SUMMER 1987 Vol. 3 No. 1

Forest Products NEWSLETTER

PULPING RESEARCH ACTIVITIES IN WESTERN AUSTRALIA

C. J. Fallick

The state forests of the south-west of Western Australia cover 1·85 m ha and are composed of three principal species. Jarrah *(Eucalyptus marginata)* and mixed jarrah and marri *(Eucalyptus calophylla)* forests account for about 1·5 m ha., and karri *(Eucalyptus diversicolor)* or karri-marri accounts for 0·2 m ha. Jarrah and karri are logged for timber, but marri has little value for this purpose.

Until the late 1960s, marri was regarded as a weed species, remaining after the selective logging of the more desirable sawmilling species. Marri logs generally contain 'water shakes' or cracks which make them unsuitable for sawlogs because when the timber is sawn it tends to fall apart on the saw-bench.

However, an assessment of the pulpwood quality of marri forest residues by CSIRO workers (1) demonstrated that marri is a valuable resource for pulping and this work has been helpful in gaining overseas acceptance of WA woodchips for fine writing and printing papers. This research has led to the establishment of a woodchip mill at Manjimup and an export terminal at Bunbury.

The export woodchip and timber industries are in a sense, symbiotic. Both benefit from the activities of the other. Marginally economic timber milling operations gain additional income by selling timber offcuts as woodchips. This is an important contribution as normally less than one-third of the available log in a tree can be utilized for timber and the remainder would otherwise be burnt.

On the other hand, the woodchip industry is permitted to take additional wood from the forest after the timber wood has been removed. This practice enables an improved forest to be regrown instead of leaving a forest consisting mainly of marri and small quantities of extremely poor form karri and jarrah trees.

Forestry operations by the Department of Conservation and Land Management (CALM) are made more economical because unwanted residues from mining, timber and fire-prevention operations, which once were burnt, are now being used for woodchip export. From the first shipment in 1976, the export woodchip industry has grown and now earns the state more than $30 million per year in export income and produces jobs for more than a 1000 people.

Currently the woodchip export mixture consists of approximately 70 per cent marri forest residues and 30 per cent karri mature wood (non-sawlog trees and sawmill offcuts). The WA Chip and Pulp Co. Pty Ltd (WACAP) is continually working to maintain the quality of their export chips.

Chip size distributions and the presence of bark and fine material require constant monitoring. Pulping quality variations due to changes in the proportions of young and old wood or marri to karri are also

in this issue . . .

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CSIRO Division of Chemical and Wood Technology

difficult to control. Whereas the marri-karri woodchip mixture has gained commercial acceptance from buyers, an equally large amount of jarrah pulpwood chips from sawmill offcuts is available annually, but cannot be sold because of its less economical pulping properties.

In Western Australia, other wood species are of interest because of plantation activities. The mixture of available species for pulpwood will change substantially as forestry management practices affect the total forest composition. Options available to the woodchip industry for improving the acceptability of jarrah chips are mainly related to mixing the lower pulp-yielding material from jarrah sawmill offcuts with higher pulp-yielding chips.

The higher quality material could come from thinning operations in renewed karri and jarrah forests (young jarrah has better pulping properties than older wood). There are also stocks of *Eucalyptus globulus* and possibly pines (*Pinus radiata* and *Pinus pinaster*) which may be available for woodchip production.

CSIRO Pulping Studies

Initial pulping studies were carried out on various WA wood samples in the early 1960s by Phillips and Watson (2) and Phillips *et al.* (3). The species tested included marri, karri and jarrah young and old trees, thinnings and sawmill waste as well as *Pinus pinaster* plantation thinnings.

Since 1980 an officer from the Division of Chemical and Wood Technology has been based at the CSIRO laboratories at Floreat Park to continue evaluation studies on woodchips for pulp and paper manufacture. The funding, facilities and equipment for this have been obtained mainly through the support of WACAP. Some of the pulping investigations being done in Perth are discussed below.

(i) Jarrah sawmill residues

Jarrah is an excellent timber which has natural resistance to insect damage. However, it is not a good pulpwood because it consumes a relatively high amount of pulping chemical and gives a low pulp yield (38–40% based on dry wood). The resultant pulp has a relatively high lignin content, as measured by the Kappa number (Table 1). The waste

Fig. 1. Marri and jarrah forest.

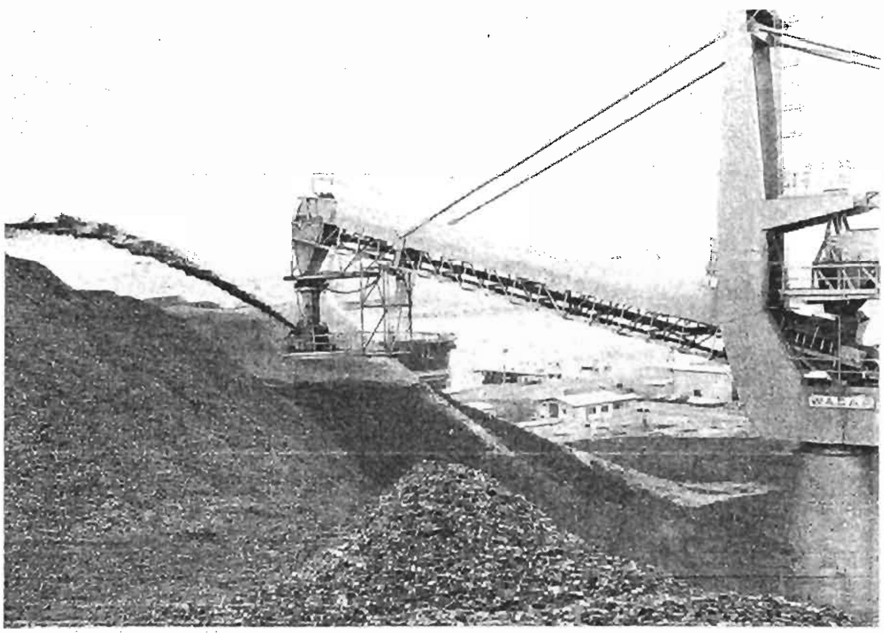

Fig. 2. Marri-karri export woodchips at the port of Bunbury.

Print this page

Table 1

Comparison of typical wood basic density and kraft pulping results from various woodchip sources

Sample (Reference)	Basic density (kg/m3)	Active alkali* (% as Na_2O)	Screened pulp yield* (%)	Kappa number
Marri, forest composite (1)	644	21	41·2	20·3
Marri, young trees (3)	607	14	54·4	(24·1)
Karri, sawmill waste (3)	695	14	(50·4)	(20·6)
Karri, thinnings (3)	644	14	(56·2)	(12·3)
Jarrah, export quality (4)	650	18	39·5	34
Jarrah, young trees (+)	610	18	42·7	19
Young plantation trees (+)				
E. globulus, 8 yr	422	13·5	51·2	23·0
11 yr	494	12·3	57·1	19·1
19 yr	594	13·0	53·9	18·5
E. muellerana, 17 yr	533	12·5	48·8	21·5
E. regnans, 12 yr	470	11·9	56·0	23·7
E. saligna, 11 yr	470	13·0	50·9	18·8
19 yr	481	15·0	47·2	20·5
E. maculata, 8 yr	443	16·0	40·6	21·4
E. resinifera, 8 yr	465	15·0	41·9	20·3

Values in parentheses are for unscreened pulps
* Percentages based on o.d. wood
\+ Unpublished results from CSIRO

pulping liquors can provide substantial heating energy on burning but the liquors are relatively difficult to process because of their high viscosity.

Some good points can be noted. Jarrah is a fast pulping wood and the pulp has a high bulk density which is necessary for fine printing papers. Also, the high density of the wood is an advantage (i) in reducing shipping freight costs because these are usually charged on a volume basis, and (ii) in batch pulping because the digester has a limited volume and more pulp can be obtained from each digester charge of dense wood.

Details of pulping, bleaching and black liquor properties of jarrah have been published (4) with particular emphasis on the improvements possible using rollers to squeeze the chips before pulping. The process is dubbed "roll destructuring" and produces a noticeable increase in pulp yield and a substantial reduction in shive and knot rejects.

An alternative to selling jarrah chips alone is to mix jarrah with higher quality chips. Mixing woodchips from jarrah (a hardwood) and pine (a softwood) is one solution but it has a potential problem. The mixture tends to be over- or under-pulped because softwoods require a longer pulping time. Roll-destructuring the mixture goes a long

Fig. 3. Screening woodpulp in the laboratory.

way to solving the above problem because relatively short pulping times can then be employed with improved pulp yields (4).

Mixing jarrah with other hardwood chips so that the mixture has approximately the same pulping properties as the present marri-karri chips is a current CSIRO project. In order to evaluate a number of potential woodchip mixtures, CSIRO is currently undertaking a collaborative project funded by WACAP to assess the pulping quality of forests to the south of Perth. Particular emphasis is being placed on the residues expected to be available from timber activities in these areas.

(ii) Marri-karri export chips

The export income that is generated by the sale of marri-karri chips is dependent upon the pulping quality of the chips, and the uniformity of yield and bleaching quality that is obtained from the pulp. WACAP therefore need to monitor the pulping properties of the chips in order to maintain a consistent quality in export shipments of the marri-karri mixture. The information obtained is also needed for determining prices relative to other woodchip sources in Australia.

(iii) Miscellaneous species

Reforestation of dieback-affected areas has been a problem in WA, especially in the northern jarrah forest areas. ALCOA of Australia Ltd. has been experimenting with replanting eucalypts and other species in dieback affected areas. Although initial attempts were simply directed at reforesting, it has now become clear that these sites would be very productive for sawlogs, poles or piles, and pulpwood.

Young eucalypts (*E. globulus, E. muellerana, E. maculata, E. saligna,* and *E. regnans*) have all been found to give good pulping and papermaking properties (Table 2), although *E. regnans* does not appear to be as resistant as jarrah to *Phytophthora cinnamomi* (the primary cause of dieback). The best pulpwood species in terms of growth rate and pulp yield was *E. globulus.*

Marri, karri and jarrah are the only WA woods which have been investigated in detail for pulping and papermaking properties. Other species might have superior pulping or papermaking characteristics, but these are not available in commercial quantities. However, various forest understory species may be worth investigating in the future as they can contribute considerable amounts of biomass. Banksias and acacias could be considered for pulpwood as well as eucalypts.

Table 2
Comparison of some typical papermaking properties of unbleached pulps at 250 CSF.

Sample	Bulk (cm3/g)	Tear index (mN.m2/g	Tensile index N.m/g
Marri, forest composite	1·76	8·8	58
Karri, sawmill waste	1·75	11·4	69
Jarrah, export quality	1·57	8·9	66

Fig. 4. CSIRO paper testing laboratory.

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Non-Destructive Determination of Timber Density Using Computed Tomography

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A number of speakers at the recent 22nd Forest Products Research Conference, held at the CSIRO, Division of Chemical and Wood Technology in Clayton, Victoria, discussed the quality of timber and, in particular, how this may be measured in terms of mass density. Discussion followed on not only the importance of average density, but also on the need to accurately measure variation in wood density.

Staff within the Applied Physics Department at the Chisholm Institute of Technology have, in the last 18 months, developed an interest in the use of computed tomography (CT) as a means of non-destructive testing and evaluation of various materials. CT is an ideal tool for the non-invasive determination of density in timber, and to demonstrate to those in the timber industry that an opportunity exists to obtain information concerning the structure of wood that may be used to increase both the quality and the optimisation of timber resources.

CT is a technique that allows the operator to obtain, in a totally non-destructive manner, a two-dimensional map of the mass density of a section of interest within a specimen. Until recently CT has been used almost exclusively in radiology as a medical diagnostic aid. However, during the last five years tomograpohy has been exploited overseas in a wide range of industrial applications and its value to the timber industry in a range of areas has been clearly demonstrated. An indication of these applications is provided by some suggested further reading listed at the end of this article.

Conventional radiography, utilising film or image intensifier techniques, along with CT, use (in timber applications) x-radiation in the range 10-200keV. As x-rays travel through material the beam becomes weakened according to the well known expression

$$I_t = I_o \exp(\mu x),$$

where I_o is the incident beam intensity, I_t the transmitted intensity in the direction of the incident beam, and μ is the (average) linear attenuation coefficient of the material of thickness x. In a radiographic application one essentially determines μ, and if the x-ray beam is monochromatic, or nearly so, it is well established that μ is directly proportional to mass density, ρ.

