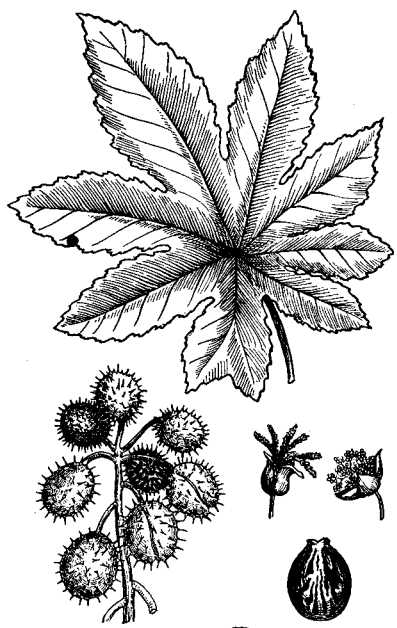
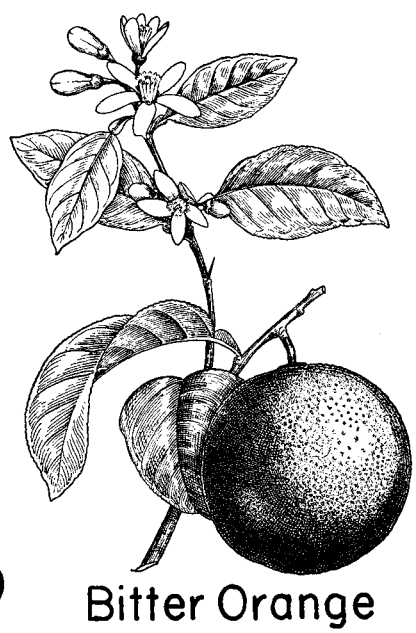
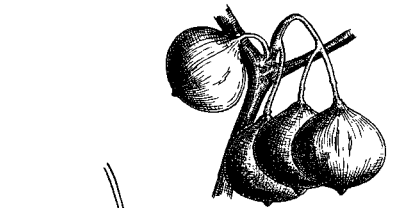
Sassafras

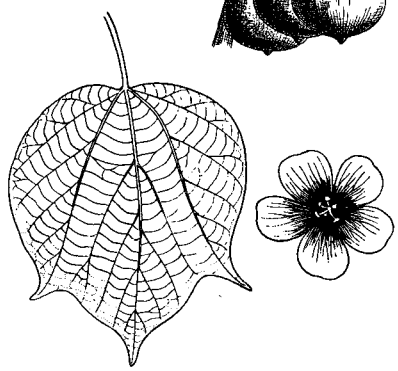


Castor Bean

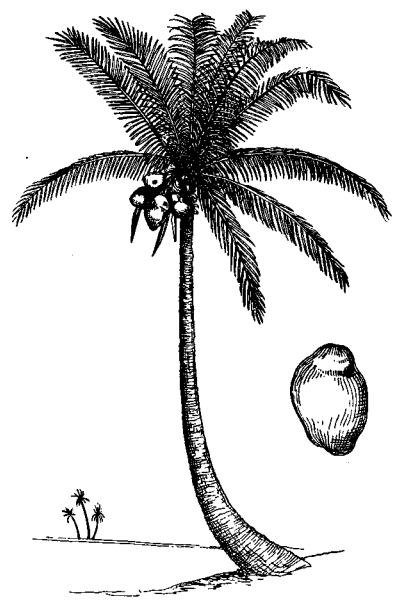


Bitter Orange

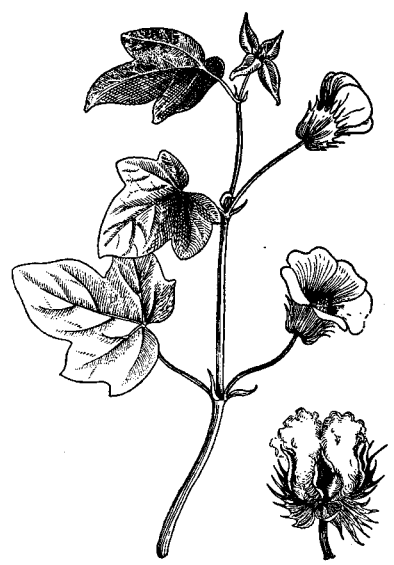




Tung-oil Tree



Coconut Palm



Cotton

When most of us think of the oil industry it is usually in terms of the oil coming from our mineral resources. As a matter of fact, however, plants can give us a never-ending supply of oil, much of which, gallon for gallon, is worth much more than petroleum. Of course, it is not likely that we will soon use oil from plants to drive our motor cars, nor is it likely that we shall use petroleum for some of the uses found for plant oils.

