

A Look at
BLACK WALNUT
Timber Resources and Industries



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COVER PHOTO. — These black walnut veneer logs, harvested in Ohio, are destined for export to Italy.

The Authors

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A Top-Rank Tree

OUR BLACK WALNUT tree (*Juglans nigra* L.) has always had top rank among trees in America. It claims its rank on two counts: it is one of our major nut trees; and its wood has a beauty and utility that few other trees can match.

Colonists were quick to make friends of the walnut tree. Its large nuts, collected by the bushel in the fall, provided a tasty and nourishing addition to the table fare. They used its wood to make their beds, tables, chairs, cradles, and dozens of household implements. Many of these works of colonial craftsmanship survive today as cherished antiques and museum pieces, their beauty and usefulness undiminished after more than two centuries of use.

As colonists moved westward from the Seaboard States into the Central States, they found black walnut even more plentiful. Trees were reported up to 6 feet in diameter, and 150 feet tall. The wood was so clear and easy to split, and so durable, that it was used extensively for fence rails. When Abe Lincoln was split-

ting fence rails, he probably split up many a walnut tree. The wood was used for building cabins, and later for trim in fine homes.

Walnut has always been the preferred wood for gunstocks. Pennsylvania gunsmiths used it for the long rifles that became famous in the wars with the Indians and the British. During the Civil War, and later during World War I and World War II, the demand for walnut for gunstocks was so great that it put a heavy drain on the resource of this timber.

The major use for black walnut today, both at home and abroad, is in furniture manufacture. One main mark of walnut's distinction is that many other fine woods are stained to make them look like walnut.

Walnut wood — ranging from rich dark browns to pleasing lighter browns — can be finished without stain. Under a good finish, the grain gives the wood those ineffable highlights, changing with the light and the angle of view, that few other woods possess.

American black walnut now is in strong demand in both American and foreign markets. The sharply expanding foreign market and the steady domestic market have raised questions as to the adequacy of the present and future supplies of black walnut timber. As a result, numerous measures to increase or sustain the supply have been taken. These include the establishment of a quota on the export of walnut logs and bolts, requests that the domestic veneer industry cut thinner veneers, and expanded research and extension work to encourage walnut culture.

To understand and evaluate the black walnut situation, one must know the extent of the resource and its growth characteristics. This report summarizes our current knowledge of these things and evaluates the present and anticipated use of walnut. The U. S. Forest Service's 1965 report on *Timber trends in the United States*, and forest surveys conducted since 1946 in the central region, where some additional information was collected, provide the basic information for this report. However, because black walnut is a minor species in every state in which it grows, the findings of these surveys are subject to large statistical variation, especially when applied to small areas or small volumes.

The Walnut Resource

Black walnut most frequently occurs as scattered trees in hardwood forest stands. It also occurs in narrow wooded strips along streams, in pastures, and in fence rows.

Black walnut is a fairly fast-growing tree that does best on rich, moist, but well-drained soil. Good agricultural soil is ideal. The tree does not grow well at high elevations or on wet bottomland and is intolerant to shade except in the early years of growth.

Location

Black walnut is found throughout most of the eastern half of the United States (fig. 1). The area of greatest commercial importance, however, is the central region.

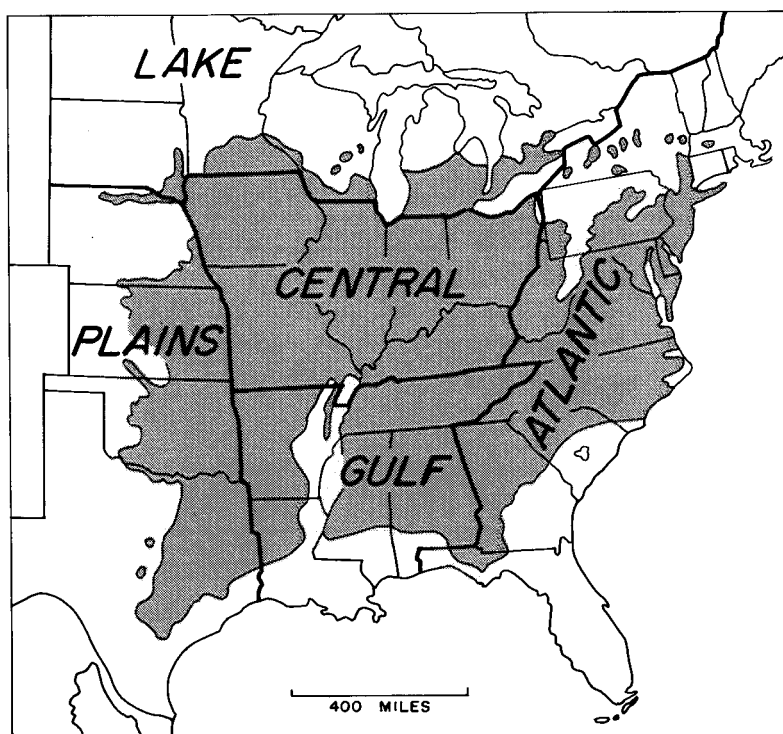


Figure 1.—The range of black walnut, and the geographical regions discussed.

The 1962 appraisal of the timber resources of the United States shows that there is more than 1 billion cubic feet of walnut growing stock (trees 5.0 inches d.b.h. and larger) on commercial forest land. Of this, approximately 62 percent is in sawtimber-size trees. The sawtimber volume is estimated to be 2.7 billion board feet. More than half of this volume is in the central region (table 1).

In addition to the walnut timber on commercial forest land, some walnut is growing in open pastures and narrow forested strips along small streams, windbreaks, and fence rows. These areas, although tree-covered, are not classed a commercial forest

