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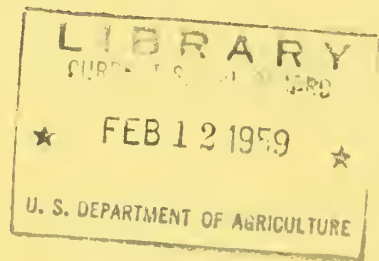
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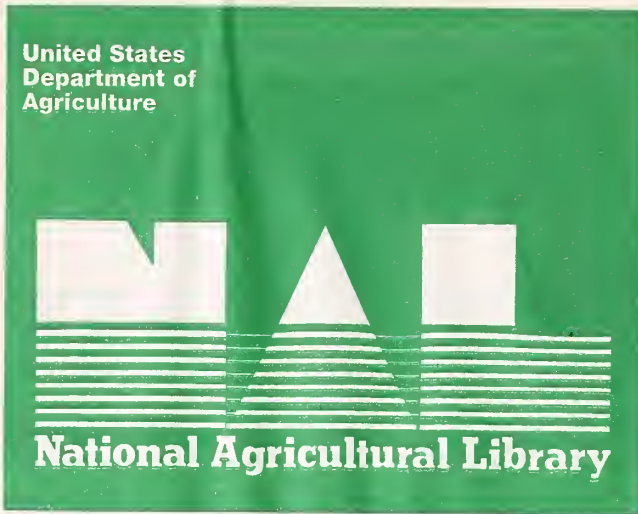
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Silvical Characteristics of Plains Cottonwood

by R. A. Read



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U. S. Depart-
ment of Agriculture
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unpublished, but scattered and often difficult to locate. To compile this material systematically and make it available to foresters generally, the Rocky Mountain Forest and Range Experiment Station is preparing reports on 4 individual tree species. Similar reports on other species are being prepared by other Forest Service experiment stations. A comprehensive national publication containing the silvical characteristics of all important forest trees of the United States will be issued soon by the Forest Service, U. S. Department of Agriculture.

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Cover photo: Plains cottonwood has a spreading crown when grown in the open.

SILVICAL CHARACTERISTICS OF
PLAINS GOTTONWOOD

by

R. A. Read, Forester



ROCKY MOUNTAIN FOREST AND RANGE EXPERIMENT STATION
FOREST SERVICE U. S. DEPARTMENT OF AGRICULTURE

The station maintains central headquarters at Fort Collins,
Colorado, in cooperation with Colorado State University.

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SILVICAL CHARACTERISTICS OF PLAINS COTTONWOOD

by

R. A. Read

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Plains cottonwood (Populus sargentii Dode) was first characterized as variety occidentalis Rydb. of eastern cottonwood (P. deltoides Bartr.) (8, 18). Although it closely resembles the eastern species, it is considered to be a smaller tree. Other common names are plains poplar, Texas cottonwood (8), river cottonwood, western cottonwood, and Sargent cottonwood (18).

DISTRIBUTION

Plains cottonwood is the largest, most rapid growing, and most widely distributed tree of the Great Plains region. It grows principally along streams and river flood plains, in moist ravines, and in low areas of sandy uplands where the water table is fairly close to the surface. It is found from southern Saskatchewan and Alberta, Canada, southeastward through the Plains region and the foothills of the Rocky Mountains to New Mexico and the Texas Panhandle (fig. 1) (8, 13, 18). Its eastern limit is not well defined because it mingles with and probably hybridizes with eastern cottonwood. According to Sudworth, it follows the Missouri and Platte rivers into eastern Nebraska (18). Phillips et al. (11) and Pool (12), however, do not recognize a distinct Plains species, and show eastern cottonwood throughout Nebraska and Oklahoma.

Although best development of the species is restricted to river flood plains and other subirrigated sites, it has spread naturally from plantings to many low areas on the uplands throughout the Plains.

Distribution of plains cottonwood overlaps the ranges of balsam poplar (P. balsamifera L.), lanceleaf (P. x acuminata Rydb.), and narrowleaf (P. angustifolia James) cottonwoods in the northern and northwestern parts, and the range of eastern cottonwood in Oklahoma, Kansas, Nebraska, and South Dakota.

