UPGRADING HARDWOODS
A REPORT ON THE HARDWOOD INDUSTRY ON THE EAST COAST OF THE UNITED STATES

ANDREW N. ROZSA

1988 GOTTSTEIN FELLOWSHIP REPORT

JOSEPH WILLIAM GOTTSTEIN MEMORIAL TRUST FUND

The Joseph William Gottstein Memorial Trust Fund was established in 1971 as a national educational Trust for the benefit of Australia's forest products industries. The purpose of the fund is *"to create opportunities for selected persons to acquire knowledge which will promote the interests of Australian industries which use forest products for the production of sawn timber, plywood, composite wood, pulp and paper and similar derived products."*

Bill Gottstein was an outstanding forest products research scientist working with the Division of Forest Products of the Commonwealth Scientific Industrial Research Organization (CSIRO) when tragically he was killed in 1971 photographing a tree-felling operation in New Guinea. He was held in such high esteem by the industry that he had assisted for many years that substantial financial support to establish an Educational Trust Fund to perpetuate his name was promptly forthcoming.

The Trust has had three major forms of activity,

(1) Fellowships - each year applications are invited from eligible candidates to submit a study programme in an area considered to be of benefit to the Australian forestry and forest industries. Study tours undertaken by Fellows have usually been to overseas countries but several have been within Australia. Fellows are obliged to submit reports on completion of their programme. These are then distributed to industry if appropriate.

(2) Study Tours - industry group study tours are arranged periodically and have been well supported.

(3) Seminars - the information gained by Fellows is often best disseminated by seminars as well as through the written reports.

The Wood Science Course is a new initiative undertaken with considerable enthusiasm. The Trustees are confident the venture will be of substantial benefit to industry and so conform with the Fund's original objectives.

Further information may be obtained by writing to, The Secretary, J.W. Gottstein Memorial Trust Fund, P.O. Box 56, Highett, Victoria, 3190. Australia. (03) 556 2211.

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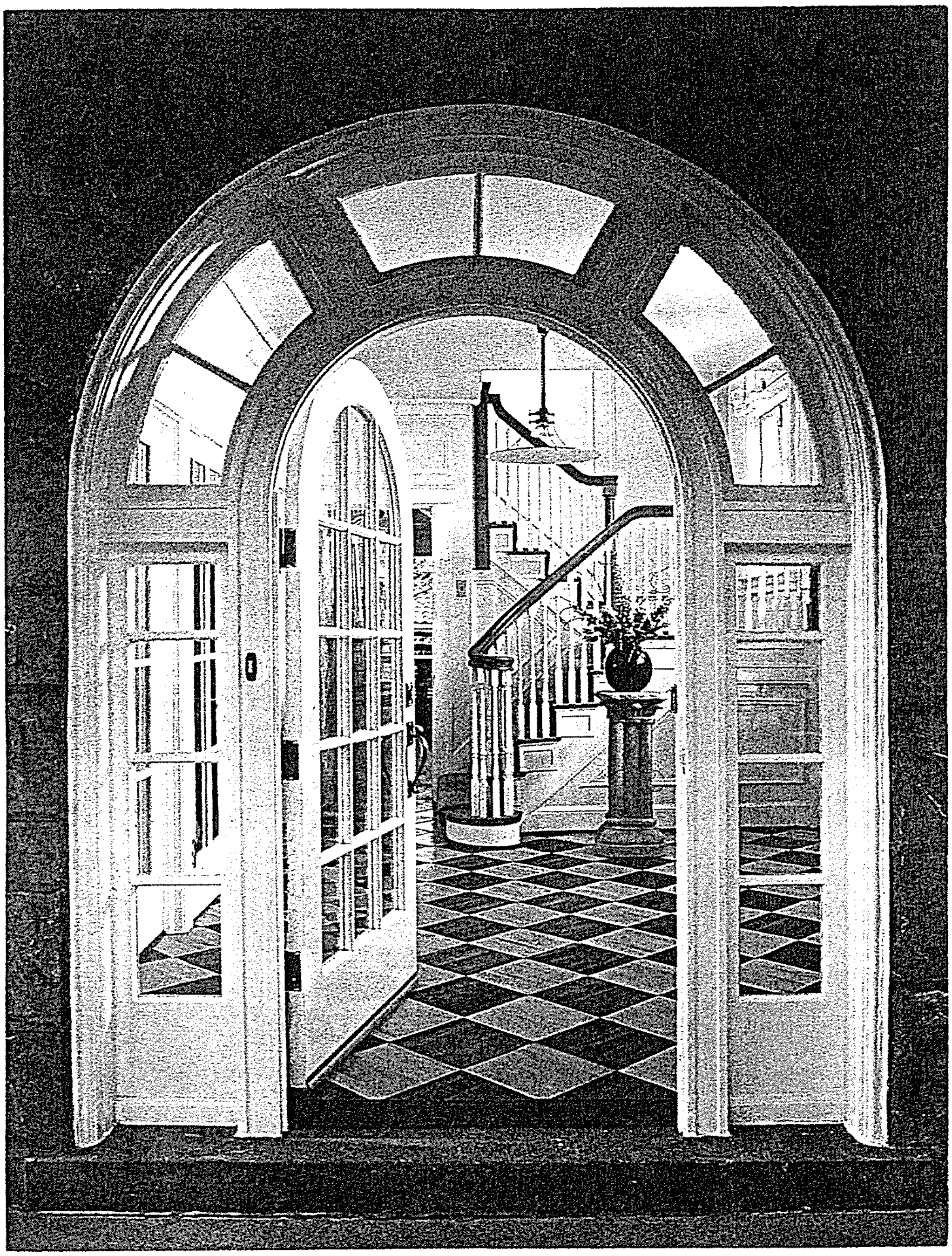

A Showplace of Design Ideas

The Hardwood House

SOLID HARDWOOD FROM THE USA

Andrew Rozsa is an experimental scientist with CSIRO's Division of Forestry and Forest Products. He is a member of the Institute of Wood Science, and has a diploma in applied chemistry and post graduate qualifications majoring in psychology and statistics.

He has worked for some twenty years in various aspects of the study of wood, from its structure and chemistry to its utilisation. For the past two years he has been a member of a multidisciplinary research team which has been assessing the future of young, regrowth and managed or plantation eucalypts as a resource base for hardwood needs. His particular interest has been the production of higher end value sawn timber products from these trees, with an emphasis on the problems of drying this sometimes refactory material.

The award of a 1988 Gottstein Fellowship enabled Andrew to study the methods used by the timber industry based on the East Coast of the United States to produce and market hardwoods as a high value quality product from a resource that has many similarities to our own hardwood forests.

GOTTSTEIN REPORT

ANDREW ROZSA
GOTTSTEIN FELLOW 1988

UPGRADING HARDWOODS

A REPORT ON THE HARDWOOD LUMBER
INDUSTRY ON THE EAST COAST
OF THE UNITED STATES OF AMERICA

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ACKNOWLEDGEMENTS

This study tour was undertaken with the financial support of the J.W. Gottstein Memorial Trust Fund.
I wish to offer my sincere thanks to the trustees of the fund in granting me the privilege of a 1988 Gottstein Fellowship and making this study and report possible.

I also wish to thank my employer CSIRO without whose support I would not have been able to carry out this work.

I would also like to thank the many people who so willingly gave their time and hospitality to me during this time. A special word of thanks must go to Dr. Hank Montrey and Ms. Colleen Morfoot of the USDA Forest Products Laboratory in Madison Wis. for the way in which they helped me plan and carry through a very complex itinerary.

SYNOPSIS AND RECOMMENDATIONS

This report is the result of a study tour undertaken through the sponsorship of the Joseph William Gottstein Memorial Trust Fund as a Gottstein Fellow in 1988.

The fellowship consisted of a visit of six weeks to the East coast of the United States of America to gain some practical understanding of whether there could be some aspects of their hardwood conversion and marketing process that could be applied to the Australian situation. The main interest was to improve the utilisation of Australian hardwoods in general, but more particularly to investigate the possibility of upgrading the end product value of wood from our regrowth and shorter rotation eucalypt forests which are now coming on to the market in increasing quantities.

The study looked at the industry from three levels:
Research, Production and Marketing. Many similarities of kind were found between the two countries in their problems with resource, conversion and utilisation. Significant differences in the way the Americans dealt with these problems became evident along the way.

This report suggests a number of areas of change that are worthy of consideration and further investigation with a view to applying them to certain sectors of our hardwood industry.

The main points that came from the study:

1. Resource Management and Forest Practices.

There needs to be a rationalisation of the end use of different quality logs. Small defective logs can be turned into high value products given certain technical requirements and financial inducements. The way logs are sorted and graded will need to change to reflect their potential end-uses.

It will need specialisation for parts of the industry and extensive investment in new manufacturing processes. Inevitably it will require a higher unit cost all along the line to produce a quality product. The value of any resource must be set so that an economically viable product can be produced.

2. The Conversion Process

For any segment of the industry that decided to aim at upgraded products from lower quality logs, the entire conversion process would need to be geared towards a speciality product, or a range of such products. The main feature of such a high value product should be that it has been further processed to a high quality standard so that it can be readily used by the next stage processor at an economic advantage to both.

There is a need for some rationalisation of production especially in the use of fall down material. The pallet industry in the United States provides a vast market for the hardwood material that does not make appearance grades. There seems to be a potential in Australia to encourage a larger pallet industry to make use of short lengths of lower grade material, rather than consigning it to the chipper.

Quality control of the whole process from log sorting, sawing, and product presentation is probably the most important aspect of being able to produce something that will sell at a premium price. Present industry standards in general are not up to meeting the stringent requirements of this sort of product.

Education and training in sawing and drying our more difficult to handle woods needs to be improved. The Americans have instituted excellent educational programs especially in the drying and management areas.

The grading rules for these types of products need to reflect more closely the end-use application of the material. They need to allow for shorter clear lengths, shop floor docking of fall down pieces and have a financial benefit to buyer and seller to encouarage change. The varied uses of wood in appearance products means that the rules must embody some rationalisation of the permitted defects especially in regard to surface and internal defects.

3. Hardwood Products.

There is a vast potential range of products that can be manufactured from short defective logs. Most of these products in shorter lengths depend on a furniture type end market. Longer lengths produced by end jointing are suitable for a large range of architectural joinery products. Dimensioned hardwood timber, accurately sawn, properly dried and dressed is a valuable commodity in the appearance product manufacturing industry, or in the do-it-yourself market. Dimensioned pre processed parts such as panels, seats and legs ready for manufacture into furniture would be a distinct possibility for domestic or international markets.

4. Research and Marketing.

None of the above points has any significance unless the products can be made to the required specification, and then sold in the marketplace at a reasonable return.

The first requirement is for the industry to achieve a level of technical competence in the conversion process.

Our young eucalypts in particular have not been adequately researched for their resource quality, sawing and drying characteristics. There is an important need to develop sawing and drying systems specific to our native timbers that will enable the production of a consistent quality product at an economic cost.

If we can produce these higher value processed materials, we still need to sell them. There is at present virtually no hardwood market for the types of speciality products described in this report. There would be an urgent need to change the marketing concept of timber products, both from the producer's, final manufacturer's and consumer's point of view so that each chain in the market would understand exactly the standard of what is being produced, and that it is appropriate to the intended end-use. The production of wood needs to be integrated through the whole process to a specific end use for a given market and with a define value

SECTION 1

INTRODUCTION

1.1 REGROWTH HARDWOODS

The hardwood timber industry in Australia is facing a time of change.

Community perceptions and government legislation have led to a resource that is decreasing in volume, accessibility, size and quality.This, combined with increasing costs and pressures from competing products mean that to remain viable the industry will be compelled to make some drastic changes.

In the South Eastern States of Victoria and Tasmania in particular, the supplies of large older trees suitable for dry sawn products is rapidly being replaced by a younger, smaller regrowth resource that is proving to be quite different in many of its properties to what the industry has become accustomed to in the past.

Within a short time a significant proportion of Australian hardwood will come from what is commonly known as a regrowth resource. Regrowth material is that which is grown from regenerated sites as a result of timber production, destruction of forests by fire or clearing, and plantation for timber production or land reclamation. These stands range from natural regrowth to fully managed plantations and vary in species and location throughout Australia. Wood from the regrowth resource has in common an earlier than usual harvesting age, and different characteristics and physical properties to that produced from traditional mature forest resources.

In the ash type eucalypts regrowth trees are being harvested at smaller diameters, the logs often have high growth stresses and a greater incidence of defect caused by knots and gum veins. Novel techniques of handling, sawing and seasoning are required to minimise any further degrade during the conversion process. Even produced under ideal conditions, the timber will be different. It will be of lower density, its mechanical properties may be changed. It will have more knots and a higher rate of seasoning degrade. The wood from the ash-type eucalypts on the other hand is often paler and more even in colour, and therefore more easily marketed, and as the smaller logs dictate that backsawn boards will provide more interesting figure grains for appearance products.

At present it appears that there is a potential for producing satisfactory products from much of this resource, however the end result particularly for sawn timber will be a different range and value of product than we have obtained in the past.

There are substantial pressures on the timber industry for legislative, community, environmental and financial reasons to produce as high a value product from the available resource as possible. It is already apparent that for sawn timber products, the greatest potential for improving the value of is in the grades that produce seasoned sawn appearance product.To acheive a marketable product especially from this lower grade resource will take investment in research, production facilities, marketing and a major change in attitude towards what our producers and consumers of forest products expect from the industry.

1.2 PURPOSE OF STUDY

The hardwood areas on the east coast of the United States of America produce large quantities of sawn dried hardwood intended mainly for appearance grade end uses. Over the years the Americans have experienced a trend to lowering quality of resource in their hardwood forests. Logs have become much smaller, of lower grades, much more defect prone and have problems in conversion and seasoning. Despite this, the industry in the United States still produces hardwood for the high value end of the market. There seem to be some parallels between the problems the American industry is coping with and the predicted problems that will soon be apparent in the Australian industry.This study tour was undertaken to investigate the American hardwood industry at three levels: research, industry and marketing.

1.3 METHOD OF STUDY

The traditional hardwood areas of the Eastern seaboard of the United States extend some 1600 kilometers along the chain of the Appalachian Mountains from New York State in the North to Georgia in the South. The sawmilling industry, furniture producers, marketing bodies and research centres are widely scattered East and West across the mountains. It was thought that the only way to get a perspective of such a broad range of resource and industry was to cover as much of the area on the ground as possible. Consequently this study involved driving some 6000 km. over a period of five weeks within this area, followed by a week at the major forest product research laboratory in Madison Wisconsin. (Figure 1, itinerary Appendix 01)

SECTION 2

BACKGROUND:
THE UNITED STATES HARDWOOD INDUSTRY

2.1 THE HARDWOOD FOREST RESOURCE

The Hardwood forests of the United States are obviously physically very different to our prime ash type forests in that there is usually a large mix of size range, species, and ages within a stand.In reality there is a better comparison with our under-utilised lowland mixed eucalypt forest resources such as found in coastal areas of East Gippsland.

Commercial forest land is defined in the Eastern states as that which can produce 1.4 cubic metres per hectare per year.

Average growth rates on these forests are in the order of 2 cubic meters/year on industry owned land, 1 cubic meter/year on Federal land about 0.85 cubic meters/year on private lands. The species tend to be selective for growing conditions, the more exposed South and West slopes producing the less desirable scarlet oaks, hickory and blackgum, in the moist hollows oaks, yellow poplar and cherry, while the moister more protected North and West slopes produce the prime oaks, ash, maples and beech.

Trees from commercial species considered as saw timber trees need to be 275mm diameter breast height (DBH) and contain at least one 3.6m or two non contiguos 2.4m sawlogs.

Sawtimber stands need to be stocked to a minimum of 10% of full stocking with growing stock trees and half or more of such trees as pole timber, sawtimber, or both. the stocking of sawtimber must be at least equal to that of pole timbers. Standard stocking levels in the Eastern United States are considered to be in the order of 7sq.m/ha basal area for trees 100mm DBH or larger. Sawtimber is measured in board feet to the international rule in which the nett volume is the gross volume less an allowance for defects.(1000 board feet log measure is approximately 3.48 cubic meters of actual log volume) The Appalachian area contains 56 million ha of commercial forest land, most of which is in private hands. (see table 01)

This forest resource can be divided into three areas:-

1. The Eastern Forests:

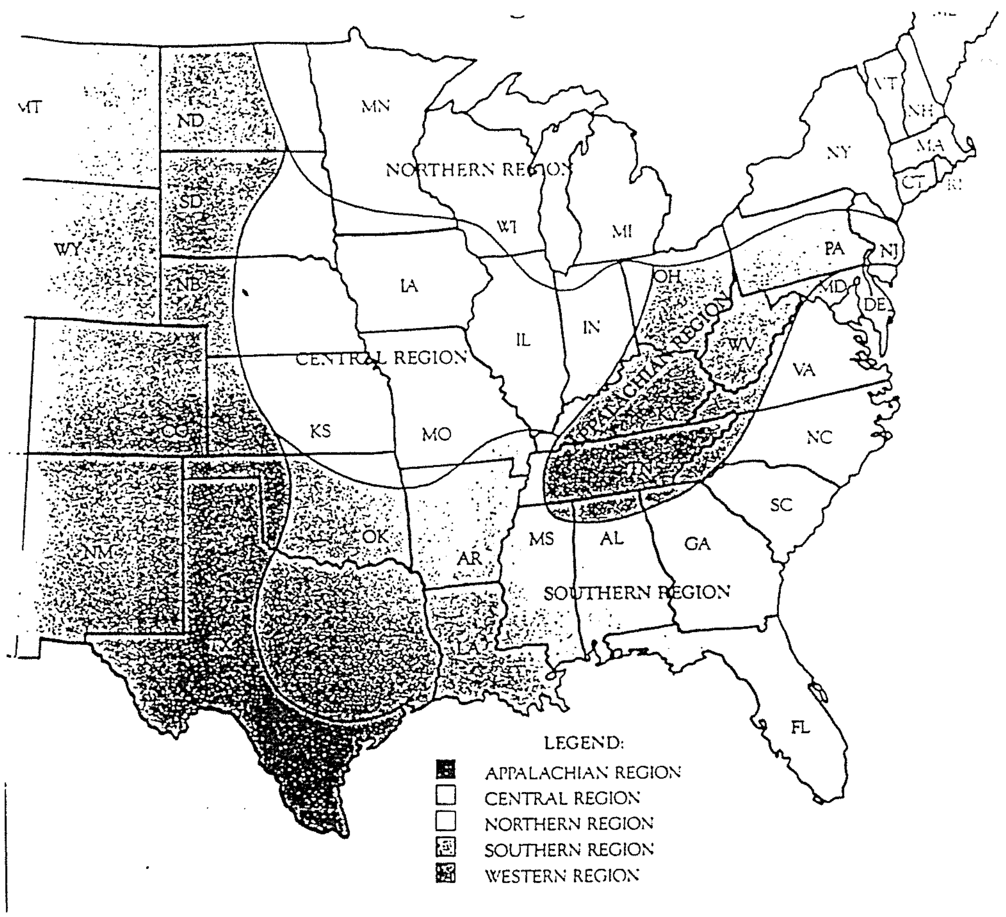
The Eastern (or Northern) forests comprise the highest quality resource.It is in the mountainous Appalachian area between New York state and Northern Georgia. These forests are above the 330m altitude contour and represent 15% of the hardwood forest land area and furnish 20% of the hardwood timber production. The species are mainly oak hickory and ash.

2. The Central Hardwood Forests:

Stretch West to the great plains East to the Appalachian foothills and from the great lakes South into Tennessee. The forests are generally in the river valleys rolling up into the foothills. These forests are of lower site quality and stocking, growing oak, sugar maple, yellow poplar, white ash basswood and hickory.

3. The Southern Forest:

South of the central area and comprising most of the South Eastern states along the Atlantic coast to Maryland, up the Mississippi to Illinois and west as far as Texas. These forests contain oak, gum, cottonwood, hickory, pecan, and willow. Some of this forest is of very low quality being natural regrowth from several rounds of selective cutting and abandoned cotton land, with hardwood being pushed out by softwood regeneration after clearing.



Commercial Forest Areas of the
Eastern United States

Table 01

APPALACHIAN AREA COMMERCIAL FOREST LAND OWNERSHIP

Ownership (1000 Ha.)	Area	%
National Forest	2519	4.5
Other Federal	797	1.4
State & local	1938	3.4
Forest Industry	5621	10.1
Other Private	44634	80.4
	------	-----
Total	55109	99.8

Table 02

THE EASTERN HARDWOOD RESOURCE LOG VOLUMES

(Billion cubic meters (10^9) log volume)

	All hardwoods	All Select Export Species
Northern States	1185	530
Southern States	1348	281
	------	------
	2533	811

Table 03

ESTIMATED QUALITY OF EASTERN SELECT EXPORT SPECIES

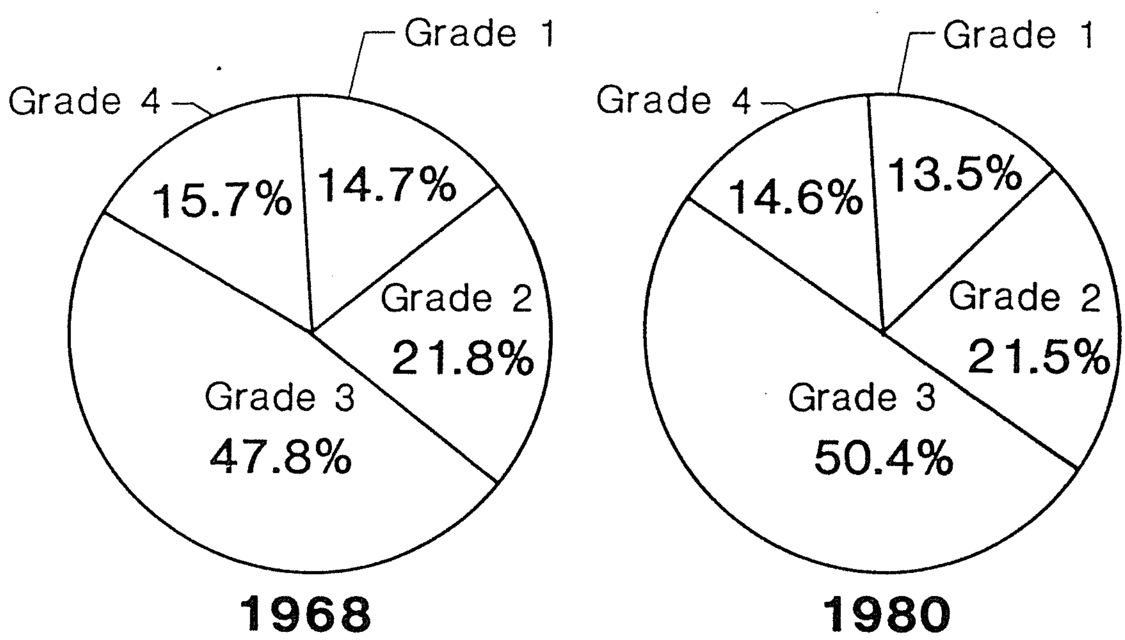
	% in each log grade			% in each lumber grade			
	1	2	3&4	FAS	1C	2C	<2C
All select	15	24	61	12	23	27	38
Select Oaks	15	24	61	12	24	27	37

(See appendix 02 for log and timber grade descriptions)

Wood quality estimates show that in 1983 for the 17 Eastern States 33% of hardwood logs were in log grade 1 or 2, and 67% were grades 3 and 4. The overall inventory of hardwoods in the Eastern United States shows that there are some 557 thousand cubic meters (1976) available. Projections show that growth will exceed removals until the year 2020 when the stock will be 940 thousand cubic meters or twice the 1952 level.

