CHAPTER VI - UTILIZATION

(*) See Annex 2

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UTILIZATION

ROUND UP OF INDUSTRIAL USES AND RESEARCH NEEDS, INCLUDING OBSTACLES TO WIDER USE

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I. Introduction

It is not intended in this paper to summarize or repeat unnecessarily the more detailed technical information of later papers. These should be referred to for greater knowledge and for the utilization of particular species. Nor is it proposed to deal with such uses as pulp and paper** and chemical utilization generally of wood, bark, and leaves, except in so far as they can take part in integrated utilization.

It is, however, proper to deal briefly with some of the properties and behaviours which influence utilization of wood in the round, hewn, and sawn form, and to indicate the type of procedure which is likely to be necessary to overcome any disabilities.

The experience with plantation grown Eucalypts throughout the world has generally followed a similar pattern. Their first use has been for firewood, charcoal and pulpwood often overlapped by their use in the round form for fence posts, mining timber, simple structures, scaffolding, telephone and electric supply poles and piles.

In some cases they have been preferred to local timbers, in other cases used reluctantly because of their greater weight, hardness or difficulty of working compared with the timbers traditionally used. Such rapidly grown round timbers are not durable, containing as they do a high percentage of sapwood so that in some countries preservative treatments have been introduced using a vacuum pressure system with water soluble salts, a modified Boucherie process, a hot and cold bath oil treatment or a combination of these.

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** There is already an excellent precis of the use of Eucalypts for pulp and paper in Pulp and Paper Prospects in Latin America - UN and FAO 1955 (FAO/ETAP No. 462 Add. 1) para 177 to 195.

Where Eucalypts have been sawn, troubles have invariably arisen due to splitting, cracking, warping and excessive shrinkage of the logs and sawn timber. As a result, the timber has generally first been used in small sizes and short lengths for minor purposes such as stakes, pickets and tree guards; although there has been some success with large sizes not requiring seasoning such as timbers for heavy construction and ship building. In some cases, the Eucalypts have proved satisfactory for sleepers but the tendency to end split and crack and the difficulty of preservative treatment have generally discouraged this use.

For more exacting requirements such as house framing, and those requiring thoroughly seasoned timbers such as joinery and furniture there have been a few cases of successful use, but the greatest success in this field has been with flooring, particularly parquet, because narrow widths and short lengths can be used. This applies also to containers such as fruit and other cases, barrels and crates as well as to cross arms, tool handles and sporting goods. In many of these uses, the recovery of finished product from the log has been low, but the good strength and other properties of the timber have sometimes assisted commercial utilization.

Where wood is scarce or expensive, utilization of the Eucalypts has generally proceeded to a higher degree but where adequate supplies of easily utilized timber are readily available, then the tendency has been to restrict the use of Eucalypts to round wood products such as posts, poles, mining timber, firewood and pulpwood. Further, as the use requirements become more exacting, the number of species used for these higher purposes becomes less and less so that very few plantation grown species have entered the highest fields of furniture, joinery, etc.

It is a very natural and common reaction to decide that, if a timber does not behave satisfactorily with a conventional practice which gives excellent results with other timbers, the timber is at fault and is useless for the purpose intended. This was the initial attitude in Australia where at one time only eucalypts which gave little trouble (if the usual utilization practices were followed out) were used. The remainder of the eucalypts were ignored or classed as suitable only for such low-grade purposes as firewood, and the balance of the timber requirements of the country were imported.

This was the position when the Division of Forest Products was set up in Australia nearly 30 years ago. At that time Australia's sawn timber consumption was about 1000 million super feet, but only half of this was produced locally, the balance being imported. Today the consumption of local timbers is about three times as great and, even with this expanded consumption, importations have declined to about 2/3rds of their former extent. In spite of the fact that the more favoured and readily available eucalypt resources have been reduced, the total percentage of eucalypts in present production has been increased to about 80%. Further, many eucalypts which were at one time regarded with disfavour are now preferred for a number of exacting uses, in which imported timbers are only accepted where there is a deficiency of supply. For example, in Melbourne 90% of the flooring requirements were imported from Scandinavia, whereas today eucalypts are almost entirely used.