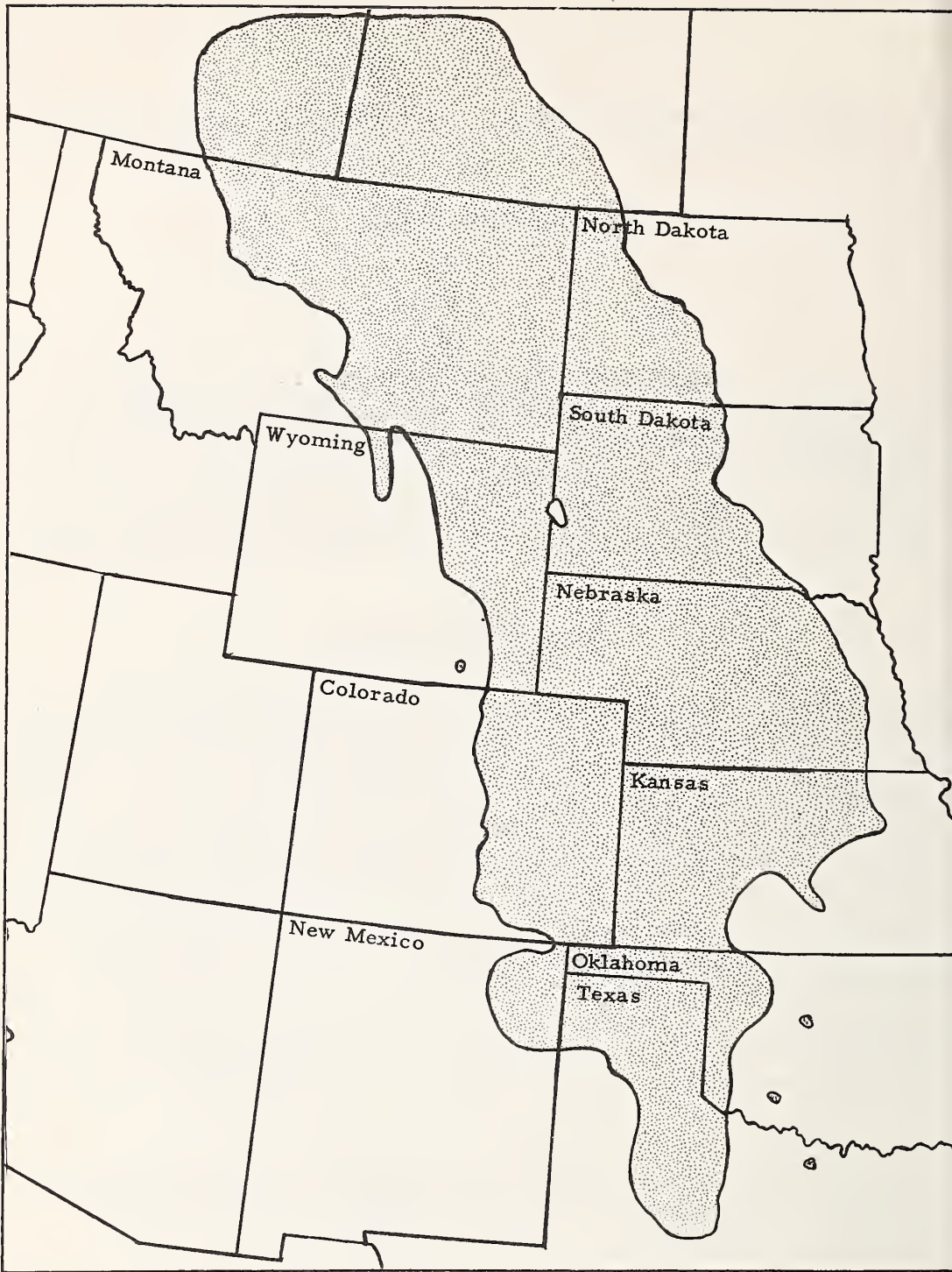


Figure 1. --Natural range of Plains cottonwood.