Figure 02

CHANGES IN HARDWOOD SAWTIMBER QUALITY DISTRIBUTION



SECTION 3 – HARDWOOD PRODUCTS

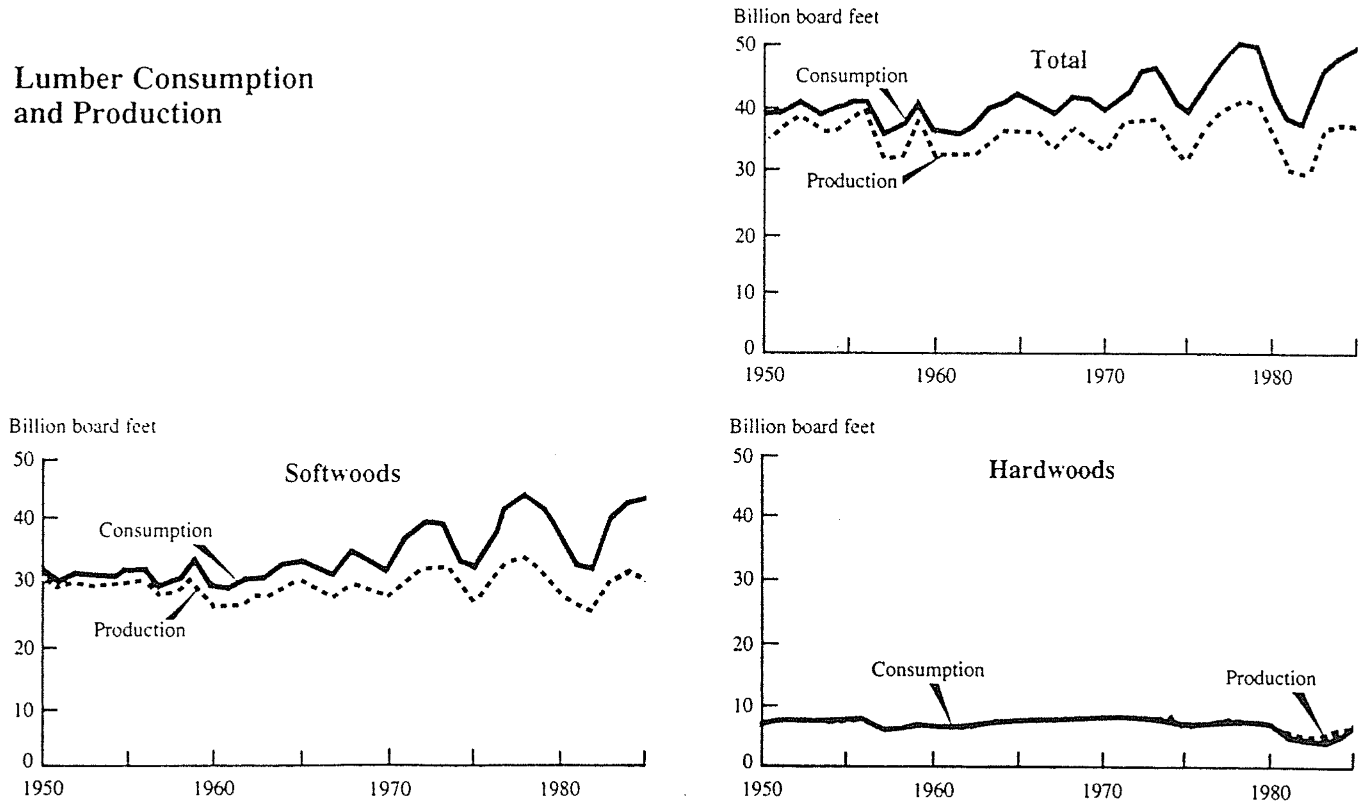
3.1 HARDWOOD PRODUCT MARKETS

Current hardwood product statistics are not very easy to obtain in the United States. The United States Department of Agriculture, through the Forest Service Department has regularly published a ten year summary, the last being for 1977 and another probably due out soon for 1988. Various workers in the field have produced more recent figures, but because they have been obtained from different sources, there are some discrepencies between production and consumption figures.

Total hardwood production in 1987 was around 18 million cubic meters of lumber. The largest proportion of this went into materials handling products predominately pallet manufacture, with furniture as the next biggest market.

Figure 03

LUMBER CONSUMPTION AND PRODUCTION



Source: U.S. Timber Production, Consumption 1950-1985 USDA FS Publication 1453

Figure 04

MARKET SHARES FOR HARDWOOD LUMBER (1980)

Market	Consumption (%)
Shipping and Materials handling	37.89
Furniture	26.9
Mines and ties	15.2
Construction	6.7
Miscellaneous	9.1
Export	4.3

The overall growth of the industry has been relatively slow over the last few years with an increase in rate of around 0.5% per annum (table 04)

Table 04

PRINCIPAL USERS OF HARDWOOD 1946 - 1977
(million cubic meters of lumber)

Year	Container & Dunnage	Pallets	Furniture Fixtures	Other Manufacture	Total
1946	3.42	0.26	3.66	1.75	9.09
1960	2.59	2.41	4.06	1.63	10.6
1965	1.14	2.52	5.19	1.46	11.86
1977	1.25	5.35	4.41	0.90	11.91

Although the growth in hardwood usage has been only slow, the use to which the material has been put has changed. There has been a major increase in the volume used for pallet manufacture.

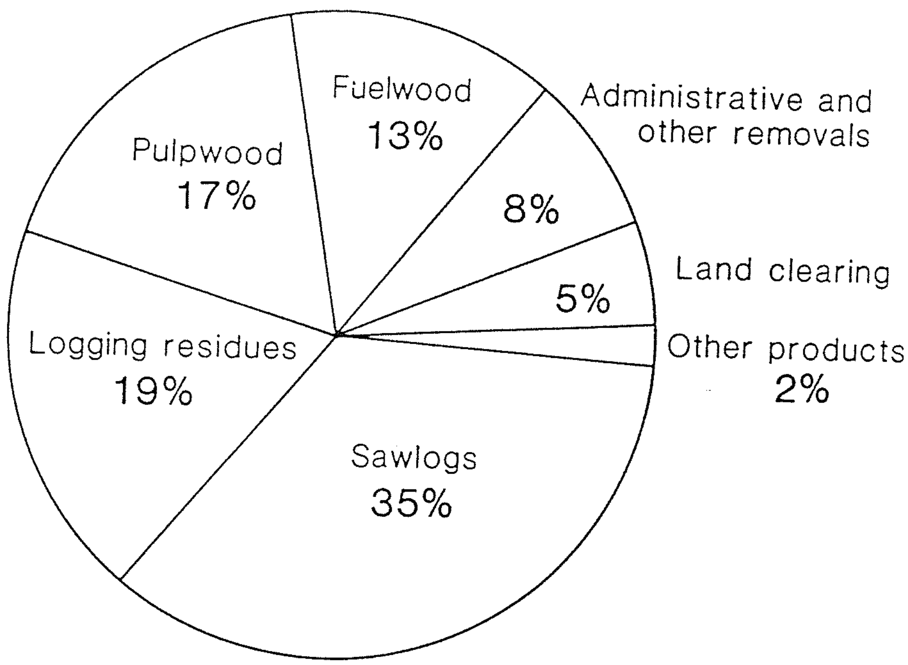
3.2 HARDWOOD PRODUCTS

3.21 Paper Board and Wood Pulp

Although hardwoods are generally considered as a high value resource, it should be borne in mind that in the East some 50% of all wood leaves the forest for pulp purposes. In 1985 the total production of paper and board products was some 34 million tonnes. In the Southern States there has been a marked decline in hardwood timber production over the last decade. In 1976 around 50% of the logs left the forest as saw or veneer logs. Now virtually all the hardwood trees are mechanically harvested from mixed softwood and hardwood stands for shipment by road or rail to to pulp plants. In the North where log qualities are generally higher, solid wood products dominate.

Figure 04

TIMBER REMOVALS FROM GROWING STOCK NEW YORK STATE 1979)



3.22 Plywood and Veneer

Although the production of plywood in the United States has steadily increased, hardwood plywood production has dropped markedly since the early seventies, the shortfall being taken over by softwood. (Table 05).

Most of the hardwood plywood goes into mobile homes, millwork, (mouldings etc.) kitchen cabinets and domestic furniture. Some 0.67 million cubic meters of hardwood veneer (70% of the total) were used in 1977.Its use is declining at the expense of softwood veneer.

Table 05

PLYWOOD PRODUCTION

(million cubic meters)

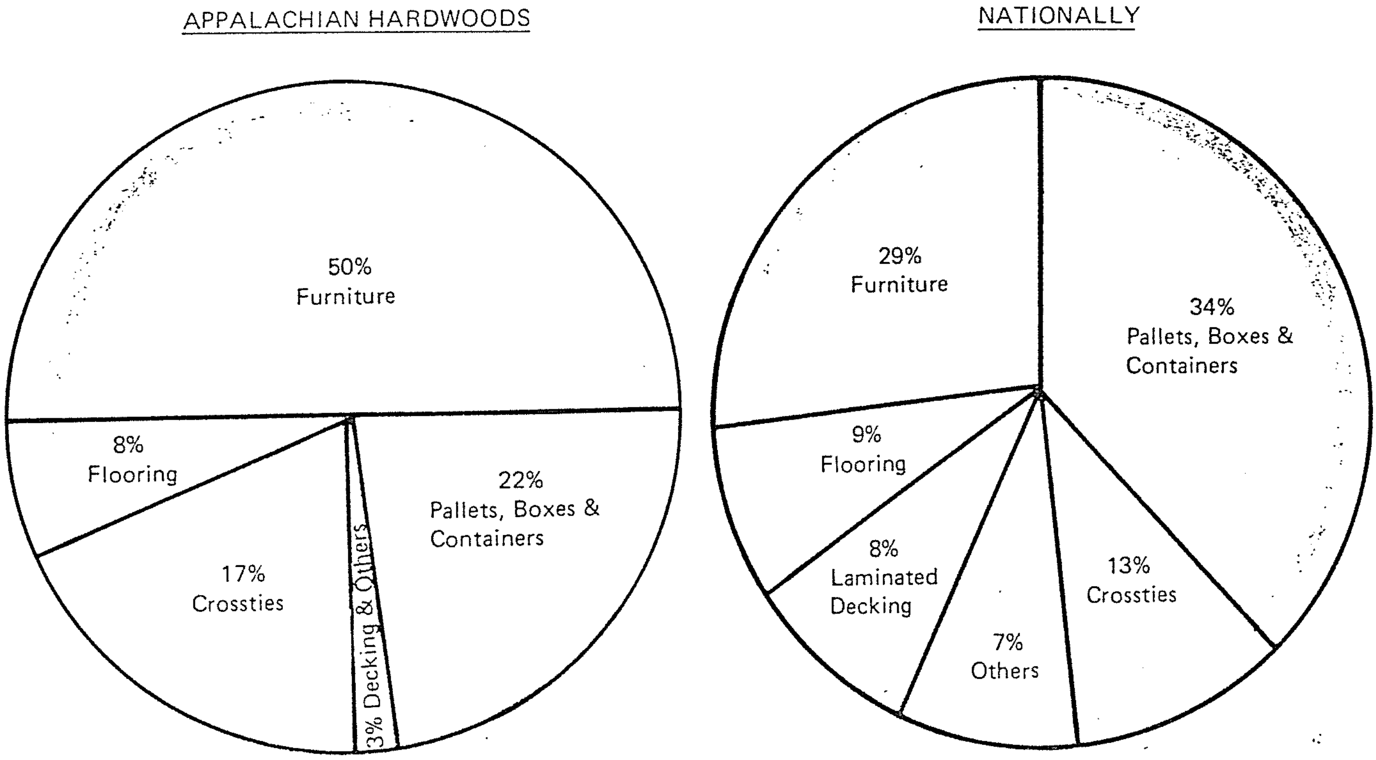
Year	Hardwood	Softwood	Total
1960	0.98	6.87	7.84
1970	1.60	12.52	14.11
1980	0.92	13.70	14.62
1985	0.73	17.00	17.73

3.23 Lumber and Sawn Wood Products

Timber in the solid form is used for a large variety of products, most of them familiar to Australian producers, however the mix of end uses is quite different to our hardwood industry. (figure 06)

Figure 06

SAWN HARDWOODS ESTIMATE OF MAJOR END USES (1976)



3.24 Furniture

Furniture is a a major user of hardwood and consumption has been relatively stable. Although nationally some one quarter of sawn hardwood goes into furniture the higher quality Appalachian areas produce a much higher ratio of better grade timbers with as much as half the output going into furniture.

In 1982 some 3.9 million cubic meters of hardwood lumber went into the furniture industry, and this represented around 60% of the total sawn wood used.

The furniture industry is critical to the hardwood market, because not only is it the second largest user of hardwood timber, but it also uses the highest grades and therefore values of timber.

The wooden household furniture segment is the largest single user of high quality hardwood lumber (and veneer) usually using mainly first and seconds grades or number one common and better. (see appendix 02 Grading Rules) Since these higher grades of timber go for high prices the furniture industry is very important economically to the hardwood lumber market.

In furniture production over the last twenty years the use of hardwood lumber has dropped by 18% veneer by 38% and plywood by 30% to be largely taken up by an increase in the use of composite panels of some 73% and softwood timber by

70%. Recent data shows a levelling off in the use of composites and an increase in hardwood timber usage particularly in domestic furniture.

Furniture as the main consumer of quality sawn timber has shown a remarkable stability in the market despite a number of economic cycles, and although household furniture has shown almost no growth over the past twenty years, commercial furniture has almost doubled (to 1982). The industry has suffered losses to imports particularly as return of exported timber in the form of furniture from Asia, and the substitution of non wood or composite panel products. There does however, seem to be some evidence of a resurgence of demand for quality local production.

3.25 Pallets and Packaging

Pallets are the dominant users of hardwood in terms of volume, and it is similar to the the furniture industry in that it is not one industry but several industries each producing a different but related product. Pallets and containers used some 12 million cubic meters of hardwood timber in 1982, which represents a 66% increase in the last twenty years. The growth in the pallet industry has been remarkable, and it is interesting to note that despite enormous gains in the efficiency of the amount of timber used per pallet, there have still been large gains in the quantity of timber used used. (Table 06, Figure 07) The growth in hardwood materials is increasing faster than that of softwoods.

Table 06a

PALLET PRODUCTION 1948 - 1985.

Year	Number of Pallets (Mill.)	Lumber used (Mil.cub.m.)
1948	9	.53
1980	250	8.40
1985	450	10.08

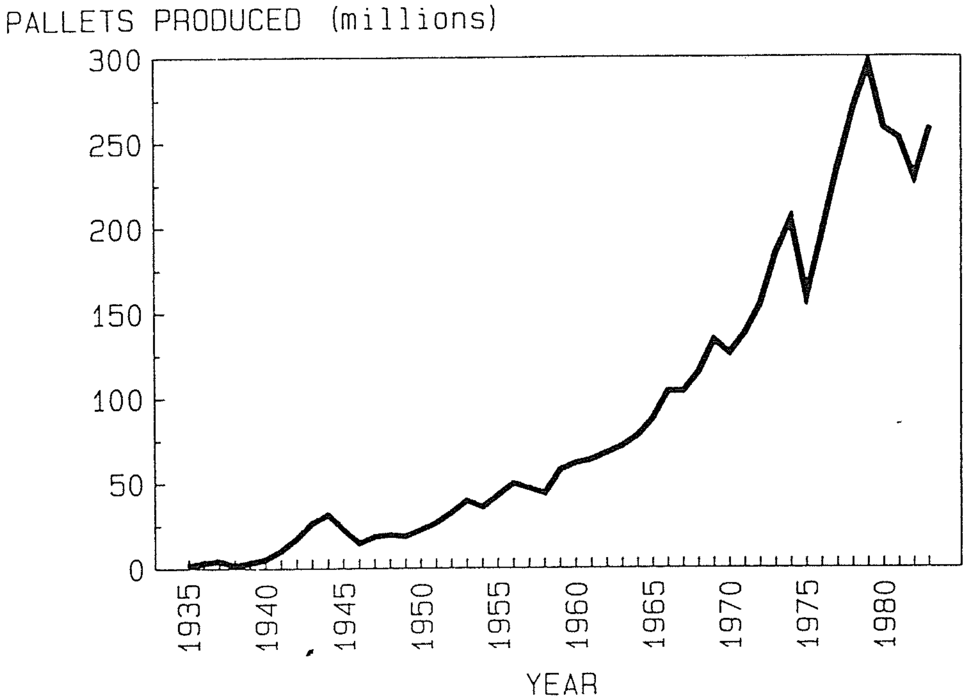
Table 06b

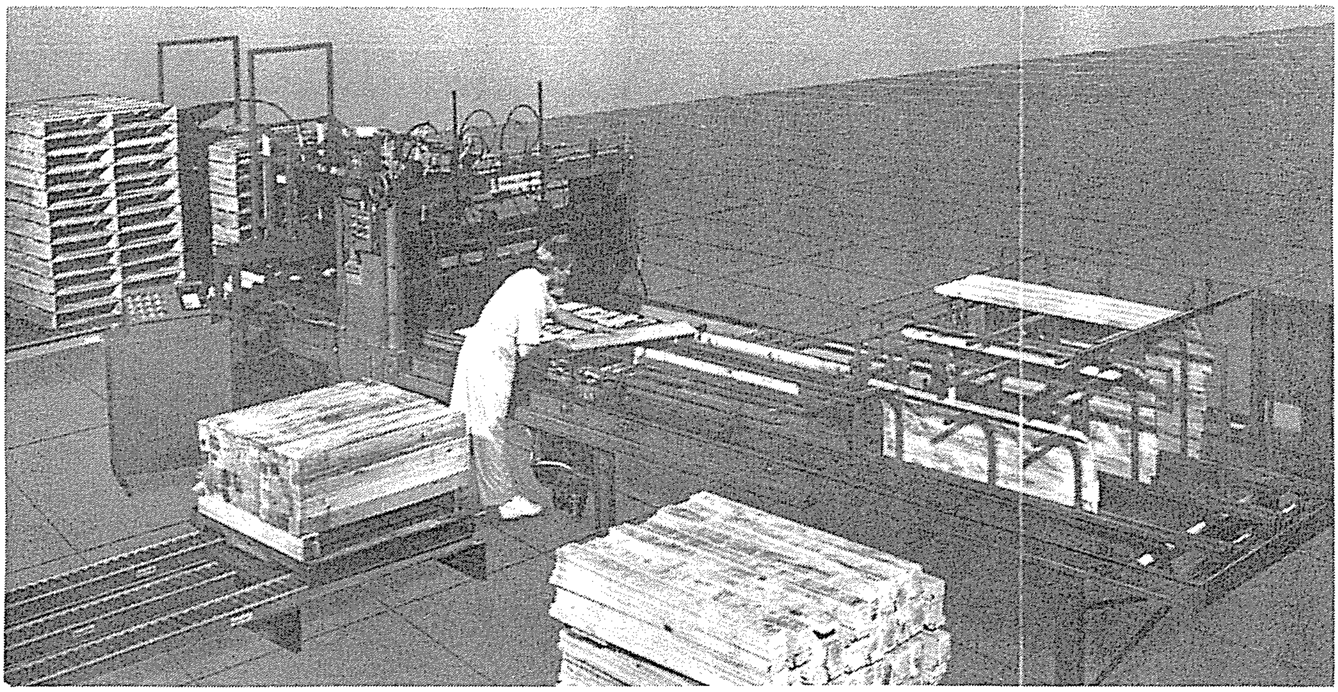
DECREASING VOLUME OF LUMBER PER PALLET

Year	Volume per Pallet (m3)
1948	0.067
1960	0.061
1965	0.054
1977	0.041
1982	0.032

Figure 06

PALLET PRODUCTION TO 1980





One Man Automated Pallet Production

3.26 Flooring and Mouldings

Hardwood flooring has been a cyclical user of lumber since the sixties. Changes in fashion and floor coverings brought about a dramatic fall in the use of timber as a flooring material as well as its use in other architectural mouldings. Since 1980 however, the volume of lumber used by the flooring industry has more than doubled. In 1980 only 0.24 million cubic meters of hardwood flooring were produced in the United states. By 1987 this had climbed to approximately 0.64 million cubic meters.

3.27 Dimension Lumber and standard Sized Hardwood Blanks

There is some confusion of terms in the North American market about "dimension lumber". It can refer to dimension lumber as a raw dry sized board or be more specific as "dimension product" being a further processed stage, and finally as "dimension parts" which are specific smaller sizes for particular end uses. "Standard dimension blanks" are a further refinement of prefinished timbers.

