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Forest Bulletin No. 84

1934

# The Identification of the Commercial Timbers of the Punjab.

BY

**K. AHMAD CHOWDHURY, B.A., B.Sc., M.S.,**

*Wood Technologist, Forest Research Institute, Dehra Dun.*



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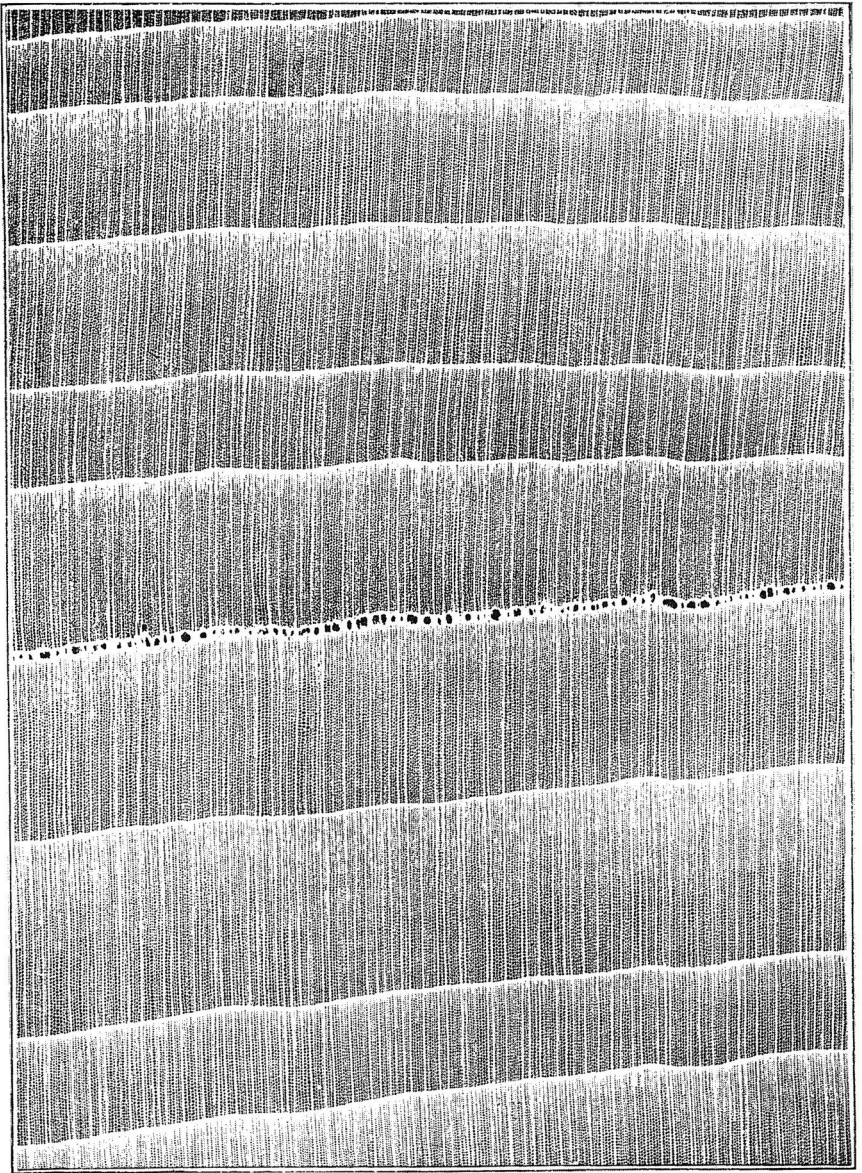
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DEODAR.

*Cedrus deodara*, Loudon.

( X 10 ).

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## PREFACE.

In Forest Bulletin No. 77 (1932) "The Identification of Important Indian Sleeper Woods", it was mentioned in the Preface that it was the intention of the Forest Research Institute to publish keys for the identification of the woods of each Province in India. A key for Burma timbers has already been published. This Bulletin represents the next step in that direction, and covers the common commercial woods of the Punjab. Punjab commercial woods are few in number and their identification is not difficult. At the same time, confusion often arises, especially amongst purchasers of timber who are not very familiar with the subject, and it is hoped that this little booklet will help in clearing up any doubts that may exist.

In order to make the Bulletin as useful as possible, brief notes on the strengths, seasoning properties, durability, working qualities and uses have been added for each species, and as the information given is up-to-date and the latest available for the timbers in question, it may prove of use even to experienced timber users, and will, perhaps, help to dispel some of the popular fallacies which are known to exist in respect of some of the timbers concerned.

In addition, photographs of cross-sections of the timbers described, as seen under a pocket lens, have been included, so that, with the help of these and the key, no difficulty should be experienced, even by the novice, in identifying any of the timbers mentioned.

FOREST RESEARCH INSTITUTE,  
DEHRA DUN.  
December 1933.

H. TROTTER,  
*Forest Economist.*

## INTRODUCTION.

Intensive research during the last twenty years has resulted in an increased knowledge of the timber resources of India. At present the number of timbers sold in the market is much greater than it was a few years ago. This has caused a certain amount of difficulty in the correct identification of some of the species which the timber trade is now handling. The aim of this Bulletin primarily is to show the differences of the anatomical structure of some of the more common commercial timbers of the Punjab and the way to identify them on the spot with the help of a pocket knife and a hand lens. Secondly, it was thought that short notes on the strength, durability, seasoning properties and working qualities of these timbers would be helpful in addition to the anatomical descriptions, and these have been added.

To start with, the publication contains some elementary notes on wood structure. Although these notes were published in a former publication on the identification of timbers, they are again included in this Bulletin in order to make it as complete as possible. A key for the identification of the timbers has also been added. This is meant as a guide and includes only those anatomical characteristics which are of distinguishing value. A detailed description of the wood structures visible with a hand lens follows. This is based on an examination of numerous specimens in the collection of the Forest Research Institute at Dehra Dun, and gives the range of variation that is likely to be found in a species. In order to help in identification, low power (X 10) photomicrographs have also been included. In this connection it may be mentioned that there are two methods of taking photomicrographs—negative prints and positive prints. Positive prints are suitable for high-power work, when one examines sections under a microscope. But for low-power work negative prints are usually the most helpful, for in their case the cell lumen appears dark, *i.e.*, exactly as seen with a hand lens, although in the case of conifers the general look of the photomicrograph is somewhat open to criticism. For the sake of general uniformity throughout this Bulletin and of its ultimate utility, the latter method has been followed.

In conclusion, my thanks are due to Capt. H. Trotter, Forest Economist, for his help and suggestions during the progress of this work. Acknowledgments are also due to the Officers-in-Charge, Timber Testing Section (Mr. L. N. Seaman), Wood Preservation Section (Mr. S. Kamesam), Seasoning Section (Dr. S. N. Kapur), and Wood Workshop Section (Mr. W. Nagle) for supplying me with the notes on their respective spheres of work.

I take this opportunity of expressing my thanks to Mr. C. G. Trevor, President, Forest Research Institute, Dehra Dun, for his criticism and suggestions.

DEHRA DUN ;  
*December, 1933.*

K. A. CHOWDHURY,  
*Wood Technologist.*

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# The Identification of the Commercial Timbers of the Punjab.

## I. THE GROSS STRUCTURE OF WOOD.

(a) **Sapwood and heartwood.** The light coloured outer portion of a log is called sapwood and the deep coloured central portion heartwood. The sapwood, as the name implies, is for the conduction of sap (liquids), while the heartwood is dead and does not take any active part in the life of a tree except to give rigidity to the trunk. The colour distinction between these two portions of a log is not, however, always present. There are certain species like mango (*Mangifera indica*), Himalayan silver fir (*Abies pindrow*) and spruce (*Picea morinda*) which do not show any difference in colour between sapwood and heartwood, although from the physiological point of view a certain amount of heartwood is always present in the mature wood of any species.

It is well known that under identical conditions heartwood is more durable than sapwood. For this, no explanation can be put forward from an anatomical point of view, since there is little difference between the anatomy of sapwood and heartwood. The greater durability of heartwood has often been attributed to the presence of chemical deposits such as gums, resins and oils, which may serve as natural preservatives of the wood. Moreover, on account of the carbohydrates and starch deposits in the living cells of the sapwood, favourable conditions necessary for the germination of fungal spores are more likely to be created in the sapwood than in the heartwood.

There seems to be a popular notion that heartwood is stronger than sapwood, but there is no foundation for such a theory. Researches carried out in timber testing laboratories in different parts of the world show that under identical conditions sapwood is as strong as heartwood. This can be well understood, when the fact that, anatomically, there is little difference between sapwood and heartwood is taken into consideration.

When logs are left in the open for some time, they are often subjected to what is known as 'sap-stain'. When this happens, the logs are discoloured and look defective but actually the strength of the timber is not materially affected. This appearance of discoloration in the sapwood is caused by some fungi, which live, for the most part, on the carbohydrates and starch deposits in the wood but do not damage the timber as a whole.

(b) **Spring wood and summer wood : early wood and late wood.** The terms spring wood and summer wood were originally applied to timbers in temperate regions, where there are two distinct growth seasons—spring and summer. In India, these terms cannot be applied in the same sense, for, at least in some localities, growth activities of trees do not correspond to the spring and summer seasons. On the other hand, there are trees in which variable intensity of growth is prominent—a rapid growth in the form of thin-walled cells followed by a slow growth of thick-walled cells. The former may be called early wood and the latter late wood. Early wood, as a rule, has a lighter shade of colour than late wood.

*Growth rings.* The greater the difference between late wood and early wood, the more distinct is the growth ring, often also called the annual ring\*. Rate of growth shows great variation, depending on many factors such as species, locality, and the condition of the soil in which the tree grows. Boxwood (*Buxus wallichiana*) and parrotia (*Parrotia jacquemontiana*) have usually very narrow growth rings, while in other species like mulberry (*Morus alba*) the rings are very wide. Again, there are many Indian trees which do not show any distinct growth ring due to the fact that their intensity of growth is more or less the same throughout the growth season.

(c) **Tracheids, vessels or pores.** Wood is composed of minute tube-like cells, whose size and shape show considerable variation, depending on the physiological and mechanical functions they have to perform in the living tree. In conifers, tracheids are the main longitudinal elements and their function is to conduct

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\* As the ring shows the difference in growth from season to season which may not be one full year, it seems judicious to use the term 'growth ring' instead of 'annual ring'.

liquid (sap) and to give rigidity to the tree. Tracheids are minute, narrow, elongated, thick-walled cells with closed tapering ends. In broadleaved trees, there is a division of labour; there are vessels for conduction and fibres for strength. The vessels or pores are comparatively short cells with wide openings, and are usually visible to the eye or with a lens. The wood of broadleaved trees is, therefore, called porous, and that of conifers, non-porous.

*Ring-porous and diffuse-porous woods.* Porous woods are divided into two groups, namely, ring-porous and diffuse-porous. In ring-porous wood, the early pores are comparatively larger than the late pores and they form a concentric band at the early part of the ring; while in diffuse-porous wood, the early and late pores show no appreciable difference in their size and are more or less evenly distributed throughout the ring. Among the porous woods included in this Bulletin, the following are ring-porous:—toon (*Cedrela toona*), hill toon (*Cedrela serrata*), mulberry (*Morus alba*), European ash (*Fraxinus excelsior*), Persian lilac (*Melia azedarach*) and teak (*Tectona grandis*), and the rest are diffuse-porous.

Again, the manner in which the pores or vessels are distributed in a growth ring is of some value in the classification and identification of timbers. In mulberry (*Morus alba*), for example, the late pores are arranged in tangential groups of many, while in toon (*Cedrela toona*) they are either single or in radial lines of 2-4.

*Tyloses and their importance in the utilization of wood.* Pores of certain timbers contain in-growths known as tyloses. With a hand lens, they appear as shiny foam-like structures, which often fill up the entire pore-cavity. When tyloses are present in a species, they are a constant feature of the heartwood and occasionally of the inner sapwood.

It has been found by experience that tylosed timbers are usually durable. Sal (*Shorea robusta*), for example, when used as sleeper, in contact with soil, lasts a long time, and it is a profusely tylosed timber. This, however, does not mean that tyloses by themselves make timber durable, but they control, at least to some extent, the moisture and the temperature of the wood inside, and thus serve as a protection against fungal attack.

*Gummy deposits.* Some timbers contain chemical deposits in their pores. The colour of the chemicals present is usually characteristic and has often been used with advantage for the classification and identification of timbers. Toon (*Cedrela toona*) and babul (*Acacia arabica*), for example, have brown-coloured deposits, while in the case of teak (*Tectona grandis*) the colour of the deposit is yellowish.

(d) **Fibres.** Fibres are anatomically similar to the tracheids of conifers. They are present in broad-leaved trees and are responsible for the strength of the timber. Individually they are too minute to be visible with a hand lens, but collectively their distribution may be of some value in the identification of timbers.

(e) **Parenchyma cells or soft tissues.** Parenchyma cells or soft tissues are short, thin-walled cells. Like fibres, they are not individually distinguishable with a hand lens, but collectively their distribution and arrangement are of importance in the classification and identification of timbers. For example, in walnut (*Juglans regia*) and North Indian ebony (*Diospyros tomentosa*), they are in fine tangential lines forming more or less a reticulum with the wood rays, while in babul (*Acacia arabica*) and cutch (*Acacia catechu*) they form conspicuous eyelets round the pores and also sometimes demarcate the growth ring by fine tangential lines. Again, another type of distribution is found in sal (*Shorea robusta*) in which they are scattered throughout the wood.

*Pith flecks.* Certain timbers show irregular patches of parenchyma cells in the midst of fibrous elements. These patches are called pith flecks and are formed as a result of injury caused by insects in the cambium. On the face of a board they sometimes show up rather conspicuously against the natural colour of the wood and may be mistaken for resin canals. Unless they are of large size, they are not serious defects of any timber. However, the presence of pith flecks in certain timbers is often of diagnostic value, for some timbers seem more liable to form pith flecks than others.

(f) **Wood rays or medullary rays.** Rays, wood rays, or medullary rays, are groups of horizontally arranged cells running radially from the bark towards the centre of the tree. Their function is storage and radial conduction of food materials. On

the end surface they appear as straight lines, sometimes too inconspicuous to be visible to the eye. On the tangential surface even they are not always visible to the eye, but with a hand lens, or by moistening the surface of the cut, their somewhat dark, spindle-shaped structure is easily visible. On the radial surface also they are not usually visible to the eye, except in the case of unusual height when they appear as small plates and produce the effect known as "silver grain".

*Ripple marks.* In some timbers, ray or other vertical cells are arranged in tiers so as to bring about, on the tangential surface, the effect of fine, equidistant, wavy lines at right angles to the grain. These are called ripple marks. Andaman padauk (*Pterocarpus dalbergioides*) is a typical example of this. Among Punjab commercial timbers none has pronounced ripple marks except sissoo (*Dalbergia sissoo*), and this species shows these marks only occasionally.

(g) **Resin canals.** Some timbers of both conifers and broad-leaved trees have resin cavities, known as resin canals. These run vertically along the grain and are responsible for the dark streaks that are often found on board faces of spruce and pine. In some species they are also present in the wood rays, but too minute to be visible with a hand lens and hence beyond the scope of this Bulletin.

The arrangement of resin canals is usually of two types. In sal (*Shorea robusta*), toon (*Cedrela toona*) and deodar (*Cedrus deodara*) they are found in bands of variable length at irregular intervals, while in pine and spruce they are more or less evenly distributed throughout the wood.

## II. THE GENERAL PROPERTIES OF WOOD.

(a) **Colour.** Colour in wood is due to the infiltration of chemical products that are present in the wood. The heartwood of a tree, as a rule, contains more infiltration products than the sapwood, and that is why the heartwood is usually darker in colour than the sapwood.

Colour is a very variable feature in wood. It varies not only in different species but also in the same species. Although one cannot entirely rely on the colour of wood for its identification, yet it has some diagnostic value, especially when timbers are similar in structure but show a difference in colour. For instance, blue pine (*Pinus excelsa*) and chir (*Pinus longifolia*) can often be separated by their colour, in spite of their somewhat similar structure.

Many woods become darker on exposure to light and air. This is due to the oxidization of chemical deposits under ordinary light and atmospheric conditions. Mulberry (*Morus alba*) when freshly cut is a dull golden brown but on exposure turns to a dark brown colour. Steaming also darkens wood. Commercially, this is extensively practised in some countries. For example, in the United States of America, it is a common practice to steam black walnut (*Juglans nigra*) logs so as to get a uniform colour in both sapwood and heartwood.

Natural colour usually indicates soundness of timber. Discoloration or loss of colour may be due to fungal attack. In this connection, the blue-stain found in pine and spruce may be mentioned.

(b) **Lustre.** Lustre or sheen in wood is due to some special property of the wood cells to reflect light. This property, however, is not present in every timber. For example, spruce (*Picea morinda*) and boxwood (*Buxus wallichiana*) have a characteristic lustre, while other timbers like deodar (*Cedrus deodara*) and teak (*Tectona grandis*) are not lustrous. When lustre is present in a wood, it is usually found on the longitudinal—more often on the longitudinal-radial—surfaces.

Some timbers when quarter-sawn reflect light from their rays in contrast with the non-lustrous fibres. This gives a pleasant “figure” effect to the planks, and for such planks there is always a good market for high class furniture.

(c) **Odour.** It is the chemical deposits in the form of tannins and oils that give odour or scent to certain timbers. Owing to the abundance of chemical deposits in the heartwood, it usually gives off a more pronounced odour than the sapwood. Certain freshly cut timbers have a strong odour which, however, may

disappear on prolonged exposure, but can be regained by making a fresh cut and moistening it with water.