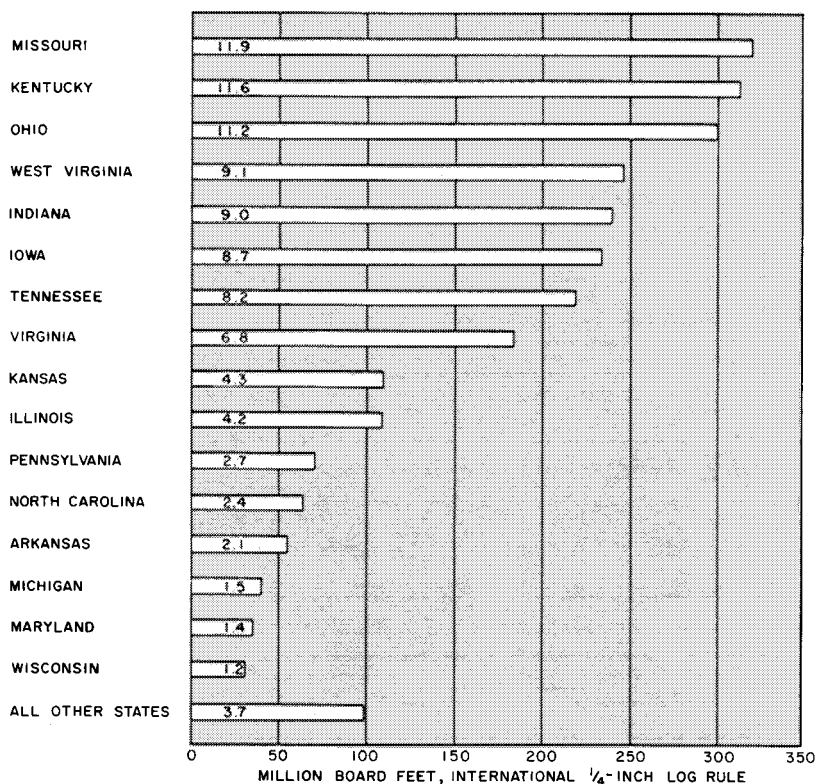
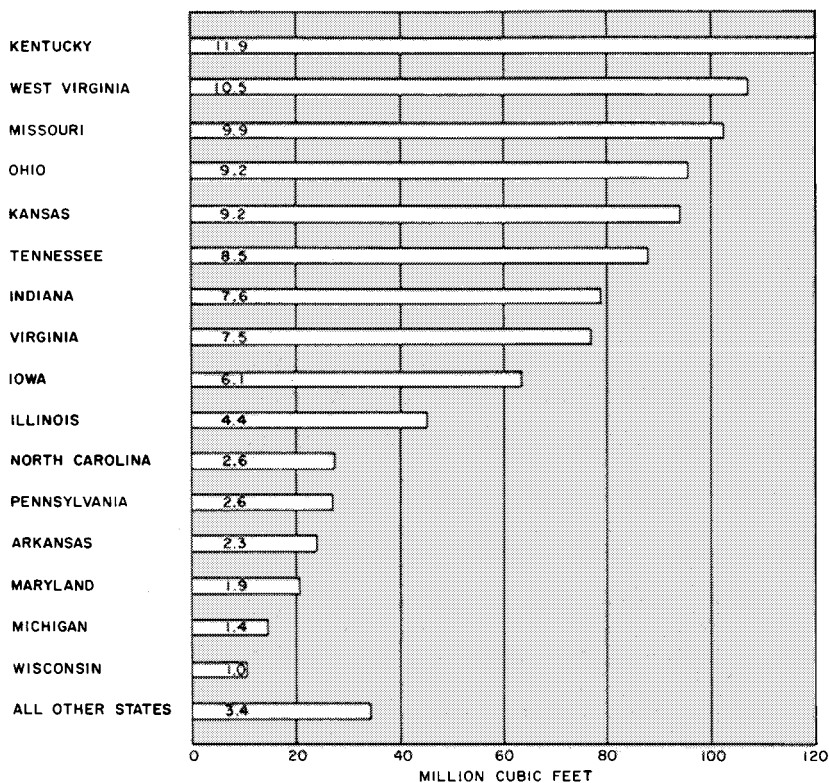


Figure 2. — Net volume of walnut sawtimber, by states, January 1963. The numbers in the bars show percentage distribution. Source: TIMBER TRENDS IN THE UNITED STATES, U. S. Forest Serv. Resource Rep. 17; except for Kansas, which reflects new unpublished information.

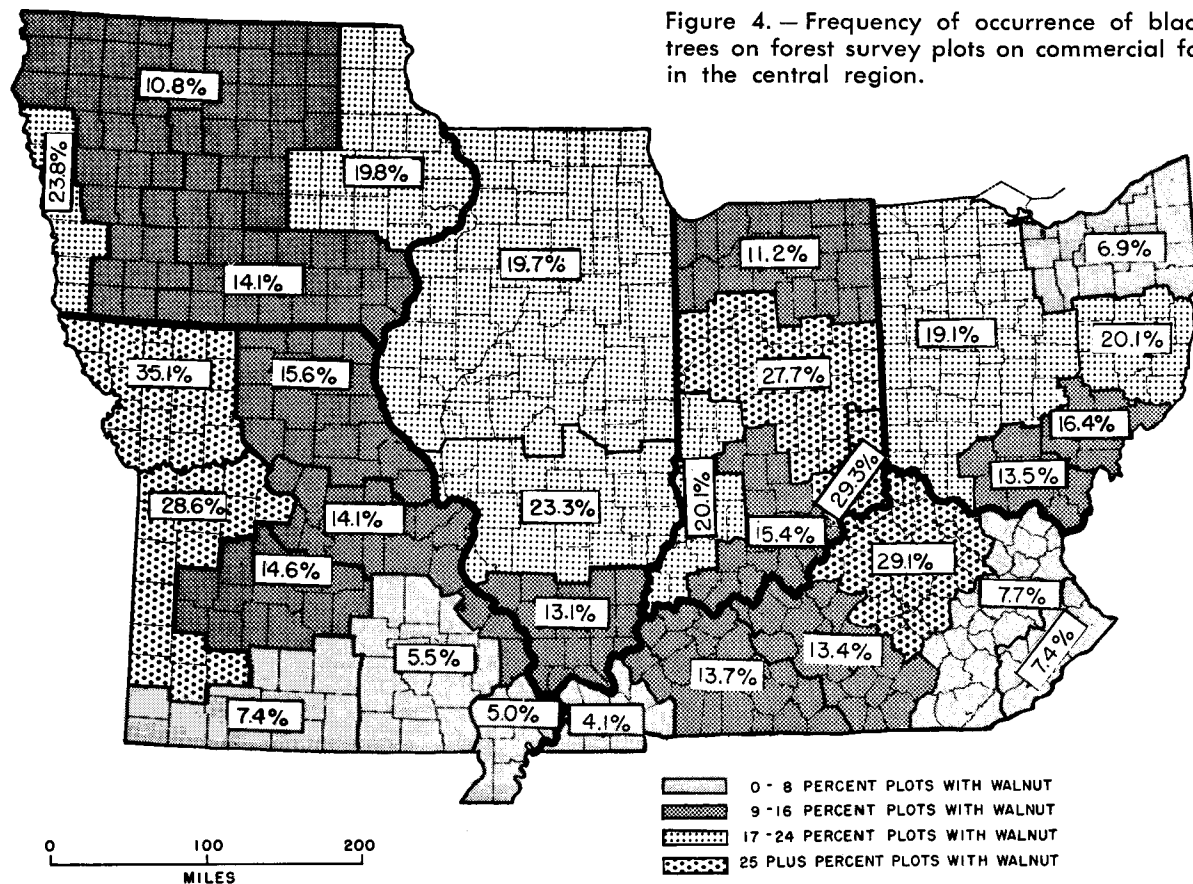
Figure 3. — Net volume of walnut growing stock, by states, January 1963. Source: TIMBER TRENDS IN THE UNITED STATES, U. S. Forest Serv. Resource Rep. 17.



land because of their small size. Therefore standing timber from these sources is not included in the timber-volume estimates reported.