Hardwood dimension lumber is timber with a nominal thickness of more than 50mm but less than 100mm and a nominal width of 50mm or more. (Lumber less than 50mm thick is usually refered to as boards) Hardwood dimension products are normally kiln dried and processed to the point where maximum waste has been left at the mill and the pieces are of specific sizes, and lengths for maximum utility to the end user. They may be solid or glued up as specified.

Hardwood blanks are remanufactured wood parts that have been edge glued together to form a larger panel or sometimes finger jointed to increase length. The panels may be made up of a number of random width or pre-determined and uniform sized peices of wood. The production of blanks in standard sizes is a relatively new concept with a number of advantages for hardwood lumber users. Blanks upgrade lower value timbers and minimise wastage.

Some 52% of the timber produced falls into these dimension categories, and in 1982 the the value of products was around 442.2 million dollars (US). The largest user of dimension type products is the household furniture industry, and although because of foreign competition, the share of the market has dropped from 70% in 1975, it still uses around 50% of all shipments. The next largest use of dimension timber would be in the production of cabinets.

3.28 The Do-It-Yourself Market

The DIY market is a large potential buyer of dimensioned blanks. Display stands are set up in many retail hardware/timber outlets offering a variety of widths in lengths from 900 to 1800mm, mainly 20mm thick. The wood is of very high quality, surfaced on four sides with at least two clear faces, and retails around $US 2500 per cubic meter for red oak. The estimated growth potential for the market is 144% p.a. with a retail value in 1986 of $US 362M

SECTION 4

THE PRODUCTION OF SOLID TIMBER PRODUCTS.

4.1 FOREST PRACTICES.

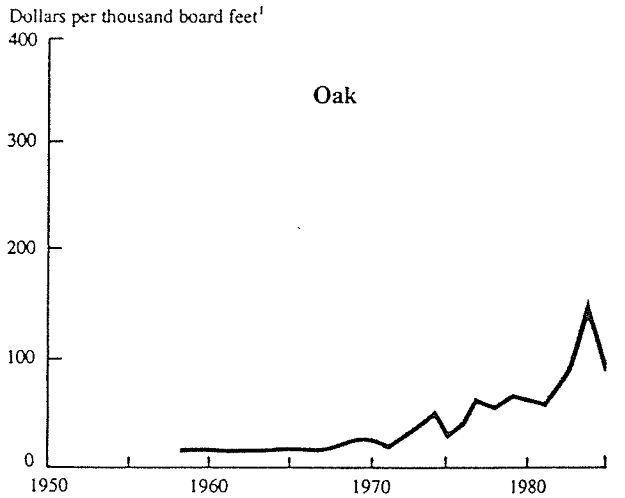
there are many factors in the harvesting of these North American hardwoods that can bear comparisons being drawn between their industry and ours. Although the deciduous forests are of course physically quite different, many of the problems we have in access, variation in terrain and quality, escalating logging costs and stumpage rates were all too often voiced in the logging areas visited.

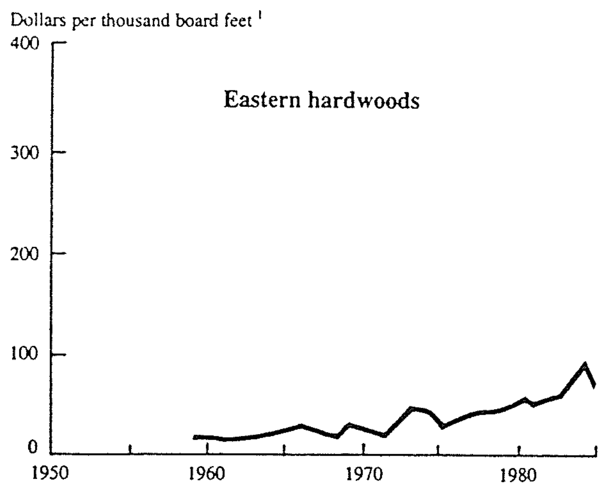
The most obvious difference, and that which probably has the greatest effect on the subsequent value and processing of the forest resource is the matter of land ownership and the competitive bidding system for most of the resource. High value logs are accorded appropriate prices, and the fact of private ownership increases competition among bidders. Although log quality varies enormously with site, most of the logs (around 75%) would be considered of low quality ranging between 250mm and 600mm diameter.

In the period from 1970 to 1978 stumpage prices for mixed hardwoods on a national basis rose by 36%. By the last quarter in 1985 the stumpage price for all Eastern hardwoods was averaging $18.00 (US) per cubic meter, while the more highly valued oaks reached as high as $41.67 in early 1984, they had settled to around $21.58.

Figure 07

NATIONAL FOREST SAWTIMBER
STUMPAGE PRICES
(From US Timber Production, Trade, and
Price Statistics 1950-1958)





The large proportion of private ownership of land has led to some marked differences in the way forests are managed. Despite denials private ownership probably decreases log costs as management and environmental practices proscribed for public lands cannot be enforced to the same degree as on our department lands here. In the lower value areas (particularly the Southern states) virtually no management takes place. Logs are sold to the highest bidder often largely as a pulp resource with some sawlog salvage. Regrowth is often natural regeneration with in many cases pine taking advantage of the cleared land to become the dominant species. In the higher valued Northern areas natural regrowth still favours the hardwoods and although there is still only minimal management of private acrerage the forests are generally maintaining quality although the species mix tends to change. New York State as an example of a quality forest area has some six million hectares of commercial forest land which is 51% of the land area. Some 13% of this is in public or industry hands, and has some of the best forest areas, the rest is distributed among 450,000 private land owners. The majority of these own less than 3.6 hectares each, which leads to a difficult situation for implementing management practices.

Harvesting is generally more mechanised than in Australia with the smaller trees in the Southern regions being exclusively mechanically harvested. More generous log length transport allowances permit whole tree trucking in some cases which can mean more efficient utilisation and sorting at the mill.

4.2 SAWMILLING

In general a hardwood sawmill on the East coast of the United States would not be a big surprise for an Australian hardwood sawmiller. A typical mill would have a sawn throughput of ten to twenty thousand cubic meters of log per year. A circular headrig for breaking down followed by a twin edger and gang saw. (usually fixed arbour multi circular saws) Timber is docked in lengths up to around 9.6m. The mill will usually have a debarker - Rosser head or ring type - and a chipper to handle waste. Many still have no kiln facilities with some mills having a small dehumidifier for higher quality products. their main product outurn is 25mm red oak and is often marketed through through a broker or direct to a furniture manufacturer or pallet producer for further processing. In round terms he will produce around 12% of his stock graded as first and seconds, (FAS) for which he gets about $US350.00 per cubic meter green or $450.00 dry. 25% of product would number one commons worth around $200.00 green or $300.00 dry. the rest of his output (typically 50%) would be no.2 and 3A commons, pallet and flooring.

A more detailed description of some different sawmilling practices wil be found later in this report.

4.3 SEASONING

Most of the East coast hard-hardwoods (those over 600kg per cubic meter dry) are similar in their drying characteristics to our easier to dry hardwoods such as blackwood or the denser mature eucalypts.

The most common method of seasoning particularly for the oaks is some form of predrying followed by kiln drying. Predrying is often air drying for a period of around 100 to 180 days to get the initial moisture content down from the green value of around 100% to 25+%.The air drying is sometimes carried out in open air drying yards, especially in the warmer climed Southern states, but is often done under shelter in a shed, sometimes in partially enclosed buildings with large fans in one wall to promote air flow. As an illustration of the similarity of problems between the two countries, it was noticed that in some of these forced air dryers the drying was too rapid especially in the summer months, resulting in surface checking. The solution was to place stacks of very green timber on the apron in front of the shed and allow the moist air to be drawn over the material inside. Predriers or large low temperature kilns seem to be becoming more accepted and were common in the colder northern areas where outdoor drying times were prolonged. Predryers were usually very large a capacity of over 5000 cubic meters was not unusual. They were usually loaded by fork lift rather than being tracked and had a mixture of species and moisture contents within the kiln.

Drying kilns were generally conventional, steam heated with internal fan forced circulation. They were more usually package loaded rather tha tracked systems. Some were direct fired, and a few had supplemental steam or water spray for humidification particularly where wood was being dried from green. almost invariably they had reasonably good control system with quite a few of the larger installations having fully microprocessor controlled systems. Dehumidifiers either electric or worked as gas fired heat pumps were quite popular in mills were dried lumber output was not large.

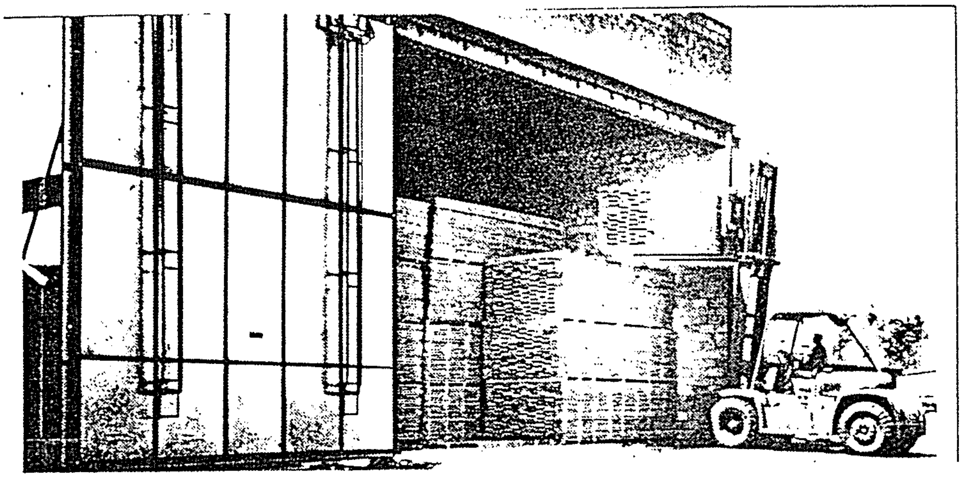
4.4 QUALITY CONTROL

Hardwood mills in the United States vary in capital investment, management practices and commitment to quality control much as they do in Australia. However, in most of the medium to moderately large mills there was a a serious attitude towards ensuring that the material was optimally processed with a view to the final product.

Generally there was a keen interest in quality control at each stage of processing. This was reflected in management by having someone in an executive position being responsible for supervision of the running of the plant, and the relative high level of training of at least senior operators in the different areas.

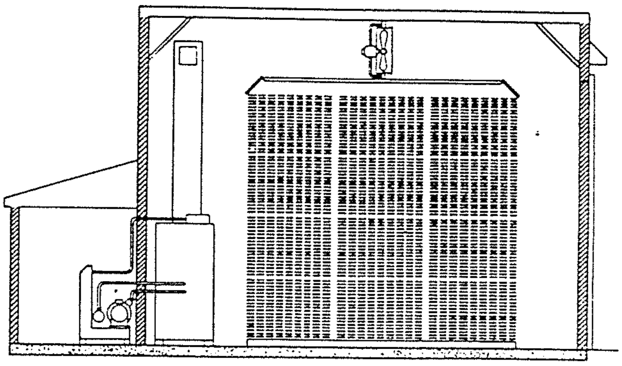
Quality control was a seen as a vital part of the drive for hardwood exports, this was reflected in the work of both the hardwood regional organisations and the National Hardwood Lumber Association in stressing the consistent quality of their product.

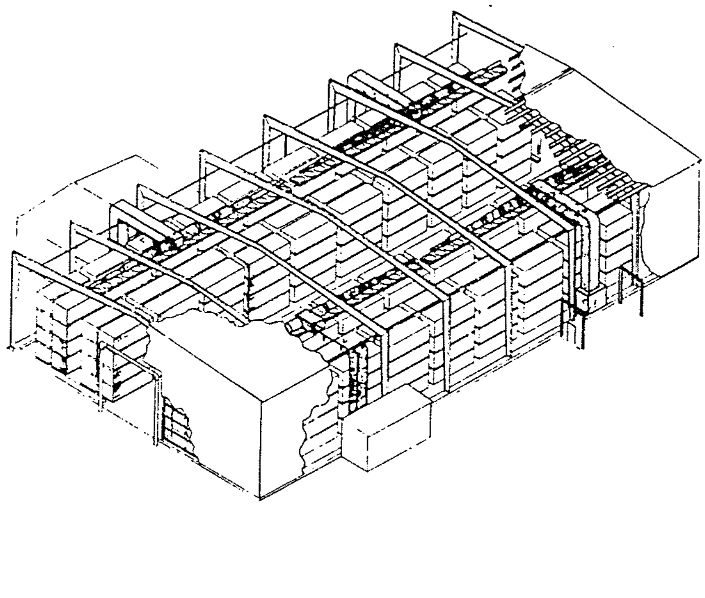
Courses for managemnent and operators for most aspects of quality control in sawmills were provided by a number of organisations. In particular the Virginia Polytechnic Institute in Blacksburg, the University of North Carolina in Raleigh and the USDA Forest Product Laboratory in Madison provided specialist services and extension progams either as a consultant to the particular organisation or as periodic open seminars.



Loading Wharehouse Type Drying Kiln

Wharehouse Type Dehumidification Kiln





Large Predrying Kiln With Centre Aisle

SECTION 5
MARKETING AND RESEARCH

5.1 INDUSTRY BASED ORGANISATIONS

There are some thirty or so industry based organisations with involvment in the American hardwood industry. Many of these are regional and specialist bodies dealing with small sectors of their own markets. (Refer Appendix 03 Industry Organisations.)

Of the various bodies, these major organisations represent much of the activities of the hardwood industry:

5.11 The National Hardwood Lumber Association.

This national body has some similarity to our state based timber promotion bodies in that it has the task of representing and promoting the use of hardwoods in many applications as well as setting the recognised industry standards for quality.

The Association covers the Hardwood Manufacturers Association which represents more or less the primary (sawmillers) end of the industry, and the Hardwood Research Council. The organisation operates out of its headquarters in Memphis Tennessee, with an administrative office downtown and a complex on the outskirts of the city which serves as the office for the Research Council and the centre for educational services.

Membership of the Association stands at around 1200 who pay subscriptions ranging from $US500 to a maximum of $2200 dependent on sales volume and number of branches. The Association provides an extensive membership directory which is available to interested parties.

Through the Hardwood Institute the Association promotes the use of hardwood timber in domestic and commercial construction and furnishings. A curent promotion has hired an advertising agency to mount a national campaign to demonstrate hardwood applications to consumers and simplify their means of access to supplies. There is a strong emphasis on export markets.

Educational services provide seminars on on manufacturing, marketing and kiln drying.They provide training for timber graders from short courses to inspector levels.

The Hardwood Research Council is an educational and scientific body which does not carry out research as such but provides an information and referral service for the industry.

The Association provides an inspection service for the grading of lumber. Grading inspectors can be hired to provide a consultant grading service or to arbitrate disputes. The service graded some 126000 cubic meters in 1987.

5.12 The Appalachian Hardwood Manufacturers Inc

The Association of Appalachian Hardwood Manufacturers Inc. operates from an office in High Point North Carolina. This city is the hub of the hardwood furniture industry and provides the venue for several huge annual furniture expositions. This organisation represents the producers of hardwoods from the Appalachian area and actively promotes timber from the Appalachian Area as the best available quality with a strong emphasis on furnishing applications.

5.13 The Lumber Manufacturers Association Of Virginia

This organisation is based in Sandston Virginia and is again a privately supported association of individuals, firms, and corporations with an interest in the local industry, providing a communication service to the public and its members, it organises the biennial East Coast Sawmill and Logging Exposition which is one of the largest such shows in the country.

5.14 The National Dimension Manufacturers Association

This organisation is based in Marietta Georgia and represents those manufacturers that produce a further processed product in dried sawn timber, whether it be as accuately sawn timber boards or semi and prefinished component parts.

A large part of their work is in establishing appropriate standards and the inspection of hardwood products as well as the development of the dimension manufacturing industry. The NDMA represents some 87 manufacturers, mostly in the Appalachian area and the Eastern half of the United States.

Typical products from dimension manufacturers include edge glued panels, solid and laminated squares, stair parts, draw fronts and turnings. they are not competing with finished furniture but are rather producing component parts, and would like to see a change of term from "dimension" to "wood component products".

5.2 RESEARCH BASED ORGANISATIONS

Research in the hardwood area is primarily carried out by the United States Department of Agriculture Forest Service (USDAFS) laboratories, and a number of Universities in the area. These organisations provide both a research base for the industry and a heavy orientation towards extension (education/technology transfer) work in the areas of plant development, economics, quality control and marketing. I was fortunate in being able to visit a number of the USDAFS research stations as well as the Forest products Laboratory in Madison Wisconson, and the forest products departments of the universities of New York, Virginia and North Carolina. A short summary of the work being in each of these organisations follows:

5.21 USDA Forest Service Research Laboratories

The USDAFS is divided into 10 regions. The Eastern regions are involved in the utilisation of the hardwood resource. The Headquarters for the Eastern Region (mainly administrative) are in Milwaukee Wis.. The main research field stations working in hardwood utilisation are:

The North East Forest Experimental Station in Broomhall West Virginia.

Most of the work here is associated with forest growth, modelling and harvesting practices. There is not a lot of product improvement work at this station.

The Forestry Sciences Laboratory at Princeton in West Virginia.
(Formerly the Forest Products Marketing Laboratory.)

Changes in Forest service research priorities have meant the downgrading of some of the product and marketing research programs that have come from this laboratory in the past. There are however still a number of research areas that are directly relevant to the Australian hardwood industry.

The development of the system 6 concept to produce standard sized blanks for the furniture industry from low grade hardwoods was developed here. (see appendix 04 system 6). Although system 6 as a packaged technology has not taken off in the United States some variations of its concepts are most certainly working in mills producing dimensioned parts and one of these will be described later. System 6 is based on the the principle of gang sawing cants from small (200-300mm) diameter logs of short length (1.2-1.5m). These short boards are dried and then gang sawn and docked as a cross cut as a dry product to provide clear material for edge gluing or component manufacture. The system probably never achieved much popularity because at the time it was produced green chain production methods were slow and not very automated. Modern optimisation and automated docking equipment could make the process viable.

The laboratory is doing quite a lot of work on sawmilling systems and the recovery of product from small short logs. an interesting development is dramatic increase in recovery that can be obtained for clear board recovery from sprung boards or bent logs by docking to shorter lengths before ripping. The work is associated with that done to determine timber face areas and length requirements for use in a furniture/cabinet manufacture plant. Results indicate that a surprising amount of very short clear material is used in production.Programs suitable for use in a personal computer are available for costing and developing the system six and standard blanks type of technology (BLANKS), as well as for various sawmill production and design parameters (DESIM and SOLVE II) (Appendix 04).

Product development work is concentrated in the areas of pallet manufacture and flooring systems. There were some interesting composite floors that used short downgraded material to make composite flooring strips, prefinished tongue and grooved ready for laying on top of an existing floor substrate. There was a large market for hardwood parquet flooring and one form of this which could suit the material to come from small regrowth logs was manufactured by ripping 25mm backsawn boards into 25mm strips then making the (now) quartersawn surface the face and glueing into 100mm squares then assembling into 300 mm blocks for laying.

The ten year forest industry statistics summary originates mainly from this laboratory and it was hoped that the 1988 summary would be available next year.

The Southeast Experimental Station Athens Georgia

Concentrates its work on forest pathology and recovery of products from the very low quality mixed hardwood forests in the area. Most of the resource here goes for pulp and solid wood recovery is a salvage operation and usually very small scale. There is some encouragement to use hardwood especially yellow poplar for construction but it seems to meet a lot of consumer resistance when its competitors are more appealing.

COMPLY a composite plywood structural beam originated from research done by staff here, and although a plant was set up to manufacture this efficient truss systems, it has not done well, and it is suggested that it has been down marketed to compete with spruce as a cheap building product rather than as a well designed component which could command a surchage.

The Forest Products Laboratory Madison Wisconson

Operates as a national wood research laboratory with a wide range of interests in the utilisation of wood.

The laboratory has set out out a range of its its priority technology transfer projects for this coming year, and a detailed explanation of the ones most relevant to this report appear in appendix 05 (forest Products Laboratory research.) The projects from the Wood Products and Process and Protection Research Groups which are given the highest level of emphasis are:

(1) Improvements in engineering design

(2) Production of a new "Wood Handbook" (complete)

(3) Wood frame house construction

(4) Moisture in buildings

(5) Timber bridges

(6) Steam injection pressing (composite boards)

(7) Dry kiln operators manual (update)

(8) Finishing wood exteriors

(9) PROFIT system (compilation of computer optimising programs in the utilisation industry)

The research at this laboratory that appeared to me to be of primary interest to the Australian industry were those sectors that were becoming increasingly involved with projects involving the utilisation of eucalypts in less developed countries. A workshop on growth stress in tropical countries with particular emphasis on South American eucalypts had recently been conducted, and a manual was in the process of publication which included suggested kiln drying schedules for fast grown Eucalypts.

The disappointing aspect of this program was to see how little impact Australian research on our native species had made in this laboratory. They had very little knowledge of the work that has been done in Australia on conversion of of our hardwoods in terms of coping with the difficulties in sawing and drying our refactory timbers.

Research into aspects of "wet wood" which is bacterially infected wood of higher than normal moisture content very prone to subsequent collapse and collapse checking on drying could prove to have some relevance to our own drying problems. It seems that the infection can among other effects cause normally permeable wood to become refactory and the ensuing problems in removing large quantities of moisture from a wet, structurally weak wood bear more than a passing resemblance to the problems encountered in drying some Eucalypts.

5.22 University Based research Organisations

The State University of New York (SUNY)

In Syracuse, the school of Environmental Science and Forestry contains a Department of Wood Products Engineering and carries out its work in the Baker Forest Products laboratory. In the recent past, a great deal of hardwood research both theoretical and product oriented has come from this laboratory, but it seems to have become a victim of New York City's insatiable appetite for state funds, and there have been substantial staff cuts. With the retirement of Assistant Professor Burry there is now no extension work officially carried out from this department. The two main areas of active research were firstly a new project looking at hardwood drying at moderate to high temperature parameters, and possibly including using radio frequency/vacuum drying, and some timber engineering work looking at performance of wood structures under live loads.