BOTANICAL DESCRIPTION (7, 13, 18)

Habit. -- A tall tree, up to 90 feet high and 4 to 5 feet in diameter, on deep, fertile lowland sites. Usually a single-stemmed trunk with an open, spreading, symmetrical crown of massive horizontal branches, and stout more or less angled branchlets and twigs.

Leaves. -- Alternate, simple, broadly deltoid, 7 to 13 centimeters long, but often wider than long. Subcordate to truncate at base and a rather long-acuminate apex. Leaves glabrous on both sides at maturity, with coarsely and bluntly toothed margins which are normally ciliate between the teeth. Petioles flattened and about as long as blades.

Flowers. -- Male and female flowers are borne on separate trees (dioecious) before the leaves unfold. Staminate catkins (or aments) are 5 to 9 centimeters long, short stalked, and with 20 or more stamens with yellow anthers per flower (fig. 2). Pistillate catkins are short stalked, greenish, few flowered, and elongate to 15 to 20 centimeters. Flowers have neither calyx nor corolla, and have 3 to 4 broad-lobed stigmas. Ovary is stout and surrounded at base by a cup-shaped disk.



Figure 2. -- A, staminate catkins; B, partly mature fruits and 2-week-old leaves of cottonwood.

Fruit. --Fruits are oblong-ovoid, single-celled capsules about 1 centimeter long, and 3 to 4 times longer than their pedicels (fig. 2). Seeds are oblong-ovoid about 1/16 inch long, rounded at apex, and light brown with a tuft of long, white, silky hairs attached.

Twigs (winter). --Stout, smooth, greenish to light yellow with continuous, 5-angled pith. Terminal buds very resinous, 1 to 2 centimeters long, acute, conical, with brown to yellowish puberulous scales. Leaf scars broad; 3 bundle scars; and stipule scars present.

Bark. --Young stems smooth and grayish to yellow green. Old stems have thick, gray bark, deeply divided into furrows and broadly ridged.

HABITAT CONDITIONS

CLIMATIC

Climate of the region in which plains cottonwood grows is characterized as dry, subhumid to semiarid, with large extremes of temperature and precipitation, high drought frequency, and persistent, high-velocity winds (2, 19). A general statement of climate, however, is somewhat misleading in characterizing the specific sites on which cottonwood grows. Along watercourses and in depressions, the tree roots have access to better moisture throughout the growing season than the average annual precipitation data indicate.

Precipitation

Annual precipitation ranges from 12 inches in the northern and western Plains to 30 inches in the extreme southeastern range, averaging less than 20 inches throughout most of the species' range. Approximately 75 percent of the annual precipitation occurs during the growing season (19).

Drought periods of 35 to 59 consecutive days may be expected annually, and periods of 60 to 70 days may occur once in 10 years (19). Drought hazard is greatest in winter and in the Southern Plains, where snowfall is least.

High-velocity winds occur in all seasons but are most persistent during winter and early spring (2).

Temperature. -- Average temperatures for January range from 5° F. in the north (minimum -50° F.) to 40° F. in the south (minimum subzero). Averages for July range from 60° F. in the north (maximum 100° F.+) to 80° F. in the south (maximum 115° F.). The frost-free period ranges from 100 days in the north to 220 days in the south (19).

EDAPHIC AND PHYSIOGRAPHIC

Plains cottonwood predominates on the level, narrow stringers of river flood plains and stream bottomlands that cross the region from west to east (fig. 3). In western Kansas, it is found in rather widely spaced groves in beds of intermittent streams. It is common in pure stands on riverbed sandbars and on overflow land in the bends of large rivers (1).



Photo by Nebr. Agr. Expt. Sta.

Figure 3. --A river-bottom stand of Plains cottonwood with a scattered understory of eastern redcedar.

Access to moisture appears to be of greater importance than soil texture and fertility. Plains cottonwood occurs along most streams that flow continuously through the loess soils of the Plains on sites not more than 8 to 12 feet above the water table (1). It also grows on level subirrigated uplands of deep, sandy soils. Best development, however, is made on deep, rich, well-drained loams (15, pp. 67-71).

The species grows between elevations of about 1,000 feet near its eastern range to around 6,000 feet in the foothills of the Rockies. It is seldom found above 7,000 feet (18).