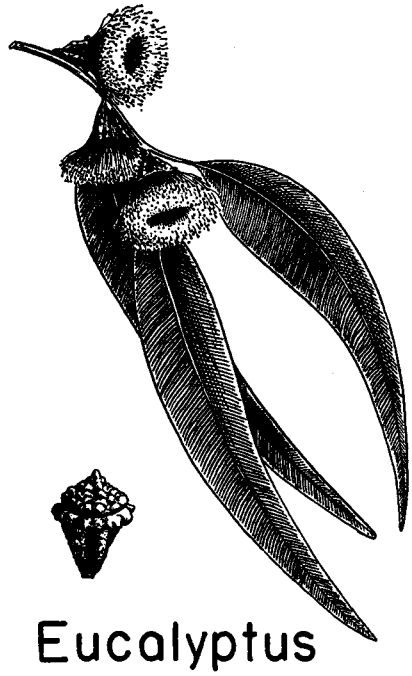
According to the dictionary, oil is any of a large class of combustible liquids soluble in ether but not in water, usually lighter than water, and soluble in alcohol. They leave a greasy stain on paper that may not be permanent and may be of plant, animal or mineral origin. The dictionary also lists 240 plant oils, thirty-five animal oils, and mentions specifically only two mineral oils.

Oils are mentioned in *The Bible* as early as the 18th verse of the 28th chapter of Genesis, apparently in reference to olive oil, which was used as food, as an illuminant and even, as today, as a dressing for the hair, the beard and the whole person. In Biblical times, as at present, much plant oil was obtained simply by the exertion of pressure on oil-bearing fruits. The name Gethsemane refers to an oil press. Sometimes the oil was expressed by treading on the fruits with the naked feet. In Micah VI, 15, we read of punishment that involved treading the olives but not having the privilege of using the resultant oil to anoint the body.

Phrases dealing with oil are relatively common in modern usage. We express hate and venom by suggesting that an enemy be boiled in oil. We speak of the oil of human kindness, in which the temperature of the oil is presumably lower. We pour oil on the troubled waters to bring about a calm consideration of things. We prepare for an examination by burning the midnight oil. We refer to oily phrases. We describe kindly

Olive

Rose Geranium



Eucalyptus

expressions as being softer than oil, and we refer to our old age by suggesting that death comes "after my flame lacks oil."

Of course, the major wheels of commerce turn profitably because of lubrication by mineral oils, for the most part. Royalties from holdings in oil wells have made the names of Texas and Oklahoma almost synonymous with affluence and wild spending, as well as with benefactions to charity, research in science, and education. Such concerns with oil may not refer to plant oils directly, but plants contributed originally to the production of much oil that now comes directly from the earth. So we owe a real debt to plant oils.

Vegetable oils are divided into two main categories based on their behavior when heated. These are the fixed or fatty oils, and the volatile or essential oils. Usually the fixed oils include the vegetable fats and the waxes. There is some relationship between gums and resins and the oils. Gums are, unlike the resins and oils, soluble in water, while resins, for the most part, represent essential oils that have been oxidized. They are not soluble in water. Dependent, in part, on reactions to this particular discussion, we may present in the future a companion unit on the gums and resins. It does not seem appropriate here to try to cover both fields in one unit. Oils frequently have a high food value, while the gums and resins usually have little such value.

Fixed or fatty oils do not evaporate, as do the essential oils. They cannot be distilled without being decomposed, as can the essential oils. Superficially, fatty oils are divided on the basis of whether they are liquid or solid at ordinary temperatures, and whether they ordinarily contain oleic acid, as in the oils, or stearic or palmitic acid, as in the fats. At ordinary temperatures, oils are liquid and fats are more solid. Fatty oils usually lack the strong taste, odor and antiseptic qualities of essential oils. They may contain both liquid and solid fats. Ordinarily non-edible fatty oils may be made edible by the addition of hydrogen. This hydrogenation process has added greatly to the world's available food supply. Lower grades of fatty oils from vegetable sources find a use in commerce and industry.

Since plants are complex organisms, it is impossible to classify plants on the basis of the fats and oils they produce since most plants produce some of each in varying proportions. However, in the chart section is information on coconut and palm-nut oil trees as sources of fats, and many plants as sources of fatty oils.

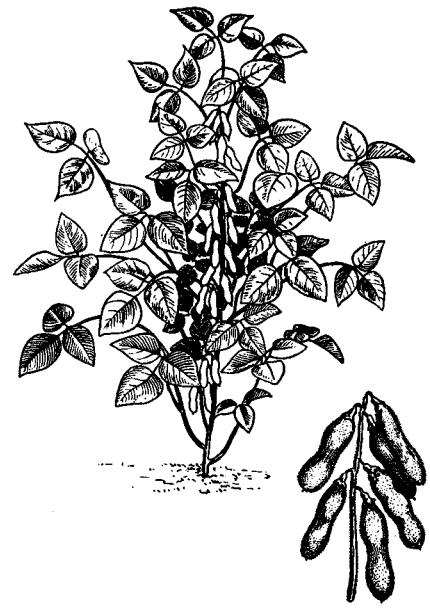
Fatty oils are conveniently divided into non-drying, semi-drying, and fast-drying types, dependent largely on the behavior of these oils in absorbing oxygen when exposed to air in a thin film. Frequently much depends on the speed with which an oil dries. Used as a dressing for leather it may be important that the oil dry slowly, or not at all. Used in a paint on cars on a production line, speed may represent the difference between profit and loss and success or failure in a highly competitive market.

Non-drying Oils

Not too many years ago much of the power used in industry was delivered at some point by great leather belts. These are now largely replaced by metal substitutes. But when such leather belts were of importance it was necessary that they be kept flexible to do their best work and to extend their period of usefulness. Motorcycles used to be driven by leather belts, and these were regularly kept in a flexible condition by the application of castor oil extracted from the seeds of castor beans. More recently this oil has been used rather extensively as a lubricant in airplane engines.