It is well-known that some timbers like sandalwood and camphorwood can often be identified by their characteristic odour. This does not, however, mean that odour is easy to define verbally. For instance, the odour of deodar (*Cedrus deodara*) is so characteristic that it can hardly be mistaken for that of anything else and yet it is almost impossible to define it. All that can be done in the way of defining the odours of wood is to compare them with some other familiar smell. Thus, teak is said to have a leathery odour, and pines that of turpentine.

(d) **Weight.** The weight of wood varies greatly in different species, in the same species, and even in different parts of the same individual tree. It depends mainly on the following factors : cell wall substance, mineral and organic deposits in cell cavities, and moisture-content. Of these, the most important from the utilisation point of view is the 'moisture-content'. 'Moisture-content' is a technical term and is used to indicate the amount of moisture in the wood, shown as a percentage of its oven-dry weight.

The moisture-content of green timber may vary from 50-200 per cent. depending on the species. Green timber on exposure first loses the free water in the cell cavities and then the water that is absorbed in the cell wall. Under ordinary atmospheric conditions the moisture-content may be brought down to from 8-15 per cent. Timbers dried in this fashion are known as air-dry timbers. Again, timbers can be dried under artificial conditions, such as in a seasoning kiln, to any percentage of moisture-content required. Lastly, timber can be dried in an electric oven till it reaches a constant weight. In giving the weight of a timber, it should, therefore, be stated whether the timber was green, air-dry, kiln-dry or oven-dry.

The following classification\* of weights is based on air-dry (12-15 per cent. moisture) weight and volume determined at the

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\* This classification is also used by the Forest Products Laboratory, Madison, U. S. A.

Forest Research Institute, Dehra Dun, and has been followed in the descriptions of the woods given in this Bulletin :—

|                            | Weight per<br>cubic ft. |
|----------------------------|-------------------------|
| Very light . . . . .       | up to 22 lb.            |
| Light . . . . .            | 22-27 „                 |
| Moderately light . . . . . | 27-32 „                 |
| Moderately heavy . . . . . | 32-39 „                 |
| Heavy . . . . .            | 39-49 „                 |
| Very heavy . . . . .       | 50 „, and over.         |

(e) **Grain and texture.** These two terms have often been loosely used causing much confusion. For the sake of a clear understanding of the description of the woods that follows, it seems advisable to define them here. 'Grain' applies to the alignment of cells, *i.e.*, the direction in which the cells run in relation to the axis of a tree. Thus a timber is described as straight- or spiral-, ribbon- or interlocked-, curly- or wavy-grained. In this connection, the spiral-grained or "twisted" chir (*Pinus longifolia*) of certain localities is too well known to require more than mere mention here.

"Texture" applies to the size of cells and their proportion in unit volume. Fine and coarse are the two terms usually used as modifying adjectives for texture. For example, boxwood (*Buxus wallichiana*) has a very fine texture, while sal (*Shorea robusta*) is a coarse-textured wood. Among conifers, blue pine (*Pinus excelsa*) has even-textured wood while that of chir (*Pinus longifolia*) is uneven. This difference is due to the fact that in the former the transition from early to late wood is gradual but in the latter it is abrupt. Thus, it will be seen that the characteristic texture of some woods is helpful in their identification, especially when they show similar anatomical structure.

### III. PROCEDURE FOR THE GROSS IDENTIFICATION OF TIMBERS.

With some experience in handling timbers, one may be able to identify some of them by their general look. But this is possible only in a few cases, and even then, too much importance may be given to variable features like colour and weight, and mistakes

made thereby. The most reliable method of identifying timbers is by the structure visible on the end surface. For the gross identification of woods two things are required; a good steel knife which must be kept *very sharp*, and a lens magnifying 10-12 times. The lens can be obtained from any scientific instrument dealer. In addition to these, a small chisel and a hammer are often useful, especially when one has to identify big pieces of timber which can not be lifted easily. A small piece can be cut off with the chisel and hammer, and examined according to the method of procedure given below:—

Make a sharp cut on the end surface, hold the lens close to the eye and gradually bring the object near till its structure is clearly visible. As a rule, moistening the surface helps to bring out the structure in detail but there are exceptions to this. Both ways should be tried until the best definition is obtained.

The wood should be held in such a way as to get a good light on the cut surface. The portion to be examined need not be large (half an inch square will be sufficient) but it must not be taken from the portion too near the pith. In most cases, a single cut will be sufficient for satisfactory identification. A number of cuts, however, may be required in some cases to ensure observation of important characteristics such as the type of distribution of resin canals. A little experience will enable one to judge when such extra checks are necessary.

#### IV. HOW TO USE THE KEY.

The key that follows this chapter, mainly refers to the anatomical structure visible on the end surface. Whenever other surfaces have been taken into consideration, they have been specifically mentioned. It will be noticed that timbers have been grouped according to their structural features, and every group has a duplicate number on the left-hand side, showing alternative characteristics. The numbers on the right-hand side indicate where further divisional characteristics are to be sought. In this way, each group is taken up separately and divided into further groups until the species are ultimately separated off. For example, a timber, on examination appears to be porous. This leads us to number 6. If it is a diffuse-porous wood, it will take

us to number 12. On further examination, if it shows resin canals, then it is sal (*Shorea robusta*): if not, it will go under 13, and we shall have to continue in this fashion till the timber has been traced. It will be observed that in one case three species have been grouped together in the final separation. This is unavoidable, for these species cannot be separated with the help of a hand lens.

It will be noticed that a certain timber has been mentioned in the key more than once. This is due to the fact that it shows structure which is on the borderline of the two alternatives, and that it may be classified under either group. On account of the difference in personal interpretation, it has been thought advisable to place them under both alternatives. Whenever in doubt, the best thing to do is to try both groups.

It should be remembered that a key is only a means for identification and cannot be made to give a full description of the wood. Only those features which are of distinguishing value are mentioned. For detailed information on structure, one must refer to the description of the wood in the latter part of the Bulletin.

Lastly, a key will offer the best help for identification, only when the structural details are clearly seen. Examination of an unevenly cut surface is often confusing, and may even lead to wrong identification. It is, therefore, of primary importance that the surface to be examined should be clean cut with a very sharp knife.

In conclusion, the key and the description of species will serve the best purpose when one has acquired the habit of careful observation, which can be attained only after some practice. Should any difficulty be encountered, a reference to the Forest Research Institute at Dehra Dun will be always treated with sympathy, and a visit from anyone interested in identification of timbers will be welcomed.

## V. KEY FOR THE IDENTIFICATION OF COMMERCIAL TIMBERS OF THE PUNJAB.

1. Wood non-porous . . . . . 2
1. Wood porous . . . . . 6
  2. Resin canals present, mostly scattered . . . . . 3
  2. Resin canals usually absent, if present grouped in tangential bands . . . . . 5
3. Resin canals fairly large, distinctly visible to the eye, fairly numerous. Wood with pronounced resinous odour . . . . . 4
3. Resin canals minute, not visible to the eye, scanty. Wood without resinous odour, lustrous. **HIMALAYAN SPRUCE**, *Picea morinda* . . . . . p. 14
4. Wood yellow to pale reddish brown. Transition from early to late wood abrupt. **CHIR**, *Pinus longifolia* . . . . . p. 17
4. Wood with a pinkish tinge. Transition from early to late wood gradual. **BLUE PINE**, *Pinus excelsa* . . . . . p. 19
5. Wood with characteristic odour. Tangential bands of resin canals occasionally present. Heartwood distinct from sapwood. **DEODAR**, *Cedrus deodara* . . . . . p. 21
5. Wood without any characteristic odour. Resin canals absent. Heartwood not distinct from sapwood. **HIMALAYAN SILVER FIR**, *Abies pindrow* . . . . . p. 23
6. Wood ring-porous or semi-ring-porous . . . . . 7
6. Wood diffuse-porous . . . . . 12
7. Late pores either single or in radial lines of 2-4 . . . . . 8
7. Late pores in tangential or obliquely radial groups of many . . . . . 11
8. Tyloses fairly abundant, partially occluding the vessels. Wood dull yellow to golden brown . . . . . 9
8. Tyloses absent but dark gummy deposit present. Wood pink to brownish red . . . . . 10
9. Wood light yellow. Pores not containing any deposit. Late pores occasionally connected by thin parenchyma bands. **EUROPEAN ASH**, *Fraxinus excelsior* . . . . . p. 25
9. Wood yellow to golden brown. Pores often containing yellow deposit. Late pores not connected by parenchyma bands. **TEAK**, *Tectona grandis* . . . . . p. 27
10. Early pores mostly inconspicuous, one or rarely two in radial line. Transition from early to late pores rather gradual. **TOON**, *Cedrela toona* . . . . . p. 29
10. Early pores mostly conspicuous, in radial rows of 2-4. Transition from early to late wood rather abrupt. **HILL TOON**, *Cedrela serrata* . . . . . p. 31
11. Tyloses fairly abundant, partially filling the pores. Gummy deposits absent. Wood golden brown, slightly darkening on exposure. **MULBERRY**, *Morus alba* . . . . . p. 33

11. Tyloses absent. Dark gummy deposits often filling the pores. Wood pinkish red to reddish brown. **PERSIAN LILAC**, *Melia azedarach* p. 35
12. Resin canals present, often containing whitish substance, grouped in long tangential bands. Tyloses completely filling the pores of the heartwood. **SAL**, *Shorea robusta* . . . . . p. 37
12. Resin canals absent . . . . . 13
13. Pores fairly large to medium size, individually distinct to the eye . . . . . 14
13. Pores minute, indistinct to the eye . . . . . 23
14. Parenchyma in eyelets round the pores, occasionally also connecting the pores by wavy tangential bands . . . . . 15
14. Parenchyma not in eyelets round the pores . . . . . 19
15. Wood moderately heavy. . . . . 16
15. Wood heavy to very heavy . . . . . 17
16. Parenchyma in thick tangential lines, clearly visible with a lens, often ending abruptly. Wood whitish yellow to brownish grey. **MANGO**, *Mangifera indica* . . . . . p. 39
16. Parenchyma in fine tangential lines, just visible with a hand lens. Wood greyish to dark brown, with darker streaks. **KOKKO**, *Albizia lebbek* . . . . . p. 41
17. Rays broad to fairly broad, distinctly visible to the eye . . . . . 18
17. Rays fine, indistinct to the eye. Parenchyma often in wavy tangential bands connecting the pores. **SISSOO**, *Dalbergia sissoo* . . . . . p. 43
18. Heartwood distinct from sapwood. Parenchyma in concentric lines, delimiting the growth rings. Pores more or less evenly distributed. **BABUL**, *Acacia arabica* . . . . . p. 45  
**CUTCH**, *Acacia catechu* . . . . . p. 47  
**PHULAI**, *Acacia modesta* . . . . . p. 49
18. Heartwood not distinct from sapwood. Parenchyma cells not delimiting the growth rings. Pores somewhat unevenly distributed. **FARASH**, *Tamarix articulata* . . . . . p. 51
19. Parenchyma forming more or less reticulum with the rays . . . . . 20
19. Parenchyma not forming reticulum with the rays . . . . . 21
20. Wood moderately heavy, moderately hard, dull grey to greyish brown, often streaked black. **WALNUT**, *Juglans regia* . . . . . p. 52
20. Wood very heavy, hard, pinkish white, occasionally containing black patches. **NORTH INDIAN EBONY**, *Diospyros tomentosa* p. 54
21. Growth marks distinctly visible, delimited by a whitish line . . . . . 22
21. Growth marks indistinct. Wood dark brown, heavy to very heavy. **JAMAN**, *Eugenia jambolana* . . . . . p. 55
22. Vessel lines clearly visible on the longitudinal surfaces. Pores rather scanty. Wood moderately hard to hard, moderately heavy to heavy. **JUJUBE**, *Zizyphus jujuba* . . . . . p. 57
22. Vessel lines barely visible on the longitudinal surfaces. Pores numerous. Wood soft, light to moderately light. **INDIAN POPLAR**, *Populus euphratica* . . . . . p. 58

23. Pores distinctly visible with a lens . . . . . 24
23. Pores barely visible with a lens . . . . . 27
24. Rays of two types present. Broad rays rather conspicuous, appearing as brownish lines on the tangential surface. **BLACK ALDER, *Alnus nitida*** . . . . . p. 60
24. Rays of one type present . . . . . 25
25. Parenchyma in tangential bands, forming more or less a reticulum with the rays. Wood pinkish white, occasionally containing black patches. **NORTH INDIAN EBONY, *Diospyros tomentosa*** . . . . . p. 54
25. Parenchyma not in tangential bands but forming eyelets round the pores and often connecting the adjoining one. Wood greyish brown to dark brown, often with a greenish tinge. **INDIAN OLIVE, *Olea cuspidata*** . . . . . p. 62
26. Wood dull yellow to brownish yellow, hard. **BOXWOOD, *Buxus wallichiana*** . . . . . p. 64
26. Wood pinkish white to brownish grey, very hard. **PARROTIA, *Parrotia jacquemontiana*** . . . . . p. 66

## VI. DESCRIPTION OF THE TIMBERS.

### HIMALAYAN SPRUCE,

*Picea morinda*, Link.

VERNACULAR NAMES : *kachal, rai, tos, raiong.*

DISTRIBUTION : Found in the Himalayas as far east as Kumaon, at 6,000 to 11,000 ft.

GENERAL PROPERTIES : Wood white to dull brownish-white, usually no difference in colour between sapwood and heartwood, although false red heartwood is found in some trees ; soft to moderately hard ; very light to moderately heavy, air-dry weight (12 per cent. moisture-content) 21 to 39 lb. per cubic foot, the average being 29 lb. ; straight-grained ; rather fine and even-textured ; with characteristic pearly lustre ; resinous odour not prominent.

GROSS STRUCTURE : *A non-porous wood.*

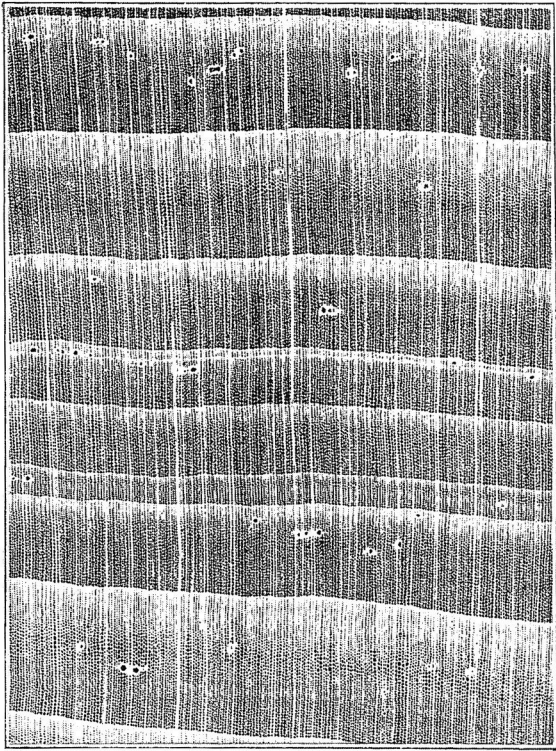
*Growth rings* distinct on the end surface, also distinct on the longitudinal surfaces, 8-20 per inch ; late wood narrow, rather conspicuous, delimiting the boundary of the ring.

*Tracheids* individually indistinct with a lens.

*Resin canals* minute, not visible to the eye but discernible with a hand lens ; on the longitudinal surfaces often visible in fine darkish lines or dots.

*Rays* mostly very fine on the end surface, those containing horizontal resin canals slightly broader, hence prominent under a lens.

SIMILAR WOODS : It resembles Himalayan silver fir (*Abies pindrow*) in having no difference in colour between sapwood and heartwood, but it can be identified on account of its resin canals, which are absent in silver fir.



HIMALAYAN SPRUCE,

*Picea morinda*, Link.

( X 10 ).

**STRENGTH :** In strength slightly inferior to Himalayan silver fir, but suitable for structural use. Its strength relative to teak is shown by the following figures :—

|                               | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-------------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .                | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Himalayan spruce<br>(Punjab). | 65      | 60                  | 75                   | 75                              | 55                       | 70                  | 70     | 55        |

Contrary to the popular notion, there is not much difference in the strength of white heartwood and red heartwood, provided the moisture-content is the same for both.

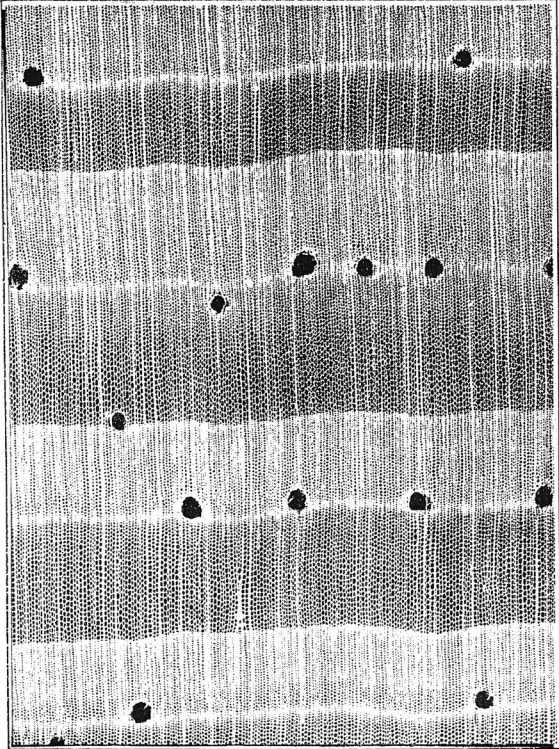
**SEASONING :** The timber is easy to air-season. It can be stacked in the open provided the stacks are covered with thatch or some other kind of protection against the sun and rain ; kiln drying is equally easy.