This vast change has been brought about by a thorough study of the characteristics of Australian timbers. Their disabilities have been overcome by the development of suitable practices for sawing, grading, seasoning, preservation, etc. Much of the information and experience is of value in assisting the utilization of plantation-grown eucalypts, although it must be recognized that new difficult characteristics may be present, and undesirable features may exist to an exaggerated extent. Nevertheless it is certain that proper investigation can result in the development of suitable practices and give satisfactory utilization with eucalypt plantations in other countries.

The first requirement is an appreciation of growth characteristics and the properties of the wood produced.

II. General Characteristics

Eucalypts are generally straight, tall, trees. They have long clear boles from which the branches drop readily; hence knots are not a major problem except for small knots in young trees, and the central portion of older trees, and large knots in the head logs of large trees. Gum (kino) veins and pockets are a common characteristic but usually affect appearance more than strength. Ring shakes also occur, and in some species are often associated with gum veins.

Growth stresses are high and occur in the form chiefly of longitudinal tension in the outer layers of the tree, giving rise to compression in the central portion. This latter stress can cause microscopic compression failures in the wood at the centre of the tree, and such wood is changed to a form of low impact strength called "brittle heart". Large compression failures passing through the brittle heart out towards the sap are not uncommon in large trees of some species. The stresses also cause star shakes in large trees. These are present in the standing tree and must not be confused with radial splits which occur particularly in small logs after cross-cutting. These latter are manifestations of tree stresses and shrinkage and collapse attendant upon drying. Tree stresses can cause deterioration therefore both in the standing and the fallen tree. In the former case, unless growth stresses can be reduced by forest management, nothing can be done. In the latter case, precise knowledge of the stresses, their magnitude and mode of occurrence, can lead to improved practice with reduction of conversion losses.

Eucalypts are diffuse porous with vessel size varying from small to large, but this size is fairly uniform in any one species. In a few species growing at altitudes carrying some snow in winter there is a tendency towards ring porosity (E. gigantea). The vessels are usually heavily tylosed and the resultant blocking increased by the presence of extractives which are generally kino-like but are occasionally waxy. A few species such as E. regnans have open vessels.

Eucalypts lay down structurally mature wood by the end of the first decade of growth. The average fibre length at the end of this time is usually about 1 mm. and remains fairly constant throughout further growth. Average fibre diameter and wall thickness vary greatly from species to species, and hence paper making and similar properties are variable.

The sapwood contains starch varying from light to heavy from species to species and tree to tree, and even within different parts of the sapwood of a single tree. Some species, such as E. regnans, E. marginata, E. gigantea, are virtually free of starch. Included sapwood is associated with old injuries such as insect attack and mechanical or other damage to the cambium. Such included sapwood is untylosed and is non-durable.

The bark is extremely variable, and is an aid to identification both in the field and under the microscope in the laboratory. It has been shown in some cases to be an index of hybridization. Bark can usually be readily removed by hand tools.

The grain is often interlocked, particularly in the denser species, sometimes changing rapidly in direction by a large angle either way from parallel to the axis of the tree. Appearance on a tangential face can therefore often give a misleading indication of the general direction of grain of a piece of timber. Interlock is generally considered to be more prevalent in the outer layers of older trees and in slower grown trees.

Interlocked species are difficult to split radially, and for firewood etc. should be broken down by tangential or oblique cuts. A few lighter species, for example E.regnans, E. obliqua, E. gigantea, are straight grained and are not commonly interlocked, and selected trees are fissile radially. Such species are split for palings, etc. Heavily interlocked logs of durable species can be split into sleeper sizes by making radial grooves with axe cuts as a preliminary to splitting off the desired billet. Although interlock is not disadvantageous to strength properties in commercial sizes, erroneous figures can result from testing small pieces of timber of heavily interlocked species. A piece of interlocked timber can be likened to a laminated beam. The individual laminations may be of comparatively low strength due to cross grain, but randomization in the whole beam virtually removes this defect.