Red Cedar

Black Birch



Soy Bean

Sunflower

Flax

Its use as a lubricant of the alimentary tract is too well known to need comment here. Castor oil is not considered as being an edible oil, and the waste material left after extraction of the oil cannot be used as food for cattle, so most of it becomes a high-grade soil fertilizer.

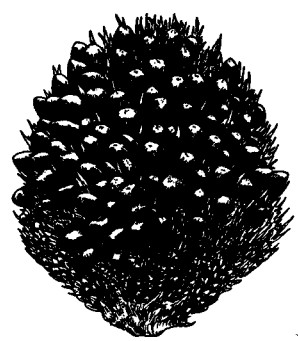
Peanuts provide us with another non-drying oil that differs from the castor oil in being a valuable human food high in protein value. It is used in margarines, in packing sardines, as a lubricant, and in the making of soap. Peanut oil has many of the properties of olive oil, and, since it is cheaper than that oil is sometimes used as a substitute, or as an adulterant of the more expensive oil. It is a common oil in some of our commercial salad oils; is high in riboflavin, thiamine and niacin. The Negro scientist, Carver, did much to bring out the commercial possibilities of peanuts, hoping thereby to improve the economic fortunes of his race. Peanuts thrive on soil that could not support an abundant corn crop.

Another non-drying oil is olive oil. This is extracted by pressure from ripe olives. Olive oil is possibly the most important of the food oils, and has the valuable attribute of remaining fresh a long time and becoming rancid only when exposed to the air. Some of us may have experienced rancid oil in the days when olives were sold in bulk. Now they are sold in bottles in which the heavy curvature of the glass magnifies the size of the fruit, and may also increase the price. Olives are raised economically in the United States in Florida, California and Arizona.

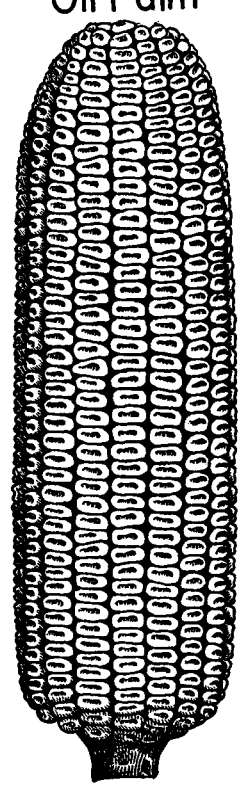
Other sources of relatively small quantities of non-drying oils, some with special values, are pistachio nuts, almond pits, seeds of grapes, tomatoes and mustard, as well as the pits of plums, peaches and apricots.

Semi-drying oils

Semi-drying oils are those that dry more quickly than the non-drying oils and less quickly than the drying oils. The more important sources of semi-drying oils in the United States are cottonseed, soybeans and corn embryo. In India a similar oil is extracted from sesame, (*continued on page 256*)