BIOTIC

Plains cottonwood is a pioneer tree, occasionally growing in pure stands but more often accompanied with various species of tree willows. This phase is considered the most widespread form of the interior, low-elevation cottonwood types of the western forests (16). Black willow (Salix nigra Marsh.) and peachleaf willow (S. amygdaloides Anderss.) are the most common associates. Boxelder (Acer negundo L.) is a common associate throughout the central and northern range. Other associates on the better sites include American elm (Ulmus americana L.), slippery elm (U. rubra Muhl.), hackberry (Celtis occidentalis L.), green ash (Fraxinus pennsylvanica Marsh.), red mulberry (Morus rubra L.), and silver maple (Acer saccharinum L.) (1, 21).

Plains cottonwood is an important constituent of the bur oak (Quercus macrocarpa Michx.) forest type which extends into the Black Hills and along the streams of the Dakotas and Nebraska. It is also an important component of the mixed hardwood stands of terrace and bottomlands in Kansas, which contain black walnut (Juglans nigra L.), American elm, slippery elm, green ash, bur oak, hackberry, and American sycamore (Platanus occidentalis L.) (21).

Eastern redcedar (Juniperus virginiana L.) is an important understory tree of cottonwood stands on the Platte River bottomlands in Nebraska and in parts of South Dakota (see fig. 3).

Common shrubs and vines of plains cottonwood stands are sandbar willow (Salix interior Rowlee), coyote willow (S. exigua Nutt.), red-osier dogwood (Cornus stolonifera Michx.), indigobush (Amorpha fruticosa L.), coralberry (Symphoricarpos orbiculatus Moench), wild grape (Vitis spp.), poison-ivy (Toxicodendron

radicans L.), smooth sumac (Rhus glabra L.), and American plum (Prunus americana Marsh.). In the western Plains shrubs are scarce in the cottonwood stands, and several species of grasses and forbs are found in their place (1).

LIFE HISTORY

SEEDING HABITS

Flowering and fruiting

Plains cottonwood is dioecious. Male and female flowers are borne on separate trees on twigs of the previous year's growth. Both sexes appear early in the spring before leaves develop (18, 20). The staminate catkins remain on the tree only about 2 weeks.

Fruits, appearing as pendulous clusters of capsules, ripen in late spring about the time leaves reach full size; this is usually 4 to 6 weeks after flowering but may range through June to August (10, 20).

Seed production and dissemination

No information is available on seed-bearing age or frequency of seed crops. However, seed production of eastern cottonwood to which it is closely related occurs annually from 10 years of age until loss of vigor or death (20).

Clean seed (cotton removed) are reported to average 429,000 to 479,000 per pound (20), and 250,000 per pound (5, 6). No information is available on insects or diseases that might affect seed production.

Seed dissemination takes place a few days after ripening. Ripening is not uniform, however, and may extend for 6 weeks or more among different trees in any one locality (5). Seeds are extremely light and are carried for miles by the wind. Water dispersal is also effective for great distances.

VEGETATIVE REPRODUCTION

Sprouting ability is excellent from both roots and stumps of young trees, but declines as trees grow older.

The species is easily reproduced by propagation of stem cuttings from 1-year-old wood. Cuttings, made during the dormant season, treated with fungicide, and held in cool, moist storage will root 95 percent without chemical stimulants.

SEEDLING DEVELOPMENT

Establishment

Seed viability is high within the first few days after ripening and dispersal; germinative capacity is 98 percent in 5 days (5, 20). Viability is exceedingly transient, however, and drops rapidly if the seeds are not kept moist, especially in warm weather (5, 10).

The ideal environment for germination is a constantly moist silt, sand, or gravel in full sunlight. Such places are especially abundant along river and stream flood plains. Fresh seeds germinate quickly (within 48 hours) and seedlings develop with great vigor. Seedlings are extremely delicate for the first few weeks and must have a constant supply of moisture during that time (5, 6).

Early growth

Seedlings make best growth when abundant moisture is available throughout the growing season. Competition for moisture by herbaceous vegetation, particularly sod, greatly reduces vigor. Young cottonwoods are very intolerant of shade and need full sunlight for best growth (18).