III. Shrinkage

In considering the shrinkage of eucalypts it is essential to distinguish between true shrinkage and collapse. The latter is common in the genus and affects most species to a greater or lesser extent. Whereas true shrinkage occurs below fibre saturation point, collapse, on the other hand, occurs only in the early stages of drying and cannot occur below fibre saturation point. It is due to a collapsing or flattering of the individual cells due to water tension and other stresses which are set up when drying is initiated. It is particularly prevalent in eucalypts with high initial moisture content and comparatively thin cell walls. It can usually be removed by a "reconditioning" treatment, but true shrinkage is not removed by the treatment.

Collapse is often evidenced as very regular shrinkage, particularly in quarter-cut boards, but sometimes its presence is not suspected, particularly in tangentially-cut boards, because the surface appearance is regular. With most eucalypts in the medium or low density range collapse is sufficient for reconditioning to be worthwhile to recover dimension and reduce distortion.

In all laboratory shrinkage determinations it is most desirable to recondition samples after measuring gross shrinkage to help detect the presence or absence of collapse. Collapse is very variable even in the same species, and investigations are now in hand to try to detect the more susceptible material so that it can be segregated before drying and be given special treatment, or it can be used for purposes where the seasoning characteristics are not so important.

IV. Density

In many species the influence of collapse is such that the final air dry dimensions can vary greatly according to the conditions of drying. This variation can be up to 25 per cent. Air dry density is therefore unsatisfactory for comparison of species. Green density is also undesirable because of moisture content variations.

For this reason basic density or oven dry weight per unit of green (or soaked) volume is preferred as the basis for the correlation of most properties, particularly when comparing species or studying the variation within a species.

Within a mature tree the central portion of the trees is usually lower in density. In species high in extractives this difference may be accentuated because, in addition to there being a lower quantity of wood substance per unit of volume, there can also be a lower extractive content. Rapidly grown young plantation eucalypts outside Australia often show lower density than Australian figures for the species, and this must be kept in mind in interpreting Australian data.

V. Logging and Sawmilling

Techniques of logging and milling have been developed in Australia round the properties of mature eucalypts, and to a lesser extent, in recent years, of young eucalypts. These techniques are an important factor in assuring good utilization and they can give a useful guide to practices for plantation-grown material. It must be recognized that before the best results can be obtained from plantations, modifications of normal practice may have to be made, taking into account any peculiarities of the particular timber grown.

An outstanding difficulty which has been common is that due to a combination of growth stresses and seasoning effects.

This has shown up in splitting, checking, and honey combing, of logs and timber. Successful conversion must depend on recognition of the factors responsible and the establishment of the best practice to take care of these disabilities. When the magnitude of the difficulties which arise with mature eucalypts, but which have already been overcome in Australia, are appreciated, it is reasonable to expect that any new problems will not be insuperable if tackled in the right way.

With difficult species, improvement in practice must start with the felling of the tree and prompt transport to the sawmill. End coatings to prevent end drying and cracking may have to be applied immediately the log is felled and cross-cut, and maximum protection against drying must be afforded to the ends of the logs. Such practice is feasible because similar treatments are already in use in some tropical countries to prevent fungal stain.

Timber dries much more rapidly on end grain than on side grain, and this drying, no matter how small, can lead to fine end checks which, though insignificant in themselves, can, by causing concentration of growth stresses, lead to severe splitting. Except where very short logs are desired, logging practice should favour full tree bole lengths, and it may be desirable to include even some of the unmerchantable head of the tree as a portion to be discarded later at the mill. Restraining the ends of logs with wires or strapping, using box wiring or banding machines, might also be worthwhile in extreme cases.

Logging practice should aim at delivering the log on to the head saw of the sawmill with the minimum of delay after felling. It is recognized that most mills like to have a reserve of logs in the mill yard to avoid falling and transport holdups. With careful planning such reserves can be eliminated by (a) having available excess falling and transport facilities for emergency and (b) arranging, where possible, for reserve forest areas with good logging conditions to be available as near the mill as possible.

Where storage at the mill is essential, due to distance from the forest and to climatic and other transportation factors, logs should be stored in as long lengths as possible, protected from sun and other drying influences. Storage under water is most desirable, but, as a next alternative, storage under water sprays can also be effective. Fire-killed E.regnans was stored for ten years or more under water and under sprays with little loss. Logs should be sawn up as soon as possible after removal from the water and after cross-cutting.