Oil Palm



Dent Corn

COMMON NAME SCIENTIFIC NAME	RED CEDAR *Juniperus virginiana*	DENT CORN *Zea mays indentata*	OIL PALM *Elaeis guineensis*	COCONUT *Cocos nucifera*
DESCRIPTION	Tree to 120 feet high, pyramidal in form and well-branched. Bark shreddy. Trunk to 4 feet through. Leaves mostly opposite, triangular, with tip free or pressed to twig. Twigs usually 4-sided.	Dent corn is one of at least four major varieties of corn and the one probably most common in commerce. The plant is an annual that grows to more than 12 feet high, has alternate, narrow leaves with clasping bases.	Tree to 30 feet high, with trunk to more than 1 foot in diameter. Holds remains of old leaves, which may be to 15 feet long, spiny margined, pinnate. Heads bear flowers in leaf axils in abundance usually.	Height of tree to 100 feet, with leaves pinnately compound and to more than 20 feet long and coming from a common head. Trunk fibrous and tough, often curved. Bark rough with muscle-like wrinkles.
RANGE AND RELATIONSHIP	Family Pinaceae. A rather common tree, found from Nova Scotia to Florida, west to Ontario and Kansas, with western red cedar, *Thuja plicata*, more closely related to eastern red cedar or arbor vitae.	Family Gramineae. A grass native of America but grown widely over the earth, from high in the mountains to sea-level. In America, it is the backbone of the hog and cattle industry. At best in middle West in United States.	Family Palmaceae. Native of tropical Africa but spread through most of tropical world and in some areas rather extensively cultivated. Java, Sumatra and western Africa main source of commercial supply.	Family Palmaceae. Originated probably in America, but widely spread over tropics of world where mean temperature is above 72°F. and there are 40 inches of rainfall a year, unless underground water is present.
REPRODUCTION	Staminate and pistillate cones on separate trees, clustered near twig tips. When young, cones appear like cones; but when mature, pistillate cones look like blueberries to ¼-inch in diameter.	Annual with staminate flowers borne in tassels at top of stalk. Pistillate flowers borne in short ears enclosed in leafy husks. Requires about 145 days from seed to seed. Chromosomes 10, 20, 40, 80. Average yield per acre 2218 pounds.	Stamens and pistils borne in separate flowers on a common plant, in leaf axils, in heads with pistillate larger than staminate, and with 3-celled ovary and loose husk. Fruits pointed, and about 1¾ inches long.	Flowers borne at head, beginning from 4 to 10 years. Flowers in club-like structures, white or yellow, with staminate having 6 stamens and pistillate producing 1-seeded "nuts" in coarse tough husks.
ECOLOGY	Found most commonly on dry hills or in dense swamps, with soil pH 5-8, usually mixed with other species, but sometimes in pure stands or isolated in old pastures. Sometimes used as an ornamental.	Soil preference pH 5-8. Medium salt tolerance. Average leaf surface per plant 7900 sq. cm. or 600-1320 per leaf. Optimum summer temperature 70-80°F., with nights about 58°F. Flowers earlier at 80°F. and later at 60°F.	Flowers are pollinated by pollen from same tree without affecting virility. Trees begin to bear at about 5-6 years and reach full production at 15 years, continuing to yield well until 70 years old.	Chromosome number is 32. May tolerate salt water and withstand drought, although limitations may decrease crop subsequent year. Subject to a number of insect and fungous pests. Virile nuts may float 100 miles.
ECONOMY	Tree is host to intermediate stage of cedar-apple disease, which harms apple crop. Wood valuable as lumber for furniture, for posts and for pencil manufacture. Little oil in sapwood. Heartwood yields 1-3½% of oil by weight. Oil is fragrant and is used in soaps, deodorants, furniture polishes, insecticides and as reputed moth repellent. Has high index of refraction and used in preparing slides for microscope use, and used in geranium and sandalwood oils and for mineral separation.	Corn oil has melting point of –20°C.; specific gravity of 0.922; saponification factor of 194.3. Corn embryos were considered a waste in the milling process, but they contain about 50% oil, which has many uses in the manufacture of soaps, cheap paints, rubber substitutes and similar products of industry. Like cottonseed oil, however, it has little value as a lubricant. It is classified as a semi-drying oil. By refining processes 75% of the oil may be used as food, and the Mazola cooking oil common in bakeries is maize oil from the embryos of corn.	Each tree may bear annually to 2000 nuts whose fibrous pulp is to more than 60% fat and yields a yellow to red-brown oil, which is eaten by natives but is used mostly in soaps, candles and such materials. More than 200,000 tons a year make up world trade in oil from fibrous pulp. Oil from kernels is a fine oil with a nutty flavor used much in margarines and making a world market of more than 500,000 tons a year. Oil may be extracted by pressure or by solvents. The waste cake makes excellent food for cattle.	Fiber around nut is "coir" of commerce. Dried endosperm of nut is "copra" of commerce and comes mainly from Ceylon. Copra may yield 60-65% of oil, with melting point of 25.1°C; specific gravity of 0.924 and high saponification figure of 268. 100 grams of nut meat may produce 359 food calories, 34 grams of fat, be 14% carbohydrate and be high in vitamin A. Oil, is pale yellow or colorless, and cold-pressed oil is edible and used as food in margarines and other vegetable butters. Other uses include soaps and salves. Waste cake is excellent stock food.

