INFORMATION LEAFLET
FOREIGN WOODS

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AVODIRE

(Turraeanthus africana (Welw.) Pellegrin
(= Guarea africana Welw. = Birgeria africana A. Chev.)
Family: Meliaceae

By

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Avodire (Turraeanthus africana (Welw.) Pellegrin) is a species from tropical West Africa that has recently become of considerable commercial importance on European and American hardwood markets. The species was first described in 1878 by Dr. Welwitch as Guarea africana (C. DC.) from Angola, West Africa. In 1909, A. Chevalier described and named it as Birgeria africana A. Chev., but 2 years later Pellegrin referred the species to the genus Turraeanthus, and the recognized scientific name is now Turraeanthus africana (Welw.) Pellegrin.

It is a member of the Meliaceae family (20, 22, 25), 2 which includes some of the best known cabinet woods, such as mahogany (Swietenia spp.), African mahogany (Khaya spp.), Spanish cedar, and andiroba (6).

Avodire is manufactured in the same manner as African mahogany, and when stained and finished, the wood is difficult to distinguish from African mahogany, although the trees do not look alike externally (22). It has been offered for sale as white mahogany, African mahogany, African satinwood, and African furniture wood (14). The principal handicaps to its extensive use are its comparatively small size and limited occurrence, the poor shape of the logs, and the tendency of freshly cut timber to stain if not carefully handled (29). Although the wood has come on the market only comparatively recently, its popular blond color, low price, beautiful figure, and easy-working qualities have created a considerable demand (6).

1Maintained at Madison, Wis., in cooperation with the University of Wisconsin.
2Underlined numbers in parentheses refer to the list of numbered references at the end of the article.
Trade and Vernacular Names

Avodire is the generally accepted trade name for Turraeanthus africana. It has the advantage of not conflicting with that of any other commercial wood on the American market. Whether this name is a combination of various native names or one given by the French is not known. The name "white mahogany" has also been used, because the wood is much like that of African mahogany except for its color, which is pale tan approaching white (22). Other names are:

<table>
<thead>
<tr>
<th>African furniture woods</th>
<th>U. S. trade</th>
</tr>
</thead>
<tbody>
<tr>
<td>African satinwood</td>
<td>U. S. trade</td>
</tr>
<tr>
<td>Agboui (Abé, Ébrie)</td>
<td>Ivory Coast</td>
</tr>
<tr>
<td>Apapaye</td>
<td>Gold Coast</td>
</tr>
<tr>
<td>Apaya</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Apeya</td>
<td>Gold Coast</td>
</tr>
<tr>
<td>Appayia</td>
<td>Gold Coast</td>
</tr>
<tr>
<td>Avodire (Appolonian)</td>
<td>Ivory Coast</td>
</tr>
<tr>
<td>Engan</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Esu</td>
<td>Belgian Congo</td>
</tr>
<tr>
<td>²Hagué (Agni)</td>
<td>Ivory Coast</td>
</tr>
<tr>
<td>Hakué (Attié)</td>
<td>Ivory Coast</td>
</tr>
<tr>
<td>Olon</td>
<td>Ivory Coast</td>
</tr>
<tr>
<td>Lusamba</td>
<td>Belgian Congo</td>
</tr>
<tr>
<td>Songo</td>
<td>Belgian Congo</td>
</tr>
<tr>
<td>Wansewa</td>
<td>Gold Coast</td>
</tr>
<tr>
<td>White mahogany</td>
<td>U. S. trade</td>
</tr>
</tbody>
</table>

Distribution and Habitat

Avodire occurs as an understory tree in the rain forests of parts of tropical West Africa, including the Gold Coast, Ivory Coast, and Angola, but is essentially an Ivory Coast species. The trees are not uniformly distributed in the rain forests, but are often localized in almost pure groups (1). Avodire is reported as abundant in the region of the east Ivory Coast from the Agneby River on the west to the Bia River on the east. Avodire and other species of Turraeanthus are also said to grow in the Gold Coast, Nigeria, the Cameroons, Gabon, Liberia, and the Belgian Congo, although they are not as common in these regions, and there is little information on the occurrence (7) or on the wood of some of these species.