In conventional radiography, a technique sometimes used for non-destructive evaluation of timber and timber products, a 2-dimensional (2D) projection, or image, of a 3-dimensional (3D) object is acquired. This method requires an x-ray source to be positioned above the section of interest in the specimen and the film or detector arrangement to be placed below the section as shown in Figure 1(a). For a "thick" object this has the great disadvantage that all information between the x-ray source and the film contributes to the final image, not just that in the section of interest, and thus desired features are often very blurred, or features are ambiguous. For example, a log may be x-rayed in this way prior to sawing, and knots, large checks and other defects may be identified, but it is impossible to predict their actual location because of the loss of information in compressing 3D detail into a 2D projection.

Tomography, however, allows an unambiguous 2D reconstruction of a map of density of the desired section of the specimen. This is accomplished by using a source/detector arrangement that moves about a plane that coincides with that section of interest, as illustrated in Figure 1(b).

As the name may suggest, computed tomography involves acquisition of sampled data from the detectors as source and detectors are moved in small linear and rotational increments about the specimen, and this data is then digitised and processed by a computer. The image reconstructed from this data will typically have a spatial resolution of around 0.5% of the overall dimensions of the object; 1mm resolution for a 250mm diameter timber specimen is readily achievable. The contrast, or density, resolution is also excellent with density fluctuations of $\Delta\rho/\rho$ of 1% or better being possible.

True 3D information may be acquired by scanning contiguous, closely

Two of the principal authors, Ms B. Suendermann (above) and Ms P. Shadbolt (below).

Dr John Davis is currently visiting major timber research institutes throughout the world, partly funded by a Gottstein Fellowship.

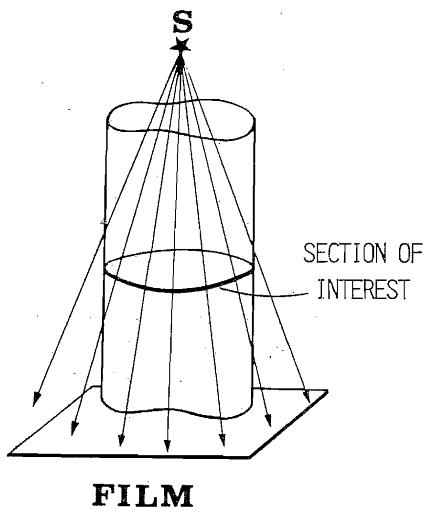
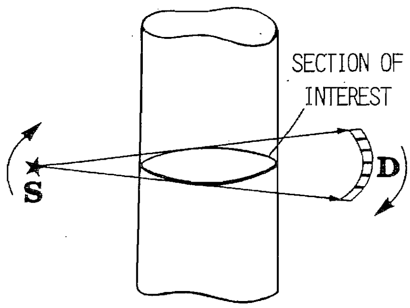


Fig. 1. (a) Arrangement for conventional radiographic imaging, where S represents the X-ray source and (b) for computed tomography (CT), where D represents the detectors.



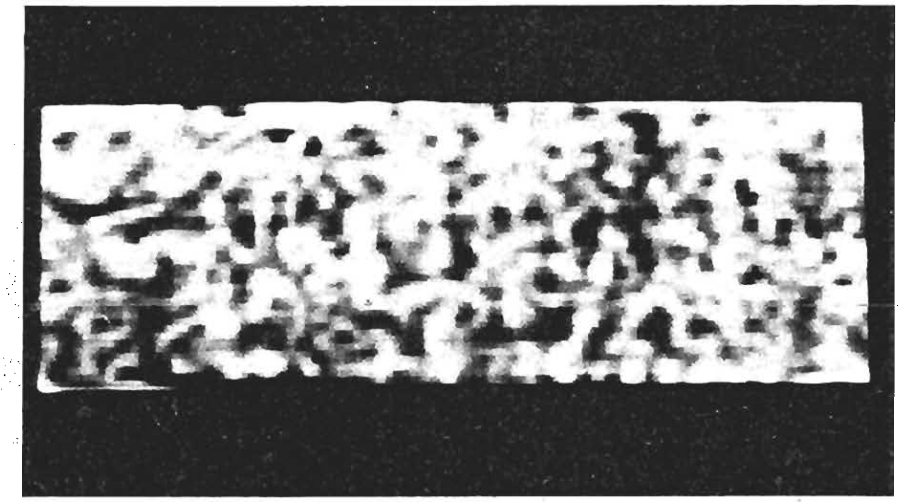


Fig. 2. CT scan of a section through 185 mm × 60 mm piece of scrimber. This image indicates the different densities of timber and glue, with the dark areas representing low density and light areas high density.

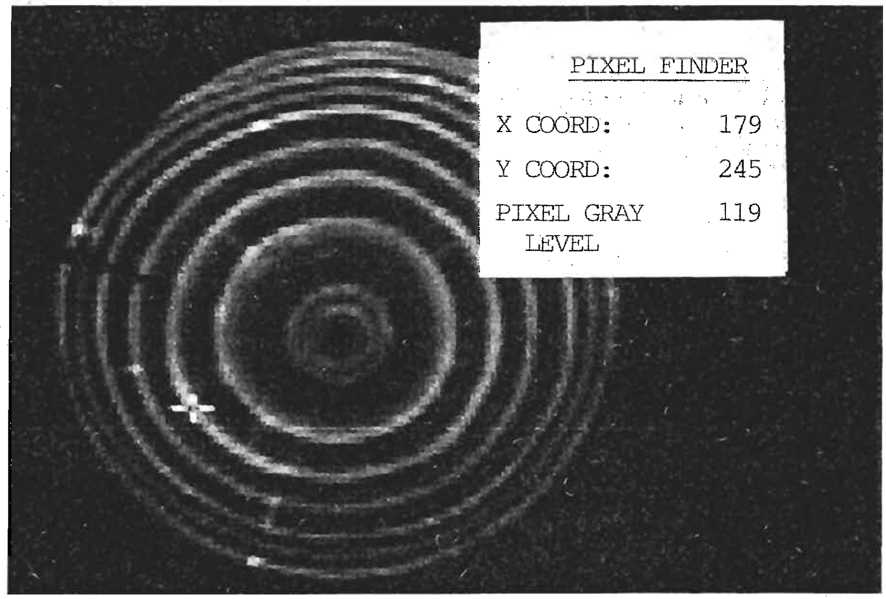


Fig. 3. CT image of a section through a radiata pine pole 180 mm in diameter. The picture element (pixel) identified has a density of approximately 700 kg/m^3. In this image light areas represent higher density regions. The densities within this section range from about 176 kg/m^3 up to 794 kg/m^3.

spaced sections of the object; the spacing between each scan being set at about the thickness of the x-ray beam. Reconstructed images of the specimen cross-sections are normally displayed on a computer monitor using a grey scale where black through white represent density variations from air to sound timber. Another major advantage of CT is that one has a digital image that is relatively easily stored, retrieved and further processed to enhance picture quality or extract features of interest. Colour coding may also be used to highlight certain features for easy identification.

The potential for this technique to be applied successfully to the timber industry in Australia is widespread and encompasses:

- scanning of timber utility poles for structural integrity.
- scanning of other structural support poles.
- scanning of logs prior to sawing in order to optimise the usage of timber resources.
- determination of density variations in timber composites e.g., scrimber laminates, etc.
- forest management and silviculture in order to determine the effects of environment, management practices, selective breeding etc.
- measuring the penetration and retention of preservatives.

Some of the applications on the above list are possible now, while others will require extensive research and development. Some representative results from the authors' own work are shown in Figures 2–4. These figures have been selected to illustrate the capabilities of tomography in identifying features in timber and timber products. Figures 2-4 were obtained with an EMI CT1010 tomographic scanner installed in the Applied Physics Department at the Chisholm Institute of Technology. The data for these three images were passed to an IBM PC for further processing and then photographed directly from the PC

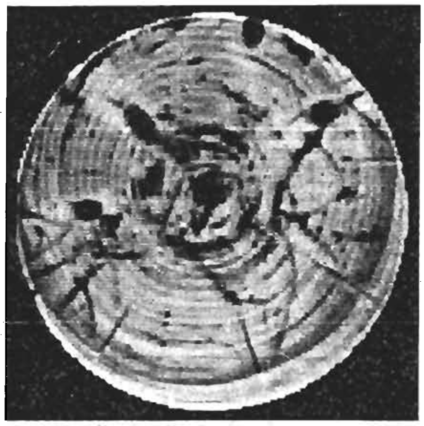


Fig. 4. Reconstructed CT image of a white stringybark utility power pole about 230 mm in diameter. Features readily seen are the ring structure, centre and ring rot, small radial checks, inspection drill holes (dark ovals) and termite galleries. The light region at the bottom of the photograph indicates the presence of more sound timber due to the penetration of creosote.

monitor.

While CT could provide huge benefits to the timber industry further work is certainly required and there are presently some severe limitations that must be spelt out. The equipment is expensive compared to conventional film radiography, and data acquisition and image reconstruction is relatively slow; a typical scan would require somewhere between 10 seconds and 5 minutes depending on source strength, detector array and computational speed. Also, at present x-ray CT scanners are essentially laboratory based, although the design of a portable system is currently the subject of a detailed study at Chisholm.

In summary, computed tomography has the potential to be a viable and valuable aid for the testing and evaluation of structural materials, including timber. CT is totally non-destructive, and the scope for assisting in the production and/or maintenance of high quality timber products in the long term is wideranging. The authors of this article, while not purporting to claim any great expertise in the study of timber,believe CT, and related techniques, have a role in the timber industry and the authors would be interested in discussing these topics with producers and users of timber with a vire to both providing additional information and seeking areas of possible development.

Further suggested reading:

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Forest Products Newsletter July 1985–Dec. 1986

† N.S. =New Series
** Three issues published in 1986.*

Forest Products Newsletter — DISTRIBUTION

Currently the *Forest Products Newsletter* is being distributed to a wide range of individuals associated with the forest products industry both in Australia and overseas. It is also supplied in bulk to industry associations, forest department and research laboratories for distribution. If you would like to receive a copy (copies), please write to the Editor giving your name, organisation, postal address and telephone number. We would welcome any suggestions or comments on either the content or the format.

Chinese Ministry of Forest Delegation to Australia

Two Melbourne Divisions of CSIRO recently received a delegation from the Chinese Ministry of Forestry. The overall objective of the visit was for the delegates to become acquainted with the methodology of planning and management of Australian forestry and forest products research organisations.

The delegation was led by Mr Fang Kan, Divisional Chief of the Ministry's Science and Technology Department. Other members of the delegation were:

Mr He Zhongmin, Director of Sichuan Provincial Forestry Research Institute

Mr Long Wenbin, Director of Guangdong Provincial Forestry Research Institute

Mr Xue Chongbo, Deputy Director of Shaanxi Provincial Forestry Research Institute

Mr Ye Shijia, Deputy Director of Guanxi Forestry Research Institute

Mr Wang Shikui, Program Officer, Ministry of Forestry and

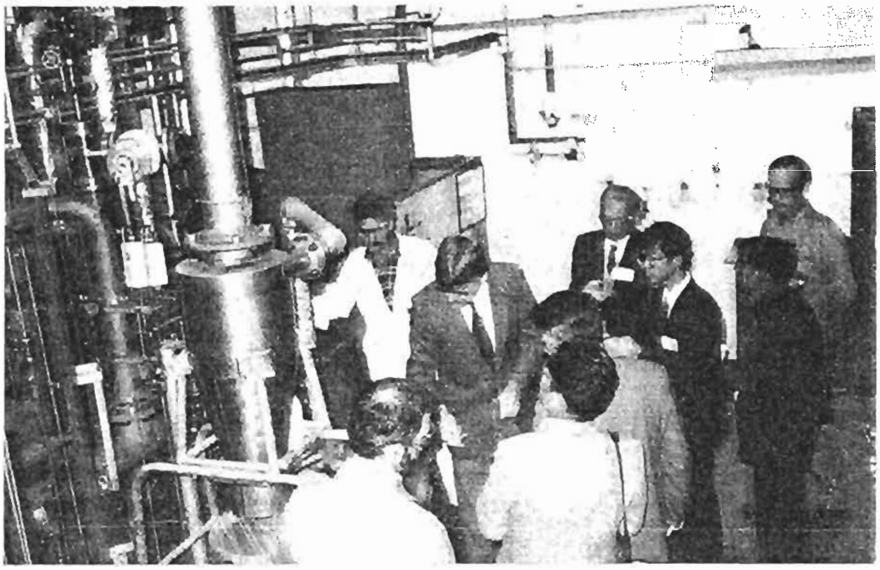
Mr Zhang Zhongtian, Interpreter, Ministry of Forestry

The one-day CSIRO visit was part of a more extensive study tour through Queensland, New South Wales, ACT, Victoria and South Australia during which inspections were made of industry facilities as well as government forestry and forest products activities. The whole tour was organised and coordinated by professional forester Brian Cumberland for the Australian Centre for International Agricultural Research (ACIAR) on behalf of the Australian Development Assistance Bureau (ADAB).

