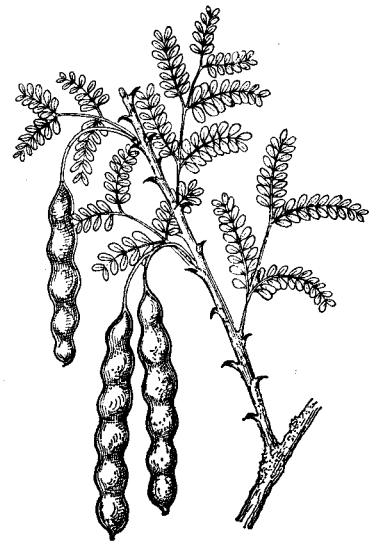


The Legumes— Our Hope for the Future?

By E. LAURENCE PALMER

Illustrations by Elizabeth Burckmyer

*This is the 102nd of
NATURE MAGAZINE'S special educational inserts.*



Cat's-claw



Scotch Broom

THE LEGUMES are not plants for the pessimists. If skeptics deplore the loss of valuable topsoil through erosion, it can be shown that the deep anchor roots of many legumes do much to hold the soil against the erosive forces of wind, water, and traffic. Should the pessimist bemoan the chemical depletion of the soil, we can show that the legumes, linked

with the bacteria with which they may be associated, enrich rather than deplete soils. When the cynics say that the future of our soil resources is bleak, we can point out that, under good circumstances, we may build topsoil at the rate of about one-half-inch a year with the help of legumes. If we worry about our supply of proteins, we know that the legumes can "save the day," if we are willing to make reasonable adjustments. If we are concerned about a lowered water-table, it is

pleasant to know that deep rooted legumes may tap a new supply. Are we lamenting our vanishing wildflowers? We should remember that some of the most beautiful, most fragrant, most persistent and hardiest of wildflowers are legumes. No, the plant kingdom will not let us down in time of need, as we shall see when we consider the potentials for good to be found in the legumes.

It would be possible to devote the whole of this article to the merits of legumes, but perhaps more useful to be specific both as to the plants involved, the services they provide, and the methods by which they may be managed to meet our needs. Whether we realize it or not, legumes play their part in our flesh and blood, in our most prized woodwork, our medicine cabinets, the dyes that please our eyes, the flavors that please our palates, and in many other important elements of our environment.

There are also legumes that are inimical to our interests. Many bear spines that tear our clothing and

Garden Pea



Field Bean



Bluebonnet



Yellowwood





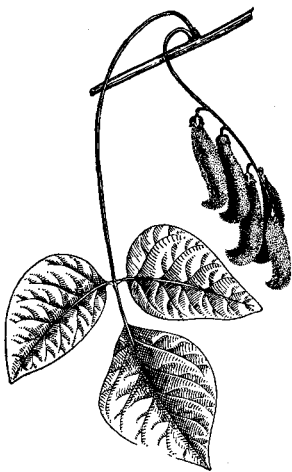
Screwbean



Kentucky Coffee Tree



Lentil



Velvet Bean

our flesh. Many produce poisons that can kill us or our domestic animals. Not a few are weeds that compete successfully with more desirable plants for growing space on our lands. Legumes find a place in our religions, in our economy, in our folklore, literature and nursery rhymes. Coupled with the grasses, they could just about meet our every need. Alone, they may offer our greatest hope for a bright future.

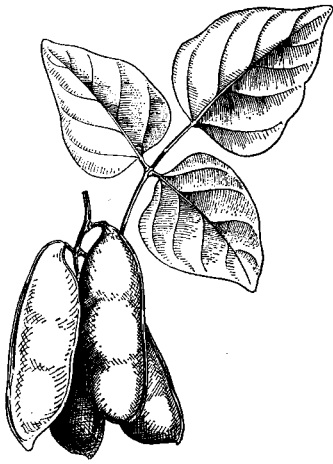
The little nursery rhyme that asks us if we know how "oats, peas, beans and barley grow" may really be more challenging than it appears. In this quartet of plants, we have two grasses and two legumes—a balanced combination that pleases the youngster who uses the phrase, the dietician and the soil manager. We find in *Genesis* mention of Esau and a diet of bread and a pottage of lentils, and the great importance that hungry man saw in them.

In our folklore, we frequently associate legumes with particular places or particular people. Boston and baked beans automatically go together. There is a saying that Leicester beans and bacon make food for a king, and another to the effect that if you shake a Leicestershire man by his collar, you will hear the beans rattle in his belly. (I have never yet tried to test the validity of this statement!) Some sayings imply that an appreciation of beans and other legumes as food is best stimulated by hunger. When I was in the United States Navy, where I learned to love beans, I would have resented any such insinuation. There are, however,

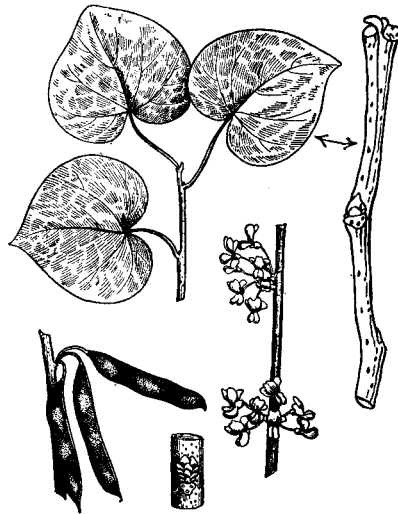
statements that say that hunger changes beans to almonds, and makes raw beans taste of sugar. Hunger, it is said, even makes hard bones sweet beans.