Ten states (the six Central States and four bordering states) each have more than 100 million board feet of sawtimber volume. These states account for 85 percent of both the total walnut growing stock and the sawtimber volume (figs. 2 and 3). Missouri, Kentucky, and Ohio alone have more than 900 million board feet or one-third of the walnut sawtimber volume in the country.

Most black walnut timber is growing on small private tracts. In the 10 states having the greatest volume of black walnut growing stock, 87 percent of the commercial forest land is held by



small woodland owners. The majority of these are farmers. Forest industry owners hold only 5 percent and various governmental agencies hold the remaining 8 percent.

Even in the states where it is most abundant, black walnut comprises only a small part of the timber volume. In Iowa, black walnut trees account for 3.8 percent of the sawtimber volume. Other states that have black walnut timber making up 1 percent or more of their sawtimber volumes are: Kansas — 2.9 percent, Missouri — 2.5 percent, Indiana — 1.9 percent, Ohio — 1.8 percent, Illinois — 1.3 percent, Tennessee — 1.1 percent, and Kentucky — 1.1 percent.

Some additional information from the surveys of the central region is available about the occurrence of walnut in forest stands. These data also show the scattered nature of the walnut supply. More than 14 percent of the forest plots (about 10,700) surveyed in the central region since 1946 contained black walnut trees 5 inches d.b.h. and larger. Black walnut sawtimber-size trees were tallied on 6½ percent of the plots. Poletimber-size trees were found about twice as frequently as sawtimber trees. On the average, only one or two walnut trees were tallied on plots where they did occur.

The survey also showed that black walnut trees were found much more frequently in some survey units than in others. In northwestern Missouri and the Blue Grass region of Kentucky black walnut trees were found on 30 percent of the plots (fig. 4). But in western Kentucky and adjacent survey units in Missouri, black walnut trees occurred on fewer than 6 percent of the plots.

Quality

No accurate nationwide surveys have been made of the volume of walnut timber that is of veneer quality. However, an estimate of the volume of high-quality walnut can be made by using information from state survey reports.

Surveys conducted in Illinois, Kentucky, and Missouri since 1960 showed that about 10 percent of the walnut sawtimber volume was in trees 19 inches d.b.h. and larger; another 30 percent was in trees between 15 and 19 inches d.b.h. And regionwide

surveys revealed that approximately 45 percent of the volume in walnut trees 15 inches d.b.h. and larger is in grade 1 or 2 logs as graded according to the U. S. Forest Products Laboratory Hardwood Log Grades for Standard Lumber (fig. 5). Applying these percentages over the commercial range of walnut, we estimate that the volume of better quality walnut timber (grades 1 and 2) is about 490 million board feet (International 1/4-inch rule).

Merchantable length is another indicator of tree quality. More than 55 percent of the sawtimber-size walnut trees have from 16 to 24 feet of merchantable length (fig. 5).

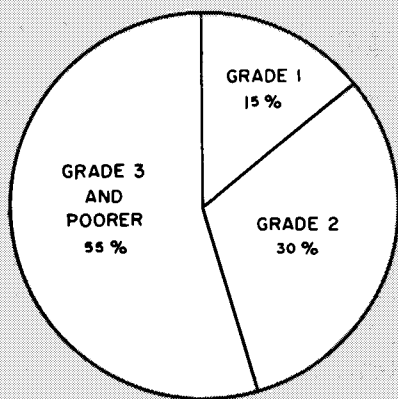
Growth

We estimate annual growth of the sawtimber-size walnut trees in the United States at about 120 million board feet. We believe that the annual increment of better quality timber is accruing at a slightly faster rate than growth on all sawtimber trees because much of the walnut timber is just growing into the size class from which good-quality logs can be obtained (fig. 5). We estimate that the growth rate of the better quality timber is 5 to 7 percent or between 25 and 35 million board feet annually.

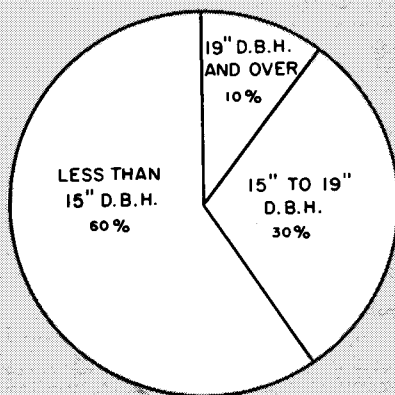
In the central region, diameter-growth measurements of a representative sample of black walnut trees showed that the trees were growing at rates up to 5.9 inches at d.b.h. during the 10 years prior to measurement. Distribution of the sample trees by diameter-growth classes was as follows:

<i>Diameter at breast height growth in 10 years (inches)</i>	<i>Poletimber (percent)</i>	<i>Sawtimber (percent)</i>
0 to 0.9	14	6
1.0 to 1.9	35	47
2.0 to 2.9	36	37
3.0 to 3.9	14	9
4.0 plus	1	1

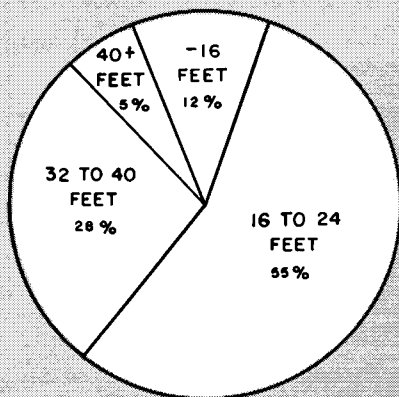
The mean rate of diameter growth for both pole- and sawtimber-size trees was 2 inches in 10 years. However, 15 percent of the poletimber and 10 percent of the sawtimber were growing at a rate of 3 or more inches in 10 years. The rapid growth of these trees indicate that rotations may be shortened under favorable conditions.



A. QUALITY OF SAWTIMBER VOLUME IN TREES 15 INCHES D.B.H. AND LARGER, BY LUMBER LOG GRADES.



B. DISTRIBUTION OF WALNUT SAWTIMBER VOLUME BY D.B.H. CLASS.



C. MERCHANTABLE LENGTH OF SAWTIMBER SIZE WALNUT TREES.

Figure 5. — Black walnut quality indicators.