Avodire is probably typical of the genus (29). According to Dr. Welwitch, avodire is not a coastal or low-altitude species but attains its best development in the foothills 50 to 100 miles inland in the upland forests. It does

²Name applied also to the Bosse wood (Guarea cedrata Pell.), which possesses different characteristics (6).
not grow, however, above the 2,500-foot contour line where conditions grade into the highland-forest type. It occurs in rich, moist soil on the borders of streams and the margins of meadows, swamps, and lakes (22).

The Tree

Size and Form

Avodicé is a medium-sized tree in comparison to the giants of West Africa. It may reach 60 to 100 feet in height but attains 90 feet or more only under favorable conditions (1; 22). It often has a diameter at the base of 3 to 4 feet, even up to 5 feet. Generally, the tree is of poor habit of growth. The trees do not develop very clear or straight trunks, which results in considerable waste in logging (22). The utilizable part of the bole is usually from 25 to 50 feet in length, rarely more than 65 feet (7). Therefore, a large percentage of the wood has to be rejected in the forest as unfit for export. A small percentage of the choicest material yields figured wood suitable for fine veneer (6). The stems very often divide into wide spreading branches and form large crowns (22). Dr. Welwitch is quoted (22) as describing Turraeanthus africana as "an immense, handsome tree" in his monograph on the flora of tropical Africa.

The Bark

The bark is ash-colored, tinged with red, and stands out in contrast with the very dark, glossy green of the foliage (22). The bark is said to have toxic properties (1). It peels off in thin strips, the inner portion being creamy yellow and possessing a very characteristic aromatic odor (29). In order to prevent fungus damage, it is necessary to remove the bark to help the wood dry out promptly; consequently, the logs entering the market are invariably free of bark (6).

Leaves

The compound leaves are large (2 feet or more in length), and are composed of 4 to 12 pairs of alternate, oblong leaflets, 1 to 6 inches long, about 1-1/2 inches wide, and rounded at the apex. The leaflets are smooth, shiny, and leathery. The midrib is very prominent on the upper surface and has many fine lateral nerves. The leaf buds, young petioles, and flower stalks are covered with a fine, rusty pubescence (29). The leaves are crowded at the ends of the branches and thus give the tree an unusual appearance (22).

Flowers and Fruit

The white to creamy-yellow flowers are in clusters in the axils of the leaves and form very conspicuous panicles that have numerous flowers. The flowers differ very little from those of mahogany. They may be found nearly all the
year round, although the main flowering period is in the spring, with a
second, though less abundant blossoming in the autumn (1, 22).

The fruit takes about 6 months to develop and generally matures in the autumn. It is in the form of a fig-shaped, fleshy capsule. These capsules are over an inch in diameter, yellow or orange in color, scented, and have a soft, whitish pulp in which the seeds (usually 4 or 5 in number) are imbedded. The seeds germinate readily, and the young seedlings are plentiful, although few survive in the dense shade of the old-growth forests. They quickly fill up any openings in the stand and are easily transplanted (1, 29).

The Wood

General Appearance

Although avodire belongs to the Meliaceae family, the wood has few characteristics of mahogany. When stained and finished, however, the figured wood may greatly resemble African mahogany superficially (22). Its natural pale color and high, satiny luster have occasioned the use of the wood as a substitute for satinwood (6). The logs vary greatly in color, grain, figure, and quality (11). The crooked, irregular logs often contain ring checks and even cross or wind breaks (22).

Color

The wood is creamy white to pale yellow, sometimes darkening to golden yellow (19). Unlike most of the Meliaceae, the color is light and uniform throughout. Since the heartwood is not distinctly colored, it is difficult to distinguish the sapwood from the heartwood areas; the wood is therefore easy to match in use and is especially valued for use where blond wood is desired (6, 24).

Luster

When worked, the wood has a high, satiny, natural luster (1, 18).