Somehow, beans are commonly associated with intelligence. It is hardly complimentary to say that a person "doesn't know beans" about a certain subject, but I have frequently questioned whether some of our high school and elementary science textbook writers knew their beans, judging by their errors. One saying associated with beans implies that a man who "knows how many beans make five" has a rather critical concept of values.

Possibly no man in modern times recognized and demonstrated more values in a single legume than did the Negro biologist, George Washington Carver, who increased phenomenally our appreciation of the value of the peanut, both in the diet of man and in the enrichment of soil. During World War I, he demonstrated to the government that a sufficient and varied diet, balanced in proteins, carbohydrates, and fats, could be made from the sweet potato and the peanut alone. This eliminated the somewhat inefficient practice of relying on "hog-belly" as an essential in planning a balanced diet. It was also one of the factors that led the South into growing legumes to fight erosion, soil depletion and the dangers of the one-crop system. The use of kudzu, velvet bean and bird's-foot trefoil is discussed in the chart section of this insert, and the importance of soybeans, peanuts and other legumes in general agriculture has been considered in earlier units. Quite possibly it was Carver's studies that gave youngsters of the world that ever-popular food, peanut butter. Here are just a few of the things that Carver derived from the one legume, the peanut—meal, instant and dry coffee, tan remover, bleaches, metal polish, axle grease, linoleum, synthetic rubber, ink, washing powder and plastics. Carver demonstrated that he could get from peanuts alone food comparable to milk, butter and cheese. This improved the health and chances of survival of thousands of people who lived in parts of the world where peanuts



Lima Bean



Redbud



Gorse

could be grown, but where cows could not survive because of insects or temperature. There is not the slightest question that but for his discoveries and his dedication to serving mankind and his ability to make friends and influence people, the South would not be the prosperous part of our country that it is now. Much of that success was based on his appreciation of the merits of legumes.

A mid-West farmer once boasted that he owned three farms, but that he paid taxes on only one. No one could do anything about it, and he prospered more than his neighbors, who farmed but one of the three farms that were also available to them. The farmer in question grew alfalfa instead of corn alone. The alfalfa roots used the soil that the corn plants would use, and then went deeper to another farm that was untouched by the corn. Water not available to the corn in the dry season was available to the deep-rooted alfalfa. Besides these two farms, the alfalfa used a third, the air from which nitrogen was extracted by the bacteria that the alfalfa harbored, but which the corn did not. This nitrogenous material brought to the soil by the bacteria enriched the soil instead of starving it, so that even the first farm near the surface was richer instead of poorer than the farm that supported corn only.

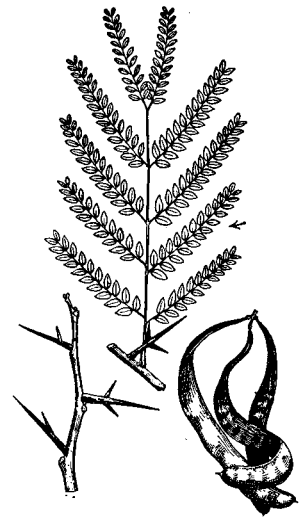
Earlier, we wrote of the valuable combination of grasses and legumes in the diet of animals. Interestingly enough, we know that there is considerable difference in the values resulting from growing Kentucky bluegrass and white clover together. A field that will yield 900 pounds of valuable forage per acre where the bluegrass alone is available, may yield to 3000 pounds per acre if white clover is grown alone. But if the clover and Kentucky bluegrass are planted together on the same soil, the yield may well be about 5000 pounds of forage per acre. Not only is there an increase in the quantity of the forage, but the quality also increases. Thus, if we measure the value of a field in terms of the yield, we may, by management alone, make an acre of land yield more than five times as much forage as might otherwise

be the case, even with methods that long had been considered sound. The importance of this to our future, with increasing populations reducing the number of acres available per person, is reflected in the fact that, by wise agricultural practices between 1950 and 1956, we increased our agricultural production by fourteen percent, while at the same time our population increased by only nine percent. By this system we also can produce surpluses

that may be useful in helping populations not so fortunate, even though these surpluses may complicate our economy. Much of this improvement in our agricultural future rests on a better understanding of how legumes may be used; not only to increase the yields of our soils, but to guarantee a sustained yield and to produce superior agricultural products. So remarkable has the record of the technical agriculturalists been that there is sometimes criticism that they have been *too* successful. But it promises well for the future.

We have changed our views about the importance and management of many legumes. Bird's-foot trefoil, once considered a weed and then a garden flower, now is considered one of the most valuable of our forage clovers and soil restorers. Sweet clover, once considered only as a weed, now is recognized as having some value as forage, excellent value as a soil anchor and restorer, and superior value as a source of nectar for honey-making bees. Even the lowly weed, none-such, has been credited by range

(Continued on page 368)