Trends in Use

Records of the annual cut of walnut timber in recent years are incomplete, but they do show that use of walnut timber for all products has been expanding since 1933. For the years in which a census of wood used in manufacturing was made, the volume of walnut wood used for all products ranged from a low of 28 million board feet in 1933 to 94 million board feet in 1960 (fig. 6). Sawmills, veneer mills, and log exporters purchase walnut timber, but until 1960 at least 75 percent of all walnut logs cut were manufactured into lumber.

Sawmills producing walnut lumber are found throughout the natural range of walnut. Most of these mills saw only a few

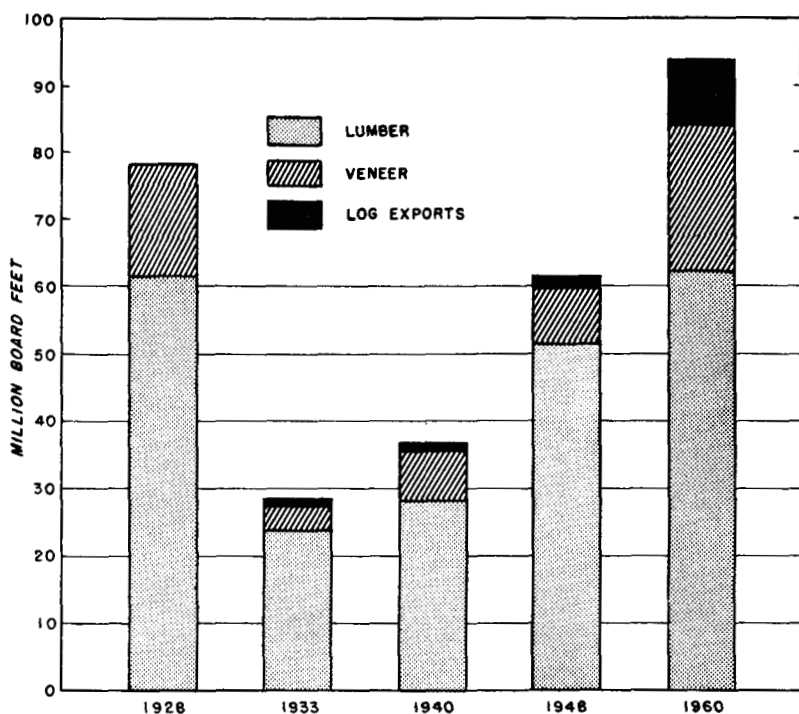
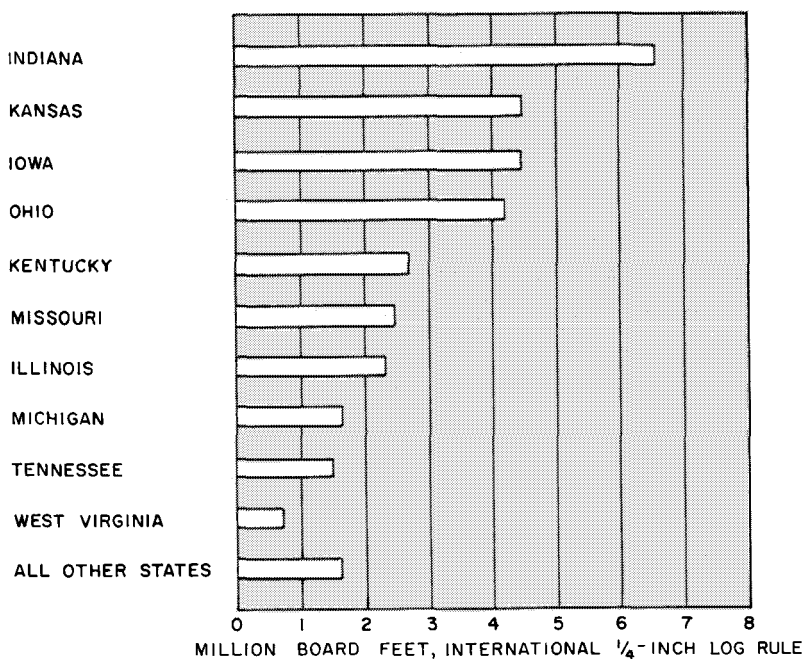


Figure 6. — Walnut wood use in selected years, 1928-1960. Source: WOOD USED IN MANUFACTURING, 1928, 1933, 1940, 1948, 1960; U. S. Forest Serv. and U. S. Dep. of Commerce export statistics.

Figure 7.—Walnut log harvest for domestic veneer mills, by states, 1963. Source: U. S. Forest Serv. Res. Note WO-6, 1964.



thousand feet of walnut lumber annually. However, there are a few mills that specialize in walnut lumber manufacture. Each of these may saw as much as 5 million feet of walnut lumber annually.

A number of walnut-using firms operate both veneer mills and sawmills. They produce veneer from the veneer-quality logs and saw the remainder into lumber. A few sawmill operators specialize in the production of walnut gunstocks. The walnut lumber then moves to furniture plants, other industrial plants, or even overseas.

The leading states in the production of walnut lumber are Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, Ohio, Tennessee, and West Virginia.

The volume of walnut wood used in domestic veneer manufacture has doubled in recent years. In 1963, domestic veneer mills

used approximately 32 million board feet (International 1¼-inch log rule). States having the largest walnut veneer-log production were: Indiana, Kansas, Iowa, and Ohio (fig. 7). Veneer production also is concentrated in the central region. Most of the walnut-using veneer mills are in Indiana.

Walnut logs, bolts, and hewn timbers are being exported in increasing quantities. Only 10 years ago less than a million board feet were exported annually. By 1963, exports had grown to more than 16 million board feet. West Germany and Italy received about half the total. Other countries receiving large quantities were Canada, Japan, Switzerland, The Netherlands, and the United Kingdom. The exported logs are manufactured into veneer and plywood to be used in fine furniture. Many sawmill operators and log buyers serve as concentrators for the exporters. During recent years, the export of walnut logs, bolts, and hewn timbers was reported by the Bureau of the Census as follows:

<i>Year</i>	<i>Quantity, log scale (thousand board feet)</i>
1957	1,395
1958	2,280
1959	3,734
1960	10,185
1961	7,171
1962	10,320
1963	14,388
1964	9,640