ENGLISH WALNUT *Juglans regia*	BLACK BIRCH *Betula lenta*	SASSAFRAS *Sassafras albidum*	PEANUT *Arachis hypogaea*	SOYBEAN *Glycine max*
Tree to 70 feet high. Trunk relatively short and straight. Bark gray or brown, rough. Twigs coarse, with diaphragms in pith. Leaves compound, of 5-15 leaflets, each 2-5 inches long, bright green and smooth.	Tree to 80 feet high, with trunk diameter to 5 feet. Bark on old trees dark and broken into irregular scales. Twigs with spurs crowded with leaf scars. Leaves to 5 inches long and 3 inches wide.	Tree to 125 feet high. Twigs rubbery, bright green when young to brown when mature. Leaves of 1, 2 or 3 lobes, alternate, to 6 inches long and to 4 inches wide. Turn brilliant red in autumn. Relatively thin.	Bunchy vines to 20 inches high with many branched stems that are somewhat hairy. Leaves of 4 leaflets, each to 2½ inches long, smooth, green, usually entire and without tendrils, blunt or short-pointed.	Erect, bushy annual, brown-haired, to 6 feet high and often with vine-like side-shoots. Leaves compound, of 3 leaflets, each to 6 inches long, entire and to 2/3 as wide as long. Plants form dense tangle.
Family Juglandaceae. Cultivated in America mostly in California and Oregon, but grown in great plantations in China and Europe. Can survive weather north into New York and south into Georgia in the East.	Family Betulaceae. Related to hazels and beeches. Black birch ranges from Florida to Newfoundland and west through Ontario and Tennessee, where it is often abundant in mixed forests.	Family Lauraceae. Family with 1000 species and 40 genera. Genus of three species found in North America, China and Formosa, with American grown as ornamental because of fall coloration but may winter-kill badly.	Family Leguminosae. Native of Brazil but carried to Old World by Portuguese and then back to Virginia from Africa by slaves. One of most important agricultural crops of the South, south of Washington, D.C.	Family Leguminosae. Native of China and Japan, but grown widely over earth, in suitable territory, for forage, soil improvement, human food and commercial oil which is of semi-drying type.
Pistillate and staminate flowers separate but on a common tree, with pistillate borne at end of year's growth. Nuts in thin husks and with thin shells. Budding and top grafting commonly practiced in culture.	Staminate catkins bloom with appearance of leaves, when they elongate from ¾ to 4 inches. Pistillate catkins cone-like, erect, to 2 inches long, shedding winged fruits through the winter.	Flowers to ¼-inch across, in broad, loose, open clusters with stamens equal in length to calyx. Fruits are bright blue, to 1/3-inch long and, when immature, with scarlet calyx enclosing them. Chromosome number 48.	Flowers yellow, in close spikes of 1-3 flowers borne close to ground and when fertilized or mature forced under ground. Self-fertilized with no inbreeding degeneration. Chromosome number 40.	Flowers, white or purple, inconspicuous, with hairy calyx. Stamens commonly fastened together. Fruit, a pod to 3 inches long and ½-inch wide, brown and hairy with 2-4, globular, vari-colored seeds. Ch. #40.
European nuts collected largely from woodlands, but in America they are grown in cultivated orchards. Wood is known as French, Circassian, Turkish or Italian walnut and is used widely in furniture.	A slow-growing tree frequently attacked by fungi and appearing injured thereby. Wood makes good furniture and indoor finishing lumber and excellent firewood, particularly for campfires.	May form considerable thickets, particularly at edge of woodlands. Plants are either staminate or pistillate, or may bear both in small numbers and appear before the development of the leaves.	Cannot survive frosts, and tops are harvested for forage before frost. Great soil enricher when used in rotation with other crops. In North, is grown for forage and soil enrichment. Best in sandy soils.	Best in warm, well-drained loam, usually planted in drills 2½-3 feet apart and cultivated at first. May be plowed under as excellent green manure for soil enrichment or cut for hay or matured for seeds.
Oil is a drying oil used for white paint and in artists' paints and for printers' inks and for soap. Best oil for these purposes is pressed hot, but it is not edible. Fresh-pressed or cold-pressed walnut oil has a nutty flavor, a good smell and is edible. The waste oil cake is used for cattle food. In America, oil extraction comes largely from nuts rejected for sale as food delicacies. Pulverized shells are used in plastic manufacture and in synthetic resin adhesives. Shells used in tires also.	Birch oil, practically identical with wintergreen oil, is distilled from bark of trunk and from twigs or from stem wood. One cord of wood, bark and twigs should yield 4 pounds of oil, and 1 ton of bark should yield 5 pounds. It takes 8-12 hours for distillation with 1 pound of Northern oil worth to $3.75, and of Southern oil, to $2.00 a pound. Oil is used in flavoring candy and soft drinks and in disinfectants, but natural oil is being replaced by synthetic oil from coal tar.	Roots yield to nearly 2 grams of oil per 100 grams of root, with a ton of material yielding commercially about 20 pounds of oil. Source is largely stumps, which are cut into fine chips from which oil is extracted by steam distillation. Oil is used in manufacture of soft drinks, in medicines for flavoring and in the flavoring of soaps and the making of perfumes. In America, the industry of making sassafras oil is best developed in Tennessee, Maryland and Virginia. Bark about 10 times as productive of oil as is the wood.	In 1955 in U.S., 1,610,-450,000 bushels of nuts were picked and used. Natural oil is 40-50% of nuts. Is most valued source of protein in diet. Oil has melting point at 3°C., a specific gravity of 0.914 and a high saponification value. 100 grams has 559 food calories and is high in thiamine, niacin and riboflavin. It is used in salad oil, for packing sardines, for margarine and as adulterant of olive oil. Poorer grades used as lubricants and in soap.	While plants are self-pollinated there is no inbreeding degeneration. Oil is high in protein valuation and is low in carbohydrate and used in diabetic diets, and also used rather extensively in manufacture of plastics like celluloid. Oil has melting point of −16°C., a specific gravity of 0.927, and a saponification factor of 190.6. Oil is midway between linseed and cottonseed oil in characteristics and used as drying or semi-drying oil. Refined oil used as salad oil, with inferior grades used in soaps, ink, candles, varnishes.