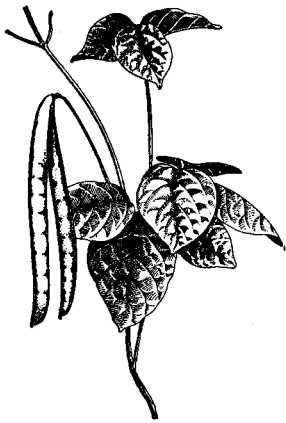
Honey Locust

COMMON NAME SCIENTIFIC NAME	CAT'S-CLAW <i>Acacia greggii</i>	SCREWBEAN <i>Prosopis pubescens</i>	KENTUCKY COFFEE TREE <i>Gymnocladus dioica</i>	HONEY LOCUST <i>Gleditsia triacanthos</i>
DESCRIPTION	Tree to 30 feet high, with trunk diameter to 1 foot. Many spreading branches, angled lengthwise and with strong, recurved spines at leaf bases. Bark, furrowed, thickened to 1 inch, longitudinally furrowed, separating into thin, narrow scales. Leaves, alternate, compounded of 1-3 pairs of feathery compound parts, to 3 inches long, slightly fuzzy or downy.	A tree, to 30 feet high, with trunk to 1 foot in diameter, round branches often fuzzy but becoming smooth and light red-brown by third year. Spines to 1/2-inch long, trunk bark thick, light brown to reddish. Leaves fuzzy, to 3 inches long, with pairs of feathery clusters of leaflets. Leaflets to 2/3-inch long and to 1/8-inch wide. Branches spreading.	Coarse tree, to 110 feet high, with trunk to 3 feet through, usually dividing 10-15 feet up into 3-4 main trunks. Twigs, coarse, blunt to 1/3-inch through at tip, brown to gray the first year, with large coarse leaf-scars, alternate. Leaves alternate, to 3 feet long and to 2 feet wide, divided into 7-9 parts and subdivided to 6-14 leaflets, with leaflets and divisions opposite.	Thorny tree, to 140 feet high, with trunk to 6 feet through, and bark to 3/4-inch thick which breaks into narrow, irregular, vertical ridges. Branches bear coarse, 3-forked spines that persist even on the trunk. Leaves doubly compound, to 8 inches long, of 18-28 leaflets 1 1/2 inches long, dark green above and lighter beneath. Foliage generally sparse.
RANGE AND RELATIONSHIP	Some 300 known species of <i>Acacia</i> , mostly found in Africa and Australia, but some in United States. This species favors dry, gravelly places such as hillsides and dry canyon walls from valley of Rio Grande, western Texas, through southern New Mexico and Arizona to southern California and into northern Mexico and Lower California east of San Pedro Martir Mts.	Found on gravelly and sandy flats or in loam near waterways. Ranges through valley of Rio Grande in western Texas and through Arizona and New Mexico to southern Utah and Nevada and on west to San Diego, California; largest in Lower Colorado and Gila rivers, in Arizona. Close relative of mesquite and cat's-claw.	Found commonly in rich bottomlands, or sometimes planted as ornamental or as curiosity. Found from southern Ontario to Pennsylvania, west to Oklahoma, Nebraska and South Dakota but not in pure stands and often isolated. But one species in genus and genus is closely related to that of honey locust. Best grown associated with other trees.	Commonest on alluvial soils that are deep. Found in woods or hedgerows or grown as barrier along property lines. Sometimes grown as ornamental. Found from Ontario to Georgia, west to Michigan, Kansas and Texas but grown outside this range frequently and as an escape; naturalized in most temperate parts of the world.
REPRODUCTION	Flowers, in heads to 1 inch through, borne on bright, creamy spikes that are fuzzy, with 2-3 clusters towards ends of branches. Calyx, half length of petals and slightly united at base. Stamens, to 1/4-inch long. Ovary covered with long, pale hairs. Fruit, to 4 inches long and 3/4-inch wide, hanging unopened until late winter or spring. Seeds shiny, dark brown, lustrous.	Flowers borne in leaf axils, in cylindrical spikes, to 3 inches long, yellow. Petals 3-4 times as long as sepals, with calyx obscurely 5-lobed, yellow, appearing in early spring and in successive crops later. Fruits ripen during summer and into fall, as closely twisted pods of to 20 turns, the spiral being to 2 inches long. Seeds to 1/16-inch long.	Flowers in showy, white clusters, clustered along a central axis near ends of twigs. Trees bear pistillate or staminate flowers with pistillate clusters to 1 foot long and staminate much shorter. Fruit a coarse thick but flattened pod to 10 inches long and to 2 inches wide, containing seeds that are to 3/4-inch wide and imbedded in sweet, dark, rich pulp in winter.	Flowers in clusters, pea-like, appearing May-July, borne from axils of leaves of previous year. Pistillate, in clusters that are slender and to 3 1/2 inches long. Staminate, in short fuzzy, to 2 1/2 inch clusters. Fruit a twisted, flattened, dark-brown pod that has thickened margins, is to 18 inches long, and is borne in clusters of 2-3.
ECOLOGY	Wood heavy, very hard, strong, durable, close-grained, brown or red, with thin, yellow sapwood. Tree strongly drought resistant. 1 pound of seeds yields about 200 usable plants, with 60% germination. One of best of bee plants, yielding superior nectar. Cattle browse plant heavily, but it survives. Generally a poor shade producer where shade is valuable.	Wood hard, durable in contact with soil, heavy, close-grained but not strong, light brown, with lighter sapwood to 7 annual rings thick. Plants are freely browsed by cattle and survive reasonable use in this way. The green or ripe fruits are eaten by cattle, and Indians eat the pods raw or grind them to make a flour that is cooked into cakes by baking.	Wood hard, strong, durable, coarse, dark red, rarely attacked by insects, weighing 43 pound per cubic foot. Seeds number 200 to 300 per pound, with high vitality and slow germination. 3-6 seeds per pod. Flowers appear in June; seeds ripen by October but remain on tree through winter. 100 pound of pods may yield 30 pounds of seeds.	Wood 42 pounds per cubic foot, very durable, bright yellow-brown, with darker streaks and pale, thin sapwood of a dozen annual rings. Pollinated by insects. Seeds distributed by pods rolling over snow. May be harvested September to February, weigh about 3000 to the pound from which about 1000 plants will develop.
ECONOMY	Good soil anchor and soil enricher. Wood finds many local uses. Excellent ground cover for jackrabbits, quail and other "game" species. Gum similar to gum arabic oozes from wounds. Spines give name of cat's-claw. Named after Josiah Gregg, a frontier naturalist and author. Is also called tear blanket and devil's-claw. Indians ate the seeds.	Wood is used as fuel and sometimes in fencing and cheap temporary construction. A stand of screwbean may provide excellent shelter and food for bobwhite, road runners and Gambel's quail. Thickets may provide some anchorage to soil, preventing wind and water erosion to some extent. An excellent honey plant, yielding an abundance of nectar dependably each year.	Wood most valuable for fence posts and used in cabinet work and in general construction. Seedlings may be transplanted from nursery at 1 year. Propagation by cutting of twigs is sometime practiced with success. In 1820, Long's expedition used roasted seeds as a coffee substitute, and pulp has been used medicinally but is not recognized of standard medicinal value.	Wood used as fenceraills, wheel hubs and general construction. Cattle enjoy eating the fruits and deer, hares, squirrels, starlings and quail known to feed on plant and find shelter under it. Sweet pulp of fruit makes a good relish for man. Plant somewhat tolerant of salinity. Root system, deep or superficial. Root nodules are not formed.