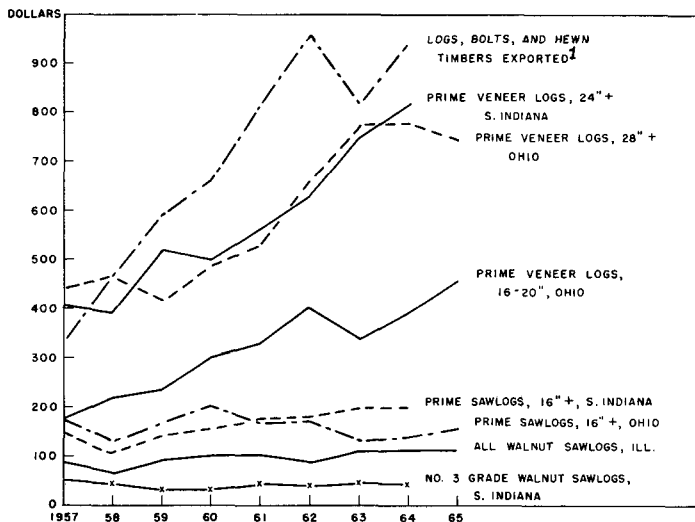
The decrease in exports in 1964 was the result of a quota placed in effect on February 14, 1964. The control on exports was removed in February 1965, and that year 18 million board feet of walnut logs, bolts, and hewn timbers were exported.

Timber Values

Because high-quality walnut trees are so valuable for veneer and other high-priced products, walnut trees are often hunted for and sold individually. The prices paid depend not only on the log volume and quality, but also on the competition among buyers.

Most walnut logs are bought and sold according to the Doyle Log Rule (table 5), but a number of grading systems are used to determine log quality. Some of the more popular rules include the

Figure 8. — Average walnut log prices, 1957-65, in dollars per thousand board feet, Doyle scale. Source: Ohio, Indiana, and Illinois timber price reports and U. S. Bureau of Census export statistics.



¹Value at port of export, including inland freight, insurance, and other charges.

American Walnut Manufacturers' Association Grading Rules, the Purdue Hardwood Log Grades, the Ohio Standard Saw Log Grades, and the Walnut Saw Log Quality Classes (tables 6 to 9).

Price ranges and averages for walnut logs are reported in several state timber price reports and in Bureau of the Census export publications. The prices are based on grades commonly used in a particular state. In Indiana it is the Purdue Hardwood Log Grades. In Ohio it is the Ohio Standard Saw Log Grades.

Average log prices range from \$50 to \$960 per thousand board feet depending on the market, log quality, and place of sale. Since 1957, the price trend has been steadily upward for the large veneer-quality logs (fig. 8).

In 1963, walnut logs harvested for domestic veneer mills and export had a value of more than \$26 million at average prices for delivered logs. Sawlogs used in lumber manufacture would increase the walnut log crop value by another \$6 million.

Nuts Also a Crop

The nuts of the black walnut are important both as a food crop and for use as seed. Of our native tree nuts, walnuts are second in commercial use only to pecans. Walnut meats have a distinctive flavor that makes them favorites for use in candies, bread, and similar uses.

The nuts, which often grow in pairs, are encased in a thick green hull. The shell is very tough, which makes removal of the meat by hand difficult. Some selected varieties are cultured for the sake of large nut meats and relatively thin shells.

A native black walnut tree will bear nuts 8 to 12 years after planting; best production occurs after about 30 years. Special varieties may bear nuts 2 to 3 years after planting. At 15 to 20 years, some of the improved varieties produce about 2 bushels of nuts per tree, whereas native wild trees produce about $\frac{1}{4}$ bushel. The Kentucky Department of Conservation estimates that 17 to 20 million pounds of walnuts are produced each year in Kentucky, of which only about one-half are harvested.

Collection of black walnuts for seed reached an alltime record in 1965, when more than 18,400 bushels (approximately 7 million nuts) were gathered in 14 states. This was 31 percent more than the previous year's collection. The 14 states reporting were Arkansas, Illinois, Indiana, Iowa, Kansas, Kentucky, Missouri, Nebraska, North Carolina, Ohio, Tennessee, Virginia, West Virginia, and Wisconsin.

Some uses have also been found for walnut shells. Cleaned and processed, they are used as abrasives and in filter materials.

The hulls may have some importance for medicinal purposes. A Columbia University research team reported that extracts from the green walnut hull were capable of immobilizing fish, mice, rats, and rabbits.



Use in Manufacturing

The Census of Wood Used in Manufacturing in 1960 shows that furniture and fixtures are the principal items made from walnut lumber and veneer. In the furniture industry, black walnut is one of the major hardwoods used. In 1960, 14 percent of the domestic hardwood veneer and plywood used in the manufacture of furniture was black walnut. Between 1948 and 1960, hardwood plywood and veneer consumption increased by 25 percent, but during the same period black walnut veneer and plywood consumption increased five-fold.

Other important items for which walnut lumber is used are gunstocks, millwork, dimension stock, musical instruments, lamps, signs, sporting goods, caskets, and cabinets for sewing machines, radios, and television sets.

Walnut veneer — on plywood and other core-materials — is commonly used for wall paneling, trailer coach interiors, advertising signs, musical instruments, and cabinets for sewing machines, radios, and television sets.

The Outlook

It is likely that demand will continue to be strong but that increasing difficulties will be encountered in obtaining the quality of walnut wood that is desired. The volume of walnut timber that will be available and used in future years is subject to future supply and demand relationships. Demand will depend largely on population, per-capita income, and consumer preference changes, and on the relation of walnut timber prices to competing product prices. Supply will vary with the level of forest management, technological developments, institutional arrangements, and annual cut and growth.

A comparison of current growth and cut — using medium growth estimates and the latest timber-cut estimates converted to standard units — shows that the current annual cut of all grades of walnut timber is slightly less than the growth accruing annually on commercial forest land. However, when quality is con-

sidered, the picture is strikingly different. The annual cut of high-quality material exceeds the annual increase in quality material by 47 percent (fig. 9). Supplies of quality logs are dwindling.

In this prevailing situation, the outlook for high-quality walnut timber in sufficient quantity to supply the current and increasing demand is not promising. Instead, we expect that both the growth and the cut in future years will be lower (fig. 10).

In Kentucky, which has been surveyed since the 1962 appraisal, preliminary results show that walnut sawtimber volume is down about one-third from the 1962 appraisal estimates. Also, in Kentucky in 1963 the sawtimber cut exceeded annual growth of walnut timber on commercial forest land by 20 percent.