The Melbourne CSIRO visit, coordinated by Doug Howick, commenced at the Division of Chemical and Wood Technology in Clayton with an overview of forest products research in Australia and in CSIRO by Chief of Division, Dr Warren Hewertson. Subsequent presentations and displays covered the following subjects:

The Cellulose Technology Program (Dr Tony Michell), SCRIMBER (John Coleman), Wood Fibre-based Materials (Dr Bob Coutts), Pulping and Pulpwood Resources (Bill Balodis), Pulping Technology (Dr Peter Nelson), Sunds Defibrator (Max Williams) and Chemical Conversion (Dr Adrian Wallis). The delegation left Clayton after lunch, for the Division's Highett site where their inspections and discussions included the Conservation and Biodegradation Program (Dr Harry Greaves) and the Timber Conversion Program (Frank Christensen). Thereafter, they spent time with the Division of Building Research, hosted by Assistant Chief John Nicholas. They showed particular interest in DBR work on Timber Structures (Dr Bob Leicester), Adhesives (Voytek Gutowski) and Technology Transfer (Bob Couper).

A subsequent letter of appreciation from ACIAR stated that the members of the delegation agreed that, as a result of the visit, they would be taking home many new ideas and directions for wood science research in China.



Dr Peter Nelson (centre) explains the intricacies of the Sunds Defibrator while Max Williams in white overalls oversees its efficient operation

Bill Balodis (back to camera) leads visitors through an inspection of the Division's pulp assessment laboratory

Autumn 1987 Vol. 3 No. 2

Forest Products NEWSLETTER

The Young Eucalypt Program

... co-operative research into the growth, harvesting and use of intensively managed eucalypts

S. M. Lucas

The *Young Eucalypt Program* brings together the forest scientists and technologists researching growth and processing in our regrowth eucalypt forests with the key users of this research—the state forest services of Tasmania and Victoria and the forest industry of these two states. The program is unique (unusual?) in the government research sphere as it is directly controlled by a Management Board with the positions of Chairman and Vice-Chairman being held by two industry representatives—Ken Harris (Tasmanian Board Mills Pty Ltd) and Angus Pollock (APM Forests Pty Ltd), respectively. Other members of the Board include: John Carson (Director, Australian Timber Research Institute); Duncan Grant (Manager Forest Operations, APPM Pty. Ltd.); Ken Felton (Tasmanian Forestry Commission); Kevin Wareing (Victorian Dept. of Conservation, Forests and Lands); Bill Kerruish (CSIRO Division of Forest Research) and Bill Rawlins (CSIRO Division of Chemical and Wood Technology). The membership of the Board is a direct reflection of the primary contributors of funds to the program—CSIRO, the two forest services and forest industries of Tasmania and Victoria.

The Program Director (Bill Kerruish) is directly accountable to the Chairman, while Chris Palzer (Tasmanian Forestry Commission) and Peter Fagg (Victorian Dept. of Conservation, Forests and Lands) coordinate research within their respective states.

The program is investigating the feasibility of more intensive management of our better productive eucalypt forests. To quote the Board's Vice-chairman, Angus Pollock, the *Young Eucalypt Program* is an investment in obtaining the information needed to manage our forests more efficiently, and which will allow us to compete in the world marketplace more effectively. To date the program has concentrated on thinning natural regeneration and its effects on products and economics. The program focuses on specific research areas, and generating information and results which are directly related to the participants concerned. The research program was initiated in mid-1985 and has a four year term. It has seven major projects:

Thinning and Harvesting

This involves the study of new technologies for the thinning (commercial and non commercial) of young stands to establish the effects of stand variables on machine productivity and costs. A modified Lako harvesting head was fitted to a Kato excavator and used to fall, debark and cross cut long and short length pulpwood on six different sites in Northern Tasmania. A final report

in this issue . . .

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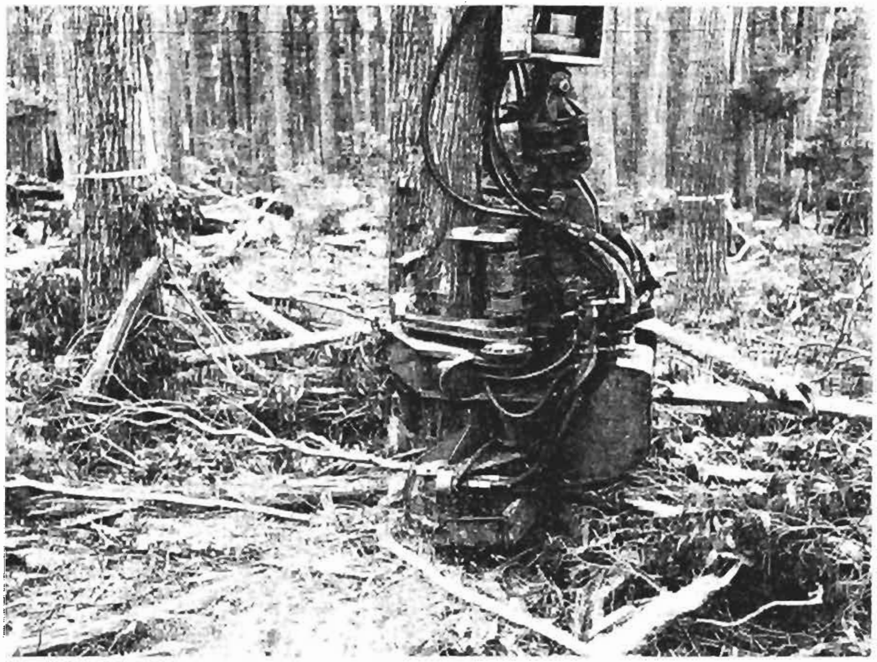
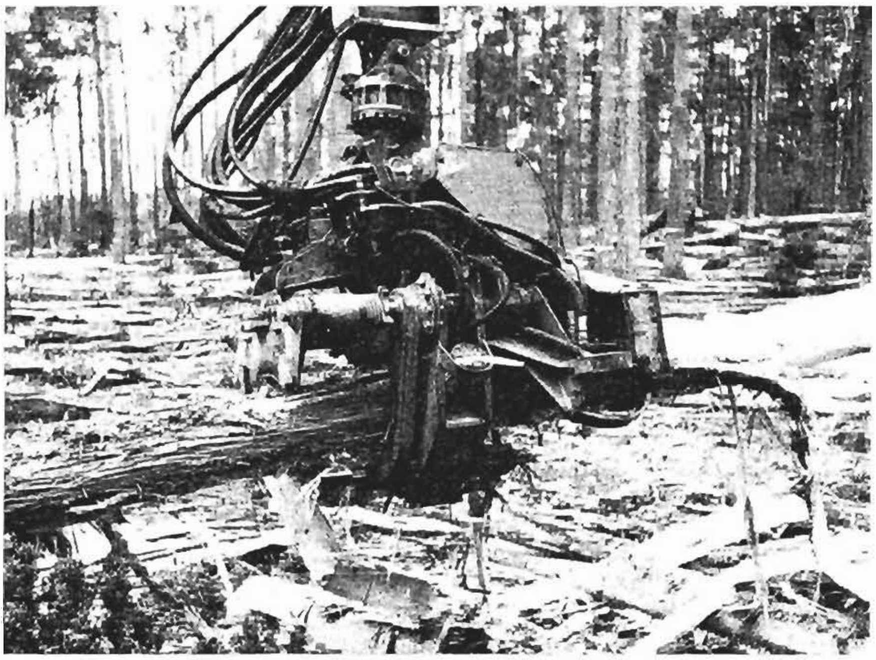
CSIRO Division of Chemical and Wood Technology

on this work is now available. Last year an experiment using herbicides in non-commercial thinning was completed in seven stands of regrowth *Eucalyptus regnans* Toolangi, Victoria. Results showed injecting stems with an appropriate herbicide appears to be a useful technique. Further development of injection techniques will continue, although the basal spear and axe/vaccinator both gave a satisfactory result. In particular, techniques which would let an operator treat a tree from one side appear to offer considerable promise in reducing labour input. The above experiment will be repeated at three sites in southern Tasmania using the stem injection technique (herbicide).





The modified Lako grapple harvester felling and debarking thinnings in a Tasmanian trial. The fibrous and voluminous bark is left on the forest floor, reducing the costs of transport and bark disposal at the mill and returning significant amounts of nutrients and organic matter to the site. The effect of increased fuel loadings on fire behaviour is not known.

Another trial will investigate mortality through the use of a variety of herbicides and application methods, including basal/foliar spraying and a new gas powered gun that directly injects the herbicide into the tree. The preliminary report on techniques is also available now. A workshop on likely chemicals as a method for killing or inhibiting the growth of selected trees and how they move through the tree and efficient means of application will be held later this year.

Project Leader: Bob McCormack
CSIRO Division of Forest Research, Canberra.

Growth Response

This project is designed to predict the growth of young stands of *E. regnans* at different spacings, and how they will respond to different thinning treatments. Progress to date has involved the development of a theoretical model. Two experiments will be established this year, one in Tasmania and one in Victoria to validate the theoretical model. The experiments will be restricted to *E. regnans* forest of high quality. The forest will be thinned and growth behaviour and physiological responses of the trees will be measured for up to five years.

Project Leader: Phil West
CSIRO Division of Forest Research, Hobart.

Stand Damage

Thinning can be expected to cause some damage to the roots and stems of a proportion of the remaining trees. Resulting changes to branch shed may also influence the occurrence of defects. A scientist has been appointed to do a comparative analysis of the development of decay and discolouration in thinned and unthinned stands and establish whether new thinning technologies can reduce the incidence and severity of damage. The project has three objectives (i) to assess the existing incidence, extent and type of defect in young regrowth stands and how it is influenced by species, site quality and stand variables; (ii) to assess the damage to residual trees from thinning and evaluate its consequences in terms of defect in the final crop trees; (iii) to examine the degree of genetic control of susceptibility of eucalypts to discolouration and decay (this is long term).

Project Leader: Glen Kile
CSIRO Division of Forest Research, Hobart.

Debarking

The project is investigating alternative technologies for the removal of bark from small diameter, fibrous eucalypts. Work on testing a small mobile ring debarker (VK 16 E) has been completed, measurements are being analysed. A feature of the machine is the arrangement of alternate scribing and debarking knives, intended to remove the bark in short, discrete lengths. Blockages to the machinery occurred when freshly cut logs of *E. obliqua*, *sieberi* and *regnans* were used. After storage for a few weeks satisfactory debarking of *E. regnans* at low feed rates was achieved, although it was limited to short logs (<3·4m) and diameter range.

A joint development contract is being finalised between SIROTECH and a manufacturer to construct and market a newly designed CSIRO compression debarking head, suitable for debarking young eucalypts in the forest. The chosen manufacturer is currently carrying out a market survey.

Project Leader: Robin Wingate-Hill
CSIRO Division of Forest Research, Canberra.