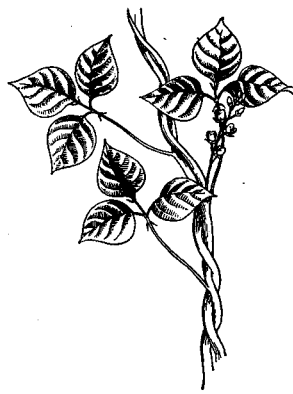
REDBUD, JUDAS TREE <i>Cercis canadensis</i>	SCOTCH BROOM <i>Cytisus scoparius</i>	YELLOWWOOD <i>Cladrastis lutea</i>	WISTARIA <i>Wistaria sp.</i>	GORSE, FURZE, WHIN <i>Ulex europaeus</i>
Small tree to 50 feet high, with trunk to 1 foot through, with grotesque branching. Branches and twigs dark. Twigs may zig-zag and are slender. Leaves with long petioles and distinctly heart-shaped blades, with entire margins and conspicuous veinings. Blades to 6 inches long and the same width. Leaves appear after the flowers.	Much-branched shrub that reaches a height of to 10 feet, nearly smooth, with long, straight branches that are erect and angled. May kill back to ground in winter but grows again in the spring. Leaves, of 1-3 leaflets, to ½ inch long, weakly fuzzy, blunt and the upper leaves without petioles and smaller than those below. Hardiness of tops varies.	Tree to 60 feet high, with trunk diameter to 4 feet, and with trunk often divided close to ground. Branches spreading, and bearing hanging zig-zag branchlets. Leaves are compound, to 1 foot long, of 5-11 leaflets, each of which may be to 4 inches long, with terminal one usually the shortest. Leaves turn bright yellow in autumn and are most attractive.	Plants usually have stout, climbing, woody trunks. The Japanese, <i>W. floribunda</i> , has 7-9 pairs of leaflets; the Chinese, <i>W. sinensis</i> , has less than 7 pairs of leaflets and flowers more than 1 inch across; the silky, <i>W. venusta</i> , has silky leaves; and the American, <i>W. frutescens</i> , has flowers less than 1 inch in diameter. Of these, the Japanese is probably most popular.	Compact, tangled, striped shrub that reaches a height of to 6 feet, is stiff, fuzzy when young but smooth when old, surviving cutting and browsing remarkably. Evergreen. Leaves reduced to scales or to narrow, fuzzy, to ½-inch-long spines that make an impenetrable hedge or tangle. Underground system makes good soil anchorage.
Found on rich lands along stream borders or on rocky hillsides, often forming a dense cover along mid-Mississippi areas. Ranges from Ontario to Florida and west to Texas and Nebraska but planted freely outside this range, where it succeeds as an attractive ornamental. 7 species known from North America, Europe and Asia, with 2 close relatives to west of range.	Established as an escape, from Nova Scotia to Virginia and west to Vancouver Island and California but of varying abundance. A native of Europe, being most abundant on sand or loam and even clay. Some 45 species in the world native of Europe, western Asia and northern Africa. This species is widely naturalized as an escape.	Found from North Carolina west to Kentucky, Tennessee and Missouri but planted widely and freely as an ornamental in the northeastern part of the United States and, in Europe, in southern and western parts. It favors the sun and dry, well-drained soils. There is but one species in the genus, and this genus is closely related to another found in Manchuria.	Ordinarily does well on dry, sandy soil but does better on rich loams. Common names suggest parts of world from which some come. The silky species comes from Korea and Japan. The American native ranges from Virginia to Florida and west to Texas with a smaller flowered species, <i>macrostachys</i> , found from Illinois to the south.	Native of western and southern Europe but has been planted and established or escaped in many parts of world. In North America, found along Atlantic Coast from Massachusetts to Virginia and along West Coast, California to Vancouver Island. In New Zealand has proved to be a blessing and a pest, since it may occupy soils that support superior crops.
Flowers borne in dense clusters, pinkish to purple, pea-like, about 1/3-inch long, appearing March through April. Flowers in clusters of 4-8, rarely white. Fruit grown in South by end of May and in North by mid-summer, being shed by early winter. Seeds about 25,000 per pound, with 80% germination, yielding to 2000 usable plants per pound. Seed treated with hot water.	Flowers are bright yellow, to 1 inch long, in long, terminal, leafy clusters. Calyx and supporting stem smooth. Anthers alternately large and small. Fruit a pod to 2 inches long, flattened and with often-persistent black to brown coiled style at tip. Flowers appear in May and June and fruits ripe in August and September.	