Early diameter and height growth is notably rapid, far outstripping any other species native to the Great Plains region. Under favorable conditions cottonwood seedlings grow 6 to 12 feet a year (15, pp. 67-71) (fig. 4).

Although initial establishment is usually good and growth rapid on coarse sands and gravels of river bottomlands, periods of drought and fluctuating water tables make subsequent development uncertain.



Figure 4. -- This cottonwood windbreak was planted with 1-year-old wildling stock only 2-1/2 years before the photo was taken. The trees averaged 22 feet tall when photographed.

SAPLING STAGE TO MATURITY

Growth and yield

Plains cottonwood is a relatively short-lived tree, usually attaining maximum height and diameter in about 40 to 50 years and deteriorating after 70. Under especially favorable conditions, however, it may remain vigorous for 80 to 90 years (15, 18). Most rapid growth is made in the first 25 to 35 years, and in this time it reaches 50 to 75 feet in height and 24 to 36 inches in diameter. Growth declines after 30 or 40 years. Mature trees reach 80 to 90 feet in height, with clear boles for 30 feet or more, and diameters of 6 to 8 feet (15, 23).

Moisture is ever important in the life of cottonwoods. The following tabulation from Albertson and Weaver (1), shows average radial increment of stands in western Kansas for 8 dry years and 8 wet years between 1928 and 1943.

<u>Habitat</u>	<u>Average radial growth</u>	
	<u>Dry years</u> (mm.)	<u>Wet years</u> (mm.)
Dry	17.4	25.0
Medium	37.4	59.1
Wet	70.4	50.7

Many cottonwoods on the Great Plains die during droughts. Mortality during the drought of the midthirties was 59 percent along intermittent streams, 55 percent near springs that failed during drought, and only 6 percent along continuously flowing streams (1).

Average annual growth of all cottonwood-type sawtimber stands in Kansas was 245 board-feet per acre, according to a 1936 survey (21). The survey presumably included eastern as well as plains cottonwood stands.

Fully stocked cottonwood stands along creek and river channels and overflow land in Kansas are estimated to yield 12,000 to 15,000 board-feet per acre at 25 to 30 years of age (15). In North Dakota, 30- and 50-year-old plantation yields were, respectively, 4,250 and 15,700 board-feet per acre, gross merchantable volume (Scribner) (17).

Reaction to competition

Plains cottonwood is intolerant of shade and root competition, and requires full sunlight for maximum growth (15). It usually grows either in pure stands, which thin naturally and rapidly, or in open mixtures with other species. Stands are nearly always even-aged.

In the eastern fringe of the type, particularly on the richer soils, cottonwood, willow, and boxelder are considered an early stage in succession to the mixed hardwood forest (1). Because of the sparse, high foliage characteristic of cottonwood stands, shade-tolerant tree and shrub species easily become established under

them (15). Cottonwood usually does not regenerate until the overstory has broken up.

RACES AND HYBRIDS

No information is available on races of plains cottonwood, but there is strong possibility that they may exist, owing to the great north-south distribution of the species. Some botanists consider that plains cottonwood is not a distinct species, but a race of the eastern cottonwood that was able to advance into and become established in the Plains region (11, 12).

Hybridization is rather common between the Plains species and other poplars to the east and west. Lanceleaf cottonwood is now regarded as a hybrid between narrowleaf and plains cottonwood (8). In addition, the many plantations of different Populus species scattered throughout the Plains provide a widely variable source of germ plasm for hybridization with the native species.

NATURAL ENEMIES

Many tree species appear to be more susceptible to insect and disease pests in the Great Plains region than in nearby forested regions. Plains cottonwood is no exception. Frequent droughts result in loss of vigor and thereby increase likelihood of attack.

Insects

Cottonwood leaf beetle (Chrysomela scripta F.) and imported willow leaf beetle (Plagioderma versicolora (Laich.)) are common important defoliators; the cottonwood leafmining beetle (Zeugophora scutellaris Suffr.) may also be involved (3, 24, 25). Other defoliators are: cottonwood dagger moth (Acronicta lepusculina Guen.), eastern tent caterpillar (Malacosoma americana (F.)), fall webworm (Hyphantria cunea (Drury)), bagworm (Thyridopteryx ephemeraeformis (Haw.)), and elm sawfly (Cimbex americana Leach) (24, 25). According to Wygant, grasshoppers were the most important defoliators during the 1930's.