Sawing equipment and sawing patterns can be further developed to take into account the type of difficulties and the deleterious influence of growth stresses. This should apply not only in cutting up logs but in ripping and edging the planks and boards produced. The principle is the same in both cases, i.e. to keep the stresses balanced by making cuts in pairs as much as possible, with each cut in wood with tha same type and intensity of stress as much as possible. For example, in a diametral plank a cut from one side near the bark will greatly unbalance stresses and lead to distorsion and possible splitting. Two simultaneous cuts on opposite sides of the pith near the bark will leave the stresses still balanced and they will be lower in magnitude. Removal of a further inch or two on each side will greatly reduce the stress in the remainder of the piece. Because of taper, such practice is obviously more suited to short than to long planks.

VI. Seasoning

The first point to be considered is whether seasoning is really necessary. In reaching a decision it is essential that existing trade practices should not be given undue weight. The final arbiter should be the essential requirements of the service which the timber is to give. This has become the general basis for decisions in Australia, and it has led to a great decrease in the problems of using eucalypts, even though the range of species and the quantity used have both increased. It applies particularly to timber used in construction; for example house framing and engineering structures. In the case of house framing much material which will distort in ordinary drying practice can be used green with satisfactory results because the restraining effect of other members and of sheating material prevents serious distortion in the final structure. It is standard practice in Australia to use unseasoned eucalypts for house framing and engineering structures, and design methods have been built up on this basis.

Seasoning problems can also be reduced if a diversity of products can be produced in milling. Not every log or every part of a log will produce wood readily suited for seasoning purposes because of the erratic occurrence of grain distortion, stresses, and collapsing tendencies. By selecting the more suitable material for seasoning grades and using the balance for green purposes much trouble can be avoided. On the other hand in a few cases where distortion is very common throughout a species it may be desirable to cut into final sizes, season under a maximum of restraint, and recondition under restraint also.

Spring requires special consideration because it is present in both green and dry sawn timber. It is common practice in Australia to store structural timbers on skids with the camber concave downwards so that the weight of the wood has a straightening effect. Advantage can often be taken of spring to give a camber in simple beams and members of trusses so that the member will tend to be straightened under full load. The effect of spring is reduced by using timber in short lengths where possible, and a variation of this practice is to partially cut

through studs or floor joists in place so that they can be straightened. At one time reconditioning of eucalypts with bad spring was often carried out with stacks built on edge and with the placing strips vertical. The practice has gone out of favour because of the difficulty of stacking, but it might be used in a modern plant with the aid of a simple tipple to rotate stacks through 90°.

It must be emphasized that the eucalypts are generally refractory drying species, and that only the best drying practice will give satisfactory results. Skilled supervision of drying is essential. These are the most important lessons which the Australian industry has learnt.

VII. Strength Properties

It is shown later that the eucalypts are strong timbers. They can therefore be used in smaller sizes than most softwoods. There is a tendency always, particularly in structures where design is difficult, as in house framing, to observe conventional practice and standardize sizes irrespective of the properties of the timber used. Full use of strength can permit smaller sizes and thus give greater service for a given volume of timber. This can offset the higher cost per unit of volume which sometimes results from some of the disabilities of eucalypts which have been mentioned.

VIII. Utilization

The eucalypts as a whole are a group of timbers which are extremely versatile in use. Some species have this versatility in themselves. For example, E. marginata has been used for the complete building and furnishing of homes, including timber in the ground, framing timber, outside and inside sheathing, roofing shingles, flooring, joinery, interior trim, and furniture. In all these uses it can be considered satisfactory, for even in furniture its density is offset by its handsome appearance.

It is more usual to select different species for different purposes, and this selection is generally on the basis of durability, density, and freedom from defects, according to the particular requirements. Nevertheless there are many cases of the one species serving widely varied uses. For example, E. wandoo has been used for sleepers, structural and waggon timbers, and flooring; E. regnans and other of the lighter eucalypts for flooring, joinery, furniture, and similar seasoned lines, as well as house framing, boxes, plywood, and some special uses; and E. maculata for sleepers, structural timbers, flooring, handles, large sizes of bent wood, and plywood. Many species are used in special crafts, such as wooden ship building where they are favoured particularly for keels, framing, and planking. At the other end of the scale there are special uses such as match splints and inpregnated bearing blocks for agricultural machinery.