**DURABILITY :** The timber is rapidly destroyed by white ants and fungi when laid down in the ground. In the form of railway sleepers and structural timber, it requires to be incised for obtaining a satisfactory side penetration with preservative fluid. When chemically preserved, it is a very good structural timber. The timber is, for preservation purposes, similar to silver fir.

**WORKING QUALITIES :** The timber offers little or no difficulty if saws to be used are well spaced and spring-set with deep round gullets. Trouble may arise in a machining process, should high-speed spindle cutters and planing knives come in contact with hard dead knots in the timber. It is suitable only for stained or painted finish, and not for polish.

**SUPPLY AND USES :** Available in large quantities in the Punjab, Kashmir and other North Indian hill states. It is difficult to

estimate its supply as it is mostly sold mixed with silver fir. Its main use is for treated sleepers, packing cases, boxes and rough furniture. Obtainable at Jhelum, Wazirabad, Dhilwan and Doraha depots.



CHIR,  
*Pinus longifolia*, Roxb.  
( X 10 ).

**CHIR,**

*Pinus longifolia*, Roxb.

OTHER COMMON NAMES : Long-leaved pine ; vern :--*chil, chir*.

DISTRIBUTION : The best quality chir is found between 2,000-5,000 ft. along the Himalayas.

GENERAL PROPERTIES : Sapwood almost white, heartwood yellow to pale reddish-brown. Wood moderately hard ; moderately light to heavy, air-dry weight (12 per cent. moisture-content) 27 to 50 lb. per cubic foot, the average being 38 lb. ; grain usually straight, although twisted grain in some localities rather common ; texture moderately fine to coarse, uneven ; lustre not prominent, occasionally may be noticed on the radial surface ; characteristic resinous odour present.

GROSS STRUCTURE : *A non-porous wood.*

*Growth rings* very distinct on the end surface, also distinct on the longitudinal surfaces. Transition from early to late wood abrupt ; late wood usually conspicuous, delimiting the boundary of the ring. Rate of growth variable, depending on the locality ; 4-20 rings per inch.

*Tracheids* not individually distinct to the eye or with a hand lens, although they form the main longitudinal elements of the wood.

*Resin canals* large and conspicuous, distinctly visible to the eye, rather irregularly distributed ; on the longitudinal surfaces they often show up as blackish dots or lines.

*Rays* mostly very fine on the end surface, some contain horizontal resin canals and are rather broad, and show up prominently under a lens.

SIMILAR WOODS : The only other timber which it resembles in gross structure is blue pine (*Pinus excelsa*), but chir can be usually identified by its characteristic colour, uneven grain and prominent summer wood.

**STRENGTH:** In strength slightly inferior to deodar, but an excellent structural timber. Its strength relative to teak is shown by the following figures :—

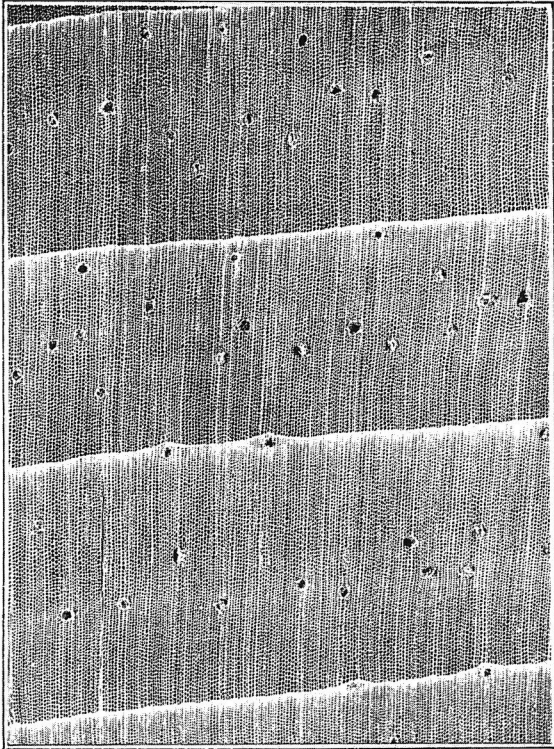
|                         | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .          | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Chir (Punjab) . . . . . | 90      | 70                  | 85                   | 80                              | 80                       | 65                  | 90     | 70        |

**SEASONING:** Except the twisted-grained wood, which is liable to surface cracking, the timber offers no difficulty. It is easy to air-season as well as kiln dry. Stacking can be done in the open, if protection is provided on top of the stacks.

**DURABILITY:** Though in the natural state, the timber is not durable, it is one of the finest timbers for antiseptic treatment. It is perhaps the only pine in the world that can be treated in the heartwood satisfactorily.

**WORKING QUALITIES:** An easy timber to work and lends itself well to conversion and machining under ordinary workshop conditions. Suitable for either paint or enamel rather than a polish finish.

**SUPPLY AND USES:** Chir is available in large quantities both in the Punjab and Kashmir. A very good timber for ordinary joinery and constructional purposes. Largely used for treated sleepers, shingles, packing-cases and rough furniture. Obtainable from Abbottabad, Jhelum, Wazirabad and Dhilwan depots.



BLUE PINE,  
*Pinus excelsa*, Wall.  
( X 10 ).

**BLUE PINE,***Pinus excelsa*, Wall.OTHER COMMON NAMES : Blue pine ; vern :—*kail, biar, lim.*

DISTRIBUTION : Found only in the Hills from 6,000 to 12,000 ft.

GENERAL PROPERTIES : Sapwood yellowish to greyish white, heartwood with a distinct pinkish tinge. Wood moderately hard; light to heavy, air-dry weight (12 per cent. moisture-content) 23 to 45 lb. per cubic foot, the average being 32 lb.; grain usually straight; texture fine to moderately coarse, even; lustre not prominent; characteristic resinous odour present.

GROSS STRUCTURE : *A non-porous wood.*

*Growth rings* distinct on the end surface, also occasionally prominent on the longitudinal surfaces. Transition from early to late wood gradual; late wood narrow, inconspicuous. Rate of growth variable, 5-20 rings per inch.

*Tracheids* not individually distinct to the eye or with a hand lens.

*Resin canals* large, but not so large as in chir; more distinct in the heartwood than in the sapwood; irregularly distributed, showing up in darkish lines or dots on the longitudinal surfaces.

*Rays* mostly fine on the end surface, those containing horizontal resin canals slightly broader, often showing up prominently under a lens.

SIMILAR WOODS : It resembles chir to some extent, but unlike chir its colour is distinctly pinkish, and the late wood inconspicuous.

STRENGTH : Similar in strength to Himalayan spruce and suitable for structural use. Its strength relative to teak is shown by the following figures :—

|                      | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|----------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .       | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Blue pine (Punjab) . | 75      | 55                  | 60                   | 60                              | 55                       | 75                  | 65     | 40        |

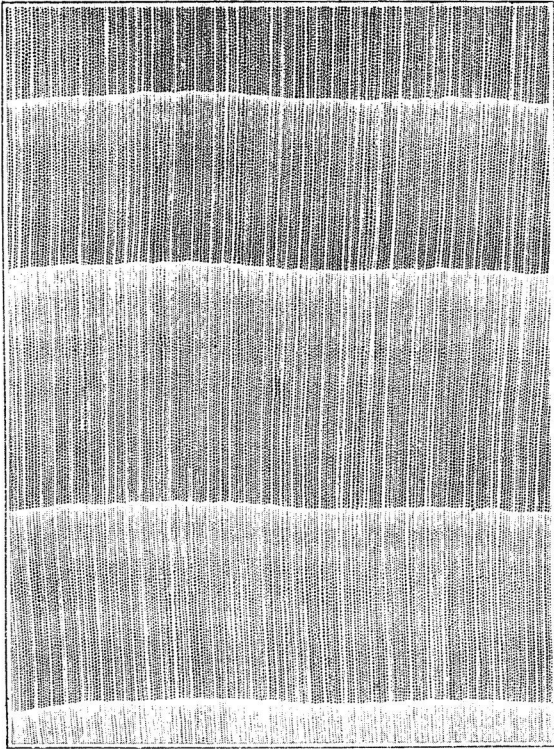
**SEASONING :** It is easy to air-season as well as kiln dry. For air-seasoning, the stacking can be done in the open, if the stacks are protected on top against the direct sun.

**DURABILITY :** The timber is moderately durable; but when used in localities infested with white-ants it requires to be given an antiseptic treatment. For pressure impregnation with wood preservatives, it is more refractory than chir, but is more amenable to treatment than spruce and fir. For satisfactory results, it requires to be incised and treated when used for structural purposes.

**WORKING QUALITIES :** It is easy to saw and machine, when free from knots. As it usually absorbs excessive polish, its surface should be sized before polishing.

**SUPPLY AND USES :** It is available in large quantities in Kashmir and the Punjab, mostly in the form of sleepers and logs. Is the best of the Indian pines, and is suitable for high class furniture construction work, pattern-making, drawing-boards, etc. It makes a good treated sleeper. Obtainable at Jhelum, Wazirabad, Lahore, Dhilwan and Doraha depots ; also at Jagadhri.

PLATE IV.



DEODAR,  
*Cedrus deodara*, Loudon.  
( X 10 ).

**DEODAR,**

*Cedrus deodara*, Loudon.

OTHER COMMON NAMES : Himalayan cedar ; vern :—*paludar*, *diar*, *khelo*, *keelu*, *kelmung*.

DISTRIBUTION : Along the Himalayas, mostly at 6,000-9,000 ft.

GENERAL PROPERTIES : Sapwood almost white, heartwood yellowish-brown. Wood moderately hard ; moderately light to heavy, air-dry weight (12 per cent. moisture-content) 25 to 48 lb. per cubic foot, the average being 35 lb. ; straight-grained ; moderately coarse and even-textured ; somewhat oily, with characteristic pungent odour.

GROSS STRUCTURE : *A non-porous wood.*

*Growth rings* distinct on the end and longitudinal surfaces ; transition from early to late wood gradual ; late wood narrow and dark. Rate of growth varies, 8-30 rings per inch.

*Tracheids* individually not distinguishable.

*Soft tissues* not visible with a lens.

*Resin canals* normally absent, sometimes present in concentric rows, not scattered as in the case of pine and spruce ; fairly large, often visible in long darkish lines on the longitudinal surfaces.

*Rays* mostly fine on the end surface ; those with horizontal resin canals slightly broader, often showing prominently under a lens.

SIMILAR WOODS : Its characteristic odour singles it out from other Indian conifers. Himalayan cypress (*Cupressus torulosa*) is the only timber to which it shows some resemblance in colour, but its odour is very unlike that of cypress.

**STRENGTH:** A typical structural timber, strongest of the common Indian conifers. Its strength relative to teak is shown by the following figures:—

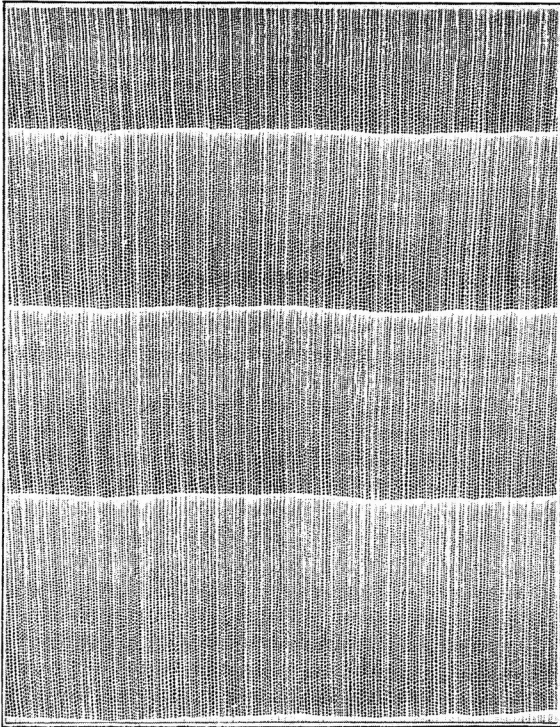
|                     | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|---------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .      | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Deodar (Punjab) . . | 80      | 80                  | 80                   | 85                              | 60                       | 85                  | 90     | 70        |

**SEASONING:** The timber loses moisture rather slowly, and is apt to suffer some surface-cracking and splitting. For proper air-seasoning, it should be stacked under cover. Can be kiln-dried with little degrade. Contains a fair amount of volatile oil (from about 3 per cent. to 10 per cent.) which affects the moisture-content results as determined by the ordinary oven-drying method.

**DURABILITY:** The timber is naturally durable in the heartwood, but it is not unknown for deodar heartwood to be attacked by both termites and fungi. The sapwood requires antiseptic treatment.

**WORKING QUALITIES:** It is easy to saw and machine under ordinary workshop conditions. It is not really suitable for a paint, enamel, or polish finish, as the oil in the wood invariably seeps through such finishes and stains them.

**SUPPLY AND USES:** Among the commercial timbers of the Punjab, this is the most important. It is available in the form of large logs, scantlings, and sleepers. Its principal use is for sleepers. It is also used for beams, posts, window frames, construction work, furniture and packing cases. Obtainable at Jhelum, Wazirabad, Lahore, Dhilwan, Doraha and Jagadhri depots. Has been imported by the Indus and Kabul rivers to Nowshera depot, North West Frontier Province.



HIMALAYAN SILVER FIR,  
*Abies pindrow*, Spach.  
( X 10 ).

**HIMALAYAN SILVER FIR,***Abies pindrow*, Spach.

OTHER COMMON NAMES : Silver fir ; vern :—*rewar*, *palundar*, *rai*, *tos*, *span*, *krok*.

DISTRIBUTION : Found in the Himalaya, mostly at 7,000-10,000 ft.

GENERAL PROPERTIES : Wood white to dull brownish-white, no difference in colour between sapwood and heartwood ; soft to moderately hard ; light to heavy, air-dry weight (12 per cent. moisture-content) 25 to 49 lb. per cubic foot, the average being 33 lb. ; straight-grained ; fine to medium-coarse textured ; lustre sometimes present ; resinous odour absent.

GROSS STRUCTURE : *A non-porous wood.*

*Growth rings* fairly distinct on the end and longitudinal surfaces, 8-15 per inch ; transition from early to late wood gradual ; late wood narrow and inconspicuous.

*Soft tissues* not visible with a lens.

*Tracheids* individually indistinct.

*Resin canals* absent.

SIMILAR WOODS : It resembles Himalayan spruce (*Picea morinda*) in general look but spruce has resin canals, while it has none.

STRENGTH : In strength it is similar to chir, and suitable for structural use. Its strength relative to teak is shown by the following figures :—

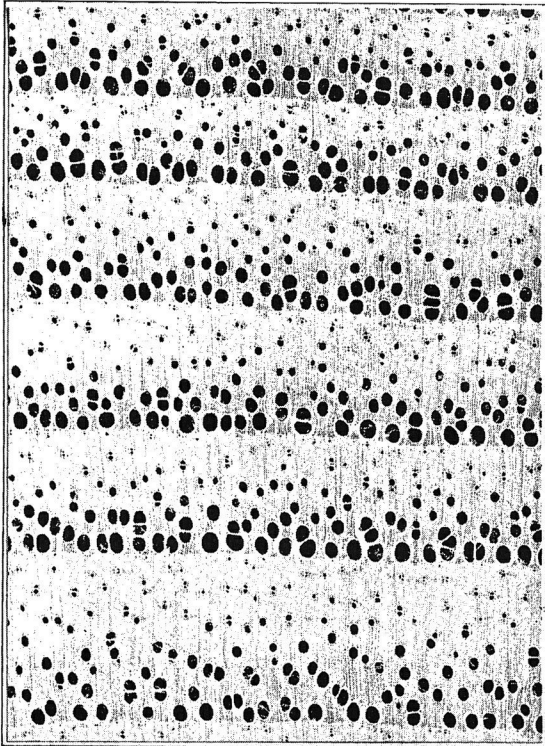
|                                    | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|------------------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .                     | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Himalayan silver fir.<br>(Punjab). | 75      | 70                  | 85                   | 80                              | 75                       | 65                  | 80     | 65        |

**SEASONING :** It behaves the same as *Ficea morinda*, and both are usually sold together under one name.

**DURABILITY :** The timber is not durable, especially when laid down in the ground. It requires antiseptic treatment. In the form of railway sleepers and structural timber, it requires to be incised on the sides to obtain a satisfactory penetration of the antiseptic.

**WORKING QUALITIES :** Same as for Himalayan spruce.

**SUPPLY AND USES :** Available in large quantities both in the Punjab and Kashmir. Used for treated sleepers, packing cases and rough furniture, and supplies are often mixed indiscriminately with spruce. Obtainable at Jhelum, Wazirabad, Lahore, Dhilwan and Doraha depots.



EUROPEAN ASH,  
*Fraxinus excelsior*, Linn.  
( X 10 ).

**EUROPEAN ASH,**

*Fraxinus excelsior*, Linn.

OTHER COMMON NAMES: Himalayan ash; vern:—*Sum, angu.*

DISTRIBUTION: Western Himalayas usually at 8-10,000 ft., Hazara, Kashmir and Chamba. Occasionally found lower down at 4,000 ft., provided the soil is suitable.