The University of Virginia and Polytechnic Institute (VPI) in Blacksburg

Was one of the most exciting places to visit in terms of ongoing research into wood products and as a model for service provided to industry.

VPI has gathered together a team of experts on campus in a number of fields of timber utilisation, including some eminent people who are based there from the Forest Service or have contracts for specific work programs.

Appendix 06 (VPI research Programs) details some of the current projects in Blacksburg.

Areas of particular relevance to this report were in the production of dimension parts from low value resource, forest economics and development, pallet design and possibly most important of all a very effective extension program servicing the state's industry.

The University of North Carolina in Raleigh

A strong forest products program, with some basic research in wood drying parameters in particular and an effective extension program providing a wide range of services to the industry made this a very effective research unit.

The drying work involved the development of a computer modelled family of simulations of moisture sorption. It appears to be a valuable contribution to the control of kiln drying rates because it relies on a fairly easily measured parameter - that of drying rate - to enable calculations of moisture gradients within a specific kiln charge.(Dr. C.Arthur Hart A Family of Simulations of Moisture Sortion in Wood available from NCSU)

A strong working group was involved with marketing and analysis of products research in the hardwood area with emphasis on pallet production and industry cost control. The group ran a number of quality control programs for specific sectors of the industry. these were very well documented and well attended.

The department had a video production capability and a subscription scheme to make available to the industry regular presentations of various topics from lumber yield improvement to furniture finishing. (see apendix 07 NCSU Wood Industry Video Series.) The cost of most of these 30 - 60 minute videos was around $US100.00 and the clips that I viewed from a selection of them showed that some would be applicable to our industry here, especially in the quality control areas. (It must be remembered that the VHS format of these tapes would require translation to bring them to Australian television standards.)

SECTION 6

THE HARDWOOD INDUSTRY
A SAMPLE

6.1 WHEN YOU ARE BIG - THE CONVENTIONAL VIEW

The Baille Lumber Company Hamburg New York

This is one of the larger hardwood timber specialists in the country. They have five locations throughout New York, Pennsylvania and Kentucky. their business is the wharehousing and sawmilling of hardwood timber. They ship approximately 180,000 cubic meters per year and produce around 30,000 cubic meters of sawn hardwood per year at the Hamburg plant. This mill produced mainly sawn dried dimension lumber in one and two commons. It had extensive drying facilities, 5,000 cubic meters kiln capacity and some 7,500 cubic meters in predriers. The mill was a large conventional sawmill producing what appeared to be quality boards from a large resource. The company view expressed by President Don L. Mayer was that there did not seem to be to be much point in further processing as most of their market wanted 1C and 2C boards with some clear grade. The pricing structure of timber did not encourage the investment required to produce different products, and as a large exporter to Europe with some Pacific and Asian penetration a smaller range of products seemed more appropriate. In terms of recovery products such as lamination or edge gluing of dimension parts stock, he felt that the consumer would always prefer the the solid timber product and his company would continue to produce this unless market presssures changed.

6.2 THE MAJORITY - THREE VIRGINIA SAWMILLS

Georgia Pacific Timber Inc. Buena Vista

A moderate sized mill producing around 10,000 cubic meters of sawn product annually. A 2.1m band breakdown saw was followed by a twin saw edger for the wings a single band resaw for producing cants and a multi circular blade resaw. The mill had kiln drying capacity with a dehumidifier in which most timber was dried after air drying to around 40% moisture content. Product outurn was in mining timbers and hardwood timber grades. this mill had recently undergone management changes and was in the process of updating some antiquated sawing equipment and improving its level of quality control particularly in the area of seasoning.

Neffs Timber Mill Broadway.

This company was a family owned mill that had been that the mainstay of the small town for some generations. They produced some 10,000 cubic meters per annum of sawn timber, mainly oak in all grades. A circular breakdown saw cut mainly backsawn boards which were edged and ripped on a circular gangsaw to make stock for lumber or pallet. Timber was dried (with little evident degrade) in gas fired heat pump type dehumidifier kilns which seemed to be very efficient. A small two-man manual pallet operation producing around 250 pallets per day took care of a lot of the short waste material.

Augusta Lumber Company North Garden.

A somewhat larger mill producing around 25,000 cubic meters annually. A 1.8m bandsaw took care of the log breakdown operation again followed by a four saw edger with one-man operation to give edged ripped boards. the product run was sawn, dried timber in a range of grades and sizes, as well as pallet flitches. A large part of the mills inventory was in the reselling and trading of the log resource. The drying facilities were excellent. A pair of steam heated kilns had just been installed and these were run by fully automated Lignomat controls all computer operated and apparently working well.

6.3 SMALL LOG SALVAGE - PALLETS

The Gutchess Lumber Corporation Cortland New York

This was a fairly large mill with an export division. they cut up to 35,000 cubic meters annually from a diverse quality log supply of mainly oak. Logs were brought into the mill in long lengths, (up to 15m) and then stored sorted by species. Debarked logs (ring type debarker) are then sorted and graded for size and quality. The logs appeared to be of very variable quality ranging in diameter from 200 to 750mm many of them having very poor form and extensive decay. The larger logs went to a carriage bandsaw and were sawn for grade recovery. Smaller logs went to another similar green chain and were sawn primarily for pallet stock with any better boards being recovered back to the main line for drying. The small log line had a multi saw edger with one side indexed for the occasional grade board and the other for sizing pallet material. pallet material was further resawn on another multi saw, one side of which produced the stringers, the other side the boards. Pallets were produced from green material on automated machinery at the rate of around 800 per day.

The grade boards from the large log chain (and the salvage boards from the pallet mill) were rough graded green, end trimmed and drop sorted. the drop sorter was an ingeneous device using suspension belts which automatically rehung after the timber was dropped. Very neat packs of even length material were end coated and arranged on 22mm stickers. Timber was dried, occasionally from green or more usually after predrying in a large wharehouse type steam heated predrier with a capacity of around 2,400 cubic meters. The predryer was stocked with a mixture of species and thicknesses and stock taken out to be end-dried as required. Stock within the dryer and its condition was monitored by computerised records. Twelve kilns with a total capacity of 6200 cubic meters (six of these had just been commissioned) took care of the drying. the kilns were again of the compartment type fork lift loaded. The new kilns were fully automated with Lignomat controls. Drying for oak (25-

38mm) from green took around 120 days ramping the dry bulb temperature from 27 to 60°C with a starting wet bulb depression of 4°C. drying results appear to be excellent with virtually no apparent degrade. The dry boards were returned to the green mill were they were automatically destacked, graded, edge trimmed again and packed. The most common outurn was 1C and 2C boards which were shipped to domestic markets and exported to the Pacific Circle or Asia.

This operation appeared to be be very well run with well trained staff especially in the drying area and a history of continuing investment in plant and process.

6.4 SMALL LOG UPGRADE - DIMENSION PARTS

Fitzpatrick and Weller Inc. Ellicotville New York.

This sawmill is the result of an old family operation that diversified from the manufacture of wooden shoe lasts into a moderately large timber producer. They sell logs, lumber, dimension timber and parts throughout the United States, Canada, Europe and the Pacific Rim. their specialities are red oak, cherry and hard maple although other species are available. Their traditional historical product seems to be reflected in their manufacturing ethos that ensures no good wood goes to waste. The mill cuts around 70 cubic meters of per day using a carriage bandsaw for the larger logs with a bandsaw linebar resaw enabling green dimension cutting. After green grading, timber thicker than 50mm or those species which are difficult to dry are sent to a predryer. (capacity 2,400cu.m.) Other material goes direct to the kilns.(1200cu.m.) Grade timber is sold as such, and any dry timber which would not make 1C or 2C boards is sent to the dimension plant. The dimension plant (actually two separate plants) is most impressive. All clear timber down to 300mm length and 25mm width is utilised. Timber is ripped into 75-150mm widths in 25- 38mm thicknesses and docked into clear lengths. Strips are then edge glued into wider panels using a PVA based adhesive and dried on clamp carrier tables. these panels are cut to customer requirements to make items such as table tops, panel infills (a large order was then being made up for an export order to Italy for colour matched panels and styles for kitchen cabinet doors) and chair bases. Large section squares were made by gluing 25mm square strips together for items such as table legs. The furniture shop fitting and staircase trades were big customers. Panels and sections were all either four side squared or face sanded and appeared to be of excellent quality. In the dimension mill there were virtually no pieces of timber longer than 1.2m., very little was wasted. For a few specialist items such as bannister rails longer lengths were finger jointed. Optimising edgers, semi-automated sorters and a minimum number of stock sizes all helped flow through the mill. One plant produced dimension parts to specific order, while the other maintained a stock of parts which could be used for the order plant or sold to manufacturers for further processing.

6.5 INNOVATION - VACUUM RADIO FREQUENCY DRYING

Dimension Drying Inc. Bluefield Virginia.

This mill had a varied resource of mostly low quality logs 200 - 400mm diameter some very rough and quite a few rotten. They were mostly oak with a few cherry and poplar. any high quality peeler logs were sold, and the remainder cut into short lengths (1.2 - 2.4m) after debarking. A circular breakdown saw led to a gang saw where boards (generally 50mm thick) were ripped to width as required. Any wide clears were salvaged, the remainder were progressively ripped or docked to end up with clears in a small range of lengths down to about 450mm. The docking is done on a production line basis with the timber passing a line of a dozen dockers. the clear lengths are block stacked into neat even length packs, strapped with plastic tape and taken to the kilns. The kilns are large steel vacuum chambers (current models of stainless steel) The packs of wood are deadpacked onto a large steel plate (Negative ground plate and stacked up until about half the kiln height. The positive electrode plate is then placed on top and packing resumed. the other negative ground plate goes on the top of the finished stack. The entire charge is then rolled into the kiln on tracks. A partial vacuum is applied to lower the boiling point of water and drying proceeds with the radio frequency generator providing direct heating energy into the stack. The stack can be deadpacked because most of the drying takes place through the end grain of the boards, and of course there is no airflow through the kiln. Drying of 50mm squares of oak is acheived in three days at low temperatures. Basically the kiln conditions are set by the application of the vacuum, a high depression for initial rapid boil off of water ramping down to the end point which is determined by the slowing of the drying rate. Theoretically the wood should come out at around 5-6% moisture content. The kiln charges consisted of boards 25-50mm thick and up to 125mm wide (although the wider boards seemed to suffer from cupping) and squares to 100mm. The boards were removed from the kiln, the plastic tie tape around the packs has been designed to shrink with the boards and the packs were simply placed on pallets and shrink wrapped for shipment. Claims for the kiln suggest that at 300mHz power consumption is about 100KV. the throughput of the kilns was around 600+cu.m. per month.

The output from the kilns of 50mm oak squares (mainly 600mm long) and the 100mm squares of poplar did not seem to have any significant seasoning degrade. Some of the material was further reprocessed in the plant, mainly as turned handles and furniture parts, but most was shipped for manufacture.

The plant and its operation was most impressive, however there must be sounded a a word of warning. The process was relatively new and had not undergone a lot of rigorous scientific assessment and there was quite a lot of resistance among the research community. Radio frequency (RF) drying has a number of problems when it comes to drying wood especially refractory hardwoods. Collapse, checking and uneven moisture gradients occur. The results of a sample of West Australian jarrah put through one of these kilns a couple of years ago were disasterous. Although the company commissioned an energy report on the process by the State University of New York, the costs of the system are a matter for controversy.

Some further explanation of RF drying will be found in appendix 08 RF Drying

SECTION 7 OVERVIEW

If one were to look at the American hardwoods and ask what is the biggest single difference between their industry and ours, the glib answer would be the end product range. However although there is a big difference between our emphasis on hardwood as a construction medium and their almost total commitment to hardwood as an appearance grade material, it must be remembered in all that has gone before in this report and all that follows that there are vast differences in scale between the two countries. In 1985 the USA had some 86 million households, from a total population of over 230 million. Some 70 million people live in the Eastern hardwood areas and the four largest cities on the North East Atlantic coast account for a larger population than all of Australia. The factor of size is not presented as a barrier to bringing about change but it is a perspective that must be borne in mind.

If it were to be thought that there was some benefit to be gained by changing the emphasis of some of our own hardwood market from its uses primarily in the domestic construction and joinery industry to a product that is used for its appearance qualities, it would be useful to look at why the Americans have ended up with such a different attitude to their use of hardwood timber.

There is a historical difference between the development of the two countries that has led to a different attitude to the use of wood. Australia's history of early immigration, often enforced, and our large scale early clearing of forest lands for pastoral use, meant that our native forests had more nuisance value than aesthetic appreciation. There was a general hunger in Australia for things that envoked the mother country, our eucalypt forests were not the deciduous forests of Europe, the timber they produced was difficult to season, and work. It did not look the same in use. It is interesting that the only hardwood that was exploited (to the point of extinction) was red cedar probably because it was a more like a familiar product.

The Americans on the other hand came to a climate and environment not all that different to their origins especially in "New England". The trees, the woods, were more familiar, houses were readily built from stone. Furniture could be easily made from the local product. The American consumer seems to have a certain respect for wood as a fine material. We Australians treat wood as a utilitarian product, and in that attitude lies a lot of the difference between how our industries have grown.

There is a difference between our resource bases and because much more of our forest is concentrated in fewer and possibly more altruistic hands we do have a resource advantage in the management of our present and future forests.

The product that comes out of our forests has a lot of comparable features to the American hardwoods. We both suffer from a dwindling of the mature quality resource. Our hardwoods like theirs, are often harvested from difficult terrains, can have a lot of defect, and the industry has to cope with a much higher ratio of smaller, defective logs than ever before.

The conversion problems are also similar. Hardwood logs are often poor in form. Growth stresses can be a problem in both our countries. The product has a poor recovery of defect free material, and the market seems to want to pay premium rates only for clear wood. Seasoning of our timbers is basically similar. Their woods are refactory to some extent and there is a lot of variation in the seasoning properties even within a species. It is at this point that the differences begin to emerge.

In a state like Virginia which could be considered a moderate quality resource area, about half the timber leaving the forest winds up as chipped product, or logging residues. Of the rest, most of which is sawlog, about one third to a half winds up in furniture and about another third in the packaging industry mostly as pallets. Our situation is entirely different. statistics particularly of the furniture industry are hard to come by but, of the hardwood material taken from our forests (Victoria 1986) some 70% is sold as green scantling by our sawmilling industry, a proportion of the remainder is dried, and since only our sawmills have drying facilities it must be assumed that any furniture grade material comes from this proportion. If half of this were dried and all the dried material was of high grade, a reasonable figure including architectural joinery, mouldings, and furnishings would be that the industry uses uses 15% of outurn as higher value added dry timber. An estimate to the Victorian Timber Industry Inquiry in 1986 suggested that the furniture industry used some 9% of our timber supply, that presumably included softwoods and imports. This quantity was spread among some 780 furniture manufacturing firms in Victoria. A guess that less than 5% of our hardwood resource nationally ends up in furniture may not be too far wrong.

If as a speculation, it was thought to be worthwhile to move our industry into the production of more hardwood for the furniture industry, what is there in the American system that makes it so different from ours?

The production of hardwoods in the United States is not very different in essence. It is different in its application. at each step of the process there is a strong emphasis on quality. That is, quality of the process and the consequent quality of product. Logs are sorted and cut with the end product in mind. If most of your product is furniture you don't need long lengths. To handle the problems of volume throughput with small logs multi rip saws are used. These may have some limitations in the Australian context, although saw technology has improved since any serious work has been done in assessing these. Where log quality is such that you cannot get a reasonable product from using whole boards, the industry has realised that the value of the timber is such that all short lengths are usable and sizes can be made up by edge gluing, laminating and jointing.

Seasoning of the timber is recognised as a critical step in the quality control process. Kilns are generally well maintained. Their operators are trained often at some semi-professional level. They usually have a managerial role within the mill and access to further training through a number of good extension programs. Many also belong to "kiln clubs" to maintain contacts with others and keep up to date with developments. Those mills that do not have drying facilities cut their timber to the sizes and tolerances needed for drying - they know that virtually none of their product will be used green.

For many mills it has been realised that the more processing (and value adding) that is done in house the greater will be the control of quality of the finished product, and presumably the value.

The timber when it leaves the mill is graded to a completely different principle than ours. Our hardwood grading rules are based on timber for its strength requirements rather than its appearance characteristics as a finished product. Australian hardwood grading rules encourage the value concept of long clear lengths. American rules have a "shop cuttings" basis.

When you buy timber whether it is First Grade or 2 Commons you know that for a certain thickness and width of board you will be able to recover a minimum percentage of clear material. As you go up in grade it is the amount of "waste" (really lower grade) material that is decreasing, as are the number of "cuts" that you need to make to get your product. You have a fair idea in advance of what proportion of that material will go into the different needs of say furniture parts. The Nationasl Dimension Manufacturers promote the advantages of furniture and cabinet manufacturers discovering the advantages of purchasing their component parts from outside suppliers rather than trying to produce everything themselves - such as better control over costs, savings on transport and storage, reduced waste and a greater return on investment.

Assuming that we can produce a quality hardwood product, and we have the secondary industry capable of manufacturing furnishings from this, we have a ready opportunity to expand an underutilised market. We need to know what it takes to have a consumer buy a product that will invariably be dearer than the bottom line equivalent of softwood or composites. In The United states there is now a rising trend for the use of solid timber at the top end of the domestic furniture market, as well as the more expensive industrial/corporate furnishings and "luxury" timber products such as exposed architectural joinery and timber flooring.

Tradition and the scale of the industry as mentioned earlier aside, both wood and the finished product from it have a strong and cohesive marketing system behind them. for example the Appalachian Hardwood Manufacturers Inc. is in reality an association of sawmillers, but their main aim appears to be consumer oriented towards the people who will be using their products:-"solid Appalachian hardwoods assure a qualiy lifetime product....in quality and domestic furniture." The Australian attititude seems to be sawmillers promote wood! Furniture trades promote furniture! There seems to be a real marketing gap in the Australian industry in encouraging consumers to buy the premium product on its quality and value rather than price.

The role that current research plays in the American hardwood market is hard to assess. Although there was nothing startlingly new in any of the laboratories I visited, there was ongoing research into product refinement and development. Most of the major problems (except possibly the increasing awareness of "wetwood") had been solved with technical solutions. The real difference between research in the United States and Australia was probably in its application. There was a very strong emphasis in many of the universities and the larger laboratories of the need for "extension work". To get out into industry, translate the research results into practical processes and apply them. There was also as part of this a strong continuing industry association and teaching concept. Seminars in all areas of wood production were rgularly given, well produced and well attended by those who needed to go. At The Virginia Polytechnic University three of the full time staff of twelve were designated "extension specialists".

There is a lot that can be compared between the industries of the two nations. It was remarkable to me how familiar the environment of the hardwood industry seemed to be whenever I walked into a mill or research establishment. The resource and conversion problems, the competition with other materials, the under utilised potential of some of the wood, and the cost for dollar return were all much the same as in Australia. There was nearly always a big difference in scale of operation to what I had become used to, but for every large manufacturer, there were a number of smaller specialist processors that had carved themselves a niche in the market. These firms could use a resource that was not exploited fully or could turn out a product that no-one else had.

If I had to come to a single point of difference between the countries, that would bring about a change in our industry; it would be that the Americans always seemed to have a purpose in mind for the the wood that went into the sawmill. The product was in a sense predetermined, and only dependent on the lowest common demominator of resource quality. Every step in the process was to upgrade its value rather than maintain it or minimise degrade. All the other aspects of investment, quality control, education and marketing flow from this philosophy to produce not just timber, but a processed product to a practical standard aimed at a specific end-user.

This report was not intended to produce any easy solutions for any present or potential future problems in the hardwood industry especially in light of the decreasing quality and quantity of our resource. No single solution or even a combination of measures could suit a majority of members of our very diverse industry. What I hope to have shown is that there are a number of different paths that can be followed by particular organisations to meet specific needs in the market. However unless the industry can present a unified view of its intentions. Have an overall control of the quality standards of its products. Be able to specify and create new markets for higher value part processed materials by educating the potential consumer to the benefits of this "new" material. Change will only come about in a very slow and spasmodic manner.

APPENDIX 01 – TRAVEL ITINERARY

WEEK 1 April 25-29
State University of New York Syracuse campus.
USDA NE Forest Station Syracuse.
Gutchess Lumber Corporation Cortland New York

WEEK 2 May 2-6
USDAFS NE Forest Experimental Station Broomhall WV
USDA FS Forestry Sciences Laboratory Princeton WV
Dimension Drying Inc. Bluefield WV

WEEK 3 May 9-13
National Hardwood Associations Memphis TE
USDAFS South East Experimental Station Athens GA
Appalachian Manufacturers Inc. High Point NC

WEEK 4 May 16-20
Virginia Polytechnic Institute Blacksburg Va
Forest Industries Biennial Expo Richmond VA
VPI Seminar: Wood Drying Richmond VA

WEEK 5 May 23-27
Mill visits Virginia/North Carolina
University of North Carolina Raleigh NC

WEEK 6 May 30- June 3
USDAFS Forest Products Laboratory Madison WI

(1) TIMBER GRADING

STANDARD GRADES

Hardwood lumber grades are a means of measuring quality of lumber. They provide the buyer and seller with a "yardstick" for measuring quality and enable the purchaser to buy the grade or grades which best suit his needs.

With some exceptions hardwood lumber is graded on the basis of the size and number of cuttings (pieces) which can be obtained from a board when it is cut up and used in the manufacture of a hardwood product such as furniture, flooring, or interior house trim. Usually we are interested only in the clear material in a board so the best grade would have the largest area of usable material. When cut up for remanufacture nearly all of this best grade could be used in a small number of large-sized cuttings, while lower grade boards would produce several smaller-sized cuttings.

The standard grades of hardwood lumber are Firsts, Seconds, Selects, No. 1 Common, No. 2 Common, Sound Wormy, No. 3A Common and No. 3B Common. Lumber may be sold separately by each grade or in combination of grades. These combinations are:

F.A.S.—Firsts and Seconds are usually combined as one grade.