Cottonwood borer (Plectrodera scalator (F.)), flatheaded apple tree borer (Chrysobothris femorata (Oliv.)), and poplar borer (Saperda calcarata Say) are important enemies that reduce quality of sawlogs and kill young trees.

Diseases

The most widespread and damaging diseases of plains cottonwood are the poplar canker (Cytospora chrysosperma (Pers.) Fr.) and leaf rusts (Melampsora spp.). The canker causes mortality and is especially damaging in planted stands weakened by drought. It is not known how important it may be in natural stands. Leaf spots (Marssonina sp. and Septoria spp.) are present but not of serious consequence (9, 14, 23).

WOOD PROPERTIES AND USES

Wood of plains cottonwood is coarse textured, odorless, soft, and light weight, but relatively strong. The heartwood is pale yellowish brown and the sapwood nearly white (18). The wood frequently warps on drying (11), splits with difficulty, and is not durable in contact with soil and other moist conditions.

It is used principally on farms for rough construction lumber, temporary fence posts, corral poles, and fuel (18). Cottonwood lumber is well suited for interior building purposes such as framing, flooring, partitions, and sheathing, and is superior to pine and fir in many ways for these purposes (15).

Specialized uses are veneer baskets, crates, and boxes for fruits, vegetables, eggs, and chickens (15, 18). It is especially adapted to these uses because it (1) is light weight, yet strong, (2) nails without splitting, (3) is clean appearing, (4) is odorless, and (5) takes printing and stenciling well. Other potential uses are woodenware, plywood, excelsior, and wood pulp. It produces a very high-grade gloss paper (11).

SPECIAL FEATURES

Plains cottonwood is an important component of windbreak planting in the Great Plains. Though a relatively short-lived tree, it will produce an effective windbarrier 40 to 50 feet tall in 15 to 20 years on stream lowlands and on deep sandy, subirrigated lands. It should not be planted on dry uplands except where irrigation is possible.

Plains cottonwood can rightfully be called the "Pioneer Tree of the Plains," for it gave shade and shelter to early homesteaders.

They planted it extensively around their homesteads and along roads (fig. 5). In more recent years, it has proved to be one of the fastest growing trees for farm windbreak planting (see fig. 4). Cottonwood was adopted as the State tree of Kansas in 1937. Groves along the Arkansas, Republican, Platte, and other rivers of the Plains were often special landmarks or rendezvous for Plains Indians, mountain men, and travelers to the mountains and west coast (4).



Figure 5. --Cottonwood provides welcome shade and beauty to roads.

To the Plains Indians, cottonwood was second in importance only to the bison. Young stands provided durable, lightweight poles for lodges and travois. Even the deltoid leaf shape was supposed to have provided the inspiration for the pattern of the tepee. A more notorious use of the lone plains cottonwood was for the "necktie parties" held for a horse thief or cattle rustler unfortunate enough to be caught.

I. D. Graham (22) sums up the virtues of cottonwood in this way:

"To the prairie pioneer whose horizon was bounded only by his power of vision, a tree among the billowing waves of green became as a sail on the sea, a harbinger of hope and contact with the infinite spaces.

"A pioneer among the trees and a missionary of better things to come was the cottonwood, lifting its stately head to the sun and pointing to the midnight stars, drawing its sustenance from the bosom of Mother Earth, breasting with bared frame the winter's blasts and sending forth its pean of praise in a thousand aeolian voices with the summer's breeze, it spread its shade like a benediction over the land.

"A need of praise to the cottonwood, the tree of the pioneer, of small intrinsic value but of unmeasured worth in rapid growth, in stately mein, in bounteous shade and as the beginning of the groves which healed the nostalgia of the home finder in an untried land and made a playhouse for the child who became the Kansan." (fig. 6).



Figure 6. --Cottonwood groves were favored places for social and recreational meetings of early settlers on the Plains.

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