GENERAL PROPERTIES: Wood whitish yellow, turning dull brown on exposure; heartwood often the same colour as sapwood; moderately hard to hard; moderately heavy to heavy, air-dry weight (12 per cent. moisture-content) 36 to 49 lb. per cubic foot, the average being 45 lb.; straight-grained, somewhat fine and uneven-textured.

GROSS STRUCTURE: *A ring-porous wood.*

*Growth rings* distinct and conspicuous on the end and longitudinal surfaces; variable in width, 7-15 per inch.

*Pores* of early wood large, oval, mostly single, forming a loose ring of 1-4 (mostly 3) in a row; partially filled with tyloses. Transition from early to late wood somewhat abrupt; extreme late pores minute, appearing as white dots to the eye but distinct under a lens.

*Soft tissues* in thin lines round the pores; occasionally connecting the pores of extreme late wood by wavy bands.

*Rays* just visible to the eye, distinct under a lens; not so conspicuous on the radial surface.

SIMILAR WOODS: Woods of different species of *Fraxinus* have almost similar structure, and it is not always possible to separate them in the field.

**STRENGTH :** A very tough and strong timber. Its strength relative to teak is shown by the following figures :—

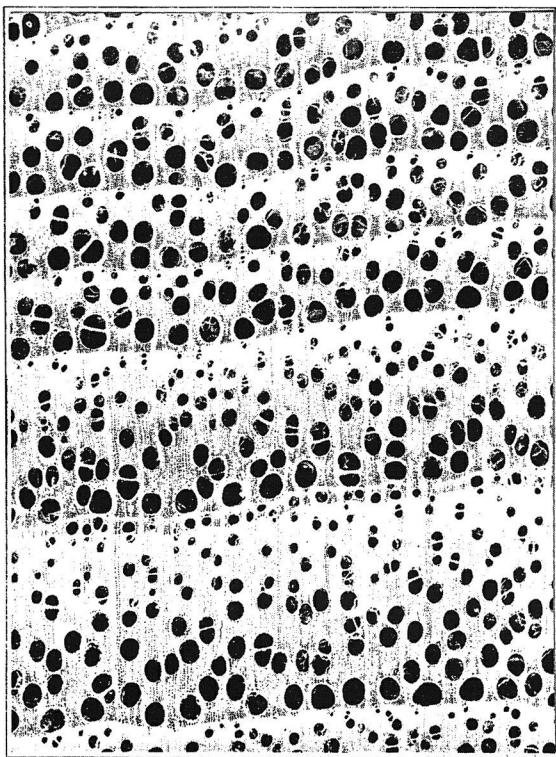
|                        | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .         | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| European ash (Punjab). | 105     | 95                  | 100                  | 85                              | 165                      | 65                  | 140    | 115       |

**SEASONING :** Girdling of trees before felling would give good results, except that there is a risk of attack by boring insects. Green conversion with prompt stacking is recommended, and some kind of end-coating may be useful in preventing end-splitting.

**DURABILITY :** Not durable in outside locations.

**WORKING QUALITIES :** Not a difficult timber to work by hand or to machine. Like the same species grown in Europe it is a good furniture wood and takes a fine finish without much difficulty.

**SUPPLY AND USES :** Either due to the difficulty in extraction or to its being available only in small quantities, the supply is limited. It is a very good timber for tool handles, oars, sport requisites, and other uses for which strength and toughness are required.



TEAK,  
*Tectona grandis*, Linn.  
( X 10 ).

**TEAK,***Tectona grandis*, Linn. f.VERNACULAR NAME : *Sagun*.

DISTRIBUTION : Teak does not normally grow in the Punjab, and has been planted only in certain localities. It is, however, a well known wood which is used in large quantities throughout the Province.

GENERAL PROPERTIES : Sapwood white to pale grey, usually small; heartwood golden-yellow to golden-brown, darkening on exposure. Wood moderately hard; moderately light to heavy, air-dry weight (12 per cent. moisture-content) 30 to 49 lb. per cubic foot, the average being 40 lb.; usually straight-grained; medium, uneven-textured; when freshly cut, often with a characteristic odour.

GROSS STRUCTURE : *A ring-porous wood*.

*Growth rings* distinct on the end surface, appearing as narrow grooves on the longitudinal surfaces; rather irregular in width, 2-18 rings per inch.

*Pores* of early wood large, oval, in a narrow, loose ring; partially filled with tyloses; often containing dull yellow chemical deposits. Transition from early to late wood gradual. Extreme late pores visible with a lens, single or in radial lines of 2-3.

*Soft tissues* not discernible with the naked eye, with a lens visible round the early pores.

*Rays* fairly distinct to the eye, moderately broad, often appearing as handsome silver-grain on the radial surface.

SIMILAR WOODS : There is no other timber in India which resembles teak. Its loose ring and characteristic colour and smell are sufficient to distinguish it from other timbers.

**STRENGTH :** A very strong timber which keeps its shape remarkably well.

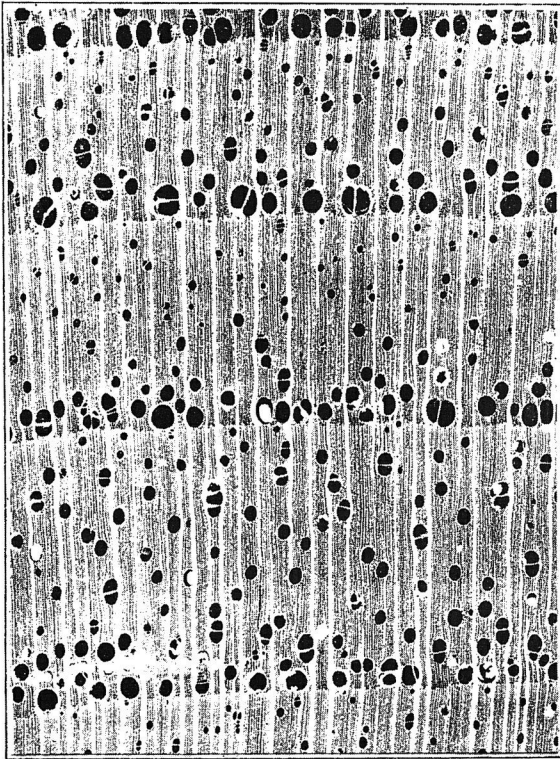
|                | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|----------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . . | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |

**SEASONING :** It air-seasons very easily and without any appreciable degrade. Stacking under cover is recommended.

**DURABILITY :** The timber, in the heartwood, is one of the most durable in the world. The sapwood, however, is easily destroyed by white ants and fungi, and if used requires to be treated with a wood preservative.

**WORKING QUALITIES :** It is easy to convert by machine or work by hand.

**SUPPLY AND USES :** Teak used in the Punjab is usually imported from South India and Burma, where it is available in large quantities. The uses of teak are too well known to require further mention here. Central Indian teak, though not so strong as Burma and Malabar teak, is usually more handsome than the timber from these areas and is, therefore, very suitable for panelling and furniture work.



TOON,  
*Cedrela toona*, Roxb.  
( X 10 ).

**TOON,***Cedrela toona*, Roxb.

OTHER COMMON NAMES : Red cedar ; vern :—*tun*.

DISTRIBUTION : Found in the plains and border hills of the Punjab up to 4,000 ft. *e.g.*, Kangra district, most of it growing eastward of Rawalpindi, very often planted.

GENERAL PROPERTIES : Sapwood dull grey to dull brown ; heartwood light brick-red, darkening on exposure. Wood soft to moderately hard ; moderately light to moderately heavy, air-dry weight (12 per cent. moisture-content) 26 to 34 lb. per cubic foot, the average being 30 lb. ; straight-grained ; moderately fine and slightly uneven-textured ; lustrous ; with a pleasant odour.

GROSS STRUCTURE : *A ring-porous wood.*

*Growth rings* distinct on the end surface, also distinct on the longitudinal surfaces, delimited by the large pores of early wood ; often irregular in width, 2-9 rings per inch.

*Pores* of early wood large, oval, in a loose and narrow ring ; without tyloses, often plugged with darkish-brown gum ; transition to late wood zone rather gradual ; extreme late pores single or in radial lines of 2-3.

*Resin canals* or *gum canals* normally absent, occasionally found in short tangential groups, often containing blackish deposits.

*Soft tissues* not discernible with the eye, just visible with a lens, especially round the early pores.

*Pith flecks* fairly common, visible to the eye as darkish spots or streaks.

*Rays* in fine lines, visible to the eye, of almost the same colour as the fibrous tissue.

SIMILAR WOODS : It resembles hill toon (*Cedrela serrata*) in almost every respect, except for the fact that its early pores form a narrower band than any that can be found in hill toon.

**STRENGTH :** A light, soft timber. Its strength relative to teak is shown by the following figures :—

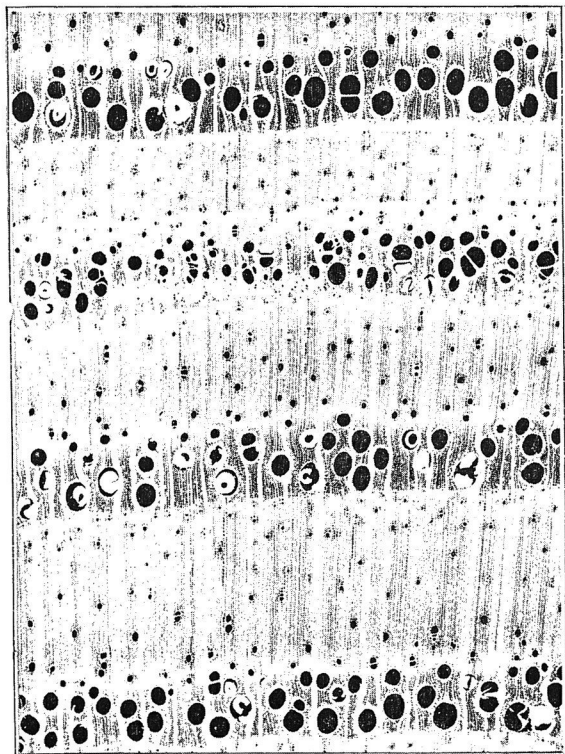
|                        | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .         | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Toon (U. P.) . . . . . | 70      | 55                  | 65                   | 60                              | 60                       | 65                  | 100    | 65        |

**SEASONING :** The timber is usually subject to warping and collapse, which is due to irregular growth, as the trees are generally grown either on the road-side or singly in fields. Stacking should be done immediately after conversion into scantlings, and the stacks weighted on top. Kiln-drying gives more satisfactory results than air-drying. It is liable to excessive shrinkage during drying.

**DURABILITY :** The timber is not durable when exposed to outside locations.

**WORKING QUALITIES :** Toon is an excellent peeler, and makes a durable, and often handsome, plywood panel. The timber converts and machines well, and presents little or no difficulty when being worked on almost any type of wood-working machine. Though sometimes woolly, the timber is not difficult to clean to a good finish. It takes a good spirit polish. A medium type of hardwood saw tooth gives good conversion results.

**USES AND SUPPLY :** It is extensively used for cheap furniture, packing cases, and tea boxes, because it is easy to work and plentiful. It is a common wood and can be obtained in any local bazar.



HILL TOON,  
*Cedrela serrata*, Royle.  
( X 10 ).

## HILL TOON,

*Cedrela serrata*, Royle.

VERNACULAR NAMES : *drawa*, *drawi*, *darl*, *duri*.

DISTRIBUTION : It grows in the Himalayas, mostly at 4,000-8,000 ft. elevation.

GENERAL PROPERTIES : Sapwood pinkish white, heartwood brick-red, darkening on exposure. Wood soft to moderately hard ; usually lighter than toon (*Cedrela toona*) ; straight-grained ; moderately fine, uneven-textured ; lustrous ; with an aromatic odour.

GROSS STRUCTURE : *A ring-porous wood.*

*Growth rings* very distinct on the end surface, more so than in toon ; on the longitudinal surfaces appearing like grooves, rather irregular in width, 2-5 per inch.

*Pores* of early wood large, oval, conspicuous, in a well marked ring of 2-4 in a row ; without tyloses, but often plugged with darkish gum ; transition from early to late wood abrupt. Late pores very much smaller than early pores ; visible with a lens, single or in radial lines of 2-3.

*Resin canals* or *gum canals* absent.

*Soft tissues* not discernible with the naked eye, just visible round the pores in early wood.

*Pith flecks* fairly common, appearing as darkish spots or streaks.

SIMILAR WOODS : It resembles (toon *Cedrela toona*) in general look, but its early pores form broader bands than those found in toon.

**STRENGTH :** The Burma species is moderately strong wood. Its strength relative to teak is shown by the following figures :—

|                             | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-----------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .              | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Hill toon (Burma) . . . . . | 80      | 75                  | 85                   | 85                              | 85                       | 75                  | 115    | 80        |

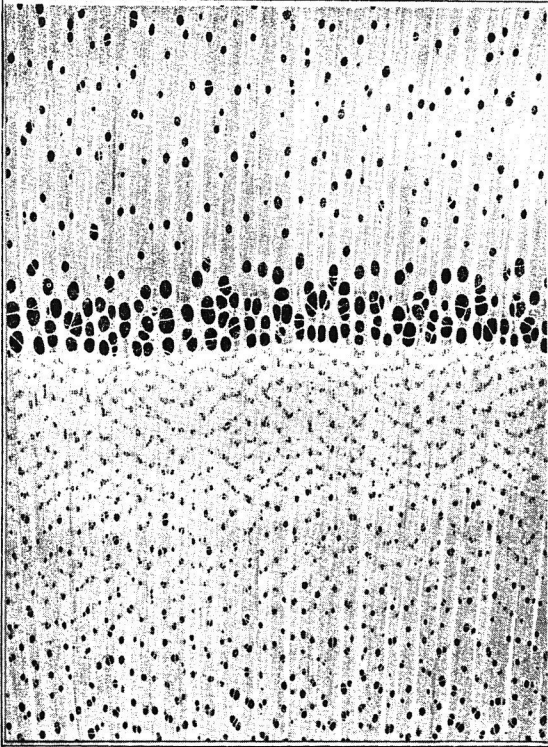
These figures apply only to samples from Burma. Punjab samples have not been tested and may possibly not give such good results.

**SEASONING :** Behaves more or less similar to *Cedrela toona*.

**DURABILITY :** The timber is moderately durable even when exposed to outside locations.

**WORKING QUALITIES :** The timber is easy to work, and converts and machines well. It takes a good spirit polish. Pretty grain effects are often obtainable.

**USES AND SUPPLY :** It is used for the same purpose as *toon*, namely for cheap furniture, packing cases, etc. It is obtainable in fair quantities in the hill districts.



MULBERRY,  
*Morus alba*, Linn.  
( X 10 ).

**MULBERRY,***Morus alba*, Linn.VERNACULAR NAME : *tut*.

DISTRIBUTION : Mostly found in the plains and lower hills ; extensively grown in the irrigated plantations.

GENERAL PROPERTIES : Sapwood white to yellowish-white, heartwood light golden-brown, turning to darker colour on a few hours' exposure ; hard ; moderately heavy to heavy, air-dry weight (12 per cent. moisture-content) 39 to 45 lb. per cubic foot, the average being 42 lb. ; lustrous ; straight-grained ; fine to moderately coarse, uneven-textured.

GROSS STRUCTURE : *A ring-porous wood.*

*Growth rings* distinct and conspicuous on the end and longitudinal surfaces ; variable in width, usually broad, 1-4 per inch. Early wood narrow ; late wood comparatively broad.

*Pores* of early wood large, oval, conspicuous, forming a ring of 2-5 in a row ; partially filled with tyloses ; often containing white gummy deposits. Transition from early to late wood abrupt ; extreme late pores minute, appearing as white dots to the eye, but visible with a lens, arranged in wavy tangential groups.

*Soft tissues* in thin lines round the pores, often connecting extreme late pores in interrupted but conspicuous bands.

*Rays* in fine lines on the end surface, distinctly visible to the eye ; rather conspicuous on the radial surface.

SIMILAR WOODS : In general look it resembles *Morus serrata* which is not so well known commercially and from which it can be separated by its wider band of early pores. Its golden-brown colour, ring-porous character and distinctly wavy tangential bands of parenchyma at the extreme end of the growth ring single it out from all other Punjab timbers.

**STRENGTH :** A strong wood, and very tough, and of much the same quality as good ash. Its strength relative to teak is shown by the following figures :—

|                     | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|---------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .      | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Mulberry (Punjab) . | 100     | 85                  | 85                   | 80                              | 135                      | 65                  | 145    | 125       |

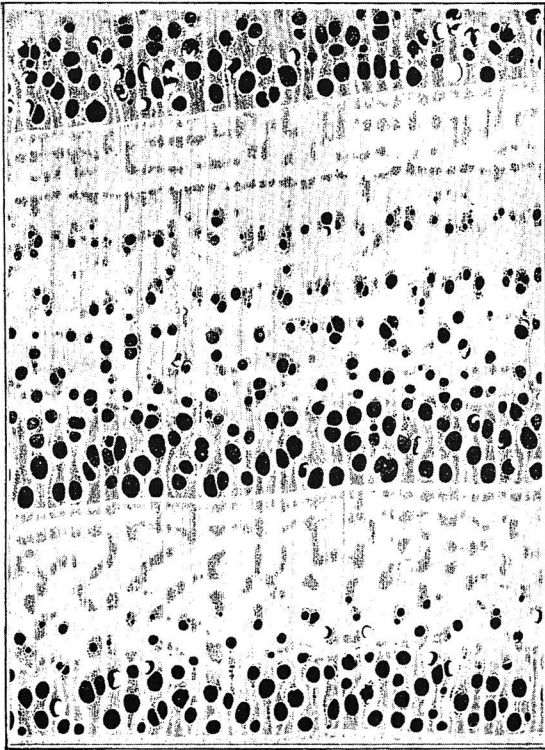
**SEASONING :** As the timber is required green by the Sialkot Sports trade and is extracted and sold immediately after felling, its seasoning properties need not be discussed here.