No. 1 Common and Better—The full run of the logs with all grades below No. 1 Common excluded.

No. 2 Common and Better—(Log Run)—The full run of the logs, excluding all grades below No. 2 Common as defined for the various species under "Standard Inspection."

No. 3B Common and Better (Mill Run)—The full run of the logs; below grade lumber excluded.

No. 3A Common and 3B Common may be combined as No. 3 Common and when so combined and specified shall be understood to include all the No. 3A Common that the logs produce.

Hardwood Grading Terms

Definition of Terms—Lumber grading cannot be understood or practiced until the individual knows and understands the terminology. The following are some basic definitions.

Board Foot—Bd. Ft. A board foot is the unit of measurement of lumber. A board foot is one foot long, one foot wide and one inch thick, or its equivalent. The formula for determining board feet in a board is:

1. Thickness in inches × width in inches × length in feet ÷ 12

EXAMPLES

1″ × 12″ × 12′ ÷ 12 = 12 bd. ft.
1″ × 6″ × 16′ ÷ 12 = 8 bd. ft.
2″ × 8″ × 12′ ÷ 12 = 16 bd. ft.

Surface Measure—S.M. The surface area of a board in square feet. To determine surface measure multiply the width of the board in inches and fractions by the length in feet, and divide the product by 12.

1. Width in inches × length in feet ÷ 12

EXAMPLES

6″ × 8′ ÷ 12 = 4 ft. surface measure
6″ × 12′ ÷ 12 = 6 ft. surface measure

Cutting: A portion of a board or plank that would be obtained by cross-cutting, ripping, or both. Diagonal cuttings are not permitted. Cuttings in the Common grades shall be flat enough to surface two sides to standard surface thickness after they have been removed from the board. In the grades of Firsts, Seconds and Selects, the board as a whole shall be sufficiently flat to permit surfacing to standard surface thickness.

Clear Face Cutting: A cutting having one clear face (ordinary season checks are admitted), and the reverse side sound as defined in Sound Cutting. The clear face of the cutting shall be on the poor side of the board, except when otherwise specified.

Sound Cutting: A cutting free from rot, pith, shake and wane. Texture is not considered. It will admit sound knots, bird pecks, stain, streaks, or their equivalent, season checks not materially impairing the strength of a cutting, pin, shot, and spot wormholes. Other holes ¼″ or larger are admitted, but shall be limited as follows: One ¼″ hole in average diameter in each cutting less than 12 units (144 square inches); two ¼″ holes or one ½″ hole to each 12 units (144 square inches) and on one side only of a cutting.

Cutting Unit Method: A cutting unit is 1″ wide and 1′ long. A square foot (144 square inches) of surface area would contain 12 cutting units. Cutting units are used in determining the grade of a board and are obtained by multiplying the width in inches and fractions thereof by the length in feet and fractions thereof. First and Seconds (FAS) require the greatest number of cutting units and 3B Common the least number of cutting units.

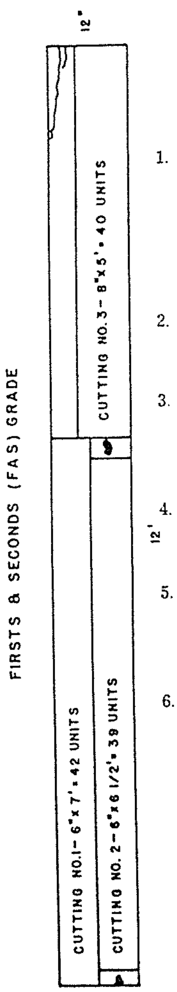
Lumber Thickness: Lumber 1″ and thicker may be expressed in quarter inches such as 1″—4/4; 1¼″—5/4; 1½″—6/4, etc.

CHART OF CUTTING REQUIREMENTS FOR STANDARD GRADES, EXCEPTIONS AND OTHER REQUIREMENTS ARE STATED UNDER CAPTIONS OF RESPECTIVE GRADES AND SPECIES IN THE RULES BOOK

FIRSTS	SECONDS	SELECTS	NO. 1 COMMON	NO. 2 COMMON
Widths: 6" and wider Lengths: 8 to 16 feet *S.M. % Cl. Face Cuts 4 to 9' 91-2/3 1 10 to 14' " 2 15' & up " 3	Widths: 6" and wider Lengths: 8 to 16 feet *S.M. % Cl. Face Cuts 4' & 5' 83-1/3 1 6' & 7' " 1 8' to 11' " 2 12' to 15' " 3 16' & up " 4 6' to 15' S. M. will admit 1 additional cut to yield 91-2/3% Cl. Face. **	Widths: 4" and wider Lengths: 6 to 16 feet *S.M. % Cl. Face Cuts 2' & 3' 91-2/3 1 Reverse side of cutting sound or reverse side of board not below No. 1 Common. 4' and over shall grade on one face as required in Seconds with reverse side of board not below No. 1 Common or reverse side of cuttings sound. See Rule (Par. 70) defining edges of boards 4" and 5" wide.	Widths: 3" and wider Lengths: 4 to 16 feet *S.M. % Cl. Face Cuts 1' Clear 2' 75 1 3' & 4' 66-2/3 1 5' to 7' " 2 8' to 10' " 3 11' to 13' " 4 14' & up " 5 3' to 7' S.M. will admit 1 additional cut to yield 75% Cl. Face.	Widths: 3" and wider Lengths: 4 to 16 feet *S.M. % Cl. Face Cuts 1' 66-2/3 1 2' & 3' 50 1 4' & 5' " 2 6' & 7' " 3 8' & 9' " 4 10' & 11' " 5 12' & 13' " 6 14' & up " 7 2' to 7' S.M. will admit 1 additional cut to yield 66-2/3 % Cl. Face.
Minimum cutting 4" x 5' or 3" x 7'			Minimum cutting 4" x 2' or 3" x 3'	Minimum cutting 3" x 2'

* Surface measure.

** Admits also, pieces 6" and wider of 6' to 12' surface measure that will yield 97% in two clear-face cuttings of any length, full width of the board.



FIRSTS & SECONDS (FAS) GRADE

1. Determine Surface Measure using lumber scale stick, or from formula:

   Width in inches × Length in feet / 12 = 12" × 12' / 12 = 12 sq. ft. S.M.

2. FAS is assumed grade of board. Percent of clear cutting area required for FAS—83 1/3%, or 10/12.

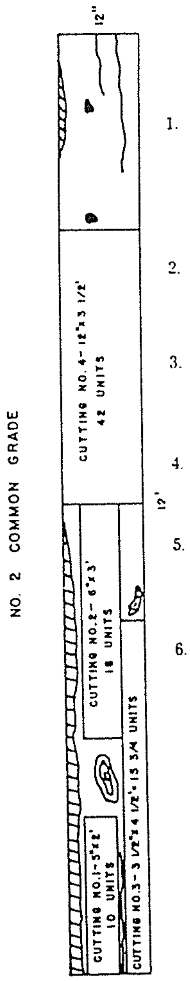
3. Determine number of cuttings permitted.
   For FAS grade—S.M. ÷ 4 = 12 ÷ 4 = 3 cuttings.

4. Determine minimum size of cuttings.
   For FAS Grade 4" × 5' or 3" × 7'.

5. Determine clear face cutting units needed.
   For FAS grade—S.M. × 10 = 12 × 10 = 120 units.

6. Determine total area of permitted clear-face cuttings in units.
   Width in inches and fractions of inches × Length in feet and fraction of feet.

   Cutting #1—6" × 7' = 42 units
   Cutting #2—6" × 6½' = 39 units
   Cutting #3—8" × 5' = 40 units
   Total Units 121
   Units required for FAS 120
   Board meets requirements for FAS Grade.



NO 2. COMMON GRADE

1. Determine Surface Measure using lumber scale stick, or from formula:

   Width in inches × Length in feet / 12 = 12" × 12' / 12 = 12 sq. ft. S.M.

2. No. 2 Common is assumed grade of board. Percent of clear-cutting area required for #2 Common—50%, or 6/12.

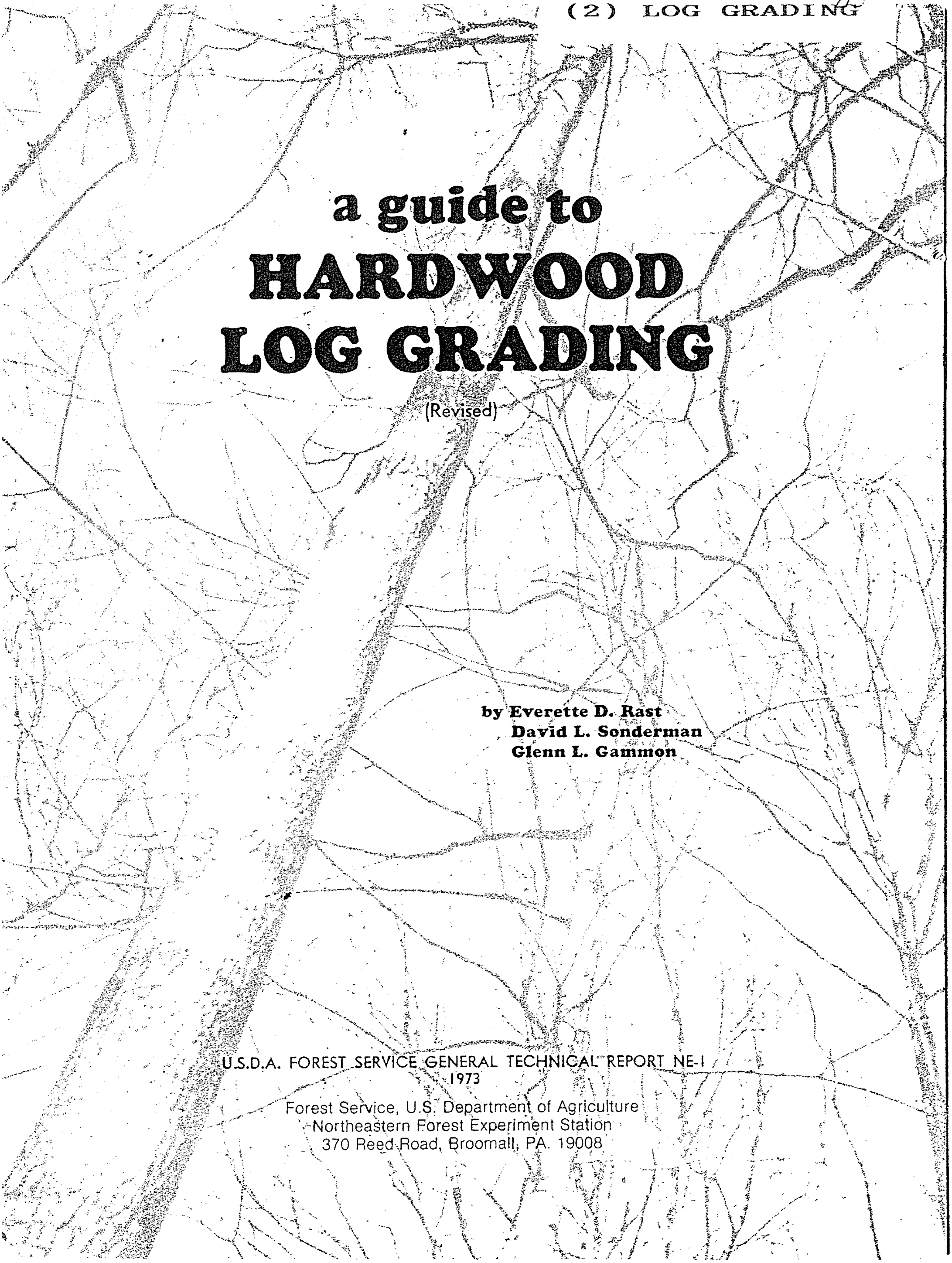
3. Determine number of cuttings permitted.
   For #2 Common Grade S.M. ÷ 2 = 12/2 = 6 cuttings.

4. Determine minimum size of cuttings.
   For # 2 Common Grade 3" × 2'.

5. Determine clear face cutting units needed.
   For #2 Common Grade S.M. × 6 = 12 × 6 = 72 units.

6. Determine total area of permitted clear-face cutting in units.
   Width in inches and fractions of inches × Length in feet and fractions of feet.

   Cutting #1—5" × 2' = 10 units
   Cutting #2—6" × 3' = 18 units
   Cutting #3—3½" × 4½' = 15¾ units
   Cutting #4—12" × 3½' = 42 units
   Total Units 85¾
   Units required for #2 Common 72
   Board meets requirements for #2 Common Grade.



a guide to HARDWOOD LOG GRADING

(Revised)

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Glenn L. Gammon

U.S.D.A. FOREST SERVICE GENERAL TECHNICAL REPORT NE-1
1973

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Northeastern Forest Experiment Station
370 Reed Road, Broomall, PA. 19008

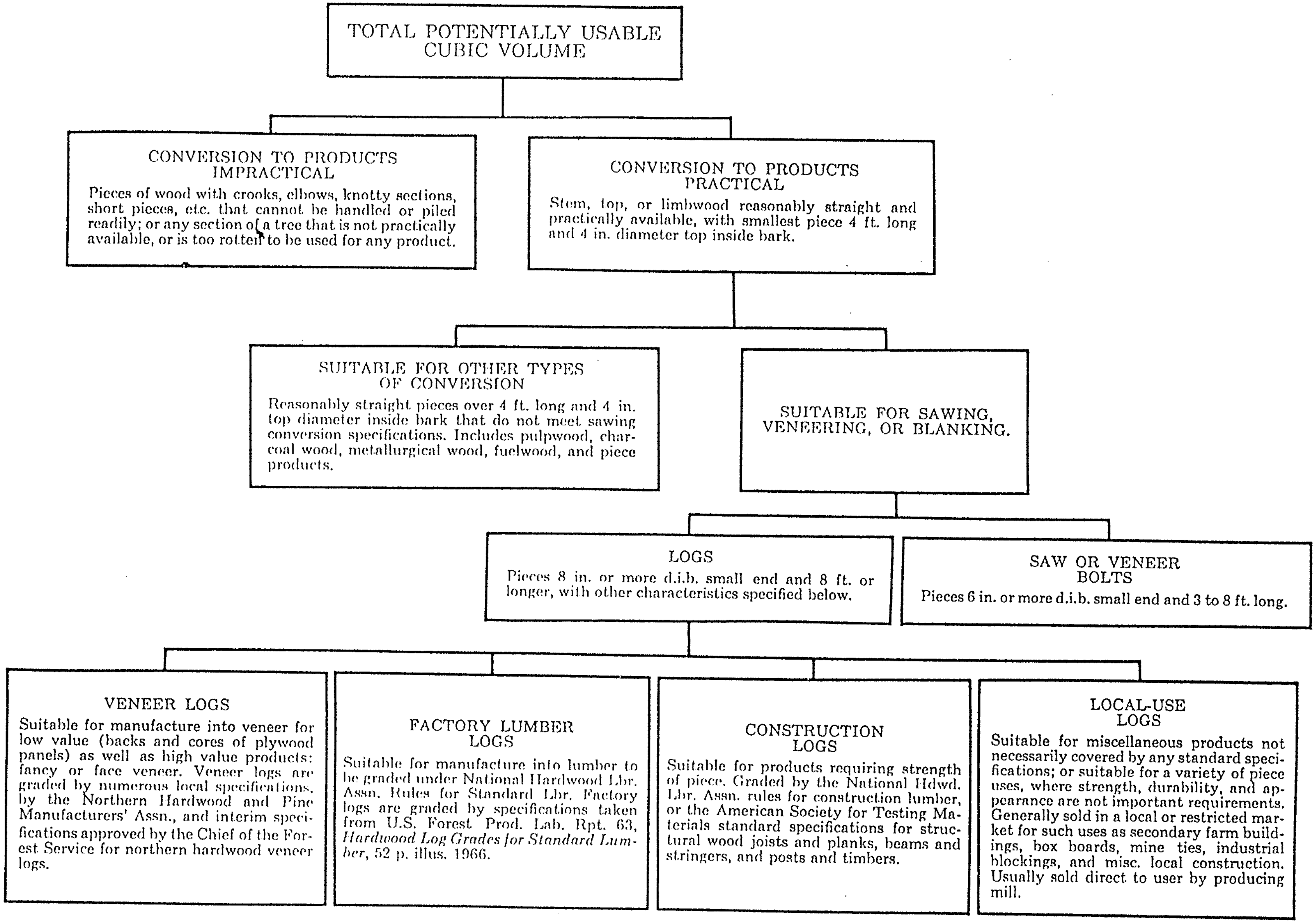


Figure 1.—The possible products obtainable from the total cubic volume in a hardwood tree.

FOREST SERVICE STANDARD GRADES FOR HARDWOOD FACTORY-LUMBER LOGS

The factory-lumber log class has been divided into three grades. The specifications for these grades (fig. 5) are closely correlated with the specifications for standard hardwood lumber grades, the grade of the log depending largely on the proportion of log length that is obtainable in clear cuttings (table 2).

The major factors that affect the quality of factory-lumber logs are: (1) position of log in tree (butt or upper); (2) size of log, especially diameter; (3) straightness; (4) amount and distribution of scalable defects; and (5)

Table 2.—Minimum length of clear cuttings by log length and proportion required

Log Length (feet)	5/6	3/4	2/3	1/2
	Feet and inches			
8	6′ 8″	6′ 0″	5′ 4″	4′ 0″
9	7′ 6″	6′ 9″	6′ 0″	4′ 6″
10	8′ 4″	7′ 6″	6′ 8″	5′ 0″
11	9′ 2″	8′ 3″	7′ 4″	5′ 6″
12	10′ 0″	9′ 0″	8′ 0″	6′ 0″
13	10′ 10″	9′ 9″	8′ 8″	6′ 6″
14	11′ 8″	10′ 6″	9′ 4″	7′ 0″
15	12′ 6″	11′ 3″	10′ 0″	7′ 6″
16	13′ 4″	12′ 0″	10′ 8″	8′ 0″

Figure 5.—Forest Service standard grades for hardwood factory lumber logs.[a]

Grading Factors		Log grades							
		F1			F2				F3
Position in tree		Butts only	Butts & uppers		Butts & uppers				Butts & uppers
Scaling diameter, inches		13-15[b]	16-19	20+	11+[c]	12+			8+
Length without trim, feet		10+			10+	8-9	10-11	12+	8+
Required clear cuttings[d] of each of 3 best faces[e]	Min. length, feet	7	5	3	3	3	3	3	2
	Max. number	2	2	2	2	2	2	3	No limit
	Min. proportion of log length required in clear cutting	5/6	5/6	5/6	2/3	3/4	2/3	2/3	1/2
Maximum sweep & crook allowance	For logs with less than ¼ of end in sound defects	15%			30%				50%
	For logs with more than ¼ of end in sound defects	10%			20%				35%
Maximum scaling deduction		40%[f]			50%[g]				50%
End defect:		See special instructions (page 18)							

[a] From USDA Forest Service Research Paper FPL-63 (*13*).
[b] Ash and basswood butts can be 12 inches if they otherwise meet requirements for small #1's.
[c] Ten-inch logs of all species can be #2 if they otherwise meet requirements for small #1's.
[d] A clear cutting is a portion of a face, extending the width of the face, that is free of defects.
[e] A face is ¼ of the surface of the log as divided lengthwise.
[f] Otherwise #1 logs with 41-60% deductions can be #2.
[g] Otherwise #2 logs with 51-60% deductions can be #3.

defects in the usable wood outside the heart center. *Heart center* is used in a restricted sense; it is a cylinder in the center of the log with a radius equal to one-fifth of the scaling diameter.

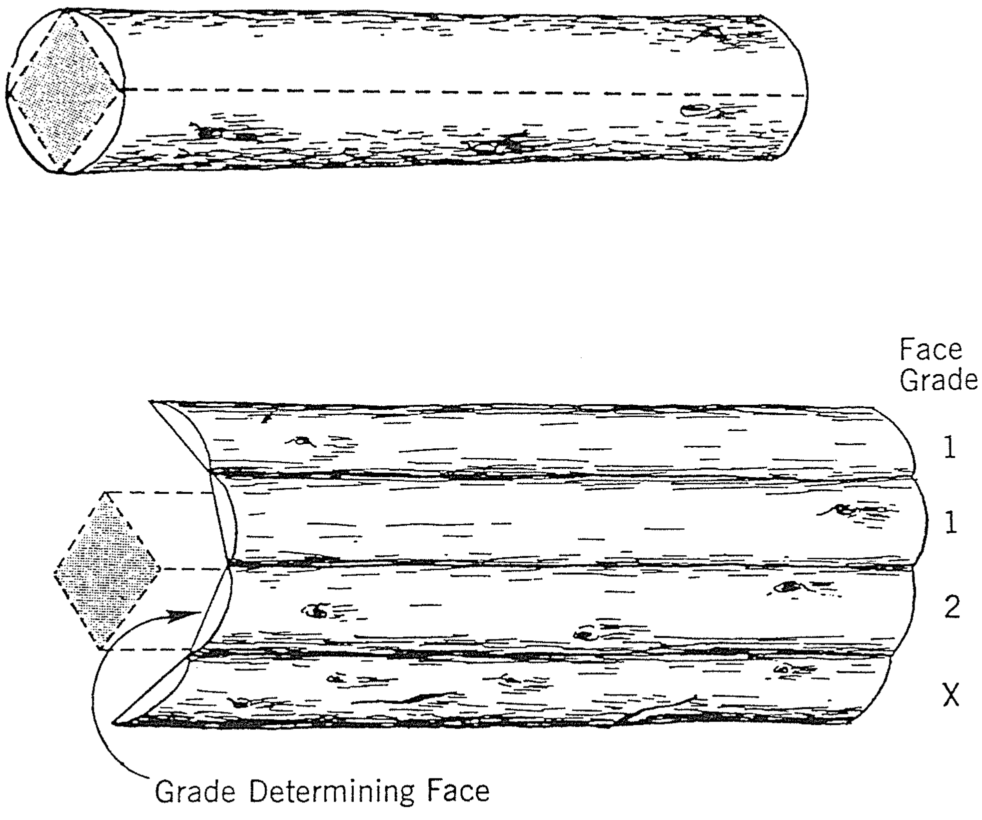
The Forest Service Standard Grades for Hardwood Factory Lumber Logs call for grading the three best faces. After taking into account the size and soundness of the log, the grader visually squares the log full length into four faces so oriented as to give the largest number of good faces. Each face is evaluated the same way a board would be evaluated, with the exception that rip and sound cuttings are not allowed; all cuttings must be clear and full width of face. The poorest face of the log is eliminated. The grade of the log is then determined by the poorest of the three remaining grading faces (fig. 6). In practice it is possible for a trained grader to pick out the controlling or grading face by a quick inspection only, and make the necessary measurements on this face.