Flowers appear May to June, in clusters of more than a foot long and 6 inches wide, appearing every other year. Corolla is white and about 1 inch long. Stamens, 10 and distinct. Fruit a short-stalked, smooth pod that appears ripe in September, is to 4 inches long and to ½ inch wide and bears 6-20 seeds that are usually shed rather soon.	Flowers of <i>floribunda</i> violet to blue, pea-like, in long, showy, drooping clusters, with a hairy calyx whose upper 2 teeth are broad and flat. <i>W. sinensis</i> blooms late in the season and may form great, drooping clusters to more than 1 foot long. There are double varieties but these are not too hardy. Plants may apparently flourish but make no blooms.	Flowers borne singly or in clusters of to 3, but usually crowded towards end of branches, bright yellow, fragrant, to ¾-inch long, with calyx and corolla almost equal in length. Individual stalks supporting flowers are short. Fruit a small, flattened, few-seeded, brown, fuzzy, ½-inch long pod that matures in August to October. Flowers in May-June.
Wood weak, hard, to 40 pounds per cubic foot, dark red-brown, with light sapwood to 10 rings thick. Plant roots do not bear nodules. Soils vary from slightly acid through sand and loam to those that are calcareous. Seeds are stored and layered in sand and given hot water treatment if planted in spring.	Highly drought resistant and will survive salt. Has been considered in part as parasitic on roots of oak but this is not a necessary relationship. Seeds weigh 65,000 to the pound and are sown in spring after being treated with hot water. Plants may be easily propagated by cuttings merely thrust into suitable ground.	Wood hard, to 39 pounds per cubic foot, strong, yellow, changing to brown on exposure, and with thin, white sapwood. Tree may thrive on rich lime soils or on neutral soil. It is normally propagated by seeds that are collected from September and October, stored in strata in sand in winter and then sown in the spring.	May be transplanted but usually with some difficulty. May be started by stem cuttings, root cuttings or by top grafting root systems that are already established. Plants grown from seeds do not normally "come true" to expectations in all respects. Flowers appear in early summer and fruit of <i>frutescens</i> is mature in September through November.	Blooming plants most popular with bees. In some parts of range it may bloom through the year, yielding nectar and pollen that is popular with honeybees. Some sparsely-spined forms have considerable value as forage and a great appeal as ornamentals but less value as a hedge builder. May sometimes be grazed by sheep and cattle.
A valuable and beautiful ornamental, grown in northeastern States and in Europe. Has an Oriental appearance. Leaves provide little if any forage for cattle, but may be eaten freely by deer. At least 3 kinds of birds, including bobwhite quail known to feed on parts of plant, which may be eaten by marsh rabbits in captivity. Supposed to blush for Judas' betrayal.	An ornamental. Good ground cover but leaves are considered as poisonous to livestock, which avoid it if other forage is available. Recommended as a soil restorer, in part because of high potash content of its ash when the cover is burned over. Burning over may eliminate the plant temporarily. Is eaten by bobwhite quail, California quail and cottontails.	Because of showy flowers the tree is a popular ornamental through wide area. Wood has some value in construction work and is popular for use in making gun stocks and sometimes in cabinet work and inlay. It is used as a fuel and yields a clear, beautiful, yellow dye. Honey from the nectar has a strong amber color and a distinctive flavor. Nectar is abundant.	Among the most popular woody vines grown on porches, on walls of stone buildings and may be sufficiently vigorous to climb walls to 4 stories high and hardy enough to survive severe winter weather almost anywhere in the United States. Pruning back to short spurs each winter may stimulate abundance of bloom, but tame just will not bloom so all.	Is a superior soil anchor since it can survive burial in sand and can exist in salty water. Makes excellent fuel, with almost explosive properties. Its acceptance of a wide variety of soils has advantages. In New Zealand, and other foreign countries, it was the practice along land boundaries to sow gorse seed on top of boundary furrows to establish a barrier.