**DURABILITY :** The timber is not durable when laid down in the ground or when exposed to white ant or fungus attack.

**WORKING QUALITIES :** Though a hard wood, mulberry is quite easy to work under ordinary workshop conditions. It machines well and turns to a good finish.

**SUPPLY AND USES :** The demand for logs is greater than the supply. At present Changa Manga plantation is the only source of supply. The timber is greatly in request for sports requisites such as tennis-racquets, badminton-racquets, hockey-sticks, cricket-stumps, etc. In India, it is used for the same purposes for which ash is used in Europe, and even in Europe is considered to be superior to ash for hockey sticks. A good firewood. When Chichawatni, Daphar and Khanewal plantations come into full bearing the supply of mulberry will be much increased.

PLATE XI.



PERSIAN LILAC,  
*Melia azedarach*, Linn.  
( X 10 ).

**PERSIAN LILAC,***Melia azedarach*, Linn.

OTHER COMMON NAMES : Bread tree, bastard cedar ; vern :—  
*bakain, drek.*

DISTRIBUTION : Said to be indigenous in Jhelum valley and Baluchistan, cultivated in the plains, grows in the hills up to 9,000 ft., fairly common in irrigated plantations, *e.g.*, Changa Manga.

GENERAL PROPERTIES : Sapwood yellowish white ; heartwood pinkish red, turning to reddish brown with age ; moderately hard to hard ; moderately heavy to heavy, air-dry weight (12 per cent. moisture-content) 36 to 41 lb. per cubic foot, the average being 38 lb. ; somewhat lustrous ; almost straight-grained ; rather coarse, uneven-textured.

GROSS STRUCTURE : *A ring-porous wood.*

*Growth rings* distinct on the end surface, appearing as wide groove on the longitudinal surfaces ; 1-5 rings per inch.

*Pores* of early wood large, mostly oval, single or in pairs, often filled with dark gummy deposits, in well defined ring of 2-5 (mostly 4) in a row. Transition from early to late wood abrupt ; although not so prominent in a wide ring. Summer pores small, appearing as white dots to the eye but visible with a lens ; numerous, arranged in radial or tangential or oblique groups, often continuous across the rays.

*Soft tissues* mostly round the spring and late pores, often connecting the late pores in continuous but irregular bands, rather conspicuous due to their light colour against the dark back ground.

*Rays* fine, usually not visible to the eye but distinct when moistened with water, rather conspicuous on the radial surface.

SIMILAR WOODS : In general look it shows some resemblance to hill toon (*Cedrela serrata*) but they can be easily separated with a hand lens. In Persian lilac the late pores are in conspicuous groups of many, while in hill toon they are rather inconspicuous, and mostly in a group of 2-3.

STRENGTH : No strength figures available, but Gamble quoting Skinner gives a transverse strength of 7,414 lb. per sq. inch which represents about half the strength of Burma teak (Pearson).

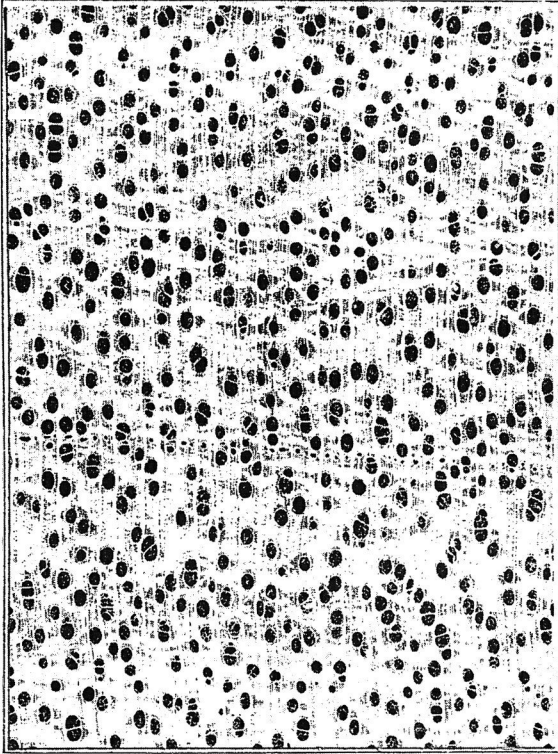
**SEASONING :** It offers no difficulty in seasoning.

**DURABILITY :** Reputed to be one of the best of the Punjab timbers for withstanding attack by white ants. Has always had a good reputation for durability.

**WORKING QUALITIES :** Easy to saw and peel, though the fibre is liable to pick up under a plane. It takes a high polish (Pearson).

**SUPPLY AND USES :** Due to its scattered distribution, it is not available in large quantity from any one locality but logs are sold in the Changa Manga depot. It is mainly used for toys, small articles and sporting requisites, but Pearson says it would have a big future if supplies were available.

PLATE XII.



SAL,  
*Shorea robusta*, Gærtm.  
( X 10 ).

**SAL,**

*Shorea robusta*, Gaertn. f.

VERNACULAR NAME : *Sal*.

DISTRIBUTION : Sal grows in the Sub-Himalayan tracts in the South East corner of the Punjab but has very poor growth, as this area is on the extreme northern limit of its natural habitat.

GENERAL PROPERTIES : Sapwood pale white with a brownish tinge, narrow ; heartwood brown. Wood hard ; heavy to very heavy, air-dry weight (12 per cent. moisture-content) 46 to 65 lb. per cubic foot, the average being 56 lb. ; with interlocked grain, often showing up in ribbon bands ; coarse in texture.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* usually not visible ; concentric bands of resin canals sometimes show like growth marks, but they are not marks of true growth ring.

*Pores* moderate-sized, clearly visible to the eye ; single or in pairs, rather crowded. Tyloses often entirely filling up the pore-cavity.

*Soft tissues* mostly round the pores and resin canals, often connecting them with fine, thin bands ; sometimes irregularly distributed ; rather diffuse, also occasionally present in thin tangential bands.

*Resin canals* usually present, for the most part in long concentric rows, rarely single ; appearing as a white line to the eye, often running for a considerable distance, occurring at irregular intervals.

*Rays* fairly distinct, moderately broad, rather inconspicuous on the radial surface.

SIMILAR WOODS : Sal does not resemble any other Punjab timber and it can be easily identified by its characteristic resin canals, brown colour and somewhat coarse texture.

**STRENGTH :** Extremely strong, hard and tough. Its strength relative to teak is shown by the following figures :—

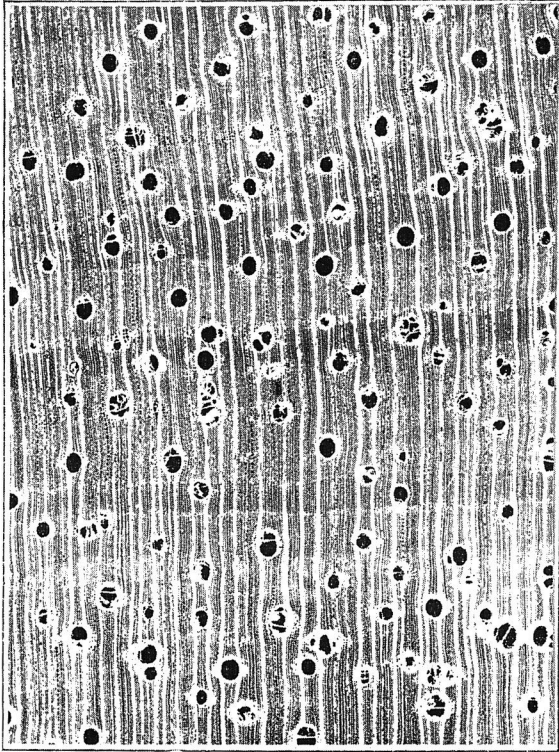
|                       | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-----------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .        | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Sal (U. P.) . . . . . | 130     | 110                 | 110                  | 110                             | 145                      | 60                  | 150    | 165       |

**SEASONING :** Loses moisture extremely slowly, and a certain amount of surface cracking during the process of seasoning is inevitable. For constructional purposes, this cracking is of little consequence. Green scantlings, if not properly stacked, are liable to warp.

**DURABILITY :** The timber, in the heartwood, is very durable, but the sapwood requires to be preserved artificially.

**WORKING QUALITIES :** It machines fairly well, although it is not an easy timber to saw by hand.

**SUPPLY AND USES :** Sal grown in the Punjab is of such poor quality that most of the supplies of this wood are obtained from the United Provinces, where it grows in abundance. Its chief use is for railway sleepers, construction work and house building, for which purposes it has a well deserved reputation. It is eminently suitable for heavy constructional works where strength and durability are required.



MANGO,  
*Mangifera indica*, Linn.  
( X 10 ).

**MANGO,***Mangifera indica*, Linn.VERNACULAR NAME : *am*.

DISTRIBUTION : Cultivated as a fruit tree in the plains and lower hills, and often found wild in the submontane districts.

GENERAL PROPERTIES : Wood whitish-yellow to brownish-grey ; no difference in colour between sapwood and heartwood ; moderately hard ; moderately heavy to heavy, air-dry weight (12 per cent. moisture-content) 37 to 48 lb. per cubic foot, the average being 41 lb. ; grain slightly interlocked, occasionally curly ; texture medium and uniform.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* usually indistinct.

*Fores* fairly large, distinct to the eye, single or in pairs, rather evenly distributed ; sometimes partly filled with tyloses.

*Soft tissues* round the pores, often forming conspicuous eyelets : also in thick tangential bands, ending abruptly.

*Rays* scarcely distinct to the eye, moderately broad with a lens, rather conspicuous on the radial surface.

SIMILAR WOODS : Mango can be identified by the soft tissues in the eyelet round the pores, and the fact that sapwood and heartwood cannot be distinguished.

STRENGTH : A moderately strong wood. Its strength relative to teak is shown by the following figures :—

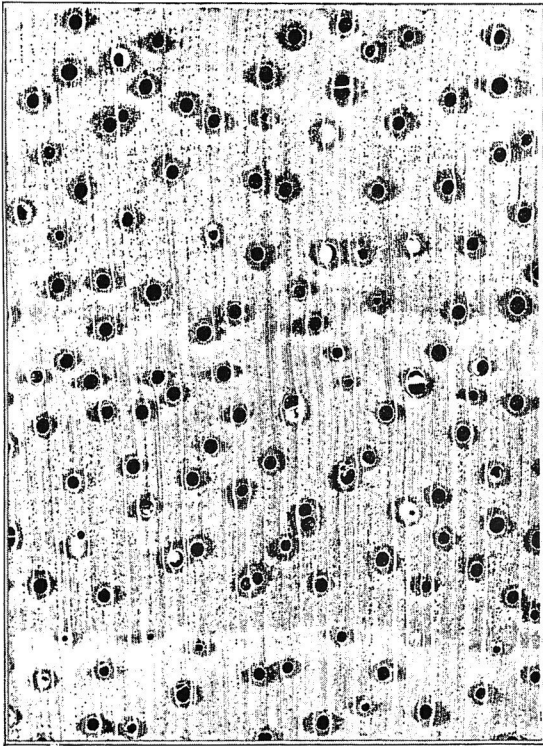
|                          | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|--------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .           | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Mango (B. & O) . . . . . | 95      | 75                  | 80                   | 75                              | 100                      | 95                  | 105    | 90        |

**SEASONING :** The timber is apt to discolour due to the growth of moulds on the surface, if not dried rapidly. Otherwise it gives no trouble during air-seasoning. Kiln-drying is easy, and kiln-dried timber possesses a good appearance.

**DURABILITY :** The timber is not durable against white ants and fungi. If used for structural purposes under shelter, it may be given a brush treatment with creosote or some other standard antiseptic. It treats under pressure satisfactorily.

**WORKING QUALITIES :** Mango is an easy timber to saw and machine to a finish. Suitable for packing cases and similar commodities.

**SUPPLY AND USES :** As it is an important fruit tree, supplies of the wood are rather limited, but it can usually be obtained in any local bazar. It is chiefly used for cheap furniture and packing cases.



KOKKO,  
Albizzia lebbek, Benth.  
( X 10 ).

**KOKKO,***Albizzia lebbek*, Benth.

OTHER COMMON NAMES : East Indian walnut ; vern :— *siris*. The name East Indian walnut should be avoided as the timber has no connection with true walnut nor does it look like it.

DISTRIBUTION : It is said to be indigenous in Sub-Himalayan tracts, often found in the Outer Himalayas ascending to 4,000 ft. ; cultivated in the plains.

GENERAL PROPERTIES : Sapwood white to yellowish-white ; heartwood grey to dark brown, streaked with light and dark bands. Wood moderately hard ; moderately light to heavy, air-dry weight (12 per cent. moisture-content) 30 to 47 lb. per cubic foot, the average being 40 lb. ; grain straight to slightly twisted, interlocked ; texture coarse and even ; prominent lustre present, especially when freshly cut.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* present but inconspicuous, often delimited by fine tangential lines of parenchyma, variable in width, 2-6 per inch.

*Pores* large, single or in pairs, scanty, evenly distributed, occasionally filled with dark gummy deposits.

*Soft tissues* (a) form eyelets round the pores, sometimes also connecting the pores by short bands ; (b) in fine tangential lines delimiting the growth ring.

*Rays* indistinct to the eye but visible under a lens ; appearing as pinkish lines against the dark back ground (heartwood).

SIMILAR WOODS : Black *siris* (*Albizzia odoratissima*), white *siris* (*Albizzia procera*) and kokko have almost similar anatomical structure and it is often difficult to distinguish them in the field. This, however, does not cause much inconvenience from a commercial point of view, for all three species have more or less similar working qualities.

**STRENGTH:** kokko is a strong constructional timber. Its strength relative to teak is shown by the following figures :—

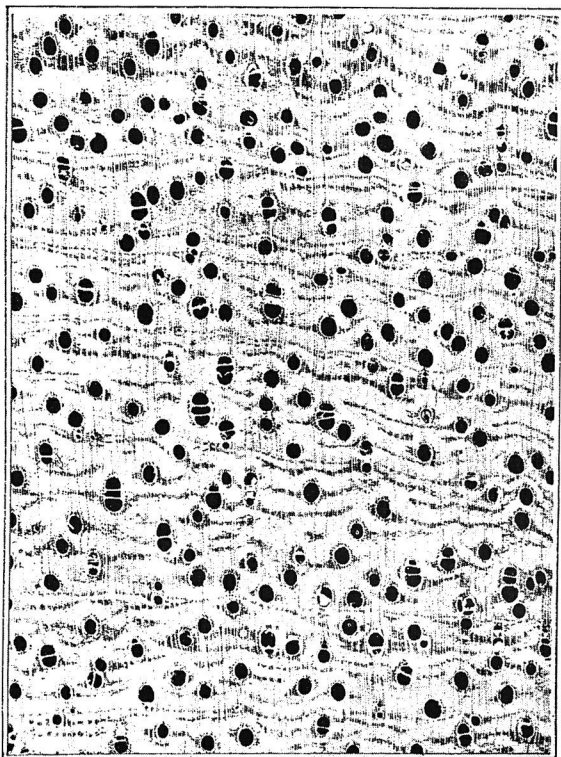
|                         | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .          | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Kokko (South Andamans). | 95      | 85                  | 100                  | 90                              | 85                       | 80                  | 125    | 100       |

**SEASONING:** It is a moderately refractory timber, requiring protection against too rapid drying. Green conversion and immediate stacking under sheds for seasoning give good results. Once seasoned it is a very steady timber.

**DURABILITY:** Moderately durable in outside locations. The heartwood is very resistant to penetration by antiseptic fluids.

**WORKING QUALITIES:** Due to interlocked fibres and rather large pores kokko is often difficult to work and bring to a good finish. Only the smallest margin of top clearance should be given in planing, for otherwise the fibres are liable to pick out and give trouble. The open pores call for intensive filling prior to polishing. While being machined, the fine dust from kokko often causes temporary irritation to the eyes and nose.

**SUPPLY AND USES:** It is an excellent wood for furniture although slightly heavy. Its other uses are for floorings, cane-crushers, oil-mills and cheap tennis racquets. The polished wood has a very pleasant golden sheen which it retains indefinitely. Furniture made of kokko at the Forest Research Institute has been greatly admired on many occasions, and in the opinion of the Forest Economist, kokko is one of the best furniture woods India possesses. This tree is of little commercial importance in the Punjab.



SISSOO,  
*Dalbergia sissoo*, Roxb.  
( X 10 ).

**SISSOO,***Dalbergia sissoo*, Roxb.VERNACULAR NAMES : *shisham, tali*.

DISTRIBUTION : Found in the plains and Sub-Himalayan tracts up to 3,000 ft. Extensively cultivated in the irrigated plantations and widely planted as an avenue tree.

GENERAL PROPERTIES : Sapwood yellowish-white, small ; heart-wood golden brown to dark brown, often with black streaks ; moderately hard to hard ; heavy to very heavy, air-dry weight (12 per cent. moisture-content) 47 to 61 lb. per cubic foot, the average being 50 lb. ; grain interlocked ; texture medium.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* scarcely distinct, delimited by fine tangential bands of parenchyma.