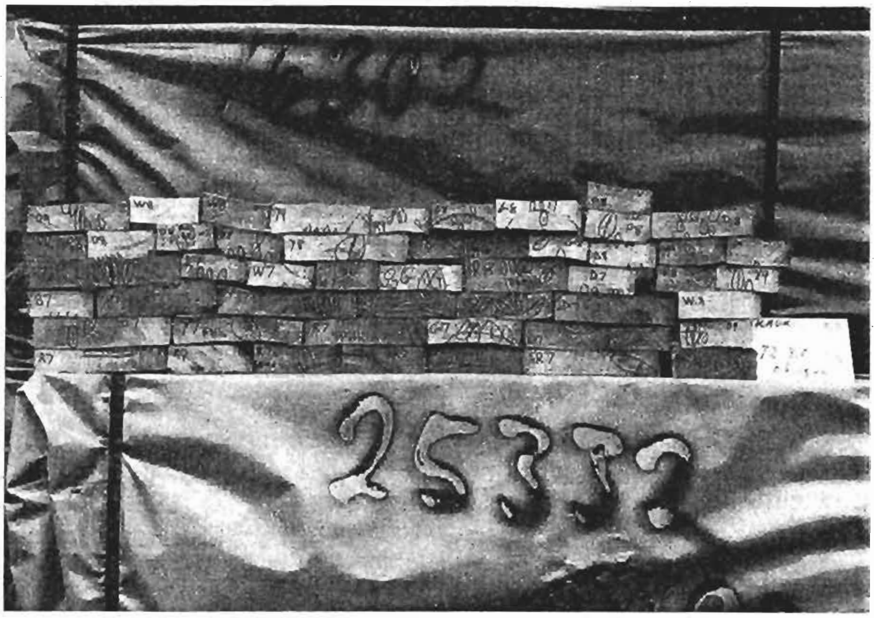
Sawn Timber Production

An initial study of Tasmanian *E. regnans* regrowth has been completed and this study is now being extended to a number of other Tasmanian species over a range of ages. A number of technical problems are being looked at including sawing, seasoning (structural properties and drying degrade), machining and finishing of timber and the relation these have to the requirements of the end-user. Preliminary work has commenced in Victoria with the logging of 1939 *E. regnans* regrowth, sawing and drying schedules/techniques will be carried out later this year.

Project Leader: Gary Waugh
CSIRO Division of Chemical and Wood Technology, Melbourne.

Pulping

The effect of age on the kraft pulping and papermaking properties of *E. regnans* and *E. obliqua* from southern Tasmania have been studied. All age classes with the exception of those less than 10 years have acceptable properties for most pulp end-uses. Studies on *E. regnans* in the age classes 10 to >110 years show that pulping and papermaking properties continue to improve exponentially to an optimum age class of 40–50 years. With *E. obliqua* over the same age range, results were similar to *E. regnans*. However, in comparison with the younger age class samples (<110 years), the old growth of *E. regnans* and *E. obliqua* (>110 years) possessed a higher basic density and extractives content. It required more alkali for pulping, produced a lower yield pulp, had poorer kraft black liquor properties and, when bleached, had a lower brightness than the younger samples. Furthermore, bleached and unbleached pulps from the old growth samples were harder to beat to a specified freeness and produced handsheets with poorer bonding properties. Results are currently being incorporated into an industry cost structure to calculate relative pulpwood values. Work has now commenced on the sampling plan for the Victorian regrowth resource following consultation with industry representatives.



Photographic assessment of internal defects in boards after seasoning.

Project Leader: Frank Phillips
CSIRO Division of Chemical and Wood Technology, Melbourne.

Resources and Markets

The project aims to assess the extent and potential of the regrowth forest in both Tasmania and Victoria. It involves the collation of existing information on forest areas and likely markets for the wood products the program is producing. Resource tables, maps and a brief introduction addressing topics on data recording, computer-mapping capability, methods of assessing stocking, current and projected rates of accession to the resource, inventory methods on private land (Tas.), etc, is included in a report drafted for limited circulation.

Project Leader: Kim Wells
CSIRO Division of Forest Research, Hobart.

Central to the implementation of the *Young Eucalypt Program* are the project groups which have been convened by the individual project leaders. These groups play an important role in integrating the knowledge and resources of the four participating organisations. All project groups have a varying number of industry representatives on them.

To date the Program has held seven Board meetings, presented its

Annual Report for 1985/86 to its members, summarising its management developments and research achievements. Details of actual expenditure for 1985/86 and estimates for 1986/87 were presented. The proposed expenditure for 1986/87 of $1 066 480 is double that spent in 1985/86, reflecting the availability of grant *monies*, increased industry participation and the start of work on the three remaining projects: Growth Response; Stand Damage; and, Resources and Markets.

Developments by the Federal Government have added funding stimulus to the Program, through the 150% taxation concession to companies who sponsor research and development within the CSIRO or other Government agencies. This scheme not only includes direct financial support, but also what can be termed "service in kind".

The Extension and Communication work is an important priority in the Young Eucalypt Program. The extension work has involved the close co-operation of the appropriate information people within the participating organisations, with the State Coordinators playing an increasing role. Currently, the program is focussing on developing communication links with its immediate participants with the aim of getting good quality information available to them at the earliest opportunity. Wider communication with the general public will be more opportunistic in nature.

The methods employed so far in the Program have been:

1. *STATUS REPORT* is prepared for the Board and the Principals by the Project Leaders and the Director on a quarterly basis. The fourth quarterly report is a verbal presentation to the Board, following the Annual Review by all Project Leaders.

2. *PROGRESS REPORT* the status reports are released as Progress Reports, after they have been cleared by the Board and Principals. The reports are aimed at getting general information out to an "interested" audience as quickly as possible. These reports assume a prior knowledge of the Young Eucalypt Program and its particular research field.

3. *ANNUAL SEMINARS* the Young Eucalypt Program aims to communicate the results to its participants at the earliest possible date, they are doing this through annual seminars— the first set having been held in Launceston in November and Melbourne in December of last year. It is important to note that these seminars are not a public relations exercise, but rather a place for the researchers to disseminate results to its participants. The seminars for 1987 will again be held at Launceston and Melbourne. The Launceston seminar will be on November 4 and the Melbourne seminar will be later in the month.

4. *SPECIALIST SEMINARS* In addition to the above seminars a series of specialist seminars and field days have been organised, six to date. These have included Sawing and Drying seminars in Tasmania and Western Australia, a Debarking Seminar. Field trials of a number of thinning and harvesting techniques including the adaptation of innovative pine plantation equipment have also been held for participants. These have included the use of the OSA feller forwarder and Timbco feller buncher for commercial thinning of 20-year-old regrowth *E. delegatensis* in Geeveston, Tasmania. The Lako Grapple Harvester was demonstrated as both a felling device and debarking head in Tasmania. The majority of these trials have been video recorded by the Tasmanian Forestry Commission or by the local television stations. These films will be an important source of information and if funds are available, they will be spliced together to form a 30 minute film at the completion of the *Young Eucalypt Program.*

5. *RESEARCH REPORTS* are being prepared for limited distribution by each project as results come to hand. These are a series of technical progress reports of individual experiments carried out, aimed at the technical/research audience.

6. *SCIENTIFIC PUBLICATIONS* are seen as the responsibility of each individual scientist.

Extension work of an opportunistic nature has also included a stand set up at the FIME '86 International in April 1986, which included demonstrations of promising thinning systems. Carmel Travers of the Towards 2000 crew presented a report on the Program. Whilst a CSIRO Division of Forest Research publication called "Trees", which is directed towards the rural print media, lifts an article from the quarterly Progress Report for circulation. The Progress Report will also be reproduced in full in the bi-monthly Logger supplement.

Finally, a more comprehensive report, including an overall economic analysis will be available on the completion of the *Young Eucalypt Program* in three years time.

Each project will release a series of progress reports of individual experiments carried out. A more comprehensive report, including an overall economic analysis will be available on the completion of the *Young Eucalypt Program* in three years time.

Additional information on the program is available from:

Program Director: Bill Kerruish
CSIRO Division of Forest Research, P.O. Box 4008, Canberra, A.C.T. 2600.
Tel: (062) 81 8235

Tasmanian State Coordinator:
Chris Palzer
Forestry Commission
199 Macquarie Street, Hobart, Tas. 7000.
Tel: (002) 30 8178

Victorian State Coordinator:
Peter Fagg
Department of Conservation, Forests and Lands
240 Victoria Parade, Melbourne Vic. 3000.
Tel: (03) 817 1381.

Wood in Use—Solid Timber

For many years, Australia has imported at least a quarter of its consumption of forest products. However, it is unlikely in the future to be able to import all its requirements at an acceptable price.

Australian resources could be improved and the capacity developed to reduce the annual import bill of over $1500 million. Moreover, our resources could be adapted to meet varying needs and to enhance export possibilities. At the same time employment in a large and mainly rural industry would be maintained and further wealth created.

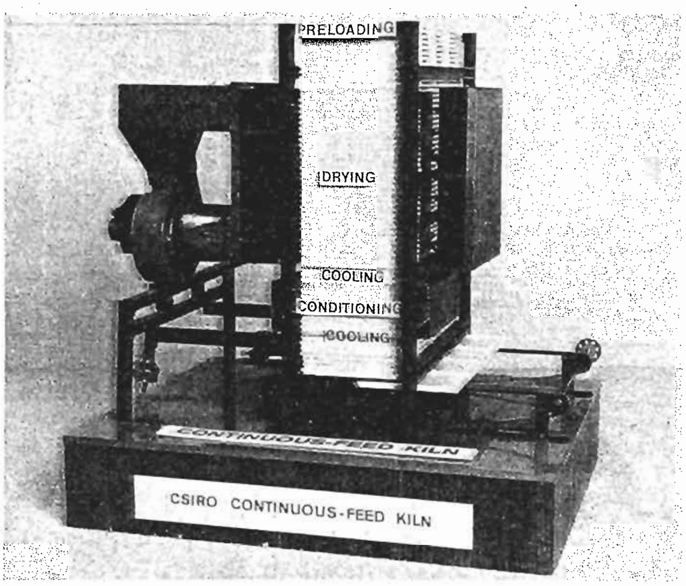
Resource Conservation and Product Quality

Currently most forest products are obtained from a natural hardwood resource whose quality is declining or changing. Within a decade, most products will come from fast-grown, short-rotation pines (mainly radiata pine). The decreasing size of the logs from these resources necessitates different conversion procedures and greater use of small-sized pieces and particles to manufacture products of the required size. To delay the onset of shortages and also to enable a greater recovery and extended use of products from the forest, better conversion methods are continually being developed and the protection of wood products against biodegradation is being improved.

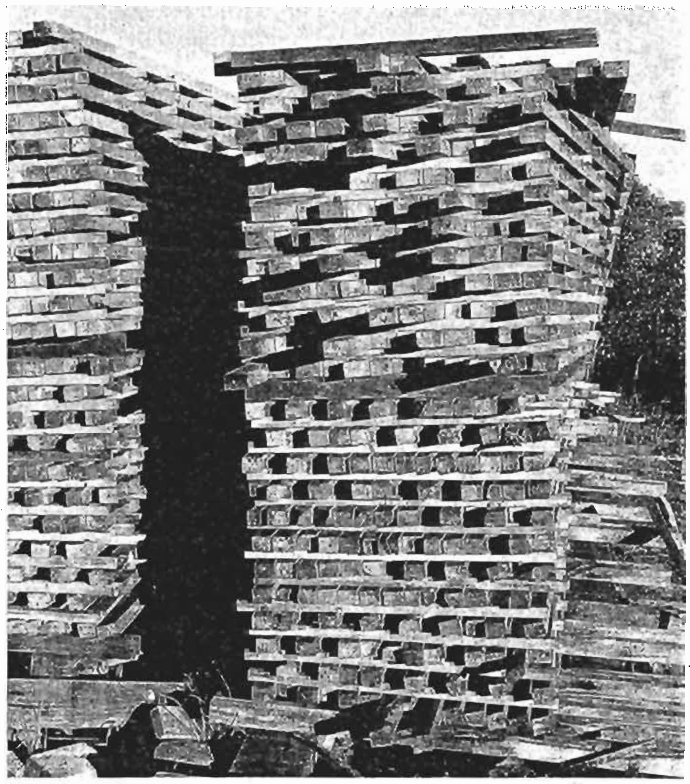
An increase in the quality and value of forest products will improve the country's opportunities to export to regions unable to grow their needs. Transport costs are a major component of many forest products so that Australia must aim for high-quality, low-volume products that are in demand on international markets.

In the past, research by CSIRO and other Australian institutions has provided the technology for the use of a native forest resource that differed significantly from that commonly available overseas. The industry that developed to use this resource is now larger than the car industry. However, the resource is changing, and further research is needed to ensure its efficient use. Furthermore, the new forest practices that have resulted in fast-growing wood-production forests can be further improved if greater attention is given to the quality of the wood that is grown. This requires the availability at all stages of cheap and rapid methods of quality assessment and control. These methods are now possible with the availability of low-cost micro-processors and minicomputers.