COMMON NAME SCIENTIFIC NAME	FLAX *Linum usitatissimum*	ROSE GERANIUM *Pelargonium odoratissimum*	ORANGE *Citrus aurantium*	TUNG OIL TREE *Aleurites fordii*
DESCRIPTION	Herb, to 4 feet high, with stems under ⅛-inch in diameter, usually divided at or near base into 2 or more nearly equal branches. Leaves alternate, to 1½ inches long. Best fiber from unbranched plants.	Normally found as a pot herb for use as houseplant or for garden flower. Under 3 feet high, freely branched. Old stems woody. Leaves with heart-shaped blades with 5-7 lobes. Perennial.	A tree to 20 feet high or more, with twigs bearing blunt spines. Petioles of the leaves have broad wings, lustrous green, waxy in appearance, to 4 inches long and usually blunt.	Tree to 25 feet high, commonly set like orchard trees, showing conspicuously smooth branches. Leaves, alternate, milky juiced to 5 inches long, heart-shaped or 3-lobed, at first, with loose fuzz beneath, then smooth.
RANGE AND RELATIONSHIP	Family Linaceae. Two major strains developed, one for fiber production and one for seed production and resultant oil. Grown most commonly in Argentina, India and the Dakotas. Known from Stone Age as a crop.	Family Geraniaceae. Native of South Africa with this species grown commercially in Florida, Texas and California. Related closely to common geranium, *Pelargonium hortorum.*	Family Citraceae. Known as bitter or Seville orange and a native of southeastern Asia, whence it was brought to Spain and cultivated thousands of years before the sweet orange was brought.	Family Euphorbiaceae related to castor bean, Para rubber tree and the spurges and closely related to candlenut, *A. moluccana,* well established in tropics. Grows on soils unsuited for normal agricultural crops.
REPRODUCTION	Flowers, ¾-inch wide, delicate blue. Chromosome number 30. May self-pollinate without inbreeding degeneration. Seeds germinate in 3-7 days at 20-30°C., weigh 56 pounds per bushel. Crop matures 75-100 days.	Flowers usually narrower than those of common geranium, with rose or pink petals, and with the two upper slightly the larger. Fruit, long, slender and 5-valved, bursting to free seeds on slings.	Flowers are several in clumps or single, white in bud and, when open, tremendously fragrant and with 20 or more stamens. Fruit is to 3 inches in diameter with sour pulp, with hollow core.	Flowers appear before leaves in open clusters appearing reddish white. 1-inch petals. 3-inch fruit, with 3-5 cells. Pollen lives 1 day at 5°C., germinates 40%. Chromosome number 22. Fruit like black walnut.
ECOLOGY	Of medium salt tolerance. For seed production is planted broadcast at 2-3 pecks per acre on fertile clay loamy soils, or drilled and rolled to 1 inch deep. Seeds threshed out. See insert #26 for fiber story.	Easily killed by frost or freezing. Under cultivation flowers and leaves should not be wet, water being best supplied from beneath. Does best in soil high in potassium and phosphate. Is rose-scented.	Bitter or sour oranges cannot survive too cold climates but are more hardy than are the sweet oranges of commerce. It is grown as an ornamental and as a base for grafting sweet oranges.	Grows best in strip 100 miles wide along coast of Gulf of Mexico, where bearing begins at 3-4 years and in 8 years an acre of 100 trees should produce 2000 to 2500 pounds of nuts yielding 400-500 pounds of oil.
ECONOMY	Grows in soil with pH of 5.-8.5 yielding about 470 bushels per acre and U.S. 1955 crop of 40,638,000 bushels. Fiber, almost pure cellulose, 15-92 cm. long. Yield about equals that of peanuts, barley, potatoes, buckwheat, sugar beets or grapes in dollars in U.S. Oil is a drying-oil used largely in paints, heating raw oil to 65°C. produces boiled linseed oil. Oil extracted by pressure, heat and solvents and used in paints, varnishes, inks, linoleum and elastic film. Waste used as cattle food.	Plants yield geranium oil by distillation of both leaves and flowers. In Europe, *P. hortorum* is commonly raised in France and Spain. Also raised in Algeria. In America, *P. odoratissimum* is species favored. Oil is used in making perfumes for use in soaps, and in disinfectants, and is commonly used as a cheap adulterant of the more expensive oil of roses, which has a high commercial value. Shoots yield .15% of oil, with specific gravity of 0.889-0.904.	Essential oil from rind is used in perfumery and in manufacture of the liqueur "curacao" and fruits are used in orangeade, marmalade and candied orange peel. From the flowers is distilled the essential oil "neroli" obtained by distillation and by solvents. The leaves and twigs yield "petitgrain oil" and the ripe peel yields "oil of orange." Neroli is the most valuable, with "neroli bigarade" coming from flowers of bitter orange and "neroli Portugal" coming from flowers of sweet orange.	First planted in U.S. in 1905, but nuts first imported in 1869. Nuts yield 20% of weight in oil. U.S. uses more than 70% of world crop, and in 1949 produced crop worth $4,728,000, or up $1,600,000 in 5 years. Oil, a quick-drying agent, speeds up automobile production by fast-drying paint. Oil is pale yellow, to dark brown, a preservative, waterproof agent used in paints, varnishes, leather finishing, linoleum manufacture, printing and electrical supplies; melts at –2.5°C. Specific gravity 0.934. High saponification factor.