*Pores* fairly large, individually distinct to the eye, evenly distributed ; solitary or in pairs ; occasionally filled with dark gummy deposits.

*Soft tissues* abundant, mostly round the pores, often connecting the pores by wavy or straight tangential bands ; sometimes also forming distinct eyelets round the pores.

*Pith flecks* sometimes present.

*Rays* indistinct to the eye but visible with a lens ; fine, equidistant ; inconspicuous on the radial surface.

*Ripple marks* sometimes present on the tangential surface, rather inconspicuous.

STRENGTH : A strong hard wood, very slightly weaker but tougher than teak. Its strength relative to teak is shown by the following figures :—

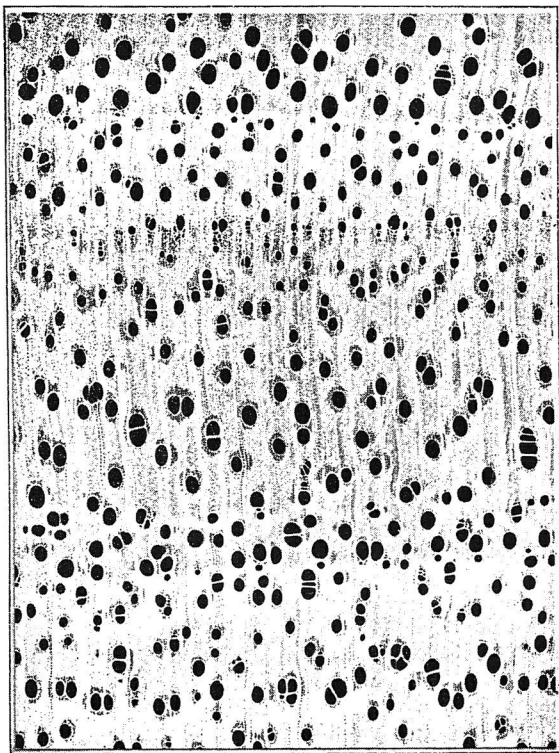
|                          | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|--------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .           | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Sissoo (U. P.) . . . . . | 120     | 95                  | 90                   | 85                              | 140                      | 80                  | 125    | 130       |

**SEASONING :** It air-seasons and kiln-dries very well with little degrade. Stacking should be done under cover. One inch thick planks air-season in about 3 months' time during the dry weather. For scantlings up to 2 inches thick, one year should be allowed for complete seasoning. The sapwood is subject to insect and fungus attack.

**DURABILITY :** The timber is durable in the heartwood. The sapwood requires to be treated with an antiseptic.

**WORKING QUALITIES :** As a rule, it is an easy timber to handle. It cuts, turns, machines, and peels well without any special machine features having to be adopted. The timber is often a little interlocked but nevertheless works up to a good finish which takes a fine spirit polish. Peeled veneers are usually very handsome in figure and make up into excellent panels.

**SUPPLY AND USES :** Available in good quantities both in log and scantling form in local bazars. One of the main sources of supply is Changa Manga plantation. Used for high class furniture, house construction, wheel spokes and felloes, posts, turnery, railway bottom boards and charpoy legs. A good firewood.



BABUL,  
*Acacia arabica*, Willd.  
( X 10 ).

**BABUL,***Acacia arabica*, Willd.VERNACULAR NAME : *kikar*.

DISTRIBUTION : It was originally imported and planted in the province but now it has become one of the commonest trees in some districts. Extensively cultivated in fields. Cannot be grown in the irrigated plantations.

GENERAL PROPERTIES : Sapwood yellowish-white, usually large ; heartwood pink, turning to dark brown on exposure ; very hard, heavy to very heavy, air-dry weight (12 per cent. moisture-content) 46 to 56 lb. per cubic foot, the average being 52 lb. ; grain straight to slightly twisted ; texture rather coarse.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* distinct to indistinct, often delimited by tangential lines of parenchyma.

*Pores* visible to the eye, mostly single, rather evenly distributed ; sometimes filled with a dark gummy infiltration.

*Soft tissues* in bands round the pores, often forming eyelets ; also in tangential lines delimiting the seasonal growth.

*Rays* visible to the eye, and appearing as fairly broad with a lens ; conspicuous on the radial surface.

SIMILAR WOODS : The general look and gross structure of babul and cutch (*Acacia catechu*) are so similar that it is not always possible to separate them in the field. The only characteristic which is sometimes helpful in their identification, is the presence of whitish deposits (*kheersal*) in the pores of cutch.

STRENGTH : An extremely strong, hard, tough wood. Its strength relative to teak is shown by the following figures :—

|                  | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . .       | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Babul (Sind) . . | 120     | 120                 | 95                   | 105                             | 170                      | 70                  | 180    | 185       |

**SEASONING :** The timber is of medium refractoriness as regards seasoning. If conversion into scantlings is done during or just after the rains, there will be little danger from excessive cracking. If converted in the dry weather, stacking should be done in sheds closed on all sides. One year is sufficient for the air-seasoning of planks up to 2 inches thick. It kiln-dries with no appreciable degrade.

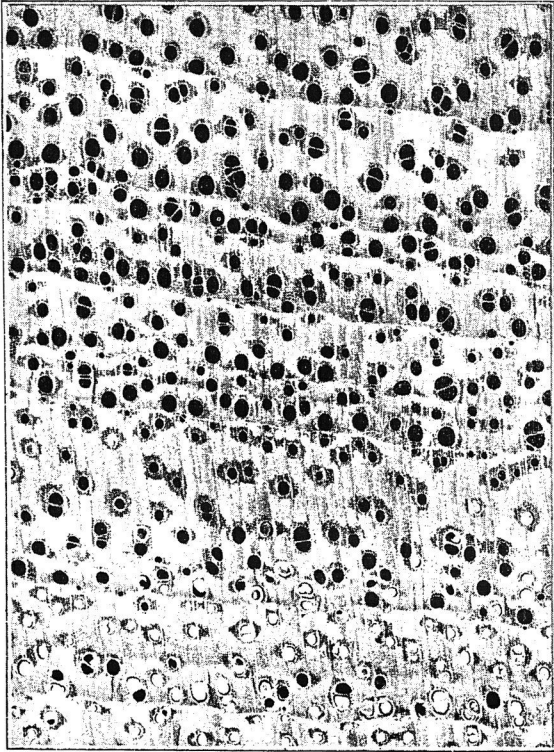
**DURABILITY :** The timber is durable in the heartwood ; the sapwood is not durable.

**WORKING QUALITIES :** It lends itself well to conversion giving a reasonably good finish on the lathe. Plate saws having a good type of hardwood tooth with spring set will give fairly good conversion results. A fiddle-back mottling effect can sometimes be had by quarter sawing.

**SUPPLY AND USES :** On account of its extensive use for firewood, it is usually available only in small logs. It is also used for various parts of carts, agricultural implements, and for hammer and tool handles. It is a suitable timber where durability and strength are required.

**NOTE.**—Three varieties of this species are found in India, of which only 2 are available in the Punjab.

PLATE XVII.



CUTCH,  
*Acacia catechu*, Willd.  
( X 10 ).

**CUTCH,**

*Acacia catechu*, Willd.

VERNACULAR NAME : *khair*.

DISTRIBUTION : Found in the Sub-Himalayan tracts.

GENERAL PROPERTIES : Sapwood yellowish-white, wide ; heartwood pink, turning to dark red to brown on exposure ; very hard ; very heavy, air-dry weight (12 per cent. moisture-content) 62 to 70 lb. per cubic foot, the average being 65 lb. ; somewhat lustrous ; grain usually straight ; texture rather coarse.

GROSS STRUCTURE : *A diffuse-porous wood*.

*Growth rings* distinct to indistinct, often delimited by tangential lines of parenchyma ; 5-14 per inch.

*Pores* fairly large, distinctly visible to the eye, evenly distributed ; sometimes containing a white deposit called *kheersal*, which appears as thin lines on the longitudinal surfaces ; also often contain dark gummy deposit.

*Soft tissues* mostly in thick bands round the pores, often forming distinct eyelets ; also in tangential lines demarcating the growth ring.

*Rays* visible to the eye, and appearing as moderately broad with a lens, conspicuous on the radial surface.

SIMILAR WOODS : Cutch is very similar to babul (*Acacia arabica*). Both have dark gummy deposits in their pores, but the former also often contains a white deposit in its pores, while in the latter this is entirely lacking. This is the only characteristic by which these two can be separated.

STRENGTH : An extremely strong and very hard timber. No test-figures are however available.

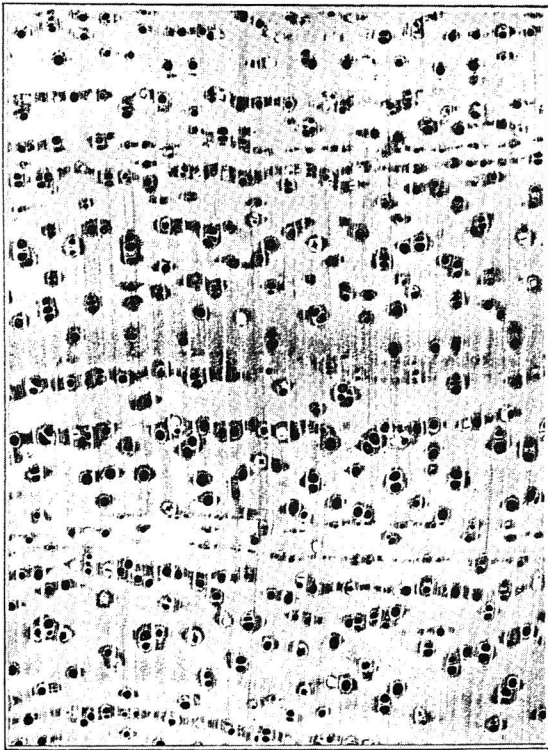
SEASONING : The timber is of medium refractoriness as regards seasoning, and behaves in much the same manner as *Acacia arabica*.

DURABILITY : The timber is very durable in the heartwood. The sapwood perishes rapidly.

WORKING QUALITIES : Some little difficulty was experienced in the sawing of this timber. The best results were obtained with a

heavy-gauge plate having closely spaced teeth and shallow gullets. The timber machines and turns reasonably well.

SUPPLY AND USES : Cutch is available only in small billets in the Kangra district. Like babul it is a suitable wood for hammer handles, mallets, cart-wheels, and agricultural implements, being strong, hard, tough and durable.



PHULAI,  
*Acacia modesta*, Wall.  
( X 10 ).

**PHULAI,**

*Acacia modesta*, Wall.

VERNACULAR NAME : *phulai*.

DISTRIBUTION : Usually grows in the Sub-Himalayan tracts and Outer Himalayas up to 4,000 ft. elevation ; sometimes also found in the plains. Common in Rawalpindi division.

GENERAL PROPERTIES : Sapwood yellowish-white ; heartwood dark brown, often streaked with darker bands ; very hard ; very heavy ; air-dry weight (12 per cent. moisture-content) 62 to 72 lb. per cubic foot, the average being 67 lb. ; grain straight to slightly interlocked ; texture medium.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* distinct to indistinct, often delimited by fine tangential lines of parenchyma ; 6-12 per inch.

*Pores* visible to the eye, single or in pairs, somewhat evenly distributed, often filled with dark gummy deposits.

*Soft tissues* mostly in bands round the pores or pore-groups ; often forming eyelets, and also connecting the pores by tangential bands ; lastly in fine tangential lines delimiting the seasonal growth.

*Rays* visible to the eye, appearing fairly broad with a lens, not so conspicuous on the radial surface.

SIMILAR WOODS : The three *Acacias* included in this Bulletin have almost similar anatomical structure and cannot be always separated in the field.

STRENGTH : No strength figures are available but this wood is well known as being strong and extremely hard. It is probably the hardest of the Indian *Acacias*.

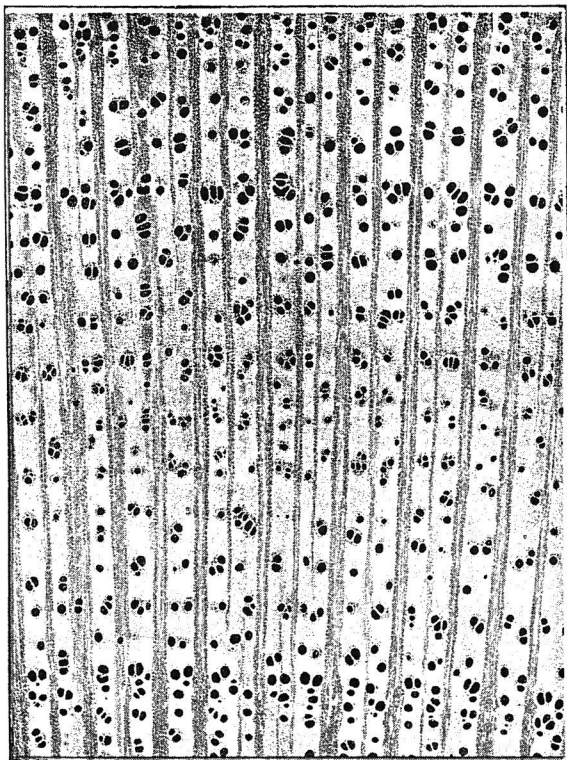
SEASONING : Very little is known of the seasoning properties of this wood, but Pearson states that from timber he has examined it would appear that it seasons well without much degrade.

DURABILITY : *Acacia modesta* is known to be a durable wood, but it has never been officially tested by the Forest Research Institute.

WORKING QUALITIES : The timber is rather difficult to saw and work. A thick-gauge circular saw gives the best results in

sawing. Not a good turnery wood as it is liable to pick up (Pearson).

SUPPLY AND USES: Only small sized logs are available from forest areas; larger trees are usually found scattered round cultivated lands. It is locally used for cane crushers and well construction, and for posts. It is popular as a fuel wood. This timber would probably make up well for furniture, as it is often streaked with dark bands, but as far as is known, it is not used for decorative purposes.



FARASH,  
*Tamarix articulata*, Vahl.  
(X 10).

**FARASH,***Tamarix articulata*, Vahl.VERNACULAR NAMES : *frash, pharwan, ukan.*

DISTRIBUTION : Throughout the plains of the Punjab extending into North West Frontier Province ; and now extensively cultivated in the irrigated plantations on saline soils. A feature of old river beds. One of the commonest trees of the country side.

GENERAL PROPERTIES : Wood white to greyish-white, no difference in colour between sapwood and heartwood ; moderately hard ; heavy to very heavy, air-dry weight (12 per cent. moisture-content) 39 to 60 lb. per cubic foot, the average being 49 lb. ; grain slightly twisted ; texture coarse, somewhat lustrous.

GROSS STRUCTURE : *A diffuse-porous wood.**Growth rings* distinct to indistinct, 2-4 per inch.

*Pores* small, just visible to the naked eye, distinct with a lens, single or in clusters of 3-5, rather irregularly distributed, tyloses absent.

*Soft tissues* mostly round the pores, occasionally also connecting them across the rays.

*Rays* prominent, distinctly visible to the eye, appearing as thick white lines ; conspicuous on the radial surface, in the form of " silver-grain ".

SIMILAR WOODS : There is no other timber in the Punjab which has similar anatomical structure. It can be easily identified by its clustered pores and broad rays.

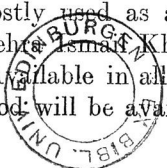
STRENGTH : No test figures are available. It is a moderately hard and strong timber.

SEASONING : It requires care in seasoning ; the logs should be converted when green, the stock open-stacked and protected from direct rays of the sun and from hot wind (Pearson).

DURABILITY : The timber is not very durable.

WORKING QUALITIES : It can be worked to a smooth surface. When quarter sawn it shows a pleasant figure.

SUPPLY AND USES : Mostly used as a cheap firewood and a windbreak especially in Delhi and Simla Khan. Also used in small quantities for turnery. Available in all plains' districts. Large quantities of farash firewood will be available in the future from Khanewal plantations.



**WALNUT,***Juglans regia*, Linn.VERNACULAR NAMES : *akhrot*, *akhor*, *khor*.

DISTRIBUTION : Found only in the Himalayas at 3,000 to 10,000 ft.

GENERAL PROPERTIES : Sapwood pale grey to brown, broad ; heartwood greyish brown, often mottled with dark brown or black streaks ; moderately soft to moderately hard ; moderately light to heavy, air-dry weight (12 per cent. moisture-content) 28 to 43 lb. per cubic foot, the average being 36 lb. ; lustrous ; texture medium and uniform.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* usually distinct, sometimes with a tendency towards ring-porous character ; 8-16 rings per inch.

*Pores* medium-sized, distinctly visible to the eye, mostly single, rarely paired, rather evenly distributed. Transition from early to late pores very gradual.