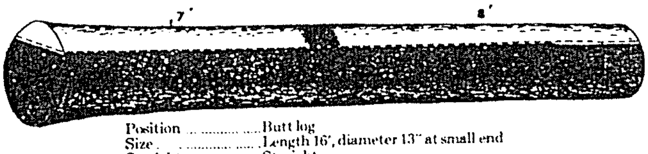
The major problem in grading factory-lumber logs is to locate clear cuttings. This requires the proper evaluation of surface indicators of defects. Branch stubs and knot overgrowths are clearly evident, so they present no problem. But the grader usually needs some training and experience to detect and evaluate accurately other less obvious indicators.

Once the faces have been graded, the log ends must be examined for grade defect indicators that may not show on the log surface. These are provided for by special instructions for evaluating end defects (page 18) and by the general restriction on the percentage of scaling deduction allowed in each grade. Minimum diameter, minimum length, maximum allowable sweep, and position of the log in the tree are also important grading factors. Examples of the three factory-lumber log grades are shown in figures 7, 8, and 9.

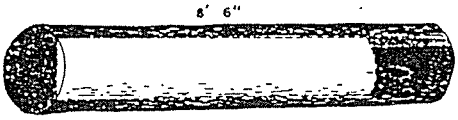
Lumber grade yields will vary by species and diameter within log grades. The yield of No. 1 Common and Better lumber for factory

Figure 6.—Selecting the grading face.

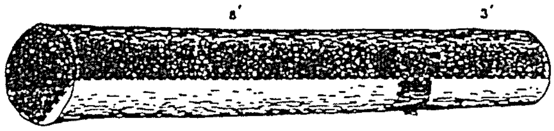




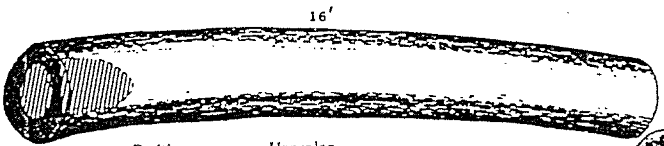
Position	Butt log
Size	Length 16', diameter 13" at small end
Straightness	Straight
Soundness	Sound
Cuttings	More than 5/6 of its grading-face length is clear in two sections 7 and 8 feet long



Position	Upper log
Size	Length 10', diameter 16" at small end
Straightness	Straight
Soundness	Sound
Cuttings	More than 5/6 of its grading-face length is clear in one section 8 feet 6 inches long



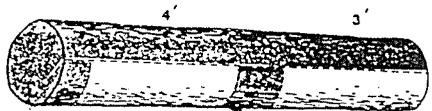
Position	Upper log
Size	Length 12', diameter 20" at small end
Straightness	Straight
Soundness	Sound
Cuttings	5/6 of its grading-face length is clear in two sections 8 and 3 feet long



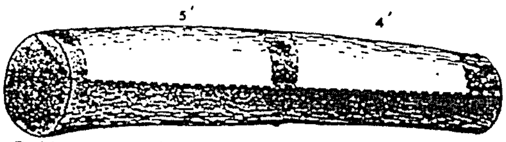
Position	Upper log
Size	Length 16', diameter 20" at small end
Straightness	10 percent deduction for 4" of absolute sweep
Soundness	5 percent deduction for center rot (sweep and rot deductions less than 40 percent maximum permitted)
Cuttings	One cutting 16'
Comments	Rot is confined to permissible rot zone and does not affect clear grading face

Figure 8.—Examples of hardwood factory grade 2 logs.

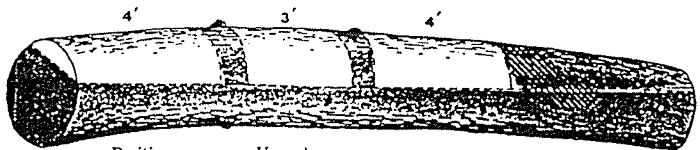
Position	Upper log
Size	Length 10', diameter 11" at small end
Straightness	Straight
Soundness	Sound
Cuttings	More than ⅔ of its grading-face length is clear in two sections each 4 feet long



Position	Upper log
Size	Length 9', diameter 12" at small end
Straightness	Straight
Soundness	Sound
Cuttings	More than ⅔ of its grading-face length is clear in two sections 4 and 3 feet long

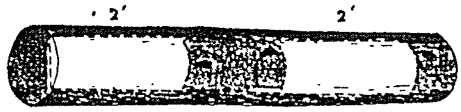


Position	Upper log
Size	Length 11', diameter 18" at small end
Straightness	Deduction of 28 percent for 6½ inches of absolute sweep (sweep less than 30 percent maximum allowance)
Soundness	Sound
Cuttings	More than ⅔ of its grading-face length is clear in two sections 5 and 4 feet long

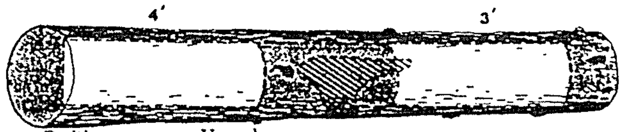


Position	Upper log
Size	Length 16', diameter 22" at small end
Straightness	9 percent deduction for 4 inches of absolute sweep
Soundness	20 percent deduction for rot (sweep and rot deductions less than 50 percent maximum permitted)
Cuttings	Rot limits cutting on grading face, but clear cuttings of 4, 3, and 4 feet give more than the required ⅔ of grading-face length

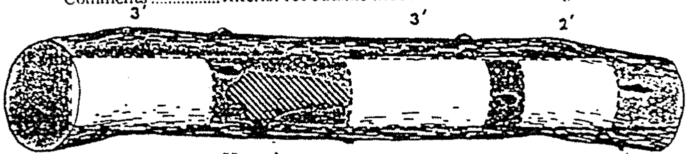
Figure 9.—Examples of hardwood factory grade 3 logs.



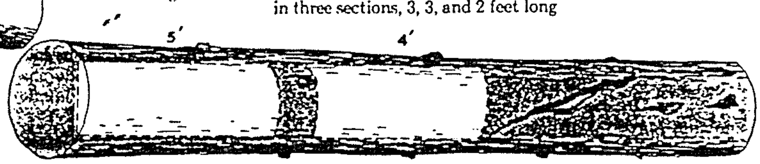
Position	Upper log
Size	Length 8', diameter 8" at small end
Straightness	Straight
Soundness	Sound
Cuttings	One-half of its grading-face length is clear in two sections, each 2 feet long



Position	Upper log
Size	Length 12', diameter 14" at small end
Straightness	Straight
Soundness	15 percent rot deduction (less than 50 percent maximum permitted)
Cuttings	More than ½ of its grading-face length is clear in two sections, 4 and 3 feet long
Comments	Interior rot outside the rot zone limits cuttings



Position	Upper log
Size	Length 14', diameter 22" at small end
Straightness	12 percent deduction for 6" x 3' of crook on both ends of log
Soundness	15 percent rot deduction (crook and rot less than 50 percent maximum deduction)
Cuttings	More than ½ of its grading-face length is clear in three sections, 3, 3, and 2 feet long



Position	Upper log
Size	Length 16', diameter 22" at small end
Straightness	Straight
Soundness	Sound
Cuttings	More than ½ of its grading-face length is clear in two sections, 5 and 4 feet long

Average stumpage prices for sawtimber sold from National Forests, by selected species, 1950-85 [Dollars per thousand board feet]

Year and quarter	Hardwoods: All eastern hardwoods[5/] Current dollars	Hardwoods: All eastern hardwoods[5/] 1967 dollars[6/]	Oak, white, red, and black[5/] Current dollars	Oak, white, red, and black[5/] 1967 dollars[6/]	Maple[5/] Current dollars	Maple[5/] 1967 dollars[6/]
1950	.....	.....	.....	.....	.....	.....
1951	.....	.....	.....	.....	.....	.....
1952	.....	.....	.....	.....	.....	.....
1953	.....	.....	.....	.....	.....	.....
1954	.....	.....	.....	.....	.....	.....
1955	.....	.....	.....	.....	.....	.....
1956	.....	.....	.....	.....	.....	.....
1957	.....	.....	.....	.....	.....	.....
1958	.....	.....	16.30	17.20	.....	.....
1959	21.10	22.30	21.40	22.60	31.90	33.60
1960	22.80	24.00	23.40	24.70	35.00	36.90
1961	18.00	19.00	15.70	16.60	26.80	28.40
1962	18.60	19.60	17.00	17.90	27.50	29.00
1963	21.50	22.80	15.70	16.60	35.30	37.40
1964	22.50	23.80	18.00	19.00	30.60	32.30
1965	25.00	25.90	21.30	22.00	31.90	33.00
1966	29.30	29.40	23.20	23.20	40.90	41.00
1967	27.00	27.00	16.80	16.80	46.80	46.80
1968	23.60	23.00	17.30	16.90	31.30	30.50
1969	30.20	28.40	28.20	26.50	41.10	38.60
1970	26.90	24.40	26.60	24.10	34.40	31.20
1971	24.60	21.60	21.20	18.60	37.80	33.20
1972	34.30	28.80	26.60	22.30	59.40	49.90
1973	46.00	34.10	43.60	32.40	71.40	53.00
1974	45.90	28.70	54.70	34.20	79.50	49.70
1975	33.90	19.40	29.70	17.00	39.60	22.60
1976	34.90	19.10	43.40	23.70	36.60	20.00
1977	37.90	19.50	60.00	30.90	42.10	21.70
1978	41.10	19.60	59.20	28.30	57.40	27.40
1979	46.80	19.90	68.80	29.20	33.90	14.40
1980	52.40	19.50	65.60	24.40	37.40	13.90
1981	50.90	17.30	63.20	21.50	41.50	14.10
1982	56.40	18.80	70.80	23.70	34.30	11.50
1983	60.10	19.80	87.90	29.00	25.00	8.20
1984	90.10	29.00	145.00	46.70	48.60	15.70
1st quarter	86.50	28.00	147.60	47.70	56.10	18.10
2d quarter	87.00	27.90	138.70	44.50	56.10	18.00
3d quarter	103.90	33.50	159.20	51.50	30.10	9.70
4th quarter	74.50	24.00	116.80	37.70	51.20	16.50
1985	65.40	21.20	94.50	30.60	56.20	18.20
1st quarter	67.40	21.80	106.50	34.50	67.50	21.80
2d quarter	74.60	24.10	106.80	34.50	66.40	21.50
3d quarter	57.60	18.70	84.60	27.50	17.60	5.70
4th quarter	62.70	20.30	75.10	24.30	23.50	7.60

4/ Pacific Northwest Region.
5/ Eastern and Southern Regions.
6/ Derived by dividing the price in current dollars by the Bureau of Labor Statistics producer price index for all commodities (1967=100).

NOTE: Forest Service National Forest prices in this table are for timber sold on a Scribner Decimal C log rule basis, except in the Northeastern States where International 1/4-inch log rule is used. Prices include KV payments and exclude timber sold by land exchanges and from land utilization project lands. Data for the years 1950-83 are statistical high bid prices; beginning in 1984, data are high bid prices which include specified road costs.

Source: U.S. Department of Agriculture, Forest Service *(39)*. Data for 1910-49 in *The demand and price situation for forest products, 1964*, table 5 *(31)*.

[a]While 1,000 board feet is theoretically equivalent to 2.36 cubic meters, this is true only when a board foot is actually a piece of wood with a volume of 1/12 of 1 cubic foot. The International ¼-inch log rule is used by the USDA Forest Service in the East to estimate the product potential in board feet. When a conversion is used, the reliability of the estimate will vary with the size of the log measure. The conversion given here, 3.48 cubic meters, is based on the cubic volume of a log 16 feet long and 15 inches in diameter inside bark (dib) at the small end. This conversion could be used for average comparisons when accuracy of 10 percent is acceptable. Since the board-foot unit is not a true measure of wood volume and since products other than dimension lumber are becoming important, this unit may eventually be phased out and replaced with the cubic-meter unit.

APPENDIX 03 – INDUSTRY ORGANISATIONS

PARTIAL LIST OF WOOD-USING AND ALLIED ASSOCIATIONS

Forest Products Laboratory
Forest Service
U.S. Department of Agriculture
One Gifford Pinchot Drive
Madison, WI 53705-2398

June 1986

ADHESIVES MANUFACTURERS ASSOCIATION OF AMERICA
111 East Wacker Drive
Chicago, IL 60601
Telephone: (312) 644-6610
Ex. Secretary: Sanford J. Hill

ALASKA LOGGERS ASSOCIATION, INC.
111 Stedman Street
Ketchikan, AK 99901
Telephone: (907) 225-6114
Public Information Director: Kirsten Held

AMERICAN FOREST INSTITUTE
1619 Massachusetts Avenue, NW.
Washington, DC 20036
Telephone: (202) 797-4500
President: Robert O. Lehrman

AMERICAN FORESTRY ASSOCIATION
1319 - 18th Street, NW.
Washington, DC 20036
Telephone: (202) 467-5810
Ex. Vice President: Rexford A. Resler

AMERICAN HARDBOARD ASSOCIATION
887-B Wilmette Road
Palatine, IL 60067
Telephone: (312) 934-8800
Ex. Vice President: James E. Nolan

AMERICAN INSTITUTE OF TIMBER CONSTRUCTION
333 West Hampden Avenue
Englewood, CO 80110
Telephone: (303) 761-3212 or (800) 525-1625
Ex. Vice President: Russell P. Wibbens

AMERICAN LADDER INSTITUTE
111 East Wacker Drive
Chicago, IL 60601
Telephone: (312) 644-6610
Ex. Director: Walter Purcell

AMERICAN LUMBER STANDARDS COMMITTEE
P.O. Box 210
Germantown, MD 20874
Telephone: (301) 972-1700
Secretary-Manager: T. D. Searles

AMERICAN PAPER INSTITUTE, INC.
260 Madison Avenue
New York, NY 10016
Telephone: (212) 340-0600
President: Louis F. Laun

AMERICAN PARQUET ASSOCIATION
1650 Union National Plaza
Little Rock, AR 72901
Telephone: (501) 375-5377

AMERICAN PLYWOOD ASSOCIATION
7011 South 19th, P.O. Box 11700
Tacoma, WA 98411
Telephone: (206) 565-6600
Ex. Vice President: Bronson J. Lewis

AMERICAN PULPWOOD ASSOCIATION
1025 Vermont Avenue, NW.
Washington, DC 20005, Suite 1020
Telephone: (202) 347-2900
President: K. S. Rolston

AMERICAN SOCIETY OF AGRICULTURAL ENGINEERS
P.O. Box 410
St. Joseph, MI 49085
Telephone: (616) 429-0300
Ex. Vice President: J. L. Butt

AMERICAN SOCIETY OF HEATING, REFRIGERATING.
1791 Tully Circle, NE.
Atlanta, GA 30329
Telephone: (404) 636-8400

AMERICAN SOCIETY FOR TESTING AND MATERIALS
1916 Race Street
Philadelphia, PA 19103
Telephone: (215) 299-5400
Managing Director: W. T. Cavanaugh

AMERICAN WOOD COUNCIL
1619 Massachusetts Avenue, NW.
Washington, DC 20036
Telephone: (202) 265-7766
President: E. D. Reiten
(Also has information regarding wood foundation.)

AMERICAN WOOD PRESERVERS ASSOCIATION
P.O. Box 849
Stevensville, MD 21666
Telephone: (301) 643-4163
Secretary-Treasurer: John D. Ferry

AMERICAN WOOD PRESERVERS BUREAU
P.O. Box 6085, 2772 South Randolph Street
Arlington, VA 22206
Telephone: (703) 931-8180
President: Charles E. Thomas, Jr.

AMERICAN WOOD PRESERVERS INSTITUTE
Tyson's International Building
1945 Gallows Road, Suite 405
Vienna, VA 22180
Telephone: (703) 893-4005, (800) 336-0148 (toll free)
President: Robert G. Smerko

APPALACHIAN HARDWOOD MANUFACTURERS, INC.
Room 408, 164 South Main Street, P.O. Box 427
High Point, NC 27261
Telephone: (919) 885-8315
Ex. Vice President: James L. Gundy

ARCHITECTURAL WOODWORK INSTITUTE
Chesterfield House, Suite A
2310 South Walter Reed Drive
Arlington, VA 22206
Telephone: (703) 671-9100
Ex. Vice President: William H. Winter

ASSOCIATED COOPERAGE INDUSTRIES OF AMERICA, INC.
Suite 100-E, 2100 Gardiner Lane
Louisville, KY 40205
Telephone: (502) 459-6113
President: Bill Bailey

ASSOCIATION OF CONSULTING FORESTERS
P.O. Box 6
Wake, VA 23176
Telephone: (804) 776-4031
Ex. Secretary: Edward Stuart, Jr.

ASSOCIATION OF STATE COLLEGE AND UNIVERSITY FORESTRY RESEARCH ORGANIZAT
c/o College of Forestry
University of Minnesota
St. Paul, MN 55108
Telephone: (612) 373-2851
President: R. A. Skok

CALIFORNIA REDWOOD ASSOCIATION
591 Redwood Highway, Suite 3100
Mill Valley, CA 94941
Telephone: (415) 381-1304
Technical Services: Peter Johnson, Jr.

CELLULOSE MANUFACTURERS ASSOCIATION
Box 4045
Falls Church, VA 22044
Telephone: (703) 931-5200
Ex. Director: William MacKenzie

BARBECUE INDUSTRY ASSOCIATION
710 East Ogden Avenue, Suite 114
Naperville, IL 60540
Telephone: (312) 369-2404
Ex. Director: Arthur W. Seeds

EASTERN SAW FILERS EDUCATION ASSOCIATION
c/o Haywood Technical Institute
P.O. Box 457
Clyde, NC 28721
Telephone: (704) 627-2821
Secretary-Treasurer: Billy Beck

FEDERAL TIMBER PURCHASERS ASSOCIATION
215 South Wadsworth Boulevard, Suite 403
Denver, CO 80226
Telephone: (303) 233-8271
Ex. Vice President: James R. Craine

FINE HARDWOODS--AMERICAN WALNUT ASSOCIATION
5603 West Raymond Street, Suite O
Indianapolis, IN 46241
Telephone: (317) 244-3311
Ex. Director: Larry R. Frye

FIR AND HEMLOCK DOOR ASSOCIATION
700 Yeon Building
Portland, OR 97204
Telephone: (503) 224-3930
Staff Ex. Secretary: Robert H. Hunt

FOREST FARMERS ASSOCIATION
Box 953585
Atlanta, GA 30347
Telephone: (404) 325-2954
Ex. Vice President: J. Walter Myers, Jr

FOREST HISTORY SOCIETY, INC.
701 Vickers Avenue
Durham, NC 27701
Telephone: (919) 682-9319
Ex. Director: Dr. Harold Steen

FOREST INDUSTRIES TELECOMMUNICATIONS
P.O. Box 5446
Eugene, OR 97405
Telephone: (503) 485-8441
Ex. Vice President: James H. Baker

FOREST PRODUCTS RESEARCH SOCIETY
2801 Marshall Court
Madison, WI 53705
Telephone: (608) 231-1361
Ex. Vice President: Arthur B. Brauner

FORMALDEHYDE INSTITUTE
1075 Central Park Avenue
Scarsdale, NY 10583
Telephone: (914) 725-1492
Ex. Vice President: John F. Murray

FURNITURE MANUFACTURERS ASSOCIATION
345 State Street, SE., Suite 26A
Grand Rapids, MI 49503
Telephone: (616) 456-9691
Managing Director: Chas. R. Solon

HARDWOOD MANUFACTURERS ASSOCIATION
2831 Airport Blvd
Memphis TN 38132
Telephone (901)346222 President Jim Lee

HARDWOOD PLYWOOD MANUFACTURERS ASSOCIATION
P.O. Box 2789
1825 Michael Faraday Drive
Reston, VA 22090-2789
Telephone: (703) 435-2900
President: Clark E. McDonald

HARDWOOD RESEARCH COUNCIL
Box 131
Asheville, NC 28802
Telephone: (704) 254-2682
Ex. Secretary: Mark A. Barford

HICKORY HANDLE ASSOCIATION, INC.
2923-22nd Avenue South
Nashville, TN 37215
Telephone: (615) 269-6436
Secretary: F. Donal Cowan

HOT MELT EQUIPMENT MANUFACTURERS ASSOCIATION
825 Rhode Island Avenue, South
Minneapolis, MN 55426
No Phone
Secretary-Treasurer: John Yuhas

IMPORTED HARDWOOD PRODUCTS ASSOCIATION, INC.
P.O. Box 1308
Alexandria, VA 22313
Telephone: (703) 836-6696
Ex. Vice President: O. Keister Evans

INDUSTRIAL FORESTRY ASSOCIATION
225 S.W. Broadway, Room 400
Portland, OR 97205
Telephone: (503) 222-9505
Director of Public Affairs: M.D. Sullivan

LAKE STATES LUMBER ASSOCIATION, INC.
P. O. Box 2413
Kingsford, MI 49801
Telephone: (906) 774-6767
Attn: Carl Danielson

MANUFACTURED HOUSING INSTITUTE
1745 Jefferson Davis Hwy.
Arlington, VA 22202
Telephone: (703) 979-6620
President: Walter L. Benning

MAPLE FLOORING MANUFACTURERS ASSOCIATION, INC.
Suite 720, South
Sperry Univac Plaza
8600 West Bryn Mawr Avenue
Chicago, IL 60631
Telephone: (312) 693-0990
Ex. Vice President: John E. Messervey

NATIONAL ASSOCIATION OF FURNITURE MANUFACTURERS
5515 Security Lane, Suite 530
Rockville, MD 20852
Telephone: (301) 884-8501
Ex. Vice President: John M. Snow

NATIONAL ASSOCIATION OF HOME BUILDERS OF THE UNITED STATES
15th and M Streets, NW.,
Washington, DC 20005
Telephone: (202) 452-0200
Ex. Vice President: Dave Stahl

NATIONAL ASSOCIATION OF HOME MANUFACTURERS
6521 Arlington Boulevard
Falls Church, VA 22042
Telephone: (703) 533-9606

NATIONAL ASSOCIATION OF UREA FOAM INSULATION MANUFACTURERS
P.O. Box 23478
Jacksonville, FL 32217
Telephone: (904) 353-8920
President: Aubrey Radford

NATIONAL BARK PRODUCERS ASSOCIATION
301 Maple Avenue
West Vienna, VA 22180
Telephone: (703) 938-3999
Ex. Director: G. A. Lynch

NATIONAL BUILDING MATERIAL DISTRIBUTORS ASSOCIATION
Suite 1616, 55 East Monroe Street
Chicago, IL 60603
Telephone: (312) 332-7127
Ex. Vice President: Frank E. O'Dowd

NATIONAL DOME ASSOCIATION
2506 Gross Point Road
Evanston, IL 60201
Telephone: (312) 475-7530

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
2102 L Street, NW.
Washington, D.C. 20037
ATTN: High Pressure Plastic Laminates Section
Telephone: (202) 457-8400

NATIONAL FIRE PROTECTION ASSOCIATION
Batterymarch Park
Quincy, MA 02269
Telephone: (617) 770-3000
President: Robert W. Grant

NATIONAL FOREST PRODUCTS ASSOCIATION
1250 Connecticut Avenue, NW.
Washington, DC 20036
Telephone: (202) 463-2700
Ex. Vice President: Ralph D. Hodges, Jr.