As previously mentioned, the walnut trees growing on nonforest land have not been included in inventory estimates. However, because some firms report using timber from these sources, the U. S. Forest Service has made surveys of the walnut volume oc-

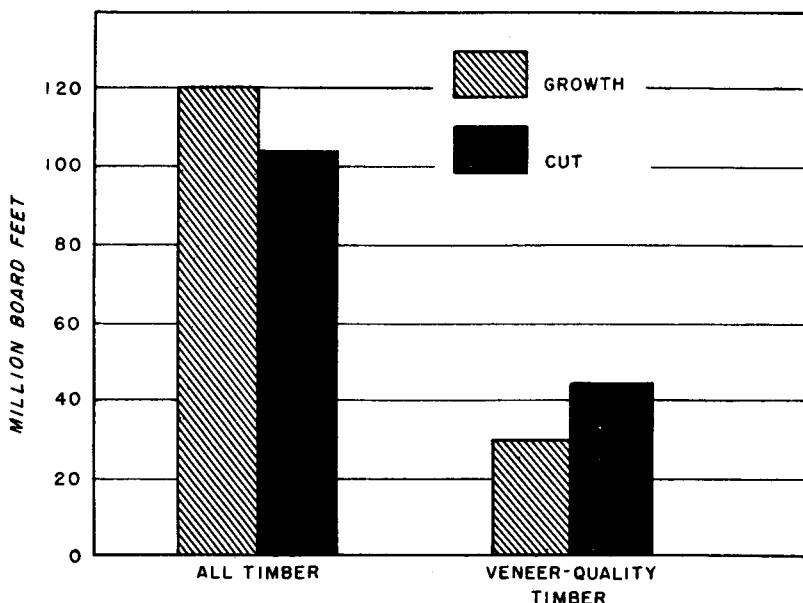


Figure 9. — Estimated current annual growth-cut relationship for walnut timber.

curring on lands not classed as forested in Kentucky and Kansas. Report on these states are being prepared for publication. In the nonforest land survey, the walnut trees tallied included single trees or blocks of trees smaller than 1 acre; and roadside, streamside, shelterbelt, and fence-row strips of timber that had crowns less than 120 feet wide.

Preliminary results of this survey in Kentucky show that a large number of walnut trees are growing on nonforest land. However, they generally are of low quality. About 40 percent of the sawtimber-size trees are culls; that is, they do not meet survey merchantability standards (table 4). Even so, in the Blue Grass area of Kentucky black walnut trees of sawtimber size and quality were found at the rate of one tree per 10 acres of open land. In the rest of the State, the average occurrence was about one tree per 25 acres of open land.

The survey showed that approximately 57 million board feet (International 1/4-inch rule) of sawtimber was growing on nonforest land in Kentucky. An additional 5 million board feet of timber was found in trees classed as cull because their merchantable length was only 6 or 7 feet. More than half of the sawtimber volume was in the Blue Grass area where narrow strips of trees occur frequently in fence rows and along streams. The walnut sawtimber volume on nonforest land was distributed among tree-size classes as follows:

<i>Diameter at breast height (inches)</i>	<i>Percent</i>
11.0 to 14.9	46
15.0 to 18.9	30
19.0 plus	30

Log quality was similar to that found on trees in the forest land. About 45 percent of the volume of trees 15 inches d.b.h. and larger was in log grades 1 or 2.

Black walnut trees on nonforested areas can augment the harvest from commercial forest land. However, timber quality on these areas is as low or lower than in commercial forest areas. In the long run, intensively managing our present resources and establishing plantations are the only sure ways to provide increasing quantities of high-quality walnut timber. But, improved

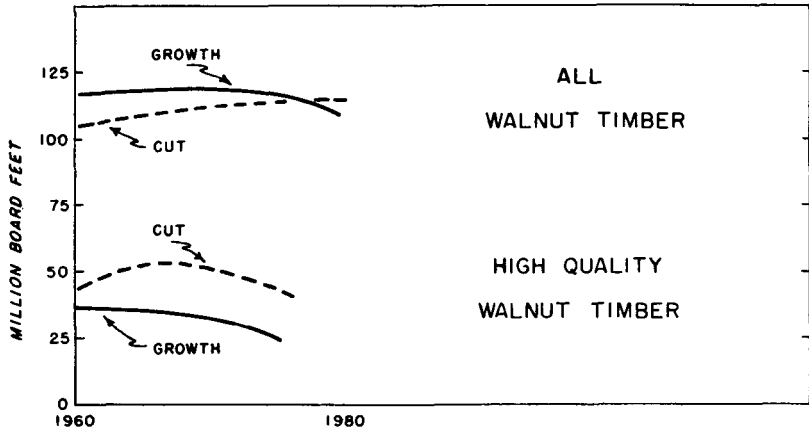


Figure 10. — Probable future growth-cut relationship for black walnut timber.

management depends on better knowledge of the responses to management actions.

A research program conducted by the U. S. Forest Service is providing this information. Studies are now under way on walnut timber management concerned with seeding and planting; yield and quality control; and the relation of yield to soil, site characteristics, and cultural work such as fertilization, hybridization, irrigation, pruning, spacing, and seed selection. The success of management efforts will control the future supply of black walnut timber.

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Appendix I

TABULAR DATA

Table 1. — Volume of walnut growing stock and sawtimber on commercial forest land, by regions, 1963¹

Region	Growing stock ²	Sawtimber
	<i>Million cubic feet</i>	<i>Million board feet³</i>
Central	506	1,532
Atlantic	274	657
Gulf	124	308
Plains	102	140
Lake	24	72
Total	1,030	2,709

¹Commercial forest land. — Includes forest land that is producing or is physically capable of producing usable crops of industrial wood (usually sawlogs and pulpwood but excluding fuelwood), economically available now or prospectively, and not withdrawn from timber utilization.

²Growing stock. — Net volume of live merchantable sawtimber and poletimber trees from stump to a minimum 4-inch-top diameter outside bark of central stem. Sawtimber trees are live merchantable trees 11.0 inches d.b.h. and larger. Poletimber trees are live merchantable trees 5.0 to 10.9 inches d.h.b. A black walnut board-foot volume table is in appendix (table 3). Cubic volume is computed in cubic feet of unpeeled wood, using a Lake States Composite Volume Table and correcting for bark thickness by species and diameter class.

³International 1/4-inch rule.

Table 2. — Walnut used in manufacturing, by industry group and form of wood, 1960

Industry group	Form of wood		
	Lumber	Veneer	Plywood
	<i>Million board feet</i>	<i>Million square feet¹</i>	<i>Million square feet²</i>
Wood household furniture	21.8	3.8	15.6
Wood office furniture	7.4	.7	3.5
Partitions, fixtures, and other furniture	3.7	.1	4.9
Dimension and flooring	5.1	—	.2
Sawmills and planing mills	4.7	(³)	.1
Veneer and plywood plants	.3	.7	9.3
Millwork plants	3.2	.2	2.4
Wood products not elsewhere classified	7.3	.8	.1
Transportation equipment	2.3	—	6.4
Signs and advertising	1.5	.1	5.7
Electrical equipment	1.4	(³)	.7
Musical instruments	.8	.4	.1
Toys and sporting goods	.7	—	(³)
Morticians' goods	.7	—	—
All other	.9	(³)	1.2
Total	61.8	6.8	50.2

¹ 1-inch basis.