COMMON NAME SCIENTIFIC NAME	BLUEBONNET <i>Lupinus subcarnosus</i>	BIRD'S-FOOT TREFOIL <i>Lotus corniculatus</i>	VELVET BEAN <i>Stizolobium deeringianum</i>	KUDZU <i>Pueraria thunbergiana</i>
DESCRIPTION	Herb, to 10 inches or slightly higher. Silky in some regions but not necessarily everywhere. Branches curve upward. Leaves with long petioles, alternate, with 5 leaflets, each to 1½ inches long and arising from common point at end of petiole. Leaflets shorter than petiole, hairy beneath, smooth above, and with narrow stipules at leaf bases.	Annual and perennial strains known. Stems to more than 2 feet tall, sprawling and ascending, slender, smooth, with many arising from a common root system that may be unusually long and penetrating. Leaves of 5 leaflets, three of which are like a clover at the tip and two of which are nearer the stem. Leaflets are pointed ovals, about ½-inch long and dark green.	Twining vine reaching a length of more than 100 feet and twining freely, somewhat white and velvety. Leaves compounded to 3 leaflets, borne on long petiole, the terminal one being the smallest. Largest leaflet may be to 6 inches long and to 4 inches wide, with entire margins, velvety under surface and rather conspicuous veining. Leaves are alternate.	Perennial woody vine, with each crown bearing 3 or 4 vines from a root system that may penetrate the soil to a depth of 12 feet or more. A single vine may grow to more than 100 feet long in a single year and vines may twist around each other, making a tangle. Leaves of 3 leaflets, borne at tip of long petiole, with entire hairy margins. Roots, large, tuberous, starchy.
RANGE AND RELATIONSHIP	Practically limited to the State of Texas where it may grow in great abundance over considerable territory in dry, open country. This is the official State flower of Texas and the only legume that is a State flower. There are more than a hundred species in the genus in the world, including 70 in North America; these are mostly western.	A close relative of the true clovers. There are about 90 species having a wide distribution and much variation. <i>L. corniculatus</i> is native of Europe and Asia but widely established in America. Some races are much more valuable as forage plants than are others. Leaf margins are entire, thus differing from those of the clovers.	Native of Asia and probably of Malaya, but widely planted in United States and thriving from Florida through Gulf Coast region. May grow as far north as Virginia and Kentucky but season this far north is too short to permit maturity. About a dozen species, of which 3 are recognized as having major economic importance and are in cultivation.	Native of China and Japan but introduced into United States and now widely established in the South and as far north as Philadelphia even though in the north it may winter-kill badly. The related <i>P. tuberosa</i> and <i>P. phaseoloides</i> are cultivated widely, the latter being introduced into the country about 1911.
REPRODUCTION	Flowers in a short, terminal, rather open cluster and somewhat scattered. Conspicuous parts are blue, with a white or yellow spot in the center of the standard. Pea-like. Calyx hairy, with the upper lip much shorter than the lower. Fruit a pod that is hairy, to 1½ inches long, and contains mottled seeds that are nearly ¼-inch in diameter.	Flowers borne in clusters of 3-12, spring from a more or less common point, yellow- or red-tinged, much like sweet pea, about ½-inch long and clusters borne on stalk to 6 inches long. Lobes of calyx about as long as tube. Fruit forms slender pods about 1 inch long, the cluster having some resemblance to foot of a bird, giving common name.	Flowers borne in clusters of 3 to 50, on long, hanging stalks, with each flower purple, to 1½ inch long, with whitish calyx that has a broad, triangular upper lip. Fruit a pod to 3 inches long, with long stiff ridged black velvety covering, containing 3-5 plump but slightly flattened seeds that are streaked, speckled or plain dark.	Flowers pea-shaped, purple, borne late in season in axils of leaves and in inconspicuous spikes. Flowers borne on older parts of the plants and so may not appear where the season is short. Flowers to ¾-inch long and fragrant, producing large, flat, hairy seed pods that bear many seeds.
ECOLOGY	Western lupines are numerous and vary from the tree-like <i>L. arboreus</i> through the shrubby <i>L. densiflorus</i> to the somewhat woody deer cabbage <i>L. diffusus</i> , and include forms that are eaten by grazing animals and which are poisonous if so eaten. Damage to horses, sheep and cattle populations may well be serious. <i>L. argenteus</i> of the West is seriously poisonous.	Long used in Europe as a forage but probably introduced into America by accident and as a weed in ship's ballast. Was long considered to be a weed. Finally, it came to be used in gardens as an ornamental but is now recognized as one of our most important forage plants and soil builders. Its use is gaining in popularity in this respect, particularly with perennial strains.	About 110-130 days from planting to reaching of maturity, but immature vines provide superior fodder and green manure long before seed production has been effected. Is often planted with corn which supplies a support for vines. Usual combination is 2 rows of corn to one row of velvet beans. This reduces corn yield but increases fodder value of crop and builds soil.	Propagation is commonly by cuttings of roots or leaves, or by seeds. 500 crowns may be sufficient for acre if planted one to every square 85 feet. Kudzu covering of ground may reduce soil temperature from 140°F. to 89°F., with consequent reduction in loss of soil moisture and conservation of soil water. Fleshy roots yield good grade of starch and bark yields a good fiber.
ECONOMY	Animals with lupine poison may froth at mouth, become highly nervous, experience difficult breathing, have convulsions and die. One record shows that, of 2500 sheep that grazed lupine, 1150 died. This does not refer to bluebonnet, which is protected by law primarily because of spectacular beauty. Pollen and nectar are collected by honeybees in March and April.	It competes successfully with clovers as nourishing food for cattle and as a soil builder, and has value as a forage plant for bees in making of honey. Blooming season may be from June through September in some closely related species and may make spectacular yields after a burnover. Honey is white and has tendency to candy early unless mixed with other honeys.	Vines are too coarse for cutting as hay but a field of corn and velvet beans provides a superior pasture for grazing cattle after the corn crop has been harvested. Vines also supply superior soil anchorage to prevent erosion and the nitrogen restorage to soil is high. Related <i>S. pruriensis</i> known as cow-itch" because of stinging hairs on the pods.	May yield to 3½ tons of hay per acre per year. Dried leaves make excellent fodder, fair breakfast food and good chicken feed. Leaves produce rich litter comparable to that of a forest. Root systems provide superior soil anchorage and plant is one of best soil restorers, adding nitrogen, stopping erosion, building humus and holding water. It is also an ornamental.