NATIONAL HARDWOOD LUMBER ASSOCIATION
6830 Raleigh-LaGrange Road
P.O. Box 34518
Memphis, TN 38184-0518
Telephone: (901) 377-1818
Ex. Manager: S. Carroll White

NATIONAL KITCHEN CABINET ASSOCIATION
P.O. Box 6830
Falls Church, VA 22046
Telephone: (703) 237-7580
Ex. Director: C. Richard Titus

NATIONAL LUMBER AND BUILDING MATERIAL DEALERS ASSOCIATION
1990 M Street, NW., Suite 350
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Telephone: (202) 872-8860
Ex. Vice President: John M. Martin

NATIONAL LUMBER EXPORTERS ASSOCIATION
1250 Connecticut Avenue, NW.
Washington, DC 20036
Telephone: (202) 463-2724
International Trade Council: Barbara LaChance

NATIONAL OAK FLOORING MANUFACTURERS ASSOCIATION
810 Sterick Building
Memphis, TN 38103
Telephone: (901) 526-5016
Managing Director: George E. Kelly

NATIONAL PAINT AND COATINGS ASSOCIATION
1500 Rhode Island Avenue, NW.
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Telephone: (202) 462-6272
Ex. Director: Larry L. Thomas

NATIONAL PARTICLEBOARD ASSOCIATION
18928 Premiere Court
Gaithersburg, MD 20910
Telephone: (301) 670-0604
Ex. Vice President: William H. McCredie

NATIONAL SASH AND DOOR JOBBERS ASSOCIATION
205 Touhy
Park Ridge, IL 60068
Telephone: (312) 692-9200
Ex. Vice President: Carl W. Nagle

NATIONAL WOOD FUEL ASSOCIATION
1263-B Rand Road
Des Plaines, IL 60016
Telephone: (312) 298-0044
President: Victor A. Gauger

NATIONAL WOODEN PALLET AND CONTAINER ASSOCIATION
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Telephone: (202) 667-3670
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NATIONAL WOODWORK MANUFACTURERS ASSOCIATION, INC.
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NORTH AMERICAN WHOLESALE LUMBER ASSOCIATION, INC.
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NORTHEASTERN LOGGERS' ASSOCIATION, INC.
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Old Forge, NY 13420
No Phone
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NORTHEASTERN LUMBER MANUFACTURERS ASSOCIATION, INC.
4 Fundy Road
Falmouth, ME 04105
Telephone: (207) 781-2252
President: Ex. Director: H. Keith Judkins

NORTHEASTERN RETAIL LUMBERMAN'S ASSOCIATION
339 East Avenue
Rochester, NY 14604
Telephone: (716) 325-1626
Ex. Vice President: Horace G. Pierce

NORTHERN HARDWOOD AND PINE MANUFACTURERS ASSOCIATION, INC.
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NORTH WEST TIMBER ASSOCIATION
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PLYWOOD RESEARCH FOUNDATION
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RAILWAY TIE ASSOCIATION
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St. Louis, MO 63102
Telephone: (314) 231-8099
Ex. Secretary: D. B. Mabry

RED CEDAR SHINGLE & HANDSPLIT SHAKE BUREAU
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Bellevue, WA 98004
Telephone: (206) 453-1323
Marketing Manager: Marshall R. Ritchie

SMALL HOMES COUNCIL-BUILDING RESEARCH COUNCIL
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SOCIETY OF AMERICAN FORESTERS
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Bethesda, MD 20814
Telephone: (301) 897-8720
Ex. Vice President: Hardin R. Glascock, Jr.

SOCIETY OF AMERICAN WOOD PRESERVERS, INC.
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Falls Church, VA 22042
Telephone: (703) 237-0900
President: George K. Eliades

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Memphis, TN 38103
Telephone: (901) 525-8221
Ex. Vice President: George E. Kelly

SOUTHERN FOREST PRODUCTS ASSOCIATION
P.O. Box 52468
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Vice President for Marketing: Karl W. Lindberg

SOUTHERN FURNITURE MANUFACTURERS ASSOCIATION
Box 2436
High Point, NC 27261
Telephone: (919) 885-5065
Ex. Vice President: P. Douglas Kerr

SOUTHERN PINE INSPECTION BUREAU
4709 Scenic Hwy.
Pensacola, FL 32504
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Ex. Director: R. G. Kimbell, Jr.

TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY
P.O. Box 105113
Atlanta, GA 30348
Telephone: (404) 394-6130
Ex. Secretary-Treasurer: Philip E. Nethercut

TIMBER OPERATORS COUNCIL, INC.
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Telephone: (503) 620-1710
Ex. Vice President: Karl F. Glos

TIMBER PRODUCTS MANUFACTURERS
951 East 3rd Avenue
Spokane, WA 99202
Telephone: (509) 535-4646
Manager: George J. Tichy

TREES FOR TOMORROW ENVIRONMENTAL CENTER
Box 609
Eagle River, WI 54521
Telephone: (715) 479-6456
Ex. Director: A. Earl Plourde

TRUSS PLATE INSTITUTE
583 D'Onofrio Drive, Suite 200
Madison, WI 53719
Telephone: (608) 833-5900
Managing Director: Charles B. Goehring

WEST COAST LUMBER INSPECTION BUREAU
P.O. Box 23145 - 6980 SW. Varns Road
Portland, OR 97223
Telephone: (503) 639-0651
Ex. Vice President: Ray L. Todd

WESTERN BUILDING MATERIAL ASSOCIATION
P.O. Box 1699
Olympia, WA 98507
Telephone: (206) 943-3054
Ex. Director: C. E. Link

WESTERN FOREST INDUSTRIES ASSOCIATION
1500 Southwest Taylor Street
Portland, OR 97205
Telephone: (503) 224-5545
Ex. Vice President: Joseph W. McCracke

WESTERN RED CEDAR LUMBER ASSOCIATION
Yeon Building
Portland, OR 97204
Telephone: (503) 224-3930
Secretary-Manager: Robert H. Hunt

WESTERN TIMBER ASSOCIATION
211 Sutter Street
San Francisco, CA 94108
Telephone: (415) 956-0410
Ex. Vice President: William N. Denniso

WESTERN WOOD PRODUCTS ASSOCIATION
1500 Yeon Building
Portland, OR 97204
Telephone: (503) 224-3930
Manager, Field Services Department: C.

WISCONSIN/MICHIGAN TIMBER PRODUCERS
201 W. Wisconsin Avenue
Tomahawk, WI 54487
Telephone: (715) 453-5159
Attn: Carl Theiler

WISCONSIN PAPER COUNCIL
1920 American Court
Neenah, WI 54956
Telephone: (414) 722-1500
Attn: Tom Schmidt

WOOD FOUNDATION INSTITUTE
8600 West Bryn Mawr Avenue
Chicago, IL 60631
Telephone: (312) 693-0990
Ex. Vice President: John Messervey

WOOD HEATING ALLIANCE
Suite 700
1101 Connecticut Avenue, NW.
Washington, D.C. 20036
Telephone: (202) 857-1181
(Source of information on various aspects of wood as a fuel and wood burning equipment)

WOOD AND SYNTHETIC FLOORING INSTITUTE
108 Dania Circle
Lehigh, FL 33936
Telephone: (813) 369-3637
Ex. Vice President: Robert Hitchens

WOOD MOULDING AND MILLWORK PRODUCERS, INC.
P.O. Box 25278, 1730 S.W. Skyline Boulevard
Portland, OR 97225
Telephone: (503) 292-9288
Ex. Vice President: Barnard J. Tomasko

WOOD PRODUCTS MANUFACTURERS ASSOCIATION
715 Boylston Street
Boston, MA 02116
Telephone: (617) 266-6800
Managing Director: Richard Gild

WOODWORKING MACHINERY IMPORTERS ASSOCIATION
P.O. Box 8591
Baltimore, MD 21234
Telephone: (301) 665-1276

WOODWORKING MACHINERY MANUFACTURERS OF AMERICA
1900 Arch Street
Philadelphia, PA 19103
Telephone: (215) 564-3484
Ex. Vice President: Don White

This listing is prepared solely for the convenience of our correspondents and does not represent any endorsement on the part of the U.S. Department of Agriculture. Additional names will be added to this list upon request.

New Technology for Using Low-Grade Hardwoods: System 6

by Hugh W. Reynolds and Charles J. Gatchell

Introduction

Only the best hardwood lumber is presently used to make the solid wood parts in high-valued products such as furniture and kitchen cabinets. Hardwood forests do not yield enough large, high-quality logs, and this causes shortages of high-quality lumber. Although we are growing more hardwood timber than we are cutting, the surplus is in small-diameter, low-quality trees. These small trees cannot, in general, be sawed into standard lumber profitably.

But small trees can be raw material for the furniture and cabinet industries if we use new technology and a new intermediate product. The new technology we call System 6; the new product is called standard-size blanks (Fig. 1). Together they can make conversion of the low-grade hardwood resource profitable and relieve the shortage of hardwoods.

Standard blanks have been developed by Araman[1] from an analysis of the rough part sizes required by 32 major manufacturers of kitchen cabinets and furniture. A standard blank is a piece of solid wood (it may be made from narrow pieces edge-glued together) of a predetermined length, width, thickness, and quality. These blanks may be processed efficiently into the needed rough parts by simply ripping and crosscutting with a very small loss in kerf and end trim.

Details of System 6 Technology

The details of System 6 have been developed from numerous trials at our Methods Testing Plant at Princeton, West Virginia.[2] Several manufacturers of furniture and kitchen cabinets have tried System 6 blanks and have found them satisfactory for the production of fine solid wood products. For System 6 to give the best results, seven sequential steps must be followed:

1. Divide the low-grade hardwood resource into different roundwood products.
2. Saw bolts suitable for System 6 into cants, not lumber.
3. Use automated cant sawing to make boards.
4. Use the best drying practices.
5. Remove most of the defects with automated cut-up.
6. Bring pieces to specified size and quality with manual cut-up.
7. Make standard-size blanks as the final product of the System 6 rough mill.

Details of these seven steps are:

Step 1: Divide the low-grade hardwood resource into different roundwood products. To make maximum use of the small-diameter, low-grade hardwood resource, all timber that meets the System 6 bolt criteria sould be used for System 6. The remainder should be used for less valuable roundwood products, such as pallet bolts, pulpwood, and firewood.

The System 6 bolt criteria are:

Minimum length:	6 feet nominal; 75 inches actual or 8 feet nominal; 99 inches actual
Sweep:	1½ inches maximum, any diameter
Diameter:	8-through 12-inch diameter class (7.6 inches minimum to 12.5 inches

[2]Reynolds, Hugh W.; and Gatchell, Charles J. New technology for low-grade hardwood utilization: System 6. Res. Pap. NE-504. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1982. 8 p.

[1]Araman, Philip A.; Gatchell, Charles J.; and Reynolds, Hugh W. Meeting the solid wood needs of the furniture and cabinet industries: standard-size hardwood blanks. Res. Pap. NE-494. Broomall, PA: U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1982. 27 p.

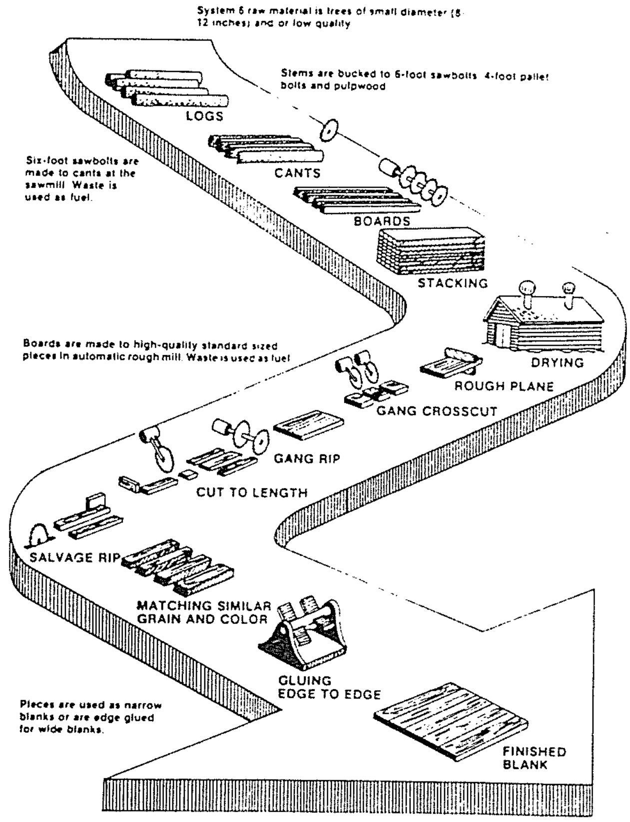


Figure 1.—System 6 begins with logs and ends with blanks.

	maximum diameter inside bark on small end)
Quality:	Sound and solid. Sound defects without limit.

Step 2: Saw System 6 bolts to two-sided cants, not lumber. Sawmills lose money sawing small Factory Grade 3 and poorer logs to lumber. The sawmills must make a different product—one that can be produced quickly and easily and sold at a profit. A market analysis[3] shows that circular headrig sawmills should be able to make cants profitably if they use the procedures shown in Figure 2.

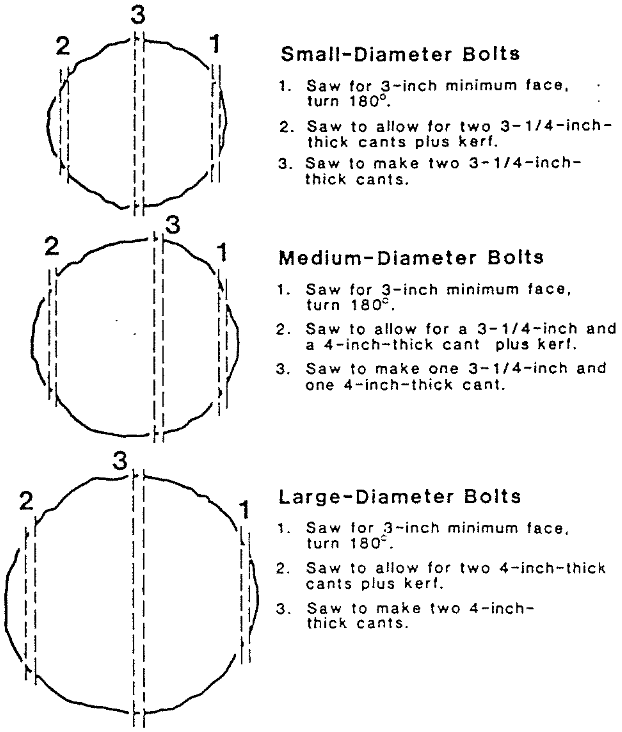


Figure 2.—Sawing System 6 bolts to cants.

[3]Reynolds, Hugh W.; and Gatchell, Charles J. Marketing low-grade hardwoods for furniture stock—a new approach. Res. Pap. NE-444. Broomall, PA. U.S. Department of Agriculture, Forest Service, Northeastern Forest Experiment Station; 1979. 7 p.

Gang ripping of acceptable pieces

Pieces coming from the gang crosscut saw are accepted if they contain at least a minimum-size cutting (1½ inches wide by shortest blank length to be made). Only one cutting will be made from each piece. To speed processing and make the operator's decisions easier, we recommend cutting-width increments no smaller than ½ inch. In our work, we have standardized on five cutting widths: 1½, 2, 2½, 3, and 3½ inches. Each piece to be gang sawed is inspected to choose its better edge; this edge will be given a ¼-inch dressing cut. Then the piece is placed in one of five pockets on the gang rip table. The ¼-inch edge cut and the width cut to remove defects are made at the same time. Pieces coming from the gang ripsaw have edges of glue-joint quality.

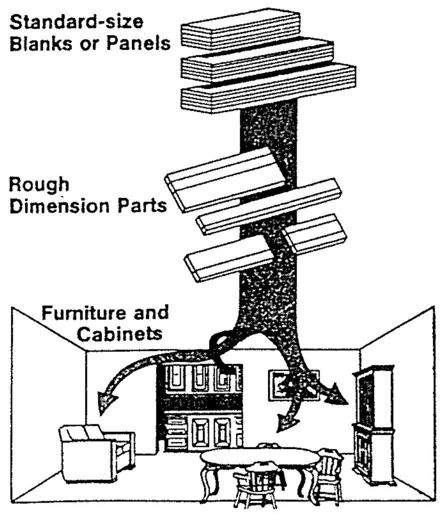
Step 6: Bring pieces to specified size and quality with manual cut-up. After gang crosscutting and gang ripping, the cuttings are in no more than five lengths. There may still be some defects that need removal. A manually controlled crosscut saw is used to remove end defects and cut pieces to blank lengths. A manually controlled glue-joint ripsaw is used for salvage ripcuts when required.

Step 7: Make standard-size blanks as the final products of the System 6 mill. Blanks are made to specified thicknesses, widths, lengths, and qualities, chosen to be the rough size of the most commonly needed parts or multiples of those rough sizes. Blank widths from 1½ to 3½ inches in ½-inch increments work very well for narrow parts, or wider edge-glued blanks can be ripped to the needed sizes.

Summary

Four basic concepts differentiate the new System 6 technology from the techniques conventionally used to convert hardwood tree stems to furniture and kitchen cabinets. These concepts are: (1) a new, nonlumber product called standard-size blanks that is the output of the System 6 process; (2) highly automated rather than manual techniques for converting logs to blanks; (3) total processing of every board that contains a minimum-size cutting; and (4) minimized operator decisions and limited choices.

Hugh W. Reynolds and Charles J. Gatchell are forest products technologists at the Northeastern Forest Experiment Station, Forestry Sciences Laboratory, P.O. Box 152, Princeton, WV 24740.