CASTOR BEAN *Ricinus communis*	COTTON *Gossypium hirsutum*	EUCALYPTUS *Eucalyptus globulus*	OLIVE *Olea europaea*	SUNFLOWER *Helianthus annuus*
Tree or herb reaching height of to 40 feet in sub-tropics or to 15 feet as herbaceous annual. Leaves like great stars with palmate veins, thick, to 3 feet across, smooth or with spiny structures beneath.	Herb to 8 feet high heavily branched from central stem. Leaves to 6 inches long and to 5 inches wide, heart-shaped, 3-7 lobed, coarse-veined. Sometimes an herbaceous shrub. Annual with 1 main taproot.	Tree to more than 300 feet high, with bark that peels off in great longitudinal sheets or strips. Leaves opposite, borne on young shoots, thick and leathery, pointed at one end, to more than 1 foot long, often whitened.	Tree to more than 25 feet high, with thornless twigs, nearly round in cross-section, with evergreen leaves to 3 inches long, dark green above and silvery beneath, opposite and elliptic and entire.	Height to more than 15 feet. Stem coarse, little branched below, rough-scaled and somewhat hollow. Leaves alternate, to more than foot long and of about equal breadth, coarse, rough.
Family Euphorbiaceae. Related to spurges and to tung oil tree. Native of Africa but now widely distributed over world in suitable climates, and raised as ornamental under cover or in summer gardens north to New Jersey.	Family Malvaceae. Related to mallows. 95% of U.S. crop is upland cotton, *G. hirsutum*. Other cottons include Egyptian cotton, *G. peruvianum*, and sea-island cotton, *G. barbadense*. See also insert #26. 29 species.	Family Myrtaceae. Native of Australia but naturalized in California and many other parts of the world where soil and climates are suitable. More than 300 species known from native area. California introduction in 1856.	Family Oleaceae. Related to our ashes. Native of the Mediterranean region, where wild form has 4-angled twigs that are thorny and has broader leaves than cultivated species. Grown in California.	Family Compositae. Native of North America or of Peru, but found wild in many gardens throughout much of United States. May establish itself where it has been under cultivation north into Canada.
Flowers, staminate or pistillate, borne on common plant in rather open terminal clusters, with numerous stamens and fruits bursting into 2-3 sections freeing the large attractively marked seeds rich in oil. Fruits spiny.	Flowers white or light yellow, turning to purple, usually less than 2 times length of bracts. Chromosome number 52. Cross pollination effective 18% at 1 foot; 7% at 100 feet; 2% at 900 feet. No inbreeding degeneration.	Flowers to 1½-inch across, solitary or in small groups, with hard calyx-tube covered with a blue-white wax. Fruit stalks flattened. Chromosome number 20. May be self-fertilized but commonly crosses.	Flowers are fragrant, white, axillary, with 4-toothed calyx and 4-lobed short tube on corolla, 2 stamens and egg-shaped cherry-like fruit. Chromosome number, 46. May be self-fertilized without deterioration.	Flowers borne in broad flat heads. Chromosome number is 34 or 68. Heads borne at top of plant or at branch ends. Ray flowers appear as yellow streamers, with disc flowers crowded, brown to purple.
Chromosome number is 20. May be self-pollinated but cross-pollination is more common. Grown for ornamental in North; should be started in early spring under cover and then transplanted.	Requires about 200 days with mean summer temperature of 77°F. and 10-22 inches rainfall after harvest. Seeds planted 1-3 bushels per acre 2 weeks after last killing frost, with maturity usually September to November.	Flowers from December through May in California, with flowers yielding much nectar attractive to bees but resultant honey does not have a good flavor and brings a low price.	Grows at best in soil with pH 5.-8.5. Is of medium tolerance to salt in soil. Roots may penetrate soil to depth of 9 feet for water supply. Trees may be considered as long-lived usually.	Favors soil at pH 6-7.5. Is medium tolerant of salt in soil. Is sterile to own pollen. Seeds germinate in 3-7 days at 20-30°C. Seeds mature best on the plant up to time of harvest. Flowers from July through September.
Considered a blood poison (ricin). Oil has commercial value as a non-drying oil useful in dressing leathers, as a lubricant in airplane engines, as an illuminant in candles, in making soap and in medicine as a well-known household purgative. Oil cake of waste is poisonous to cattle but makes excellent fertilizer. Seeds yield 25-40% of a colorless or thick greenish oil. Expressed oil is boiled and then filtered to remove mucilage and proteins. Seeds put in rodent holes to be taken as poison.	Grown for fiber as outlined in insert #26. Grown also for seed, producing a semi-drying oil with melting point at -1.0°C.; specific gravity of 0.917; high 194.3 saponification value. Oil from the seed is used as a lard substitute, with waste used in cattle foods. The glycoside *gossypol* from the seed may cause edema of lungs, and serious irritation of kidneys. Plants have high tolerance to salt in soil and roots may penetrate to 6 feet for water. Seeds germinate in 4-12 days at between 20-30°C. A major crop.	Leaves yield oil at rate of about 2 grams per 100 grams of leaves. Oil has specific gravity of 0.922-0.966. Extracted by distillation from leaves oil is used in treatment of colds, malaria and fevers. Oil is colorless or pale yellow, spicy and pungent. Related species of *Eucalyptus* provide important sources of some kinds of tannins. Because of great demand by trees for water they are sometimes grown to reduce mosquito hazard from surface waters.	Pollen is reported to be able to cause hay fever. Major economic importance in connection with fruits used as food and for oil production. Oil is important non-drying oil. It is squeezed from pulp by hand or by machines with the finer extracted by hand. Best oil is golden, clear, odorless and edible. Poor oils are green and used in making soap, or as lubricants, and are extracted often by solvents. Produced economically in California, Florida and Arizona in United States.	Oil is edible and is cultivated for food by man in many parts of the world. Oil also finds a commercial use in manufacture of varnishes and soaps. Oil has melting point at -17°C. and a specific gravity of 0.923. It has high saponification value, making it useful in soaps. Commercially it is classified as a drying oil along with linseed oil, tung oil and walnut oil. The fruits are among the most popular feeds used for attracting birds to window feeding stations.