<p>COWPEA <i>Vigna sinensis</i></p>	<p>LENTIL <i>Lens esculenta</i></p>	<p>LIMA BEAN <i>Phaseolus limensis</i></p>	<p>FIELD BEAN <i>Phaseolus vulgaris</i></p>	<p>GARDEN PEA <i>Pisum sativum</i></p>
<p>May stand to 1½ feet high or grow as a trailing vine, depending on the variety. Trailing vines may be several feet long. Leaves, alternate, of 3 leaflets on long petiole. Leaflets to 5 inches long, entire or faintly angled, with older leaves short-pointed, stipule bearing. In general, vegetation like that of garden beans.</p>	<p>Herb to 1½ feet high, lightly fuzzy and profusely branched annual. Leaves compound, commonly of 2-7 pairs of leaflets, each about ½-inch long. Leaves usually end in a short tendrill. Leaves may be alternate or opposite. Leaflets slender, oval and entire. Plants may be independently erect or may be partial climbers. Roots bear nodules of importance in soil building.</p>	<p>Bush or dwarf lima bean var. <i>limenanus</i> is bushy and not a climber. Typical pole lima bean may have vines to more than 10 feet long which are strong, stout, rather late maturing. Plant is generally velvety, with thick, coarse leaves, each with 3 leaflets, each of which may be to 5 inches long and to 3 inches wide, with rounded bases, pointed tips and thick texture.</p>	<p>Field and garden beans include climbers, bush, bunch and dwarf types. Variation is great but common and trade names have become attached to conspicuous types. Dwarf field beans include red kidney beans and short-vined navy beans. Leaves to 6 inches long, compounded of 3 leaflets, each with rounded bases and pointed tips.</p>	<p>Climbing vine that may reach a length of 6 feet, smooth, shining green, often with a bloom that may be rubbed off. Leaves alternate and compounded of paired leaflets and ending in a freely branched, slender tendrill. Leaves supported at base by stipules that are usually larger than the leaflets. Leaflets are to 2 inches long, oval and entire and in 1-3 pairs. An herb.</p>
<p>Probably of Asiatic origin, having been under cultivation in southeastern Asia more than 2000 years. Grown extensively in warmer parts of the world, coming to the West Indies in 17th century, U. S. in 18th. Closely related to asparagus bean or yard-long bean, <i>V. sesquidalis</i>, and catjang, <i>V. cylindricathe</i>; latter only slightly cultivated.</p>	<p>Native of southeastern Europe where it is grown for its edible seeds much more than is the custom in the United States. In western Asia and the Mediterranean region, there are about 6 species of the genus with but one cultivated for human food. Grows commonly on dry sandy soils of loams either rich or of poor quality.</p>	<p>Native of tropical America and most extensively cultivated in California in many forms. There are large-seeded and small-seeded, bush and pole lima beans and other types. Lima beans grown mostly in frost-free parts of South and shipped to northern markets. Related sieva bean, <i>P. lumatus</i>, is of the bush type and has smoother, thinner and smaller leaflets.</p>	<p>Native of the Americas. Plants were under cultivation by Incas and used by Indians to the north long before the white man came to America. There are some 200 species recognized in the genus, each with variable types based on size, seed color, speed of maturity, growth habit and the like.</p>	<p>Native of Europe and Asia, mostly in western Asia and the Mediterranean region. Now widely cultivated in almost all temperate countries of the world. Field pea is var. <i>arvense</i>, sometimes having gray marked leaves; edible-podded pea is var. <i>macrocarpon</i>, and early dwarf pea is var. <i>humile</i>, all edible and yielding valuable food to man and beast.</p>
<p>Flowers like greenish-yellow peas borne on long stalks. 10 stamens in groups of 9 and 1, usually opening early morning, closing by noon and falling in afternoon. Fruit, a slender pod to 1 foot long, not flabby or inflated, and bearing many colored seeds of many shapes, which are to ½-inch long and smaller than those of asparagus bean.</p>	<p>Flowers in clusters of 1-3, small, being about ¼-inch long, with the calyx sometimes enclosing the white or blue corolla. Flowers borne on slender stems and rather inconspicuous. Fruits short, broad pods, containing 2 round, flattened, doubly convex, greenish-brown or darker-colored seeds. Genus name, <i>Lens</i>, refers to the shape of the seeds.</p>	<p>Flowers bear slender bracts to the calyx, the bracts being about 1/3 the calyx length and with oval, strongly veined characters. Fruit a large, thick, heavy pod common in groceries, having a length of to 5 inches, a width of 1 inch, a short, blunt, stout beak and containing a number of large, plump, whitish seeds that the pod may open to free.</p>	<p>Flowers pea-like, white, cream, red or violet, with prominent broad calyx bracts that equal the calyx itself. Garden beans are planted in rows to 36 inches apart, at ½ bushel to the acre, usually about 1-2 inches deep, or may be planted in hills to 2 feet apart at the 70 pounds to the acre. May yield a harvestable crop in 60 days from the planting under good conditions.</p>	<p>Flowers usually few, usually two to a cluster, borne on ends of long stems that arise from axils of leaves, usually white in garden pea, or bluish or lilac in field peas. Fruit a pod that splits easily to free the delicious spherical seeds, is to 4 inches long. The 2-10 seeds are eaten green either fresh or canned, raw or cooked, and become smooth or wrinkled at maturity.</p>
<p>Seeds about size of navy bean are fed to cattle and poultry and used by man as a coffee substitute. Plants highly sensitive to frost. Seeds are planted in drills at 5 pecks per acre; in rows, at 3 pecks and broadcast, at 8 pecks. When grown for use as hay, plants are often harvested in September, cured 2-3 days as cut, and then stored.</p>	<p>Seeds sown in drills in March, in lines 1½ to 2½ feet apart and require little care after planting. Seeds are frequently preyed on by weevils. Herbage makes excellent fodder for cattle or superior green manure if plowed into the ground. Seeds likely to deteriorate after they are removed from the pods.</p>	<p>Plants cannot be counted upon to mature in the North, since they usually require a frost-free period of to 120 days, and it is not safe to do planting until the soil is well warmed. These conditions make a lima bean crop a considered gamble. Bush type of beans naturally require more space than do the pole climbers.</p>	<p>Dried navy beans yield 1,560 calories to the pound, 22% protein, 60% carbohydrate and 2% fat as contrasted with freshly shelled beans that yield 720 calories, 30% carbohydrate, and 9% protein. Soils that are too wet or too rich in nitrogen do not mature bean fruits well. There are many insect and fungus enemies.</p>	<p>Peas grown for canning are sown in fields, in drills 12-30 inches apart. About 50-100 seeds in one ounce and ½ pint should plant a row to 80 feet long that should yield enough peas for a family for about 10 days. Best to plant at intervals of a week to assure a sustained supply. May be planted early, even before last frost.</p>
<p>One of the best of plants for restoring fertility of soil. Hay is rich in protein. When plants are allowed to mature, the hay and straw decreases in value as cattle food. Submits successfully to being pastured by cattle. Common in rotation such as cotton, corn, cowpeas. Winter grain is planted after the corn and then the cowpeas are planted.</p>	<p>Seeds, the common base of lentil soup, are usually cheaper than beans but fully as nutritious, and in the soup the seeds do not usually retain their entity as is the case with beans. Esau is reported to have sold his birthright to Jacob for a "mess of pottage" made from red lentils, so they must have had considerable value in his eyes, at least.</p>	<p>Seeds rich in protein and starch, and are considered good tissue builders and energy developers by dieticians. They equal lean meat in many qualities and if pork is added to the cooked beans an excellent, balanced ration results. Prolonged cooking is recommended because the proteins are to be found at best in thick-walled cells.</p>	<p>Beans rank high as source of protein and starch in man's diet. Baked beans are a good substitute for lean meat. Green beans are rich in vitamin A, good for vitamin B, and excellent for vitamin C. All beans serve important role in enriching the soil as a part in a crop rotation plan. Usually book-keeping procedure is rather long, but it is worth it.</p>	<p>Canned peas are a staple household food almost the world over but frozen peas are becoming equally important and these support a major agricultural and commercial industry. Field peas that become too old or tough for use as green peas are sold as "split peas" and commonly used in soups. Marrow-fat peas popular because of size and sweetness, but usually sweetest.</p>