The wood of many eucalypts is potentially suitable for high-quality appearance-grade material. However, drying schedules used in the industry do not take account of wood characteristics that cause degradation on drying. CSIRO wood scientists recently developed techniques to enable basic features to be measured rapidly by



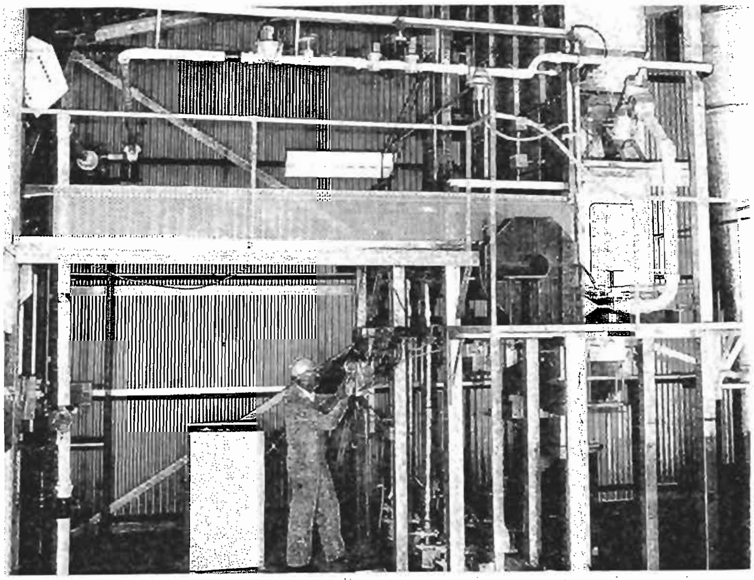
CSIRO research has led to the development of a fast, continuous-feed timber drying system that virtually eliminates distortion and degrade.



A major problem facing Australian sawmillers is that fast-grown trees often distort on drying, as shown in this stack of hoop pine timber.

microprocessor-based technology so that degrade-prone material can be detected and channelled to low-grade uses. It is planned to develop devices to enable the remaining material to be dried in conditions that maximise production of the highest quality material.

The increasing growth rate and use of smaller logs of radiata pine have resulted in greater volumes of juvenile wood being used for building purposes. The juvenile wood of conifers often distorts at temperatures normally used for drying. Drying procedures using temperatures exceeding 120°C and restraining loads have resulted in a product with greatly improved quality, increased market acceptability and reduced drying costs. The procedures are now widely used in Australia. A newer development, the CSIRO continuous-feed drying system, enables very rapid drying with virtually no distortion or other drying degrade.



Fluidised-bed carboniser for producing charcoal from wood residues.

Biodegradation

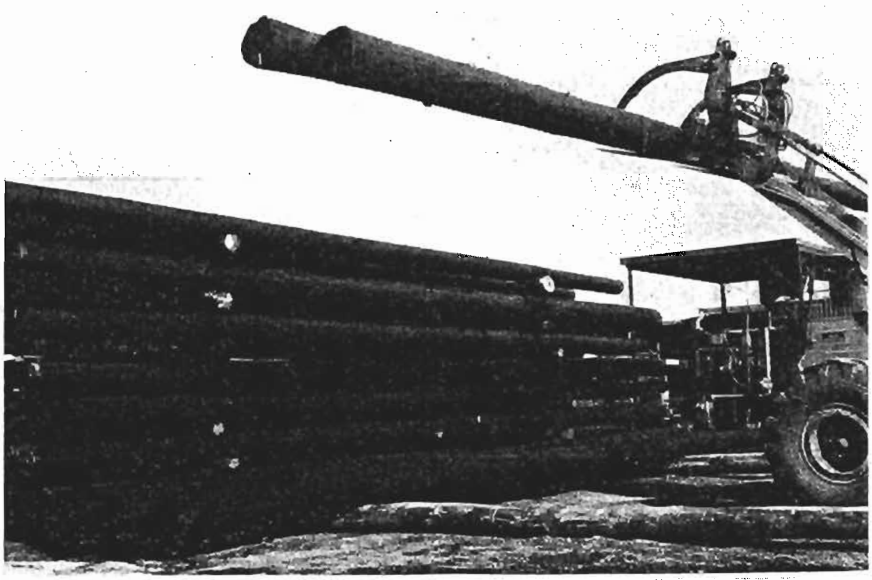
It must be recognised that wood, though a renewable resource, is also biodegradable, and most has to be protected to provide an economic service life. Fungi, termites, wood-borers (insects and marine organisms), fire, chemicals, and the weather all cause degradation and deterioration. Consequently, Australia's wood preservation industry supplies a large market, with an estimated annual value of about $100 million.

CSIRO is concerned with research and development for the wood preservation industry, which ranges from large organisations to the home handyman. The work, carried out by multidisciplinary teams, focuses on the organisms that break down wood, the chemicals that control them, and the methods by which preservatives are applied.

The research emphasises the development of environmentally acceptable control mechanisms. One important part of the work is 'pigment emulsified creosote' (PEC) which has now largely replaced standard creosote. Poles and railway sleepers treated with the new formulation are cleaner, drier and much easier to handle. Work is also under way on the development of other safe preservatives directed at specific uses such as fence posts, external joinery and wood-based panel products. Naturally new formulations have to be tested and screened in the laboratory for safety, as well as tested in field and exposure tests.

In Australia, 2·7 million tonnes per year of sawdust and other woody wastes are produced each year. The waste could form a nutrient source for microbes that break down lignin and cellulose, producing useful by-products in the process. It is theoretically possible to use such wastes as growth substrates for several groups of fungi, and to convert them into protein, sugars, and other chemicals. A knowledge of how micro-organisms biodegrade wood is being applied world-wide to converting lignocellulosic wastes, such as sawdust, to 'value-added' products. Instead of preserving the wood, researchers are interested in turning the biological agents that break it down to our own advantage.

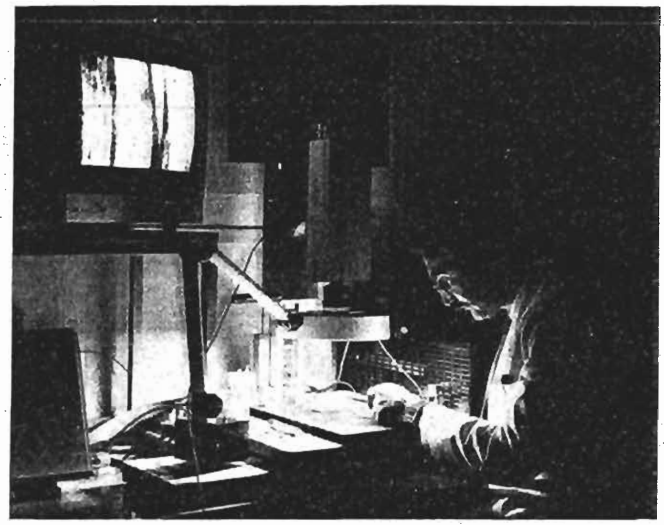
Traditionally, CSIRO has strongly assisted Australia's saw-milling industry, which generates a turnover of more than $1000 million a year. The fragmented nature of the industry and the small average size of the mills has meant that the



Pigment emulsified creosote provides a drier, cleaner and more easily handled formulation than traditional creosote preservatives. Protecting timber from degradation is an important research area in CSIRO.

industry has relied heavily on technology transfer from CSIRO's research. This situation still exists even though the industry has undergone a significant rationalisation in recent times.

Hardwood regrowth and soft-wood thinnings have substantially different sawing and peeling characteristics



A CSIRO researcher carries out an anatomical study of a piece of wood. Basic knowledge of wood structure underpins many advances in timber technology.

from the large, mature logs of the same species that formerly made up the bulk of the resource. A significant proportion of these small logs contains low-density, low-strength corewood, and they often show more irregularity in the stem, greater growth stresses and more spiral grain than mature logs. These inherent defects reduce the yield and quality of sawn timber and veneer, increase conversion costs and produce more residue.

The application of techniques already developed can ameliorate this situation to some extent, but continuing research is needed to optimise conversion practices, particularly in the areas of improved sawing strategies, upgraded primary and secondary treatment of products, quality control and operator performance. All of these factors are also relevant to the conversion of large, mature logs.

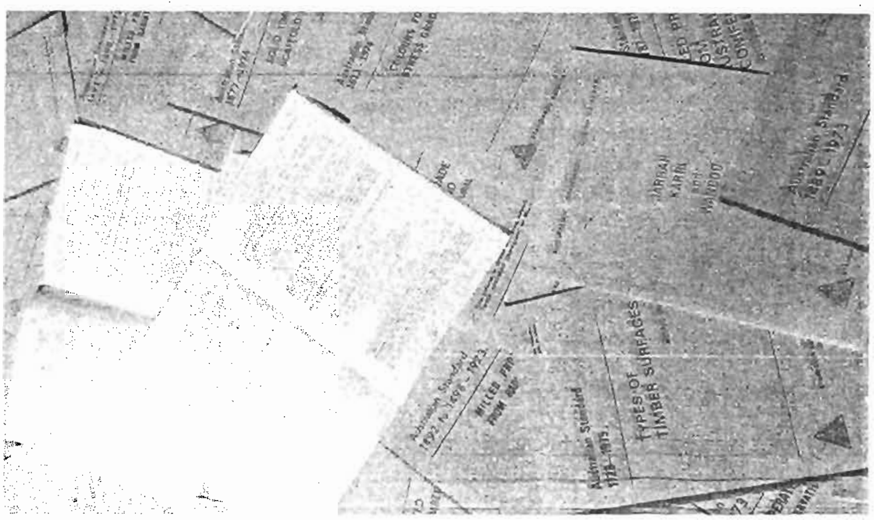
Adhesives

The larger volume of small-sized material now being produced requires adhesives for the manufacture of uniform and reliable panels, and joined or laminated boards. Increasing attention is being given to the development of adhesives from non-petroleum sources such as bark extracts. Radiata pine bark contains polyphenols that can be converted into waterproof adhesives. However, to compete with low-cost synthetic adhesives, they have to be produced in high qualities. The quality of pine bark varies depending on its history of growth and storage, and extraction procedures also affect the quality of the extract. A procedure has been developed to obtain a high yield of extract that is purified by a process for which patent coverage is being sought. The results are materials of high and consistent quality suitable for adhesive formulation.

Standards

Australian Standards play a most important role in improving the productivity of industry in a safe and efficient manner. This is true of the timber industry, which has continued to request the preparation of timber standards over the last fifty years. During that time, CSIRO has played an active part in the experimental and committee work necessary to produce the wide range of standards used in the Australian forest-products industries. The Organisation is regarded as a principal source of technical input to the committees, while at the same time making a significant contribution in the field of technology transfer. There are several instances where incorporation of the most recent research information into an Australian timber standard has resulted in the relevant information being permeated throughout the industry much sooner than it might otherwise have done.

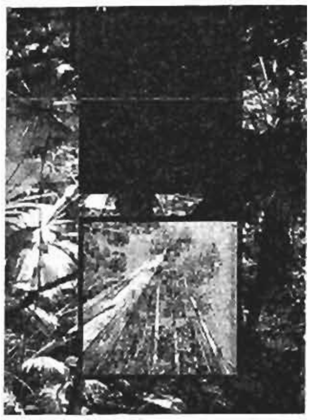
The consumer also benefits from standards, although their influence may not always be apparent. By far the major use of solid timber is in building construction, and domestic house frames form the most important use in terms of volume. The house-owner is protected through a range of timber standards incorporated into building regulations in all States. These standards provide for a code of practice to ensure good workmanship, structural adequacy of the load-bearing members and protection from factors that could adversely affect certain timber components. Such standards reflect many years of research in CSIRO and serve as a practical example of effective information transfer.



CSIRO has long been involved in the development of Australian Standards for the timber industry.

Publications from Chemical and Wood Technology

Each book is simply written and beautifully illustrated with colour photographs and drawings.



Forests and Their Products

This book provides details and outlines the current CSIRO research contributions in forestry and the development of end-products. It also provides information on CSIRO's collaborators, such as other government departments and industrial bodies as well as contact points should the reader require further information.