Weight

The wood is rather light to heavy in weight and soft to moderately hard; specific gravity 0.45 to 0.60 (air-dry), which is in the mahogany range; weight usually about 31 to 37 pounds per cubic foot (18, 26). It is fairly resistant to indentation (29). Avodire proved less hard than most of the cabinet woods tested by Harrar (10). The results given in table 1 are taken from his tests.
Table 1.—Results of tests of hardness on cabinet woods

<table>
<thead>
<tr>
<th>Species</th>
<th>Moisture content</th>
<th>Specific gravity (oven-dry weight and volume)</th>
<th>Average and comparative hardness&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Compared to black walnut</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avodire (W. Africa)</td>
<td>5.6</td>
<td>0.18</td>
<td>860</td>
<td>66</td>
</tr>
<tr>
<td><em>Turraeanthus africana</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mahogany (Colombia)</td>
<td>5.2</td>
<td>.51</td>
<td>1,050</td>
<td>83</td>
</tr>
<tr>
<td><em>S. ijetenia macrophylla</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup> Load required to embed a 0.444-inch ball to one-half its diameter.

Grain, Texture, and Figure

The grain may be straight but is frequently wavy or interlocked, which produces a mottled figure on quarter-cut material. The texture is fine and uniform (16). The irregular grain combined with the high luster may give a fine moire appearance to the finished surface, which at its best suggests figured satinwood (1). The figured wood may show considerable variety, such as stripe, curl, or mottle (22).

Odor and Taste

Odor and taste are absent or not distinctive (29).

Mechanical Properties

The information on the mechanical properties of avodire is meager, but it is reputed to be a strong, tough, elastic timber in proportion to its weight (1, 11, 16). The following comparison of West African species is taken from an article by Monnin and Collardet quoted in Weltholzwirtschaft, Ubersee Holzer Beilage Nr. 16, April 1950 (31).
Table 2.--Physical and strength properties of three West African species

<table>
<thead>
<tr>
<th>Species</th>
<th>Specific gravity</th>
<th>Volumetric shrinkage</th>
<th>Compression parallel to grain</th>
<th>Bending tension perpendicular to grain</th>
<th>Tension parallel to grain</th>
<th>Tension perpendicular to grain</th>
<th>Cleavage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Avodire Turraeanthus africana</td>
<td>0.55</td>
<td>11.6</td>
<td>110</td>
<td>840</td>
<td>21.0</td>
<td>14.0</td>
<td></td>
</tr>
<tr>
<td>Limba Terminalia superba</td>
<td>0.56</td>
<td>12.3</td>
<td>1140</td>
<td>800</td>
<td>20.5</td>
<td>13.0</td>
<td></td>
</tr>
<tr>
<td>Obeche Triplochiton scleroxylon</td>
<td>0.40</td>
<td>9.5</td>
<td>270</td>
<td>580</td>
<td>12.0</td>
<td>6.5</td>
<td></td>
</tr>
</tbody>
</table>

1Based on weight and volume when air dry.
2Based on green volume.

**Durability**

Because avodire is subject to decay and insect attack, logs should be converted into lumber as soon as possible after felling, unless storage in fresh water is provided (7). The wood should not be used in damp situations and is not durable in contact with the ground or in exposed situations (16, 22).

**Seasoning**

Avodire is reported to season readily, but care is needed to avoid splitting and warping (16). From tests by Harrar (12), the percent of shrinkage of avodire is compared in table 3 to that of some of the cabinet woods with which it competes.
Table 3.—Percent directional and volume shrinkage from green to oven-dry condition

<table>
<thead>
<tr>
<th>Species</th>
<th>Shrinkage</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Longitudinal: Percent</td>
</tr>
<tr>
<td>Avodire (W. Africa)</td>
<td>0.24</td>
</tr>
<tr>
<td>Turraeanthus africana</td>
<td></td>
</tr>
<tr>
<td>Mahogany, African</td>
<td>0.28</td>
</tr>
<tr>
<td>Khaya ivorensis</td>
<td></td>
</tr>
<tr>
<td>Mahogany, Colombian</td>
<td></td>
</tr>
<tr>
<td>Swietenia macrophylla</td>
<td>0.18</td>
</tr>
<tr>
<td>Satinwood, Ceylon</td>
<td></td>
</tr>
<tr>
<td>Chloropica swietenia</td>
<td>0.12</td>
</tr>
</tbody>
</table>