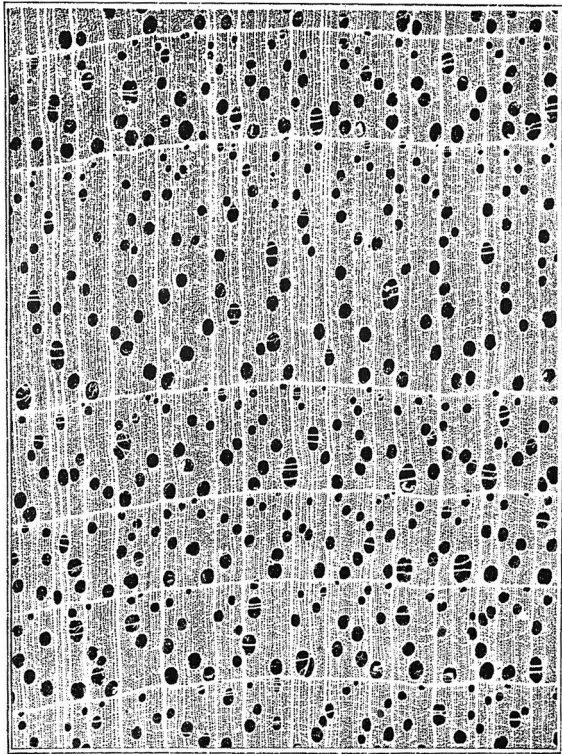
*Soft tissues* in fine, thin tangential lines, often with a tendency to form reticulum with wood rays, also in terminal bands delimiting the growth rings.

*Rays* rather fine, visible to the eye, inconspicuous on the radial surface.

SIMILAR WOODS : There is no other timber in the Punjab which resembles walnut either in colour or in structure.

STRENGTH : A moderately strong wood, which keeps its shape well. Its strength relative to teak is shown by the following figures :—

|                            | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|----------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .             | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Walnut (Kashmir) . . . . . | 85      | 80                  | 90                   | 75                              | 105                      | 65                  | 95     | 70        |



WALNUT,  
*Juglans regia*, Linn.  
( X 10 ).

**SEASONING :** It is extremely easy to air-season and kiln-dry. Should be stacked under cover. Green conversion is recommended as the best method of seasoning.

**DURABILITY :** The timber does not offer much resistance to destruction by white ants and fungi. When used for making furniture, an antiseptic stain can, if required, be applied to the surface.

**WORKING QUALITIES :** The timber is easy to work by machine and hand. In machine-planing, knives bevelled at  $35^{\circ}$  produce a fine finish. It is also easy to work on edge tools. It appears to be a very suitable wood for turnery work.

**SUPPLY AND USES :** The greater portion of the supply comes from Kashmir, only small quantities being available in the Punjab and N. W. F. Province. At present the greater portion of Indian grown walnut is used by the Government Ordnance Department for army rifle parts. It is also used for gun stocks. Other uses are for high class carving and furniture. Walnut burr is well known for its beautifully mottled figure, but the supply is very limited. The Indian walnut has not the figure of Italian walnut.

**NORTH INDIAN EBONY,**

*Diospyros tomentosa*, Roxb.

VERNACULAR NAMES : *tendu*, *kinnu*.

DISTRIBUTION : Found on the lower hills from Kangra eastwards.

GENERAL PROPERTIES : Wood pinkish-white, often with black patches in the centre of the log ; hard to very hard ; very heavy, air-dry weight (12 per cent. moisture content) 53 to 57 lb. per cubic foot, the average being 54 lb. ; somewhat lustrous ; grain almost straight ; texture fine and uniform.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* usually indistinct ; delimited by a band of dense late wood, lacking in parenchyma lines.

*Pores* indistinct to the eye but visible with a lens, mostly in radial lines, rarely single, evenly distributed.

*Rays* indistinct to the eye but visible with a lens, fine, evenly distributed.

SIMILAR WOODS : Woods of various *Diospyros* species resemble one another so much that it is almost impossible to identify them individually. This, however, does not cause much difficulty from the utilization point of view, for all of them possess almost the same working qualities.

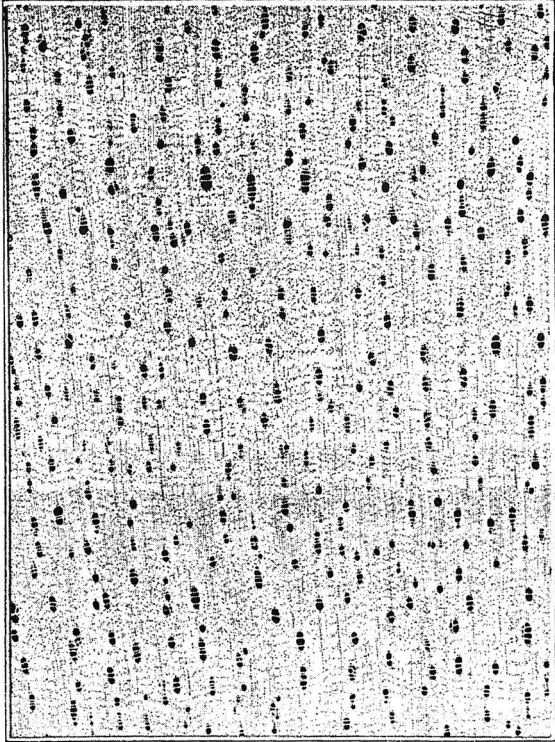
STRENGTH : A strong elastic wood. No strength figures available.

SEASONING : It is one of the more refractory woods to dry, and it is recommended that it should be converted green and stacked under cover. Quarter-sawing is said to give good results.

DURABILITY : Said to be very durable and not to require treatment, but also reputed to be subject to borer attack in the log.

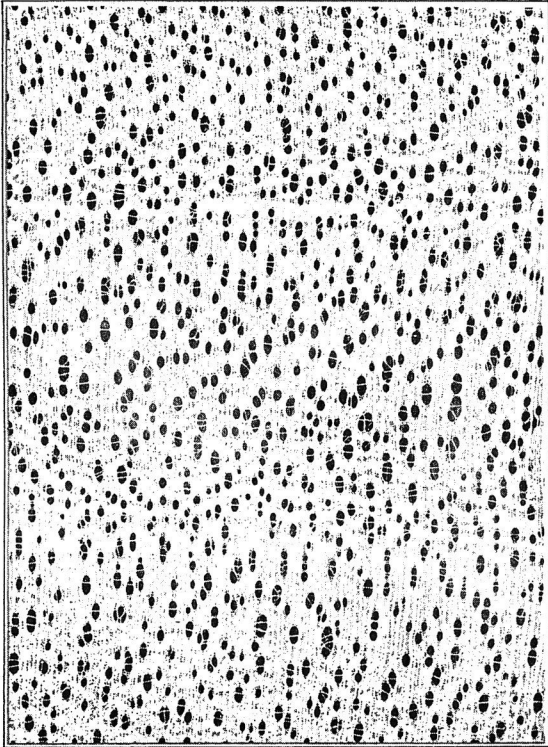
WORKING QUALITIES : The black portion of the wood is rather brittle. The white portion usually takes a good polish but requires at first a thin polish for filling the grain.

SUPPLY AND USES : A fair supply can be obtained from Kangra district. It is used for walking sticks, picture frames, toys, carriage shafts, etc., the black portion of the wood being used as a substitute for true ebony.



NORTH INDIAN EBONY,  
*Diospyros tomentosa*, Roxb.  
( X 10 ).

PLATE XXII.



JAMAN,  
*Eugenia jambolana*, Lamk.  
( X 10 ).

**JAMAN,***Eugenia jambolana*, Lamk.VERNACULAR NAME : *jaman*.

DISTRIBUTION : Found in the Sub-Himalayan tracts, east and south of Rawalpindi.

GENERAL PROPERTIES : Wood dull reddish grey, turning on exposure to dark brown, usually no difference of colour between sapwood and heartwood ; moderately hard to hard ; heavy to very heavy, air-dry weight (12 per cent. moisture-content) 44 to 57 lb. per cubic foot, the average being 48 lb. ; grain interlocked ; texture somewhat coarse but even.

GROSS STRUCTURE : *A diffuse-porous wood.**Growth rings* distinct to indistinct, delimited by a narrow dark band of fibrous tissue without pores ; 5-8 per inch.*Pores* just visible to the eye, distinct with a lens, single or in pairs, evenly distributed, often partially filled with tyloses.*Soft tissues* not visible to the eye, distinct but not sharply defined with a lens, usually round the pores and in wavy lines.*Pith flecks* often present, appearing as dark patches on the longitudinal surfaces.*Rays* fine, not visible to the eye, distinct with a lens, evenly distributed, inconspicuous on the radial surface.

NOTE.—Only in one case vertical resin cavities have been observed.

SIMILAR WOODS : It shows some resemblance to jujube (*Zizyphus jujuba*) but they can be identified in the field without much difficulty. Jaman is dark brown and coarse textured with a rough feel, while jujube is pinkish and medium textured with a smooth feel.

**STRENGTH:** Jaman is a strong structural timber. Its strength relative to teak is shown by the following figures :—

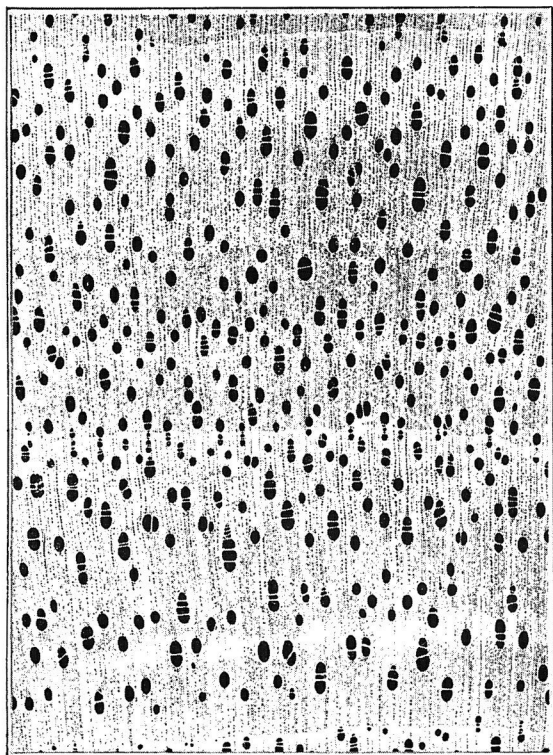
|                         | Weight. | Strength as a beam. | Stiffness as a beam. | Suitability as a post or strut. | Shock resisting ability. | Retention of shape. | Shear. | Hardness. |
|-------------------------|---------|---------------------|----------------------|---------------------------------|--------------------------|---------------------|--------|-----------|
| Teak . . . . .          | 100     | 100                 | 100                  | 100                             | 100                      | 100                 | 100    | 100       |
| Jaman (U. P.) . . . . . | 115     | 90                  | 100                  | 95                              | 100                      | 60                  | 130    | 120       |

**SEASONING :** The timber is refractory to season, as it is liable to surface cracking and splitting. Green conversion and immediate stacking under cover of sheds is recommended. It requires protection against too rapid drying, and should not be converted in dry hot weather.

**DURABILITY :** Heartwood is moderately durable, but very resistant to penetration by antiseptic fluids. In a "grave yard" test for finding the relative durability of untreated timbers, out of 6 pieces, 3 perished in 5 years 11 months, while the rest were still sound.

**WORKING QUALITIES :** It offers no difficulty in sawing and machining under ordinary workshop conditions, and cleans up to a reasonably good finish by hand.

**SUPPLY AND USES :** It is available in the Punjab in fairly good quantities. It is used for many purposes such as for posts, beams, rafters, cart-wheels and agricultural implements, and would be suitable for making plain furniture.



JUJUBE,  
*Zizyphus jujuba*, Lamk.  
( X 10 ).

**JUJUBE,***Zizyphus jujuba*, Lamk.VERNACULAR NAME: *ber*.

DISTRIBUTION: Common throughout the Punjab, ascending to the Himalayas up to 6,000 ft. Especially common on open lands and round deserted village sites.

GENERAL PROPERTIES: Wood light red when freshly cut, turning to deeper colour on exposure; moderately hard; moderately heavy to heavy, air-dry weight (12 per cent. moisture-content) 38 to 46 lb. per cubic foot, the average being 42 lb.; grain interlocked; texture medium and even.

GROSS STRUCTURE: *A diffuse-porous wood.*

*Growth rings* distinct to the eye, delimited by a narrow band of late wood, 3-6 per inch.

*Pores* just visible to the eye, individually distinct with a lens. Single or in radial lines of 2-3, evenly distributed. Tyloses present but scanty. Reddish gum occasionally present.

*Soft tissues* round the pores, forming thin whitish lines; sometimes also connecting the pores by tangential wavy bands.

*Rays* fine, indistinct to the eye but visible with a lens, evenly distributed, inconspicuous on the radial surface.

SIMILAR WOODS: It shows some similarity to jaman (*Engenia jambolana*) but they can be easily identified in the field. Jujube is pinkish and medium textured with a smooth feel, while jaman is dark brown and coarse textured with a rough feel.

STRENGTH: No strength figures available, but well known as a strong and moderately hard timber.

SEASONING: It offers no difficulty in seasoning.

DURABILITY: Moderately durable in the open, and durable under cover (Pearson).

WORKING QUALITIES: Easy to saw and work, but owing to the cross-banding of the fibres, sometimes liable to pick up in planing.

SUPPLY AND USES: Its supply is fairly abundant in the Punjab, but only in small sizes. Most of it is used locally for fuel and for such purposes as bedsteads, agricultural implements and toys, etc.

## INDIAN POPLAR,

*Populus euphratica*, Oliv.

VERNACULAR NAMES : *bhan*, *bahan*.

DISTRIBUTION : Grows only on the alluvium of the river banks, chiefly in Muzaffargarh District.

GENERAL PROPERTIES : Sapwood white, heartwood red to reddish-brown, sometimes black in the centre; moderately soft; light to moderately light, air-dry weight (12 per cent. moisture-content) 28 to 35 lb. per cubic foot, the average being 30 lb.; somewhat lustrous; grain straight to slightly interlocked; texture even, fine.

GROSS STRUCTURE : *A diffuse-porus wood.*

*Growth rings* usually distinct, delimited by a denser band in extreme late wood; sometimes with a tendency towards semi-ring-porous character.

*Pores* not visible to the eye but individually distinct with a lens, single or in radial lines of 2-4; rather crowded in the early wood; transition from early to late wood very gradual.

*Soft tissues* indistinct to the eye or with a lens.

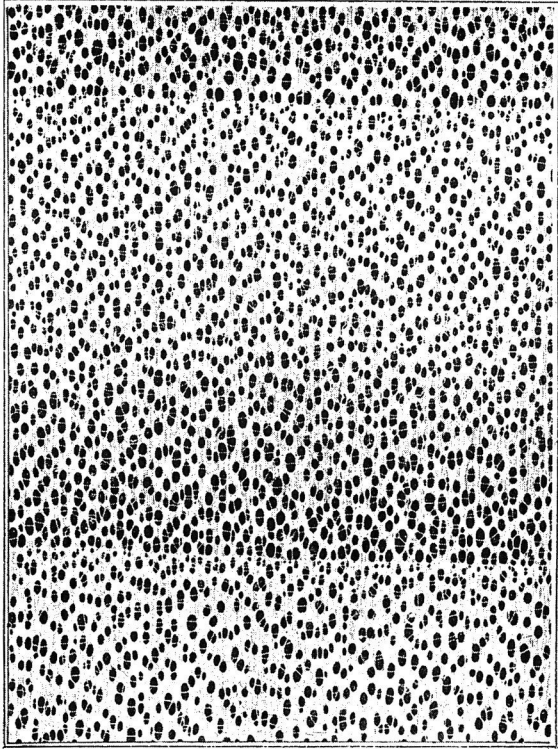
*Rays* very fine, indistinct to the eye but visible with a lens as fine lines; inconspicuous on the radial surface.

SIMILAR WOODS : Poplar and willow (*Salix* spp.) woods resemble each other so much that it is not possible to separate them in the field, but with the help of a microscope they are easily identified. *Populus ciliata* is also found in the Punjab but it is a much lighter wood than *Populus euphratica*, and is only found in the hills at 4,000 to 10,000 ft. elevation.

STRENGTH : No strength figures available.

SEASONING : On account of its liability to discoloration due to mould and fungi, this wood requires rapid seasoning after conversion. Vertical stacking in the open should be done for a couple of weeks before the usual stacking for air-seasoning. Kiln-drying is easy and attended with little degrade.

DURABILITY : This timber is not durable and is said to be very liable to insect attack.



INDIAN POPLAR,  
*Populus euphratica*, Olivier,  
( X 10 ).

**WORKING QUALITIES :** It is usually easy to work by hand or in machines.

**SUPPLY AND USES :** Considerable supplies are available in the Multan Forest division. It is used for the following purposes : turnery, well-curbs, and cheap furniture. The sapwood has been used for match-sticks and match boxes, but the wood is not really suitable for the purpose. The logs are inclined to be very rough. Used also as a firewood.

**BLACK ALDER,**

*Alnus nitida*, Endl.

VERNACULAR NAMES : *sharol*, *kosh*.

DISTRIBUTION : Western Himalayas, extending from Jumna eastward and confined mostly to moist areas. Also common in Hazara and the Kagan valley. A feature of the banks of the Beas river in Kulu.

GENERAL PROPERTIES : Wood reddish-white when freshly cut, turning to greyish brown with age ; no marked difference in colour between sapwood and heartwood ; soft ; light to moderately light, air-dry weight (12 per cent. moisture-content) 24 to 31 lb. per cubic foot, the average being 28 lb.; grain straight ; texture fine and even.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* present, fairly distinct, delimited by a band of dense late wood ; margin of the ring usually undulating.

*Soft tissues* indistinct to the eye.