² Surface measure.

³ Less than 50,000 square feet.

Table 3. — Black walnut volume table
(Gross volume in board feet¹ — International 1/4-inch rule)

D.b.h.	Merchantable log length in feet							
	8	16	24	32	40	48	56	64
10	20	38	—	—	—	—	—	—
12	29	55	78	97	—	—	—	—
14	41	77	107	136	158	178	—	—
16	57	102	143	175	207	240	266	286
18	72	131	182	228	270	310	349	388
20	89	165	229	286	339	388	436	485
22	109	203	281	351	417	480	538	592
24	129	244	336	417	495	577	650	718
26	153	291	398	495	587	679	764	854
28	181	338	466	577	679	786	892	989
30	213	398	533	664	786	902	1,028	1,145
32	246	456	616	766	902	1,038	1,174	1,309
34	282	514	703	873	1,028	1,174	1,339	1,484
36	323	582	795	980	1,154	1,329	1,503	1,673

¹Merchantable volume from a 1-foot stump to an 8-inch top. Volume corrected by a 3-percent factor based on data from walnut studies in Kansas and Missouri.

Source: U. S. Dep. Agr. Tech. Bull. 1104 (tables 2 and 14), January 1955.

Table 4. — Hardwood log-grading rule used in forest resource surveys¹

Grading factors		Lumber logs				Tie-and-timber logs
		Log grade 1		Log grade 2	Log grade 3	Log grade 3
		Butts only	Butts and uppers	Butts and uppers	Butts and uppers	Butts and uppers
Minimum diameter (inches)		13-15	16-19 20+	11	8+	8+
Minimum length (feet)		12+	12+	12+	8+	8+
Clear cuttings on three best faces	Min. length (feet)	7	5 3	3	2	Not graded on cutting basis: sound knots permitted if diameter of knot collar is not more than 1/3 of log diameter at that point; whorled or group knots occurring within a 6-inch vertical distance permitted if aggregate collar diameters do not exceed 1/3 of log diameter at that point; any number of unsound defects of any size permitted if they can be slabbed off.
	Max. number on face	2	2	3	Unlimited	
	Min. yield in face length	5/6	5/6	4/6	3/6	
Max. sweep and crook deduction (percent)		15	15	30	50	Allowable sweep in inches equal to 1/4 d.i.b. at small end of log.
Max. cull and sweep deduction (percent)		40	40	50	50	No unsound internal defect permitted.

Exceptions: In ash and basswood 12 inches d.i.b. for grade 1 butts.

¹Surveys made in the Central States by the Central States Forest Experiment Station, U. S. Forest Service. These rules for grading logs in trees are based on the Hardwood Log Grades for Standard Lumber developed by the Forest Products Laboratory, U. S. Forest Service.

Table 5. — Log scale Doyle rule¹
(In board feet)

Top d.i.b (inches)	Log length — feet				
	8	10	12	14	16
8	8	10	12	14	16
10	18	22	27	32	36
12	32	40	48	56	64
14	50	62	75	88	100
16	72	90	108	126	144
18	98	122	147	172	196
20	128	160	192	224	256
22	162	202	243	284	324
24	200	250	300	350	400
26	242	302	363	424	484
28	288	360	432	504	576
30	338	422	507	592	676
32	392	490	588	686	784
34	450	562	675	788	900
36	512	640	768	896	1,024
38	578	722	867	1,012	1,156
40	648	810	972	1,134	1,296

¹ The log scale commonly used in sales of walnut timber.

**Table 6. — Grading rules of the American Walnut
Manufacturers' Association**

Log grade	Diameter	Length	Minimum quality standards
	<i>Inches</i>	<i>Feet</i>	
Prime	12 butt	8+	Sound, straight, free of all defects, including iron.
	16 butt	6 to 7	Sound, straight, free of all defects, including iron.
Select	16 butt	8+	Three clear faces and no unsound defects.
	16 2nd cut	8+	Clear all defects.
	Prime logs except for slight crook.		
No. 2	12+	8+	Two clear faces.
	12 to 15	6 to 7	Clear logs.
	16+	6 to 7	Three clear faces.
Cull	All logs that will not meet above specifications.		

Source: U. S. Dep. Agr. Farmers' Bull. 1459, 1959.

Table 7. — Purdue hardwood log grades¹

Log grade	Minimum quality standards
Prime	Practically (90 percent) surface clear on three visible faces (a face is any $\frac{1}{4}$ of the surface of a log). Must be 16 inches or more in diameter inside bark at the small end.
No. 1	At least $\frac{3}{4}$ of the log length on the three visible faces must be surface clear in one section. Must be at least 14 inches in diameter inside bark at the small end.
No. 2	At least $\frac{1}{2}$ of the log length must be surface clear on the three visible faces in one section or in two sections, neither of which can be less than 3 feet long. Must be at least 10 inches in diameter inside bark at the small end.
No. 3	Will not meet No. 2 specifications.

¹Log grade rules developed by Purdue University and used in Indiana log-price reporting.

Table 8. — Ohio standard sawlog grades¹

Log grade	Sawlog grade specifications			Other specifications
	Minimum length	Minimum top diameter inside bark	Maximum sweep—percent of top diameter in inches	
	<i>Feet</i>	<i>Inches</i>	<i>Percent</i>	
Prime	8	16	15	The grading face (poorest of the three best faces) ² must be 5/6 clear and free from defects in 1 or 2 clear cuttings, each of which must be 7 feet or longer.
No. 1	8	14	15	The grading face (poorest of the three best faces) must be 4/6 clear and free from defects in 1 or 2 cuttings, each of which must be 5 feet or longer.
No. 2	8	12	15	The grading face (poorest of the three best faces) must be 3/6 clear and free from defects in 1 or 2 cuttings, each of which is 3 feet or longer.
No. 3	8	10	—	Logs must be straight and sound with no heart defects.
Cull	—	—	—	Below No. 3 logs.

¹Prepared by the Log Grades Committee of the Ohio Forestry Association and used in Ohio timber price reporting.

²The poorest face is disregarded for grading purposes. The next best face is used for grading.

Note: There are occasional logs of top quality or special use that will not be included in these grades.