Guayule in Australia

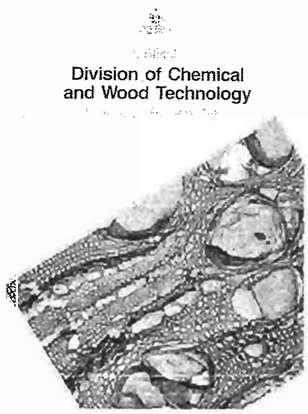
Guayule is a perennial shrub that grows in arid sub-tropic regions. The plant produces rubber which is virtually identical with that obtained from the tropical tree. This book examines research that has been done in Australia and overseas and concludes that it would be suitable for growing here in areas of land currently not being used. The main soils that appear to suit guayule are red earths, and well drained duplex and clay soils. The gross areas of potentially suitable soils is approximately 6 million hectares.

The areas identified would allow Australia to develop a new industry which would contribute significantly to our natural economy and the economics of the proposed system indicate strong profitability. In fact if only 0·5 million hectares of guayule were grown in Australia at a yield of 2/3 tonnes rubber per hectare would produce 1/3 million tonnes of rubber with a current value of $420 million. This is nine times the current Australian consumption of rubber and on current values would rank fourth after wheat, sugar and barley in our current crops.

The CSIRO Family Key for Hardwood Identification

The book describes and illustrates the anatomical and other features necessary for microscopically identifying hardwood species using the CSIRO Family Key.

This publication is particularly useful for professional wood anatomists, students of wood anatomy, timber restorers, museum curators, forensic and wood research scientists, maritime archaeologists as well as other people interested in collecting and identifying hardwood samples.



The CSIRO Division of Chemical and Wood Technology has recently published its 1985 *Annual Research Review*. The Division's work covers a wide spectrum of interest and is primarily concerned with the efficient application of chemical and biochemical technology and engineering to the utilization of such resources as forests, agricultural products and water. The *Review* reports on the projects that the Division is currently engaged in as well as the relevant people to contact should you seek further information about certain projects or information that may assist you. Also the *Review* contains topical essays covering the Division's work. This year the essays cover the following topics.

1. Process development of recombinant DNA products
2. The Sirofloc process for water clarification and decolourisation
3. Pigment emulsified creosote (PEC)—improved oil-based preservatives
4. CSIRO, industry, and high-yield pulping—a common link

Should you like to receive a copy of the *Research Review*, or copies of any of the essays, write to Mr David MacArthur, the Division's *Technical Secretary*, care of the Division's address.

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Winter 1987 Vol. 3 No. 3

Forest Products NEWSLETTER

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Forest Products and the Production Environment*

Warren Hewertson

Introduction

Tasmania has the largest percentage of forested land of all the Australian States. Serious consideration of the potential future of the products from this resource is therefore timely and appropriate. Forest products are simply materials which man can use from the forest resource in conjunction with, or in competition with other materials. Materials and energy are inexorably linked through the chemical processes of conversion of raw materials by use of energy, into useful products, be they beams, roof trusses, floors, plastics, or furniture. The industrial revolution was fired by the vast use of energy, supplied from forests, then coal mines, now oilwells and gas fields together with nuclear power and in the future perhaps, by coal and nuclear power, if the environmental problems of both can be minimised. The chemical industry gave rise to a new class of materials to supplement and compete with natural products like wood, wool and cotton, and processed minerals like steel, ceramics and aluminium. The petrochemical industry is unique in that its material and energy sources are the same—hydrocarbons.

The great growth of the petrochemical industry after World War II is no historical quirk. Oil (and to some extent gas) became the cheapest overall source of energy and feedstock, for an industry that had developed sophisticated technology, to produce a whole new range of products with highly desirable properties. This technology was initially dependent on feedstocks largely derived from agriculture and coal, but proceeded at an incredible pace once byproducts from the liquid fuel industry, together with naptha and ethane cracking technology, became available.

The essential technological features relating to the level of investment in the production of materials, are the degree of fractionation of resource and the product range. Perhaps the extremes of this material's range are bricks at the lower end, to petrochemicals at the higher end. Research support and technological development are directly related to a particular material's position in this range. In brick production, for example, relatively little purification and preparation of clay is required. In petrochemicals, however, the vast range of chemicals, required for the product range, necessitates investment in many large plants. Crude oil is separated into fractions for transport, petrochemicals, power generation and bitumen products. The naphtha fraction is then 'cracked' to a range of about ten further fractions and these, on subsequent processing, give rise to about thirty intermediates, each of which has its own train of plants to produce marketed products.

These developments necessitated a huge substitution approach, for example, synthetic fibres for natural fibres; plastics for metals, wood,

Dr. Warren Hewertson

* *This paper was originally presented at a public seminar entitled* Tasmania's Forests: Beyond 2000 *in Hobart on the 4/7/87 by the Tasmanian Division of the Institute of Foresters of Australia Inc. and The Australian and New Zealand Association for the Advancement of Science.*

in this issue . . .

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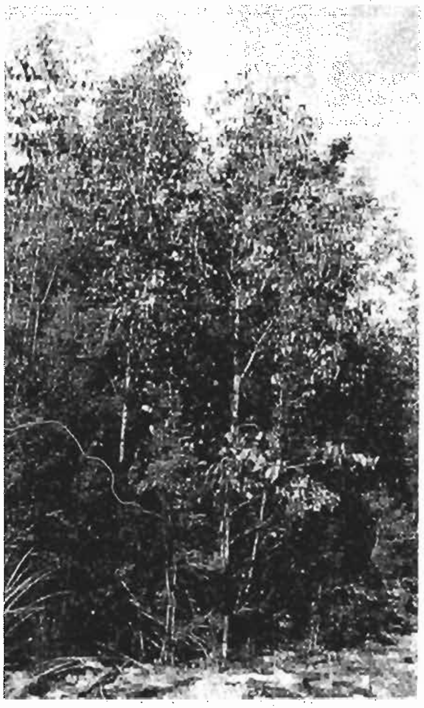
CSIRO Division of Chemical and Wood Technology



Improved techniques for dealing with young regrowth timber will provide more products for the Tasmanian timber industry.

paper, leather and rubber; synthetic adhesives for natural products-based glues. The foreshadowing of the limits to this substitution by huge rises in the price of, and finite limits to the availability of oil and gas is well recognised. However, although the world learned to cope with an increase by a factor of *two* in the price of oil in 1973 and by a factor of *five* in 1978, it did so at great cost to some areas of industry. Indeed, the closure of oil refinery and petrochemical plants in the eighties rivals the steel plant rationalisation of the seventies.

In looking forward to the theme of this Seminar—*'Tasmania's Forests: Beyond 2000'*, there is little doubt that access to oil as a source of energy and feedstock will depend not only upon its price but upon its sheer availability. Equally, the extent to which the forest resource can provide us with products will also depend upon the availability of that forest for production purposes. The obvious difference between the fossil-based resource and the forest-based resource is the renewable nature of the forests.

The Production Environment

Forest products utilisation reflects the hopes of an industry which exists to benefit from providing the range of products which consumers need and are prepared to buy. In common with many other sectors of Australia's manufacturing industry, the traditional emphasis has been on internal consumption and import replacement. It is important to recognise that matching the demands of a broad-based, sophisticated market in a country with an incredible variety of wood species and a relatively small specific product consumption, places great strains on an industry. In particular, it can rarely take advantage of economies of scale without actively pursuing an export market. Tasmania's forests have provided the resource for the export of its products for almost 150 years and continue to do so today.

Before attempting to predict what changes will be effected in production from Tasmania's forests beyond 2000, it is first necessary to consider Tasmania's involvement and potential within three product areas: (a) pulp and paper, (b) softwood products and (c) hardwood products.

(a) Pulp and paper products:

CSIRO early this century showed that native Tasmanian eucalypts could be used in paper manufacturing. In 1938, the APPM mill at Burnie commenced production of fine writing and printing papers. Three years later, ANM opened its newsprint mill at Boyer.

The most capital intensive sector of the forest products industry is pulp and paper manufacture, particularly for papers which require chemical pulp. A glance at the flow sheet of an unbleached kraft pulp mill, together with an analysis of the unit capital costs, demonstrates that the capital contribution to the cost of unbleached pulp production is about 40%. Further, that of recovery of chemicals and energy is about 30%. The recovery system allows almost total recycling of chemicals and about 65% recycling of the original energy in the feedstock.

Kraft pulp is used predominantly in packaging where strength and appearance are of importance. The major competition in this area has come from plastics where huge advances have been made in developing high strength thin films. These advances have allowed the plastics industry to produce almost double the number of end products (e.g. bags) per tonne than the paper industry can produce. This roughly offsets the higher production cost of plastics compared with that of paper.

The inference of the foregoing is that the chemical pulp industry must weather the storm by improving both the economics of production and the level of technical performance of its product range. One approach to this end is to develop products from modified mechanical pulping methods which could be used to supplement high priced chemical pulps. Some progress is being made in this area. The current low world oil prices will favour the plastics industry until the eventual and inevitable supply shortages of oil begin to have an effect. The plastics industry will remain competitive with the paper industry only as long as it can benefit from the ready availability of oil and gas. The economics of producing petrochemicals and plastics from coal can only become favourable when oil prices reach about 5 times their current level of about $(US)20/barrel.

In summary, a kraft pulp mill fractionates its feedstock into bark, pulp, lignin and sugar derivatives by use of chemicals and energy. It currently utilises the pulp byproducts to produce the majority of the power required to operate, and it recycles chemicals to carry out the pulping operation with make-up chemicals. Effluent treatment costs are proportional to the level of make-up chemicals, and the capital investment for treatment runs at about 6% of the total capital in a 1,000 tonne per day plant.

(b) Softwood products:

Although the softwood industry does not have as long a history in Tasmania as those industries based on native hardwoods, its contribution is increasingly significant. With about 40,000 hectares of Crown land already planted in exotic softwoods and an additional 800 hectares per annum planned for the future, the feedstock already exists for softwood building and joinery products. This means that softwood conversion plants have been able to be established to take advantage of economies of scale.

There are many parallels between integrated softwood sawmilling and pulp production, when either the scale of operation is sufficient to allow particleboard manufacture, or the byproducts from the milling operation can be utilised in nearby pulp mills. In Tasmania and elsewhere in Australia, there are examples where integrated softwood sawmilling and particleboard production are carried out. Logs are fractionated into sawn timber, bark, woodchips, and sawdust. Maximising return on capital traditionally involved maximising yield of sawn timber. However, with the increasing need to utilise smaller regrowth logs throughout the world, this situation is unlikely to remain universally valid.

The first naphtha crackers in the petrochemicals industry were built to optimise on the production of ethylene and propylene, mainly for the production of polyethylene and polypropylene—aromatic products at that stage were in plentiful supply as byproducts from town gas plants and coke ovens. Now the values of aromatic hydrocarbons, spurred by demands for lead-free petrol, plastics and synthetic fibres, require profit optimisation on the whole product range within the constraints of market demand. However, unlike an integrated softwood sawmilling operation, there is relatively little scope for altering the product distribution from a naphtha cracker. The lowest value of organic chemicals is that of fuel, hence the potential of any petrochemical or timber industry byproduct must be considered as a feedstock for higher value materials, particularly if low cost fuels are available locally. In this event, for integrated softwood processes, there is now little need to use byproducts for fuel, other than perhaps sander dust and bark. There is considerable scope for using softwood bark from plants close to urban areas as horticultural mulch. However, transport costs can override product value for remote plants. A potential use for pine barks is as a source of tannin adhesive and peat substitute. The former, of course, could be used 'in-house' for particleboard manufacture. Whereas wattle bark has been used for adhesive production in South Africa for many years, only faltering steps have been made in the profitable utilisation of pine bark adhesives. It is likely that further process improvements in achieving product quality control will bring about the necessary technological developments to achieve an attractive return on investment in this field. The added value in production should prove considerably higher than the processing costs and value of bark as fuel or mulch.

In the longer term, research should provide a further potential use for byproducts. Renewed interest in rayon production, initiated by the post '78 oil price increases, has given rise to potentially attractive new technologies for the production of dissolving pulps. The greater the product range from sawmilling byproducts, the greater the scope for increasing total return on investment.

Much of the foregoing obviously also applies to the softwood plywood industry, although the continued need for relatively large logs and the somewhat smaller size of operation combine to reduce the scope for 'in-house' utilisation of by-products.