Cowpea



Kudzu



Wistaria



Bird's-foot Trefoil

(Continued from page 363)

managers as having some forage value, and much value as a soil builder and soil anchor—particularly on soils too poor to support better types of plants. At least it represents a step in the improvement, not in the deterioration, of soils.

My mother and my grandfather used to speak with enthusiasm about cows standing "knee-deep in clover." Modern pasture management recognizes that cattle will eat more forage during feeding hours if the clover is not much more than six inches tall. The more forage we can put into their stomachs, the more milk we may get from their udders, or the more fat on their bones. The science of pasture management has revolutionized our concept of what it is possible to obtain from our pasture lands. Largely with the help of legumes we can now produce superior yields from lands that a generation ago were considered as marginal, or approaching depletion. Not too many years ago farmers boasted of the farms they had worn out, and a farmer who had exhausted two or three farms was considered to be a real "he-man." Now we look with favor primarily on those who have improved their lands. Almost invariably such successful men use legumes.

In our efforts to get more from our land, we often have gone far afield for help. By developing plants that will stand more cuttings per year, or will reach maturity a few days sooner, we have found it possible to grow plants in parts of our country where formerly they would not have succeeded. We have done this by the use of fertilizers, by the breeding of the plants, and by finding plants that have the characters we seek. All this is part of our modern agriculture. My grandfather never raised alfalfa, but my father began selling the seed in his grocery store. Neither of them ever raised soya beans or bird's-foot trefoil. The soil-saving kudzu, now so widely used on once-eroded lands in the South, was not introduced into America until I graduated from college, and was brought, with soya beans, from China and Japan, where they thrived on poor soils such as were developing here through unwise and abusive soil management practices.

The common names of such legumes as the clovers

may tell us much or little. We have Dutch white clover, which obviously must be associated with Holland, but there also is a giant form now popular that came from Lodi, Italy. It has large, glossy leaves, and as "Ladino clover" is recognized has having great merit. It was introduced into America about the year 1900. Some forms of white clover have colored flowers and bronzy leaves, and are known as shamrocks. But the word shamrock may refer either to a form of white clover, *Trifolium repens*, to a hop clover, *Trifolium dubium*, or to black medic, *Medicago lupulina*, which is closely related to alfalfa. It may even mean a wood sorrel, *Oxalis*, which is not even a legume. Such common names as peas, beans, mesquites, vetches, trefoils and clovers are applied to plants of such different characteristics as to make the names almost meaningless.

The proper handling of the legumes—or of any biologic asset, for that matter—is bound to be a delicate matter. Recognition of true roles is a challenge to any naturalist or scientist. Some years ago New Zealand had a Fulbright Fellow commissioned to develop a strain of bees sufficiently vigorous to withstand the blow received when they were struck by flower parts when seeking nectar. Unless these bees could reach the nectar, their visit was useless. If rough treatment during a visit deterred the bees from quickly visiting a similar flower, pollination would not be effected and the desired seed crop could not be produced.

We obviously have not exhausted the possibilities of finding, in other parts of the world, legumes that are better producers than those we now have. Possibly such foreign plants could be crossed with those that we know render superior service. We may learn how to manage the soils in which these newcomers grow so that we get better results from them. We may learn how to develop insects that would destroy the insect enemies of our legumes, or that might aid our legumes in producing better forage or other products. We may discover bacteria whose presence and proper management would increase our rewards from the legumes, or from the soils with which they are associated. The future of our relationship with the legumes holds great promise of generous reward.