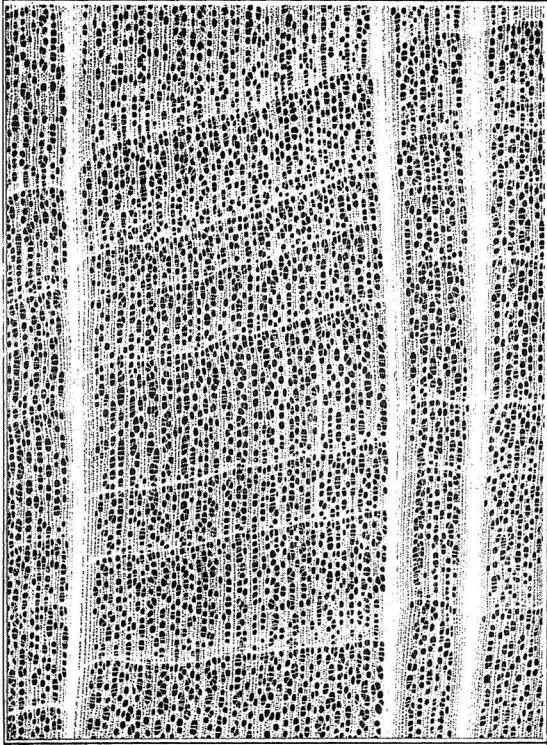
*Rays* usually of two kinds, (i) broad (aggregate) rays irregularly distributed, not so conspicuous on the end surface but prominent on the longitudinal surfaces on account of their unusual height ; (ii) fine rays, indistinct to the eye but visible with a lens, numerous, inconspicuous on the longitudinal surfaces.

SIMILAR WOODS : On account of the presence of broad rays in the oaks (*Quercus* spp.) and the alders, they show somewhat similar structure on the faces of planks, but alders are much lighter and softer than oaks, and there is no difficulty in identifying them in the field.

STRENGTH : No strength figures available. Not a strong wood.

SEASONING : It is easy to season, but requires protection against mould and blue-staining. Green conversion with prompt stacking is recommended.

DURABILITY : Not durable in the open and only moderately so under cover (Pearson).



BLACK ALDER,  
*Alnus nitida*, Endl.  
( X 10 ),

**WORKING QUALITIES :** Saws with ease and presents no difficulty in working. Does not lend itself to turnery (Pearson).

**SUPPLY AND USES :** Available in fair quantities in Kashmir and some districts of the Punjab especially Kulu. Mostly used locally for planking, box making, house building, bedsteads, water channels, etc. Has been tested for match making but yields an inferior splint. Quite a good firewood but burns quickly.

## INDIAN OLIVE,

*Olea cuspidata*, Wall.

(*Olea ferruginea*, Royle.)

VERNACULAR NAMES : *kao, khwan, ko.*

DISTRIBUTION : Found in the Himalaya, especially on the limestone of Khanpur (Hazara), Campbellpur and Rawalpindi districts. Also at low elevations throughout the hills.

GENERAL PROPERTIES : Sapwood pinkish-white to grey with dark streaks ; heartwood greyish-brown to dark brown, often with a greenish tinge ; very hard to extremely hard ; very heavy, air-dry weight (12 per cent. moisture-content) 66 to 71 lb. per cubic foot, the average being 68 lb. ; has an oily feel ; grain straight to slightly interlocked ; texture very fine and even.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* distinct to indistinct, delimited by a dense band of late wood, 6-13 rings per inch.

*Pores* minute, indistinct to the eye but visible with a lens, fairly conspicuous due to parenchyma bands round them ; often grouped in the middle of the ring ; sometimes plugged with brownish gum ; partially tylosed.

*Soft tissues* mostly round the pores, often forming eyelets, occasionally in fine tangential bands.

*Rays* indistinct to the eye, visible with a lens, fine, uniformly distributed.

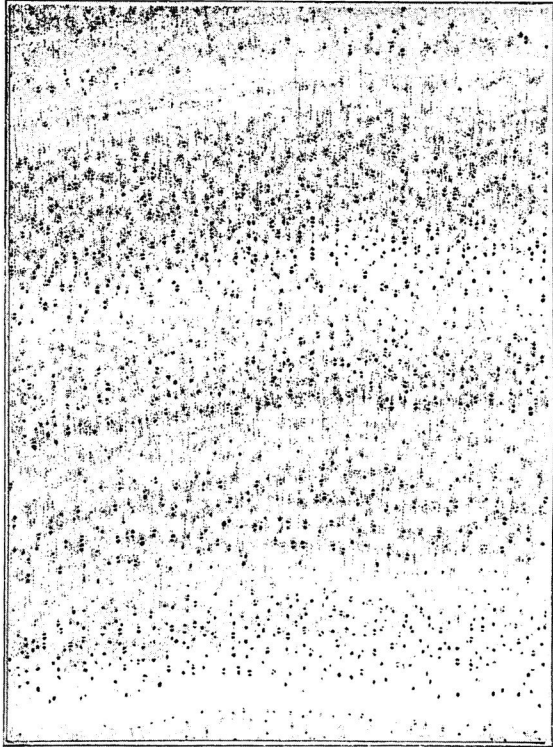
SIMILAR WOODS : The only wood which it resembles is parrotia (*Parrotia jacquemontiana*), but olive can usually be identified by its greenish tinge and bigger pores.

STRENGTH : A strong, hard, and very tough wood, equalling ash for tool handles for which it is largely used in North India.

SEASONING : It is a very refractory timber to air-season. Slow seasoning under cover gives the best results.

DURABILITY : Reputed to be durable.

WORKING QUALITIES : It is not very difficult to saw and can be brought to a beautiful smooth surface. It also takes a fine polish.



INDIAN OLIVE,  
*Olea cuspidata*, Wall.  
( X 10 ).

**SUPPLY AND USES :** Fairly large supplies are available from the Kala Chitta range of Rawalpindi division, mostly in the form of billets. A good firewood. It is an ornamental timber and is used for making decorative articles like combs, toys and carvings. It is also a good timber for inlay work. The North Western Railway has been using this wood for tool handles with satisfactory results, and it has been found excellent for police batons.

## BOXWOOD,

*Buxus wallichiana*, Baill.

(*Buxus sempervirens*, L., in part.)

OTHER COMMON NAMES : European boxwood; vern. :— *shamshad*, *chickri*, *chikdi*, *papri*.

DISTRIBUTION : Found in the Himalaya at 4,000 to 9,000 ft.

GENERAL PROPERTIES : Wood dull yellow to yellow. No difference in colour between sapwood and heartwood; hard; very heavy, air-dry weight (12 per cent. moisture-content) 52 to 58 lb. per cubic foot, the average being 55 lb.; with a silky lustre; grain straight to slightly twisted; texture very fine and even.

GROSS STRUCTURE : *A diffuse-porous wood*.

*Growth rings* distinct on a clean-cut surface, delimited by a dense band of extreme late wood; very narrow, 18-30 rings per inch.

*Pores* indistinct to the eye, with a lens appearing as dots, evenly distributed.

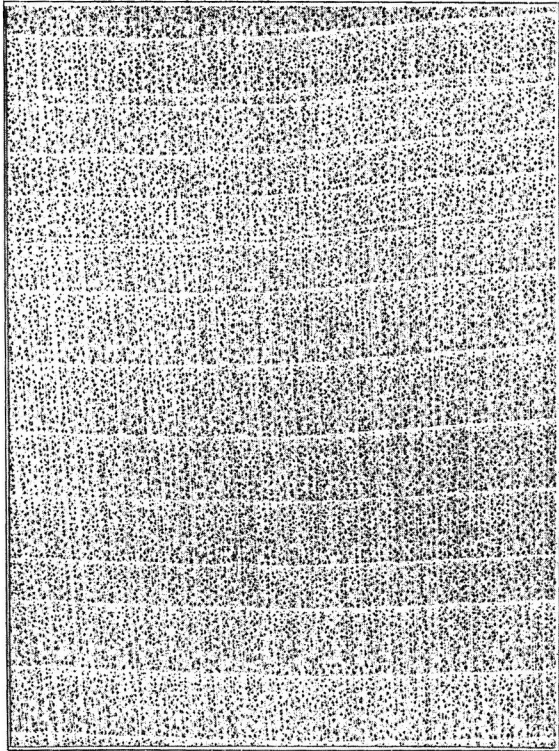
*Soft tissues* minute, indistinct with a lens.

*Rays* just visible to the eye, distinct with a lens; on the radial surface just visible to the eye.

SIMILAR WOODS : In general look, it shows some similarity to Chinese boxwood (*Murraya exotica*), from which it can be separated without difficulty. In boxwood parenchyma cells are indistinct even with a lens, while in Chinese boxwood parenchymatous concentric bands are visible to the naked eye. Various species of *Gardenia* are often sold in the market as Indian boxwood from which it can be distinguished only with the help of a microscope.

STRENGTH : Boxwood is not dependent on strength for its market value.

SEASONING : The timber is subject to heart and ray shakes, and the best method is to convert logs into "half rounds" by means of a sawcut through the centre of the log. The half-rounds should be stacked under cover, preferably with bark on. The ends of the logs should be coated with a moisture-retardant paint.



BOX WOOD,  
*Buxus wallichiana*, Baill.  
( X 10 ).

**DURABILITY :** The wood is durable and not liable to insect attack.

**WORKING QUALITIES :** It saws well and can be turned to a smooth ivory-like surface. It takes a beautiful polish.

**SUPPLY AND USES :** Its supply is very limited and it can be obtained only in small pieces. On account of the great demand, it is sold by weight, not by bulk. It is one of the best timbers for turnery work, giving a finish like ivory. It is also very suitable for engraving and carving purposes. Hundreds of small articles such as combs, toys and fancy boxes are made from it, and it is also used for sports goods such as croquet balls and mallets.

**PARROTIA,**

*Parrotia jacquemontiana*, Dcne.

VERNACULAR NAMES : *paser, killar, sha.*

DISTRIBUTION : Found in the Himalaya at 4,000 to 8,000 ft.; common in Kashmir, Kagan Valley, Buspa Valley and Chamba. Usually found as a shrub or very small tree.

GENERAL PROPERTIES : Sapwood pinkish-white to brownish-grey ; heartwood blackish-grey, narrow, sometimes absent in small billets ; very hard ; heavy to very heavy, air-dry weight (12 per cent. moisture-content) 46 to 58 lb. per cubic foot, the average being 53 lb.; grain straight ; texture very fine and even.

GROSS STRUCTURE : *A diffuse-porous wood.*

*Growth rings* distinct on the end surface, delimited by dense bands of extreme late wood, very narrow and regular, 20-28 rings per inch.

*Pores* not visible to the eye, with a lens appearing like dots, evenly distributed.

*Soft tissues* indistinct with a lens.

*Rays* indistinct to the eye, just visible with a lens, fine, equidistant.

SIMILAR WOODS : In hardness and texture, it somewhat resembles Indian olive (*Olea cuspidata*) from which it can be distinguished by its pinkish colour and smaller pores.

STRENGTH : A strong, tough wood, equalling or surpassing ash for tool handles, some users preferring the former.

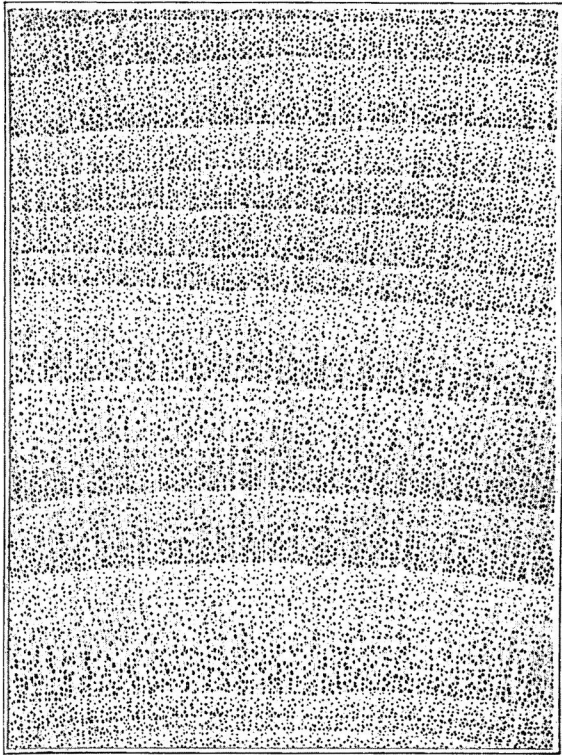
SEASONING : The billets of this species air-season very well, if stacked under cover, with bark on and the ends coated with a moisture-retardant paint. Water-soaking previous to seasoning is not suitable as it reduces the strength of the wood for use as tool handles.

DURABILITY : The timber offers poor resistance against white ants and fungi.

WORKING QUALITIES : It is a good wood for turnery work.

SUPPLY AND USES : It is available only in small quantities and in small billet sizes. It is suitable for tent pegs, hammer handles, tool and axe-helves.

PLATE XXVIII.



PARROTIA,  
*Parrotia jacquemontiana*, Dene.  
( X 10 ).

## VII—APPENDIX.

## Calorific values of some Punjab timbers.\*

A good many of the Punjab commercial timbers are used as firewood, and their calorific values, as far as available, are given below :—

| Serial No. | Name of species.          | Trade Names.   | Calorific values of completely dried and ash-free material. |                | REMARKS.                   |
|------------|---------------------------|----------------|---|----------------|----------------------------|
|            |                           |                | calories.   | B. T. U.       |                            |
| 1          | <i>Acacia arabica</i>     | babul.         | S. 4,793<br>H. 4,946  | 8,627<br>8,903 | Specimens from the Punjab. |
| 2          | <i>Acacia catechu</i>     | eutch.         | S. 5,142<br>H. 5,244  | 9,256<br>9,439 | Specimens from Dehra Dun.  |
| 3          | <i>Acacia modesta</i>     | phulai.        | S. 4,807<br>H. 5,131  | 8,654<br>9,237 | Specimens from the Punjab. |
| 4          | <i>Dalbergia sissoo</i>   | sissoo.        | S. 4,908<br>H. 5,181  | 8,835<br>9,326 | Specimens from Dehra Dun.  |
| 5          | <i>Morus alba</i>         | mulberry       | S. 4,658<br>H. 5,003  | 8,385<br>9,007 | Specimens from Dehra Dun.  |
| 6          | <i>Olea cuspidata</i>     | Indian olive.  | S. 5,126<br>H. 5,266  | 9,226<br>9,479 | Specimens from the Punjab. |
| 7          | <i>Populus euphratica</i> | Indian poplar. | S. 5,019<br>H. 5,008  | 9,035<br>9,016 | Specimens from the Punjab. |
| 8          | <i>Tamarix articulata</i> | farash.        | 4,835   | 8,704          | Specimens from the Punjab. |
| 9          | <i>Zizyphus jujuba</i>    | jujube.        | 4,878   | 8,782          | Specimens from Bombay.     |

S=Sapwood.

H=Heartwood.

\* From Forest Bulletin No. 79, 1932.

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- \* " No. V.—Testing of Raw Materials (Paper pulp Section), by W. Raitt. As. 5.
- \* " No. VII.—Kiln Seasoning of Indian Timbers, by S. Fitzgerald and S. N. Kapur. Re. 1-4-0.
- \* " No. VIII.—Testing of Indian Woods for Veneers and Plywood, including Tests on Glues, by W. Nagle. Rs. 2-2-0.
- Elementary Silviculture in Hindi, by Mohd. Hakimuddin. Rs. 3-0-0.
- Elementary Silviculture in Urdu, by Mohd. Hakimuddin. Re. 1-8-0.
- \*The methods of preparing Volume and Money Yield Tables for Teak woods and Volume and Form Factor Tables for Teak Trees from data collected in the Nilambur Teak Plantations, by R. Bourne. Rs. 9-0-0.
- \*Key to Families of Flora Simlensis, compiled by R. Banerjee. Re. 1-0-0.
- \*A System of Filing Information on Forestry, by S. H. Howard. Rs. 2-14-0.
- \*Forest Flora of the Chakrata, Dehra Dun and Saharanpur Forest Divisions, U. P., by Upendranath Kanjilal, Third Edition, revised and enlarged by Basant Lal Gupta. Rs. 3-3-0.
- \*Malaria in Forest Areas, by Lt. Col. J. A. S. Phillips. As. 2.
- \*The Common Commercial Timbers of India and their Uses, by H. Trotter. Re. 1-12-0.
- Note on "Eridera"—A Composition for Reconditioning Abrased Spike Holes in Railway Sleepers, by S. Krishna and T. P. Ghose—Railway Board, Technical Paper No. 282. As. 6.

## X.—MISCELLANEOUS PUBLICATIONS (*printed outside India*)

- †Schlich's Manual of Forestry, Vol. I, 4th edition, 1922. Rs. 7-8-0.
- †Schlich's Manual of Forestry, Vol. II, 4th edition, 1910. Rs. 7-7-6.
- †Schlich's Manual of Forestry, Vol. III, 5th edition, 1925. Rs. 14-1-0.
- †Indian Trees, by Sir D. Brandis, 1921 edition. Rs. 35-0-0.
- Silviculture of Indian Trees, by R. S. Troup, 3 Vols. †Rs. 40-0-0 for forest officers; Rs. 78-12-0 for public sale.
- Commercial Timbers of India, by R. S. Pearson and H. P. Brown, 2 Vols. †Rs. 47-0-0 for forest officers; Rs. 67-0-0 for public sale.
- †Measurements of the Cubical Contents of Forest Crops, Oxford Forestry Memoirs, No. 4, by M. D. Chaturvedi. Rs. 4-0-0.

*The above may be obtained from the MANAGER of Publications, Civil Lines, Delhi.*

\*Also obtainable from the Librarian, Forest Research Institute, Dehra Dun.

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