(c) Hardwood products:

Hardwood sawmilling is Tasmania's oldest manufacturing industry, having started in the early 1800s. However, the parallels between pulp production and integrated softwood processing mentioned earlier, did not generally apply to Tasmania's hardwood industry. The major reasons for this, apart from the relatively small scale of many operations, were associated with the diversity of species available for sawlogs and the relatively low annual availability of particular species in demand for higher value products.

Although many mills are able to utilise byproducts from sawn timber production as wood chips for pulp production, there is much resource which is not utilised to give a return on investment. The density of most hardwoods mitigates against their use in particleboard manufacture and the industry internationally is not enthusiastic as to the prospects of the darker hardwoods as particleboard feedstock, particularly for furniture grades. Obviously, the widespread differences in properties of hardwoods and the problems of scale mentioned above give rise to considerable technical problems in using a mixed resource to produce board products within close specification. Pulp production is quite appropriate for many of the non-durable species of hardwoods, but the low yields and high chemical demand of the durable species render their utilisation in pulp production an uphill task.

Bark utilisation is a much greater problem for many eucalypts than it is for softwoods. Many of the 'ash' group have rather rough stringy bark which is difficult to handle and often its cost of comminution outweighs its value as fuel.

Coupled with the technical problems of obtaining a return on the byproduct fractions from sawn and veneered hardwoods, there are many mills simply too distant from pulpmills to justify transport, either to Australian pulpmills or to export woodchip centres.

What are the options for the rather large mixed byproduct resource which is available for utilisation? The first option, which overcomes the diversity of disadvantages is simply to utilise much more of the material as useful fuel. Many small mills still incinerate 'residues' without recovering heat. As environmental pressures are applied to dispose of material within guidelines to reduce both pollution and fire risk, there is great incentive to turn a negative return on capital to a positive return. The simplest solution is to utilise 'residues' to provide heat for seasoning suitable, structural and appearance grade timber. Relatively small scale fluidised-bed boilers appear most suitable for such use. An example of such a boiler is currently installed in Tasmania for use in a dairy products processing plant to considerable advantage. Other options are discussed below.

Beyond 2000

Given the security of continued access to an appropriate proportion of Tasmania's forests for production purposes, this State is uniquely placed to enter the next century with cautious optimism. The industry has learned to improve its use of the raw material. Silvicultural practices have improved the quality of a number of species. Foresters have learned that growing for quantity at the expense of quality is not a good practice. Logging efficiencies have improved and reports of a factor of seven in productivity per man/year between 1950 and 1975 are not uncommon. Techniques of dealing with regrowth timbers are improving. Seasoning methods have been developed which allow improved quality control and reduced working capital. Progressive kiln drying is well established in Tasmania and it is likely to be supplemented by continuous kiln

Mr. B. Jones, Minister for Science with Dr. W. Hewertson at the official launch of Scrimber.

drying in the near future. Excellent technologies for reconstituting the byproducts of the sawn timber industry into sheet form, to compete with long-established plywood, have been developed and used with excellent market acceptance. Other methods of utilising sawmill byproducts are attracting much research effort, for example speciality carbons, high value chemical intermediates, new rayon processes, and semi-synthetic adhesives. Attention to high yield and low pollution pulping in the paper industry, to substitution of asbestos by wood-based fibres, and to improving methods of utilising hardwood feedstock, will all contribute to the industry being able to resist the onslaught of the plastics substitution march.

There is increasing prospect for the pulp and paper industry adding value by first exporting pulp and then paper to Japan. The likelihood of that country reducing its involvement in the importation of vast quantities of fuel and raw materials, for the manufacture of intermediate products, is high. The opportunity to add both value and employment, by reducing wood chip export and increasing pulp and paper export, is currently limited by the economics of new pulp and paper mills in Tasmania and also by the existing capacity in Japan. However, the availability of both energy and raw materials in Tasmania favour continued consideration of this approach.

Aesthetics and fashion play a role in the wood utilisation area just as they do in the fibres/garment industry. The developed world has a new-found appetite for the 'natural look'. Wood veneers surfacing a stable sheet substrate have done much to allow high volume production using relatively little, but high quality, resource. Wood preservatives have permitted the use of timber with little natural resistance to fungal and insect attack, in relatively hostile applications. Improved wood preservation products are on the horizon which will reduce hazards to operators employed in the industry.

Australian research in CSIRO, State forestry services and industry, has made significant contributions to this area and continues to do so. Perhaps the most significant early work in this vein was the development of successful techniques for the pulping of eucalypts and the production of high quality papers from this feedstock. Latterley, CSIRO has developed technology for the manufacture of high quality, structural beams from young trees. The successful development of a production process for this product could make a significant inroad into markets lost by Australian timber to both imports and to substitute products such as steel and concrete. Current work is aimed at extending the scope of this technology (the Scrimber® Process) to the utilisation of small diameter hardwood logs.

The future lies in more intensive management and growth for end use and more efficient utilisation of the logs removed from the forest. A pioneering joint program between CSIRO, the Tasmanian and Victorian Departments of Forestry and local industry was set up almost 2 years ago to address the economic, production, strategic and social aspects of increased intensity of management of regrowth forests. The significance of this work to Tasmania will be in the provision of strategies to maximise the production value of particular land to help overcome competing demands on the extent of the production forest resource.

Future success will also depend upon the development of higher valued outlets in increased proportions. Higher added value products, such as high purity carbons and activated carbons, require greater capital investment and the establishment of markets currently controlled by the chemical industry. Fortunately there are specific attractions to eucalypt-based carbons and there is considerable scope in utilising byproduct heat 'in house'.

Whereas the softwood resource permits considerable import substitution, export development must really come from hardwoods. It is becoming obvious that there is or soon will be a world-wide shortage of first class hardwoods for a variety of reasons. Whatever the reason, the climate for Tasmanian hardwood exports is improving remarkably and naturally so is the case for the more efficient use locally. It could be that the production and marketing of higher valued products in some circumstances may need to be organised on a cooperative basis to achieve economy of scale and continuity of supply. It is also clear that lines of communication between grower, producer and end-user must be maintained to ensure that what is produced is what is required.

Finally, the potential for converting short rotation plantation hardwood and softwood (or thinnings from managed long rotation regrowth) to products of high value is starting to be realised. The pulp and paper industry is already well advanced in capitalising on advantages of young eucalypts in many pulps.

CSIRO has had a long-standing involvement with Australian forest products industries extending over a period of almost 60 years. I pledge that it will continue 'Beyond 2000'!

Some Statistics of the Australian Wood Preservation Industry, 1984-85

H. Greaves

Dr. Harry Greaves

The collection of national statistics for the activities of the forest products and forestry industries in Australia traditionally has been the responsibility of the Bureau of Agricultural Economics. Information about the wood preservation sector has not been included in the collection, and any data previously published has been derived by the Timber Preservers' Association of Australia (TPAA). In addition some of the various State forestry authorities are able to provide statistical details on certain aspects of the preservation industry's operations, while specific companies are well aware of their own annual production.

The TPAA has recognised the value of obtaining as complete a picture as possible of national annual operations; collected on a regular basis, such figures for example could assist in market predictions, indicate possible research and development needs, and highlight the areas of greatest activity. Thus, in 1985, it was agreed that CSIRO on behalf of the TPAA should attempt to produce the first collection of national statistics dealing with the wood preservation industry's activities.

A questionnaire was devised with input from the TPAA, and guidance from CSIRO Division of Building Research, Shelter & Infrastructure program. Copies were sent to 260 recipients drawn from TPAA, State forestry authorities, CSIRO, and Forest Industries listings. The questions primarily sought to measure formulation consumption, treated timber production, plant capacity, timber species utilised, and quality control methods employed. Data was sought for the 1984–85 financial year, i.e. from July 1984 to end of June 1985.

The tables summarise the major features of the preservation industry's operations. The data were obtained from a 44·3% response to the questionnaire, with Tasmania (85%) and South Australia (75%) being the highest State returns. Unfortunately, the States with the biggest production of treated timber—New South Wales, Queensland and Victoria—responded relatively poorly: 40%, 39·7% and 36·2% respectively. Thus the final figures may understate the extent of the operations, and indeed the statistics from the immunising sector of the industry (generally New South Wales and Queensland producers) were well below previously believed production levels.

A detailed discussion of the data in the tables will not be presented here. For the most part the individual tables are self-explanatory. However, it is worth remarking that the survey shows that the industry has significantly greater capacity to produce treated wood than it is using, particularly in the area of LOSP and sawn timber treatments.

The LOSP markets have been rather slow in growing, despite their obvious potential to Australia's building needs. Greenacre (pers. comm.) points out that in the seven or so years since their use in treatment plants, only 38 000 m^3 of hardwood (mainly meranti) and 17 000 m^3 of softwood (mainly radiata pine) have been treated with LOSP formulations. Such formulations were introduced in Australia to facilitate better marketability of joinery using local timbers such as radiata, slash, and hoop pines and ash-type eucalypts. In point of fact Greenacre provides the following species listings for the 1986 production: Western red cedar (mostly door styles) 6·3%; radiata pine (mostly decking) 15·4%; meranti (mostly windows) 71·6%; oregon (mostly pergolas) 4·9%; and slash and hoop pines (mostly decking) 1·8%. Clearly, LOSP-treated Australian grown timbers are not being used to their full potential by the building industry, either from ignorance and lack of promotion, poor availability of timber supplies, or adverse economics.

Overall, the preservation industry continues to be highly relevant to forest products utilisation, treating about 20% of the total annual

Table 1. Preservative consumption, according to responses received, for the financial year 1984–85

	Creosote (t)	CCA (t)	Boron (t)	LOSP (L)
New South Wales	419[1]	725	57	31 475
Queensland		388	50	
South Australia	2019	1060		78 000
Tasmania		644		5 000
Victoria		450		133 000
Western Australia	1533[2]	314	2[3]	
Totals[4]	**3971**	**3581**	**109**	**247 475**

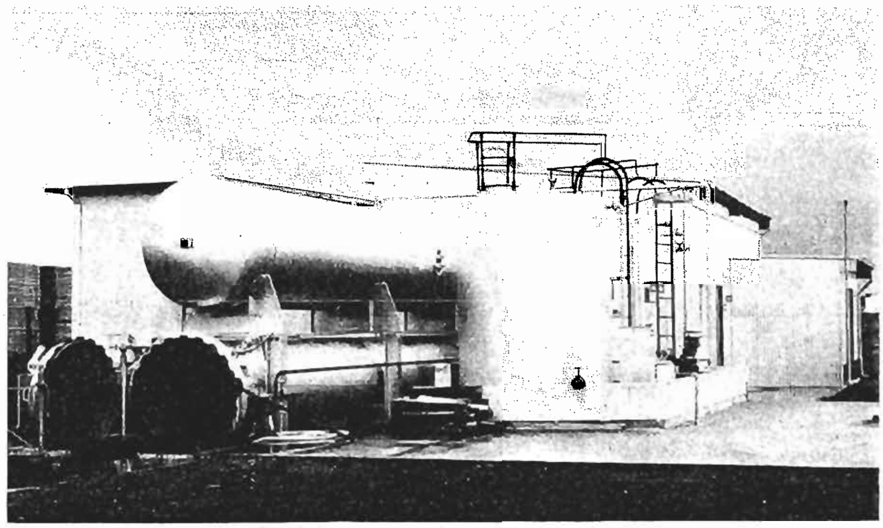
[1] *Includes 282 t PEC*
[2] *Includes 18 t Furnace oil*
[3] *Diffusion salts*
[4] *Total of all preservatives, by mass ~ 7877 t*

Print this page

Table 2. **Summary of treated wood produced, 1984–85**

Commodity	Volume (m^3)
Sawn building timber	105 272+
External sawn timber	35 540+
Wood-based panel products	1 489
Sleepers	16 584+
Round wood, including mining timber	216 514+
Miscellaneous, e.g. rails, mouldings, decorative timbers	6 940+
Total	382 339+

Note, the use of + signs indicates that the figures include estimations as shown in some returns, units of commodities converted to m³, imprecise returns, etc.



Preservative treatment plant.