**Table 9. — Specifications for walnut sawlog quality classes
based on N.H.L.A. rules for grading walnut lumber
(In inches)**

Quality factors	Prime ¹	Select ²	Common ³
Minimum diameter, inches:			
Butts	12	12	—
Uppers	13	13	9
Minimum length, feet	6	6	6
Minimum clear faces (out of four)	Two clear and one 5/6 clear	One clear and two 2/3 clear	None clear and three 2/3 clear
Clear cuttings, feet:			
Length	4 and up	3 and up	2 and up
Maximum number on face	2	3	unlimited
Maximum cull deduction, ⁴ percent	25	33 1/3	50
End defects	Instructions given in text		

Exceptions:

¹Will admit 11-inch butts and 12-inch uppers with 3 clear faces and 1 face 5/6 clear; also 16-inch butts and uppers with 1 clear face and 2 faces 5/6 clear.

²Will admit 11-inch butts and 12-inch uppers with 2 clear faces and 2 faces 2/3 clear; also 16-inch butts and uppers with no clear faces and 3 faces 2/3 clear.

³Logs that do not meet specifications for common quality are cull.

⁴Logs whose combined scale deduction for sweep and cull exceeds the maximum allowable are dropped into the appropriate quality class.

Source: King, W. W. 1958. Evaluating quality black walnut sawlogs. Forest Prod. J. 8 (9): 243-248.

II

ACCURACY OF ESTIMATES

Because walnut is a minor species in every state in which it occurs, the volume and growth estimates of the walnut resource are subject to rather sizable sampling errors. The estimates are based on classification of a large number of points on aerial photographs, followed by field verification and tree measurement of a sample of the photo points. Estimates of volume obtained in surveys completed within the 3 years prior to 1963 were used without change. In other states, data for the most recent forest survey were updated to 1963.

The error of estimate per billion cubic feet of timber in states where walnut is important ranges from 2.9 to 6.6 percent, and for most states the estimate error is less than 5 percent per billion cubic feet. About a billion cubic feet of walnut is found in the eastern United States. Therefore, it is estimated that the total walnut volume on commercial forest land in the United States has a sampling error of about 5 percent. This means that the chances are two out of three that the reported nationwide walnut volume of 1 billion cubic feet of walnut on commercial forest land does not differ from the actual volume by more than 5 percent.

Sampling errors increase for smaller volumes. They may be approximated from the following tabulation developed for use in estimating sampling errors in the nationwide forest survey.

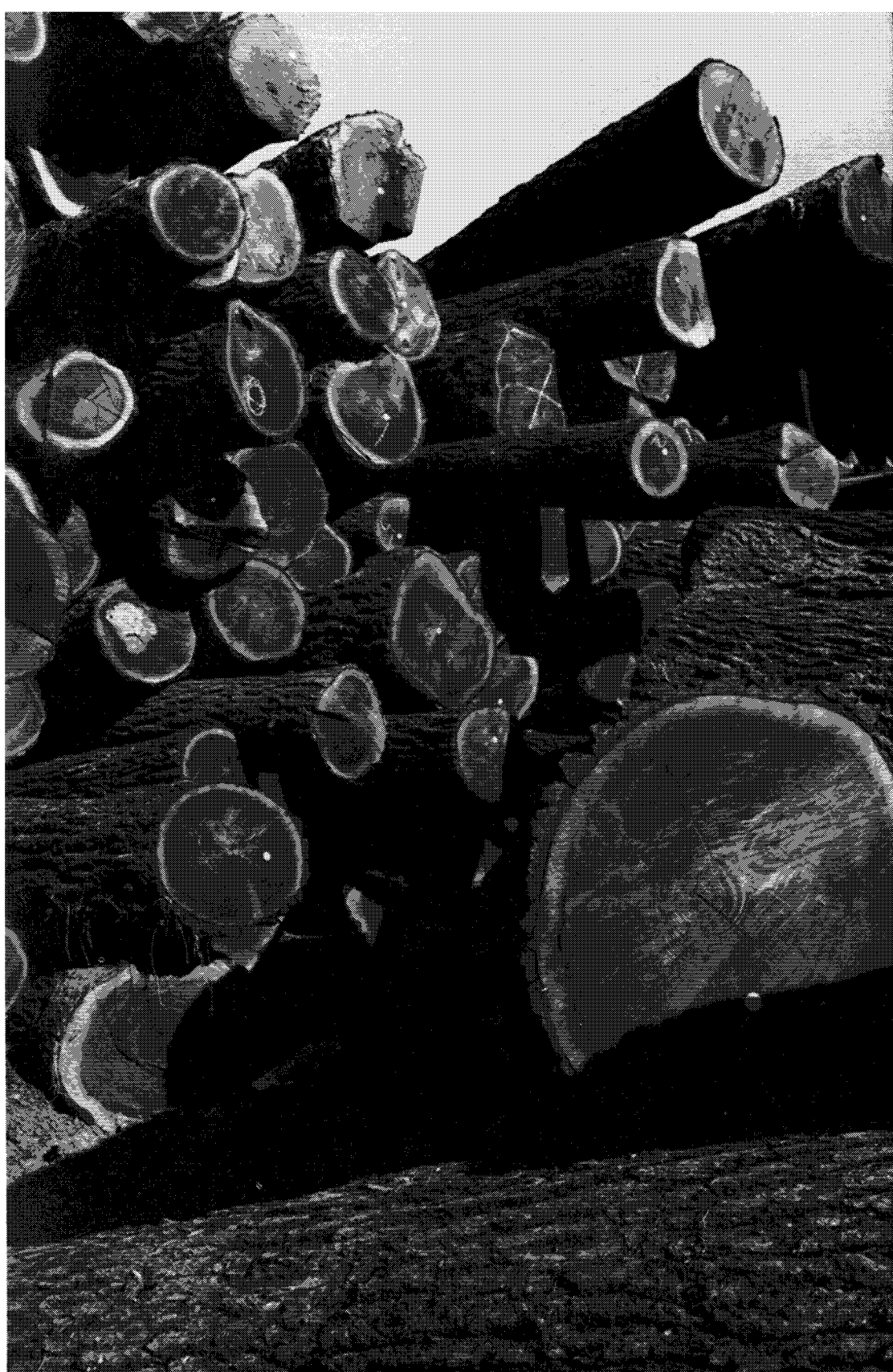
<i>Timber volume</i> (Million cubic feet)	<i>Approximate sampling error</i> (Percent)
500	7
250	10
100	16
50	23
10	50

Another source of discrepancy in growth/cut comparisons is the use of both the Doyle and International $\frac{1}{4}$ -inch log rules to report volumes. The Doyle rule consistently scales smaller board-foot volumes than the International $\frac{1}{4}$ -inch rule on logs smaller than 26 inches top diameter inside bark; but for logs larger than 26 inches, the Doyle rule gives more volume than the International $\frac{1}{4}$ -inch rule.

III

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