Directory of Research Programs

United States Department of Agriculture
Forest Service
Forest Products Laboratory

One Gifford Pinchot Drive
Madison, WI 53705-2398

Phone: Commercial (608)264 + ext. or
FTS 364 + ext.
Telex: 7400032
DG: Mailroom:S32A
Facsimile: Commercial (608)264-5692
FTS 364-5692

John R. Erickson, Director
Ext. 5717

March 1988

H. M. Montrey, Deputy Director
Ext. 5720

CURRENT INVESTIGATIONS & SCIENTISTS IN CHARGE

CHEMISTRY & PAPER RESEARCH

Vance C. Setterholm, Assistant Director
Ext. 5878

Fiber Product Design Criteria (RWU 4708)
Dennis E. Gunderson
Ext. 5880

Structural fiber products and systems
Performance of paperboard and containers in adverse environments
Press drying of printing papers

Chemistry and Pulping (RWU 4709)
James L. Minor
Ext. 5881

Fundamental nature of lignin
Basic structure and distribution of wood fiber polymers
Optimizing properties of chemi-mechanical pulps
Fundamental knowledge of the chemical reactivity of wood components

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Fiber Processes and Products (RWU 4710)
Theodore H. Wegner
Ext. 5881

Greater use of recycled fiber and underutilized hardwoods in linerboard
Role of chemicals in improving paperboard strength properties, wet stiffness, and dimensional stability
Stronger, opaque, high-yield pulps from a broad resource base
Dimensionally stable fiber-base panel products

Improved Adhesive Systems (RWU 4703)
Anthony H. Conner
Ext. 5610

Durable adhesives from renewable resources
Improved conventional wood bonding systems
Mechanical properties of adhesives and bonded joints

- -

Analytical Laboratory
Roger C. Pettersen
Ext. 5880

Measurement of chemical components in wood and pulp
Identification and structure of chemicals from wood and wood-derived materials
Microscopic examination and measurement of wood and wood fibers

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PROCESS & PROTECTION RESEARCH
Gary R. Lindell, Assistant Director
Ext. 5725

Center for Forest Mycology Research (RWU 4501)
Harold H. Burdsall, Jr.
Ext. 5635

Taxonomy, ecology, and pathology of the Armillaria mellea complex in North America
Major revision of the genus Phellinus
Taxonomy and systematics of the species in the genus Phlebia
Resolve species limits in species complexes of decay fungus culture collection and describe cultural characteristics

- -

Biodeterioration of Wood (RWU 4502)
Terry L. Highley
Ext. 5635

Manner in which decay fungi degrade wood
On-site and in-place treatments to protect wood structures from decay
Biological means of protecting wood from decay

- -

Center for Wood Anatomy Research (RWU 4701)
Regis B. Miller
Ext. 5752

Fundamental knowledge on the macro- and microscopic structures of wood and identification of emerging native and foreign commercial woods

- -

Protection of Wood Products from Biodegradation (RWU 4704)
(Gary R. Lindell, Acting)
Ext. 5865

Processing technologies for a changing forest resource
Performance assessment of new chemical treatments
Biochemical control via inhibition of chitin synthesis
Polymer deposition in wood (bulking techniques)

- -

Wood Surface Chemistry and Property Enhancement (RWU 4707)
William C. Feist
Ext. 5865

Chemical and physical factors that affect exterior finish performance
Mechanisms of weathering retardation and surface characteristics of wood
Technology to provide effective bonded treatment parameters

- -

- -

Wood Products Processing (RWU 4706)
John A. Youngquist
Ext. 5755

PRODUCT RECOVERY OPTIONS
Analytical tools to improve recovery and profits

SAWING SYSTEMS
Measurement and control of dynamic factors in sawing

DRYING SOLID WOOD
Analytical modeling of lumber drying
Improved process control in kiln drying
Investigation of non-traditional drying processes
Characterization of the relationship between bacterial infection and wood drying properties

COMPOSITES
Characteristics of materials and processing and their effect on product performance
Bond strength development and rheological properties of wood composites
Performance of wood composites in adverse environments
Evaluation of adhesive bonding systems for composites

- -

Tropical Forestry Program
Robert R. Maeglin, Coordinator
Ext. 5725

Utilization potential of tropical forests
Technical assistance to cooperating countries

WOOD PRODUCTS RESEARCH
Erwin L. Schaffer, Assistant Director
Ext. 5672

Engineering Properties of Wood (RWU 4714)
B. Alan Bendtsen
Ext. 5709

Physical and mechanical properties of clear wood
Property evaluation for commercial lumber
Stress grading lumber efficiently
Factors that affect engineering properties of wood

- -

Engineering Design Criteria (RWU 4715)
Lawrence A. Soltis
Ext. 5669

Basic failure mechanisms of clear wood
Design technology for single- and multiple-member wood systems
Design technology for mechanical fasteners and adhesive bonds
Duration of load relationship and design for structural lumber

- -

- -

Engineered Wood Products and Structures (RWU 4716)
Russell C. Moody
Ext. 5628

Performance of structural components
Performance of structural systems
Environmental design parameters (moisture/thermal)
Performance of engineered wood products

- -

Fire Safety of Wood Products (RWU 4718)
Susan LeVan
Ext. 5669

Effect of new technologies in wood construction on fire safety
Fundamental fire and thermal performance characteristics of wood products
Prediction of fire safety in actual fire situations

- -

National Timber & Wood Products Requirements & Utilization Economics (RWU 4851)
William J. Lange
Ext. 5763

Timber and wood product consumption in major end uses
Wood consumption as related to economic determinants
Economic evaluation of new and prospective wood products and processing methods
Relationship of wood consumption to timber supply

- -

Engineering Mechanics Laboratory
(Erwin L. Schaffer, Acting)
Ext. 5925

Coordinate test support needs of engineering-based research studies
Provide and maintain up-to-date physical and environmental test facilities and equipment
Provide complete testing services for physical and environmental research accomplishment
Cooperate with other Forest Service units requiring testing assistance

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INSTITUTE FOR MICROBIAL & BIOCHEMICAL TECHNOLOGY
T. Kent Kirk, Director
Ext. 5866

Basic biochemistry of lignin degradation by fungi, and application of bio-ligninolytic systems in wood processing
Enzymatic depolymerization of hemicelluloses, and fermentation of hemicellulose sugars
Applications of fungi in solid state fermentation of wood
Molecular genetics of filamentous fungi

ENERGY FROM WOOD PROGRAM
John I. Zerbe, Program Manager
Ext. 5752

Technology for conversion of wood to improved fuels and chemicals
Technology for wood combustion
Energy efficiency of building construction

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY

Blacksburg, Virginia 24061

DEPARTMENT OF FOREST PRODUCTS

Thomas M. Brooks Forest Products Center

Twelve New Techniques in Drying Lumber

by

Gene Wengert
Brooks Forest Products Center
Virginia Tech

Objectives: #1 Improve Quality
#2 Reduce Drying Time

I. Drying Systems

A. Low Temperature Steam or DH Predryer
   Back to WB/DB measurement
   Baffles are common
B. DH Kiln
   Virginia Tech has good cost data
   Booklet being published
C. RF plus Vacuum
   No new work; MC variation still a problem
D. Vacuum
   Very promising; MC variation a problem in some units

II. Drying Techniques

A. Presurfacing
   Great idea for surface check control
   Becoming more popular
B. Presteaming
   Promising for reducing checks, but no new research
C. Drying Rates
   Widely adopted throughout hardwood industry
D. Velocity
   Variable speed controls save 40 to 60% of energy bill
   Importance of velocity better defined
E. Q-C Monitoring
   New tests for monitoring QC (hardwoods & softwoods)

III. Control Systems

A. Acoustic Emissions
   No recent work
B. Automatic MC measurement
   Lignomat controls very popular (quality and speed)
C. T.D.A.L.
   Improved quality (7%) documented
   Growing in popularity for SYP

Computer Programs from Virginia Tech

The following computer programs are available from Virginia Tech (#1-9 at no cost). They are written in BASIC and will run themselves fairly well. For a free copy, please send a blank, IBM-pc formatted, double density disk to Gene Wengert. Also, please indicate whether you will need the color or black and white version.

1) HARDWOOD KILN DRYING COSTS. Calculates the cost of drying lumber in air-drying, predrying and kiln-drying, based on 65 different cost items. The user can change any of the input data to reflect his own situation.

2) KILN DRYING ENERGY. Calculates the energy used in kiln drying. Permits examination of energy savings with improved schedules, better insulation, etc.

3) HARDWOOD KILN SCHEDULES. Generates the U.S. Forest Products Lab hardwood kiln schedules. User must know the schedule number.

4) KILN RECORDS. User inputs sample weights; computer calculates MC's and stores values.

5) EMC, TEMP, RH. Calculates EMC, RH, dry-bulb, wet-bulb, vapor pressure, etc. based on user supplied information. Saves looking up values in table to use programs 2 and 3 above.

6) RATE. Calculates the drying rate of lumber. User can vary and study the affects of sticker thickness, velocity, stack width, and so on.

7) MCQC. Calculates average and spread of moisture content based on a few readings. Also graphs results.

8) HARDWOOD LOG. Calculates the log scale (Doyle, Scribner, and Int. 1/4), log volume, grade of lumber produced, and value of lumber produced given hardwood log diameter, length, and grade (optional). Available for red oak, basswood, and maple. Useful for estimating log value, checking sawmill recovery, and so on. Based on U.S. Forest Service data.

9) TRIMMING HARDWOODS. Calculates the maximum trim that can be taken to raise the grade and increase lumber value for hardwoods. User inputs current prices. Useful in training as well as everyday guideline.

10) EDGING AND TRIMMING SOFTWOODS. As in program 9, but designed for softwoods. Useful for daily updating of guidelines for edgerman and trimmerman.

11) GRADING TUTORIAL AND PRACTICE. Contains nine lessons on grading hardwood lumber and 100 pieces of lumber to be graded. 5 disks. $50. COLOR ONLY.

12) ROUGHMILL CUT-UP. Has 100 pieces of lumber to be cut up. Students results are compared with computer's "best" solution. COLOR ONLY. $50.

Extension Activities in Forest Products

* Booklets -- DH Drying for Sawmill
  Solar Lumber Drying
  Making Mngmt. Decisions in Drying
  Analyzing Sawmill Performance
  Predrying

* Articles -- over 10/yr in trade journals
  Wood Dr's Rx book
  Monthly "Management Notes"

* Short Courses/Seminars -- 18 per year
  For Management & Employees
  Including seminar booklets

* Projects -- RF/Vacuum comparisons
  End Coating Tests
  Evaluation of New Equipment
  Computerized Vision (cut-up)
  TDAL Zone Kilns
  EXPO

* Trade talks -- For example, "12 New Techniques for Drying Lumber", given at SE Lbr. Mfr. Assoc. meeting--(attached)

* Mill Visits -- 24 per year

* Computer Programs -- (attached)

Future Extension Projects

1) Effects of velocity on quality, on rate, and on energy costs

2) Managing inventories by predicting drying time

3) Internal temperature control to minimize strength loss

4) Positive feedback & dryer control (Wood's response dictates RH, velocity, and temperature)

COLLEGE OF AGRICULTURE AND LIFE SCIENCES
VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
Blacksburg, Virginia 24061
DEPARTMENT OF FOREST PRODUCTS
Thomas M. Brooks Forest Products Center

FOREST PRODUCTS IN THE COMMONWEALTH OF VIRGINIA

Gene Wengert

Brooks Forest Products Center Department of Forest Products
Virginia Polytechnic Institute and State University

I. Geography
- Location
- Climate
- Commercial Activities
- Population

II. Forestry and Forest Products
- Forest Inventories
- Ownership
- Industry
- Hardwood Sawmill
- Softwood Sawmill

III. Extension
- VPI & SU
- Department of Forest Products
- Cooperative Extension in F.P.
- Funding

IV. Major Problems in Lumber Manufacturing and Drying

"Don't make enough money!"

Lumber Manufacturing Problems

-- 2/3 of cost is raw material!
-- low grade hardwood resource (low value)
-- old equipment (yield and thickness)
-- not much secondary manufacturing at most mills
-- Canadian softwood lumber (cheaper; unfair?)

Drying Problems

Hardwoods: Surface checking and honeycomb. (2 to 16% loss); Long drying times

Softwoods: Warp, splits, and uneven final MC. (1 out of 4 pieces affected)

APPENDIX 07 – UNIVERSITY OF NORTH CAROLINA VIDEO TRAINING SERIES

NORTH CAROLINA STATE UNIVERSITY
TECHNOLOGY UPDATE SERIES
FOR THE WOOD PRODUCTS INDUSTRY
DEPARTMENTS OF WOOD & PAPER SCIENCE
AND EXTENSION FOREST RESOURCES
SCHOOL OF FOREST RESOURCES

1. The Techniques of Lumber Yield Improvement - **Proven and practical techniques for increasing rough mill yield in furniture and cabinet plants.** This 2-3/4 hour program includes valuable tips on lumber buying, yard and dry kiln operations, rough mill systems, defecting techniques and decision making, moulder, trim, and spoilage allowances.
(165 min.) - $105.00

2. Troubleshooting the Moulder - **Important viewing for both supervisors and machine operators** - Developed in cooperation with Michael Weinig, Inc., this video provides worthwhile information on moulder operation including the influence of cutting angles, feed speeds, depth of cut, size of cutterhead, knife marks per inch, tear-out reduction, etc.
(42 min.) - $69.95

3. 49 Ways to Cut Costs in Production Woodworking - **Woodworking ingenuity in action** - This presentation was video taped in actual wood-industry operations across the United States and Canada. Shown are innovative machine adaptations, jigs and fixtures, and ways to improve productivity which have been developed by the Furniture, Cabinet and Dimension Industries and shared with us.
(70 min.) - $69.95

4. 50 More Ways to Cut Costs in Production Woodworking - **More Woodworking Ingenuity in action** - This Program is a sequel to video No. 3. The innovations, jigs and fixtures, and cost saving techniques which are presented are "real" developments by wood industry manufacturers.
(56 min.) - $69.95

5. Selected Presentations on Wood Technology - **Understanding wood can improve product quality and reduce manufacturing costs** - Presented in this video are a variety of illustrations on how and why wood shrinks, swells, and warps. "High speed" photography shows wood changing shape in response to different environmental conditions. The structure of wood is explored. Also the wood cutting process including the influence of different cutting angles is explained in an extraordinary sequence of video "clips".
(47 min.) - $69.95

6. Troubleshooting the Dry Kiln and Its Controller - **Ways to analyze what is happening in the dry kiln** - This video was developed in cooperation with the Irvington Moore Co. Mike Sanders, Service Manager, shows a series of dry kiln control charts and explains how to "read" the charts and understand what is happening in the kiln. Mike also discusses some ideas on overall kiln maintenance.
(62 min.) - $69.95

7. Selected Presentations on Lumber Yard and Dry Kiln Operations - **A variety of interesting "video clips"** - The "Telemobile" lumber transporter, envelope covers for lumber piles, heat exchangers, bolster clips, and moisture pallets for lumber drying are some of the unique items shown on this video. Also included are discussions of brown stain in white pine, kiln maintenance, and an inspection of a new lumber stacking operation in North Carolina.
(69 min.) - $69.95

8. Woodworking Machine Operator Training Programs - **Available with video and written training manuals for six woodworking machines** -
   a) Router
   b) Shaper
   c) Cut-off Saw
   d) Variety Saw
   e) Straight line Ripsaw
   f) Band Saw

   Approximately $240 each machine. Ask for additional literature and specific quotation.

9. Selected Presentations on Wood Gluing - **Improve gluing quality while reducing gluing costs** - This program begins with a discussion of how to troubleshoot gluing problems by Dr. Myron Kelly of NCSU. Examples of a variety of gluing problems are shown along with preventative

measures. Next a series of cost saving or interesting ideas and devices are presented. Finally, two highly skilled clamp carrier operators are shown in action.

(40 min.) - $69.95

10. **Skilled Woodworkers in Action - Show your employees work paces which will keep your company competitive** - The following skilled operators are shown in this video: Cut-Off, Ripsaw, and Glue Reel operators, Hand "Chucker", Drawer Assemblers, Chair Assembler, Stain Wiper, Sealer Sprayer, Sealer Sander, Chair Packer.

(25 min.) - $69.95

11. **Quality Influences in Kiln Drying - A common sense presentation which can help you to reduce drying degrade** - This program is presented by Lee Fiske of Forest Products Associates. Lee has over 35 years experience operating his own custom kiln drying operations, and serving the international wood industry as a consultant in wood moisture relations. In this video, Lee tells how to avoid drying degrade, and modify drying schedules. He also discusses lumber stacking, sampling procedures, and the techniques of equalizing and conditioning.

(40 min.) - $89.95

12. **Operating and Maintenance Procedures for the Clamp Carrier - Produced in cooperation with James L. Taylor Manufacturing Co.** - The daily, weekly, monthly, and annual maintenance procedures for the clamp carrier are outlined in this video. Also shown are the correct operating procedures which can lead to reduced costs and improved quality.

(30 min.) - $69.95

13. **Efficient Wood Sanding - Part 1: Wide Belt Operations - Produced in cooperation with Norton Company. - This program is designed to take the mystery out of sanding.** Troubleshooting, critical elements of machine set-up, and tips for quality improvement and cost reduction are reviewed by Norton's William T. (Bill) Beaty. Machines reviewed include abrasive planers, intermediate wide belt sanders, and cross belt - wide belt sanding systems.

(77 min.) - $99.00

14. **Efficient Wood Sanding - Part 2: Sanding Department Operations - Continuation of Video No. 13 with the review of troubleshooting, cost saving tips, etc.,** for the following operations: moldsanding, spool sanding, brush-backed sanding, flutter sanding, stroke sanding, edge sanding, and pump drum sanding. Operations were video taped at Bassett Furniture Industries, and Thomasville Furniture Industries.

(approx. 60 min.) - $99.00

15. **Selected Presentations on Wood Machining - Presentations range from basic to thought provoking.** - Professor Robert Gilmore, of NCSU begins the program with a demonstration of maintenance checks for the Diehl straight line ripsaw. Next shown is a lumber slicing operation in North Carolina. Finally, Professor Gilmore shows some examples of possible applications for finger jointing which might apply to your operation.

(36 min.) - $69.95

16. **Wood Furniture Finishing - Produced in Cooperation with Graco, Inc. and Reliance Universal, Inc. - This four part video program is designed to assist your company to train your professional spray operators.**

NEW

This video will be the perfect training vehicle for you to help improve productivity and meet quality standards while reducing the number of rejects. You will be able to view the video over and over again whenever there is a spray finishing or training concern. The program is divided into four segments:

- The Wood Finishing Process
- Fluid Handling and Finishing Equipment
- Spray Techniques
- Troubleshooting and Maintenance

NEW

Important Viewing for Both Spray Finishing Operators and Supervisors.

(52 min.) - $105.00

Wood Industry Video
Dept. of Wood & Paper Science
N. C. State University
P.O. Box 8005
Raleigh, NC 27695-8005

Encyclopedia of Polymer Science and Engineering,
Volume 5, Second Edition.

DIELECTRIC HEATING

Heat transfer to materials that are poor thermal conductors is difficult. Surface overheating or even burning may occur. Dielectric heating can circumvent these problems. This phenomenon occurs when an electrical insulator is placed in a high frequency electric field. Because the electric field penetrates throughout the material, the heat is generated within, and penetration from without is not necessary.

Dielectric heating is clean, controllable, quick, and needs little warm-up time. The equipment cools down quickly. Except for inevitable heat losses, a dielectric heater delivers heat with cool electrodes. External heat may be desirable in some cases, such as in drying processes, to supplement the dielectric heat or remove volatiles.

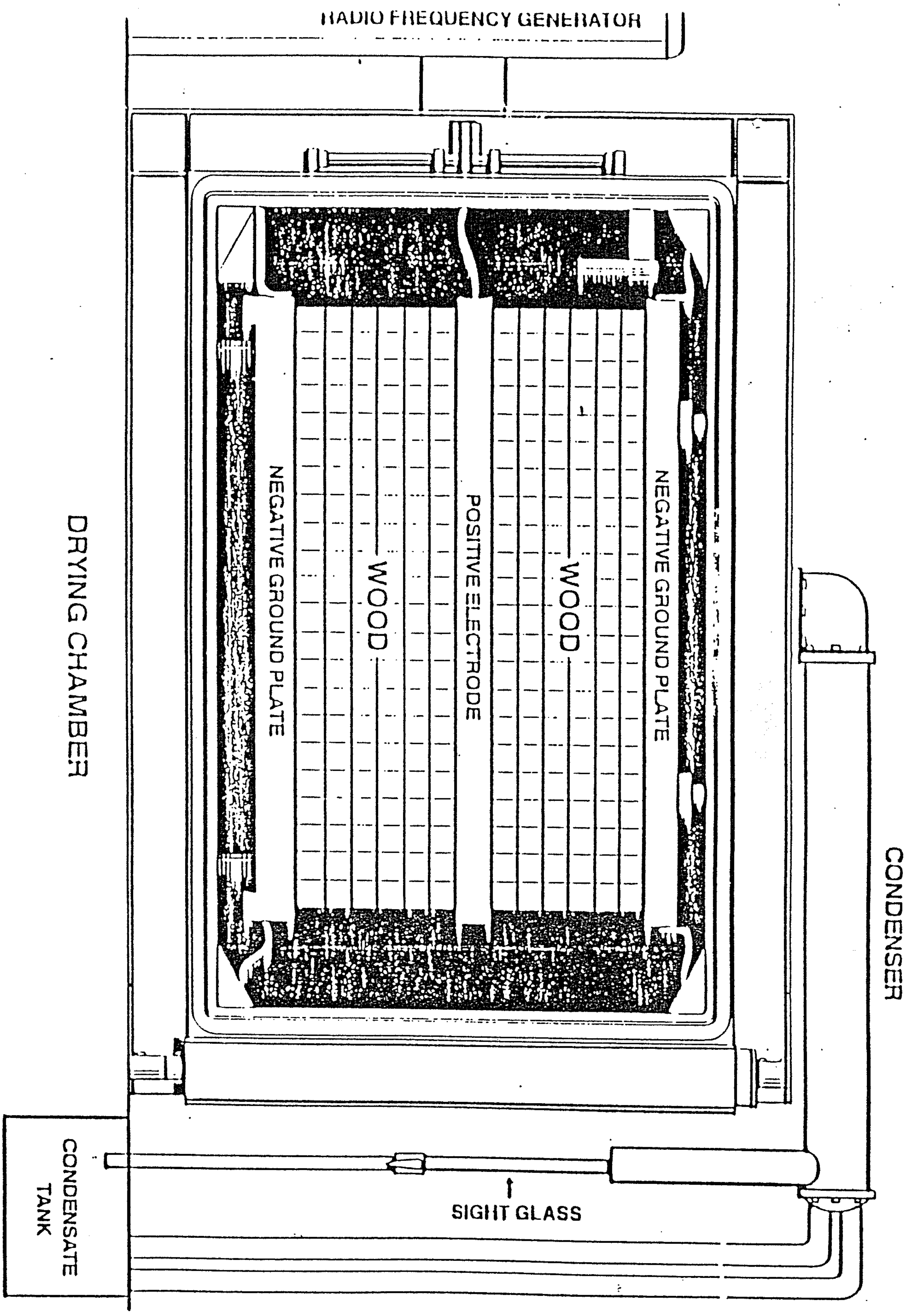
Microwave heating and dielectric heating are similar, except for the frequency at which they are operated. In microwave heating, the frequency is very high, ie, 915–2450 MHz, and the wavelength is short. In contrast, dielectric heating uses 2–100 MHz, and wavelength is much longer. Heating can take place owing to electrical conduction in the material as well as to dielectric heating alone. This has advantages, particularly in foods where salt adds to the conductivity.

Dielectric heating follows the laws of electricity. However, the frequency may be 50,000 to 2,000,000 times as high as normal power-line frequencies. Therefore, capacitive reactances are much smaller, and inductive reactances are much larger.

Dielectric-heating generators, or the applicators where heating takes place, are usually equipped with controls to adjust variations in product characteristics, such as dimensions and moisture content, and allow for the normal variations of the electrical characteristics as the temperature rises, the moisture evaporates, or the thickness changes during heating. Although calculations are guides only, they are worth pursuing in many cases.

Theory

Most molecules are polarizable in an electric field (see Fig. 1). The degree of polarization and the energy required to achieve it control the loss factor or dissipation factor of a material. A material that is readily polarized by a small electric field has a high loss factor and is easy to heat.



Schematic R.F. Timber Drying System.