Table 3. **Production details of treated wood (m^3), according to responses received, for the financial year 1984–85**

	Sawn building			Ext. sawn e.g. fencing	Panel products	Sleepers	Other	Round wood			Mining	Other
	e.g. framing	e.g. joinery	e.g. cladding					Poles	Piles	Posts		
New South Wales	24 303+	3 007	20	4 115+	—	500+	290+	28 520	846	17 134+	1900	1580
Queensland	18 052	35 558	5 358	5 517	—	—	2874+	17 482	—	5 432	—	24
South Australia	5 468	95	1 488	9 868	10	44	5	4 199	—	62 026	—	50
Tasmania	20	—	190	3 430	—	—	—	—	—	8 620	—	250
Victoria	2 453	5 463	2 297	6 610+	1479	40	247+	3 688	1830	14 183	—	420
Western Australia	500	—	1 000	6 000	—	16 000	1200+	29 304	802	20 548	—	—
Totals	**50 796+**	**44 123**	**10 353**	**35 540+**	**1489**	**16 584+**	**4616+**	**83 193**	**3478**	**127 943+**	**1900**	**2324**

See Table 2 for explanation of +signs.

roundwood and sawn timber produced. The trend, up until the time of the survey (financial year 1984–85) was for a fairly static level of activity, with both round and sawn softwood markets growing while round hardwood and sleeper markets had declined. At the time of writing, (June 1987), sleeper production is continuing to fall—treated and untreated—although the hardwood pole and pile markets are showing improvements.

There is no doubt that preservation has a vital role in both the efficient utilisation and the conservation of our timber resources. In the longer term, further surveys will be needed to provide a sound picture of the on-going activities of this most important forest products industry.

Table 4. **Breakup of treated roundwood produced, 1984–85 (m^3)**

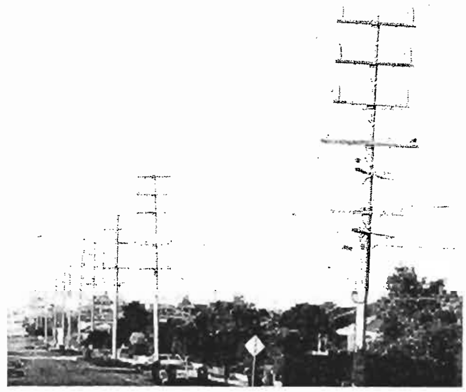
State	Poles		Piles		Posts	
	H	S	H	S	H	S
New South Wales	28 520	—	846	—	5 900+[1]	13 134
Queensland	17 482	—	—	—	1 432	4 000
South Australia	—	4 199	—	—	—	62 026
Tasmania	—	—	—	—	3 020	5 600
Victoria	3 688	—	1 830	—	183	14 000
Western Australia	29 304	—	802	—	548	20 000
Sub-total	**78 994**	**4 199**	**3 478**	—	**11 083+**	**118 760**
Total		**83 193**		**3 478**		**129 843+**

See Table 2 for explanation of + signs
H = Hardwoods
S = Softwoods
[1] *Includes 1900 m³ of mining timbers*

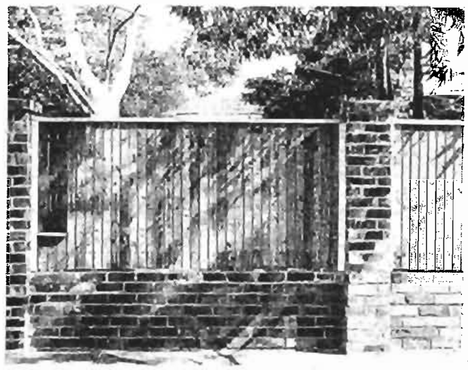
Table 5. List of timbers used, State by State[1]

State	Timber	Commodity
New South Wales	Radiata pine	ext. sawn; posts
	Slash pine	ext. sawn; poles; posts
	Spotted gum	poles; piles; posts; sawn build.; landscaping; crib walls; sleepers; mining
	Tallowwood	poles; piles; landscaping; sawn build.; mining
	Blackbutt	poles; piles; mining
	Ironbark	poles; piles
	W. stringybark	poles; piles
	W. mahogany	poles; piles
	Bloodwood	poles; piles
	Grey box	poles; piles
	Blue gum	sawn build.; landscaping
	Silvertop	sawn build.
	Messmate	sawn build.
	Y. stringybark	sawn build.
	Meranti, etc.	joinery; mouldings
Queensland	Slash pine	posts; sawn build.; ext. sawn
	Hoop pine	posts; sawn build.; ext. sawn
	Spotted gum	poles; posts; piles; sawn build.; ext. sawn; wct timbers; yard rails; tool handles
	Ironbark	poles
	Mixed hardwoods (includes rainforest)	sawn build.; ext. sawn; posts; joinery; furniture
	W. cheesewood	sawn build.
	Y. walnut	sawn build.
	Tulip oak	sawn build.; tool handles
	Red gum	sawn build.
	Blue gum	sawn build.; ext. sawn
	Tallowwood	sawn build.; ext. sawn
	R. stringybark	sawn build.; ext. sawn
	Bloodwood	sawn build.; ext. sawn
South Australia	Radiata pine	sawn build.; ext. sawn; poles; posts; rails; decorative; food bins
	Maritime pine	posts; rails
	Cypress pine	sawn build.; decorative
	Oregon	sawn build.; ext. sawn
	Western red cedar	sawn build.; ext. sawn
	Meranti	sawn build.; ext. sawn
	Sugar gum	posts
	Red ironbark	posts
Tasmania	Radiata pine	ext. sawn; posts; sawn build.; log cabins
	Cypress (*Cupressus* sp.)	ext. sawn
	Messmate	ext. sawn; sawn build.
	Peppermint	ext. sawn; sawn build.
	Silvertop	ext. sawn
Victoria	Radiata pine	sawn build.; ext sawn; poles; posts; piles; sleepers; wct timbers; barriers; panel products
	Corsican pine	log cabins; sawn build.; ext. sawn
	Slash pine	sawn build.; ext. sawn
	Hoop pine	sawn build.; ext. sawn
	Western red cedar	shingles; lining boards; ext. sawn
	Oregon	ext. sawn; sawn build.; lining boards
	Messmate	droppers; sawn build.
	Mountain ash	sawn build.
	Meranti	joinery; sawn build.
Western Australia	Radiata pine	sawn build.; posts; piles; ext. sawn
	Maritime pine	sawn build.; ext. sawn
	Jarrah	poles; sleepers; posts; piles
	Karri	cross arms
	Tawa	spindles

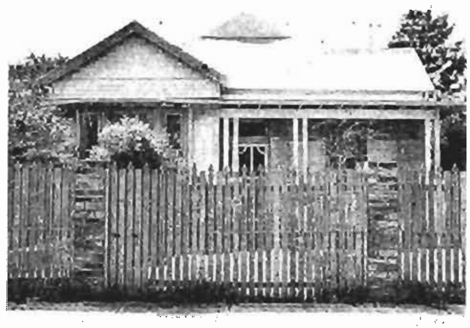
[1] *Although some data on the percentage usage was collected, it was too unreliable to be presented in the table.*



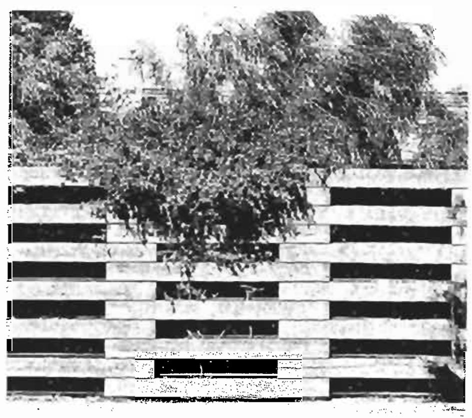
Treated poles—a major role in reticulation of energy and communications.



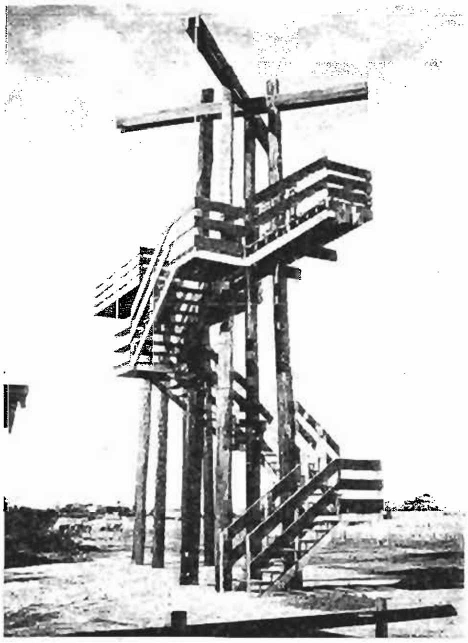
Feature front fence from preservative treated timber.



Treated wood is used here for cladding and in the feature front fence.



Baulks of treated timbers used as feature fencing.



The practical and aesthetic features of treated wood can be combined, as in this observation tower and platform.

Table 6. Summary of treatment details, State by State

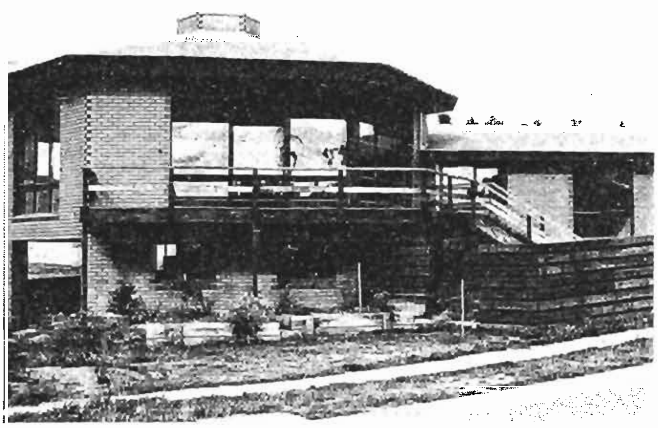
State	Treatment capacity[1] (m^3)	No. custom treating and range[2]	Schedules used[3]
New South Wales	500+	10 (<1–100)	B, D/V, St/C, S/D, D
Queensland	776+	8 (1–100)	B, APM, H/C, D
South Australia	339	6 (0·3–90)	B, L, R, D/V, D
Tasmania	70	1 (2)	B, APM, D/V, D
Victoria	338	7 (2–100)	B, W, D/V, D
Western Australia	~280	4 (30–100)	B, Boulton+B, L, D
Totals	**2303+**	**36**	—

1 *Total plant volume in cubic metres.*
2 *Figures in brackets show the range in the percentage amounts of timber which is custom treated.*
3 *B = Bethell; L = Lowry; R = Rüping; D/V = Double Vacuum; W = Worthington; APM = Alternating Pressure Method; H/C = Hot and Cold tank; St/C = Steam and cold quench; S/D = Spray or Deluge; D = Dip immerse.*

Table 7. LOSP usage patterns, from '84–'85 survey returns.

STATE	CONSUMPTION (L)	TIMBER SPECIES	COMMODITIES TREATED: Sawn building, e.g. framing	Sawn building, e.g. joinery	Sawn building, e.g. cladding	Exterior sawn, e.g. fencing	Panel products	Other	Total
New South Wales	31 475	Phil. mahog.[1]; meranti		1 570				10	1 580
South Australia	78 000	Oregon, R. pine; meranti; Cyp. pine; w.r. cedar	1500	95	900	850	10	5	3 360
Tasmania	5 000	R. pine			100	200			300
Victoria	133 000	R. pine; meranti, oregon; w.r. cedar; Vic. ash		4 250		250	320		4 820
TOTALS	**247 475[2]**	**c.7 species**	**1 500**	**5 955**	**1000**	**1 300**	**330**	**15**	**10 060[2]**

1 *A collective description for lauans, serayas, merantis, (Shorea, Parashorea, etc.).*
2 *Calendar year 1985: 347 670 L working solution consumed, 11 278 m^3 wood treated (Greenacre, pers. comm.).*



Treated timber featuring in and around the home.

Table 8. Production of treated timber in Australia for the years 1980, 1982 and 1985.

	Volume m^3 1980[1]	1982[1]	1985[2]
Round hardwood	126 000	160 000	94 000
Round softwood	136 000	100 000	123 000
Sawn hardwood	400 000	565 000[3]	605 000[3]
Sawn softwood	57 000	35 000	44 000
Rail sleepers	63 000	42 000	17 000
Totals	**782 000**	**902 000**	**883 000**

1 From TPAA Annual Reports.
2 *From detailed workings of present survey.*
3 *Figures include an estimate for the volume of immunised timber produced.*