(*continued from page 251*)

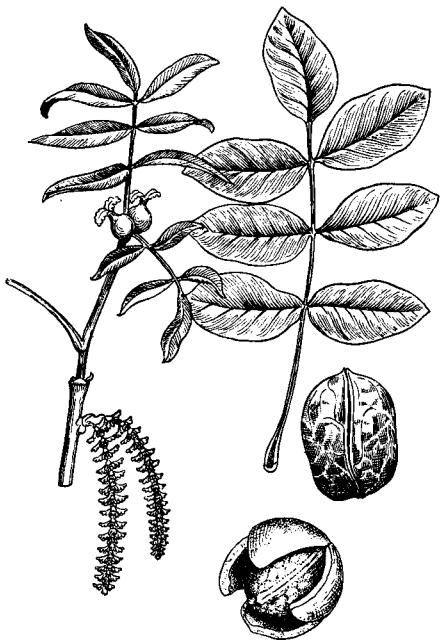
which is produced in limited quantities in the United States in the South. These oils vary in their edibility, as shown in specific ways in the chart section. In earlier times, most of this oil came in America from cottonseed, but in more recent time the yields from corn embryo and from soybeans have been increasing steadily.

A rather casual listing of the commercial products that depend upon cottonseed oil should give some idea of the broad base on which the importance of this oil is founded. In addition to being of value as food for man and beast, this oil is used in such varied products as roofing tar, glycerine, nitroglycerine, putty, artificial leather, insulation, washing powders, soap and linoleum. This whole market has been built largely on substances that, years ago, were considered as worthless by-products.

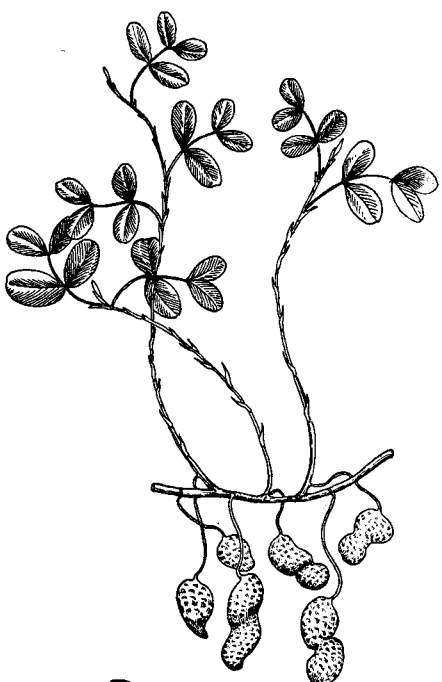
Some of the uses of cottonseed oil seem rather remote from the uses originally considered important to cotton growers. For example, when it was discovered that liver had unique dietary properties the price rose so that it could no longer be used for feeding fish in hatcheries. But cottonseed meal and cottonseed oil could be used in producing mixtures that could be fed economically and with biological success to young fishes. This, of course, made it economical to increase the fish population of our waterways and thus affect favorably our food supply from such sources. Cottonseed oil has not, however, found a use as a lubricant.

For generations the embryos of corn were a drug on the market, and added little if anything to the profit of the milling industry. Now this rejected material is recognized as of importance in the manufacture of some cooking oils used so extensively by bakeries. It also is important in the manufacture of rubber substitutes, paints and soaps of some kinds.

Soybean oil, sometimes classified as a drying oil as well as a semi-drying oil, is finding expanding industrial uses not only in edible salad oils but in printer's inks, varnishes, soaps and candles.



English Walnut



Peanut

Drying Oils

Drying oils are represented generously in the chart section of this insert. From flaxseed we get the linseed oil so universally used in paints. From tung we get tung oil so essential to rapid-drying paints used on cars in production lines. Sunflowers and English walnuts also yield oils that dry rather readily. Of these, the sunflower is the only native plant. Flax was brought to America for use as a fibre and has found importance in the production of oil from the seeds. English walnuts were brought in for the production of high-priced delicacies, and the waste nuts have found a value in the production of an important drying oil. More important, possibly, than either of these in the minds of some is the production of tung oil centered almost exclusively in America in a strip, about one hundred miles wide, adjacent to the coast of the Gulf of Mexico. Fortunately tung trees do well on soils of a quality too low to support the more established agricultural crops. Since the United States uses in its industries most of the world supply of tung oil it is fortunate that it can be produced in the raw state within our boundaries. This naturally makes us independent of foreign countries for much of our needs in this field.

Vegetable Fats

Vegetable fats, which are solid, while vegetable oils are liquid at ordinary temperatures, are important to our modern way of living. While a generation ago we were, by law, almost wholly dependent on the dairy industry for our butter, today we find vegetable substitutes reasonably satisfactory and welcomed by those who must live within a close family budget. Much of the nut margarine or nut butter, which is now legally colored to resemble butter, comes from either the coconut palm or from the oil palm, both of which are discussed in detail in the chart section. Since these are not produced extensively, or at least on a competitive commercial basis, within the continental United States we do not consider them further, even though most of us may eat some of the product, knowingly or otherwise, even in the better restaurants and hotels, if not in our own homes. The production of related waxes and soap substances in the United States is not sufficient to warrant development here.