1 Compare with value in table 2.

Working Characteristics

Straight-grained wood is quite easy to work, but care is required in planing either quartered boards showing stripe figure or curly- or wavy-grained material to avoid surface tearing (1). A small cutting angle is desirable for a clean finish. Avodire makes excellent veneer, especially sliced veneer, and has fairly good nailing, screw-holding, and gluing properties. It will take an excellent finish and can be stained evenly, although because of the present popularity of its light, natural color, this is not generally desired (16). The surface can be filled and holds filler well (22). In Harrar's tests (11) on the screw-holding power of cabinet woods, avodire showed lower values than the three other woods cited in table 4.
### Table 4: Screw-holding power of cabinet woods

<table>
<thead>
<tr>
<th>Species</th>
<th>Withdrawal resistance of No. 6 screws</th>
<th></th>
<th>Withdrawal resistance of No. 10 screws</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Side</td>
<td></td>
<td>Side</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Av. : Max. : Min.</td>
<td></td>
<td>Av. : Max. : Min.</td>
</tr>
<tr>
<td>Mahogany, Colombian</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Satinwood, Ceylon</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Chlorophora swietenia</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Uses

The figured material is usually converted into veneer for use in decorative work, such as cabinet work, paneling, interiors of railway coaches, ships' fittings (cabins on the Queen Mary), and lighter types of furniture. The plain stock may go into lumber or ordinary plywood and joinery. There is less demand for the wood as lumber because of the cross breaks and irregularities of growth (1, 14, 16, 22, 24).

Pulp from the light-colored avodire yields paper that compares well with paper obtained from the ordinary commercial hardwoods (7).

### Supplies

In the past, the Ivory Coast has been one of the main sources of log supply, especially of figured material, because logs are conveniently transported to seaports from this region. Overland transportation of logs has been poorly developed. More recently, the Gold Coast has become another of the main sources of log supply (1, 16, 22). Avodire is not available in large amounts, but logs were imported before World War II with average girths of 5 to 6 feet and lengths up to 15 feet (16). The logs first entered the French markets soon after World War I, and not until 1923 was much shipped into German markets. Several years later, it attracted notice in England and America (22).
Minute Structure

Growth rings.--The growth rings tend to be poorly defined, sometimes indicated only by a flattening of the fibers (6, 18, 24, 29).

Vessels.--The individual vessels are relatively small, oval to nearly round in cross section, and not distinct without magnification. They are numerous, evenly distributed, solitary or in radial groups of 2 to 4 vessels. They have simple perforations. The vessels frequently contain yellowish gum but no tyloses (17, 18, 22, 29).

Rays.--The rays are fine and often indistinct without magnification. Although the marginal cells are not markedly upright, the rays are classed as heterogeneous, mostly biseriate (occasionally 3 cells wide at the middle), and may be 6 to 25 but are generally 12 to 15 cells high. Low rays, rarely over 6 cells high, are usually found to be uniseriate (18, 29). Ripple marks and gum ducts are absent (18, 29).

Parenchyma.--Parenchyma is sparingly developed about the vessels and may often contain calcium oxalate crystals (18, 29).

Fibers.--Growth zones may be somewhat defined by rows of radially flattened fibers. The fibers are libriform and nonseptate with simple pits. They have relatively thin walls. Fiber dimensions are recorded as follows: length, 1 to 2 mm. (av. 1.5 mm.); diameter, 12 to 26 mm. (av. 19 mm.) (5, 18, 24, 29).

Wood Composition

Avodire wood is composed of ash, 4.56 percent; fats and waxes, 0.80 percent; cellulose, 62.15 percent; lignin, 32.49 percent (all on a dry-weight basis). On digestion with NaOH in 5 percent concentrations for 8 hours under a pressure of 3 kilograms, avodire gave a light, brownish-yellow pulp, which bleached easily and yielded 37 percent of bleached pulp (5, 24).
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