Generally speaking the durable species are selected for use in the ground as stumps, posts, poles, piles, exposed structural uses such as bridges, sleepers, etc., as well as for exposed uses requiring seasoned timber such as verandah flooring. Suitable material is selected from logs of the lower density timbers for seasoned grades such as joinery, flooring, interior trim, sheathing, and furniture timbers; the balance of the material is used for structural grades, boxes, etc. Plywood is made from timbers of this group, and they also supply the timber for cooperage. The higher density timbers are used for structural purposes and sleepers, etc., but selected material is seasoned for flooring and like purposes.

Timbers with special properties are selected for special purposes. For example, timbers of medium to high impact strength are used for handles, lifting poles, and sporting goods. Free splitting timbers are used for fence rails and palings, although these items are now more frequently sawn from a wider range of species. Some of the eucalypts show special figure. This is usually due to curly, wavy, and interlocked grain, and suitable flitches are sliced for decorative veneers. The lightest of the eucalypts have been used for woodwool (excelsior).

The use of young eucalypts in the round form is worthy of further development. Such practice, apart from avoiding the need for sawing, has the advantage of securing full value of the intrinsic strength of the wood; grain distortion and knot whorls which greatly reduce strength are not likely to occur. Preservation treatment is simplified because the surface is all sapwood and the need for very high pressure treatment is avoided.

IX. Obstacles to Wider Use

It will be seen that although the eucalypts have many disabilities they have many desirable properties. The disabilities can often be overcome, and Australian experience can point the way in many instances. Sometimes the disabilities are of a type that ideal treatment for one fault conflicts with the ideal treatment for another. For example, collapse can be reduced by drying rapidly in the early stages but this increases the extent of surface checking which can also be a serious fault. In many cases it is necessary to compromise, and here experience and a sound knowledge of the factors involved must be the guide.

Splitting due to growth and seasoning stresses requires particular attention and can be greatly reduced with improved practice. Spring in sawn timber may require special attention in milling, seasoning, and subsequent use. Brittle heart, if present and not recognized, can build up a prejudice against the wood, particularly if impact stresses are involved. Compression failures, particularly in older trees, should be looked for in grading and should be rigidly excluded in strength grades. Included sapwood can permit leakage of cask timbers. Gum veins and pocklets and ring shakes where present require flexible sawing methods if the maximum of high grade timber is to be secured.

Nailing requires special attention: firstly because of the difficulty of driving nails in dry timber in all but the lightest species; secondly there is the danger of splitting, particularly when nailing near ends. Boring is often necessary but blunt ended and oval nails can be of assistance. Nailing patterns used in green timber must take account of shrinkage difficulties. The possibility of nails staining due to tannin in exposed painted wood, such as weatherboards, should be recognized and receive attention. Nevertheless, in spite of these disabilities, eucalypts form the major timber supply in Australia and their use for an extremely wide range of requirements indicates the future which eucalypts in other countries can have once the initial difficulties are recognized and overcome.

If a timber demonstrates difficulties in conversion and utilization, it is human nature to rejct it in favour of some other wood which, even though higher in cost, behaves satisfactorily with conventional practice. The challenge is to find that set of conditions which will enable to eucalypts to be used with full satisfaction.

X. Utilization Other Than as Timber

It is not necessary here to touch on the utilization of eucalypts for essential oils, tannins, etc. These are dealt with in a later paper. Such materials are either present in economic quantities or not, and their extraction and purification generally follows conventional practice. This applies also to destructive distillation where results will vary from species to species and can only be determined by test.

Pulping is also left for a later paper because special requirements are necessary to determine the potentialities of a particular species for some type of pulp. Existing knowledge of pulping practice with eucalypts elsewhere can, however, be a useful guide. In the case of hardboard the position is much more simple, and only one small group of closely related species - E. haemastoma, E. micrantha - is likely to give trouble. These are noted for their brittle nature, and with de-fibering they tend to break up irregularly rather than produce fibres and bundles of fibres. All other eucalypt species can be regarded as satisfactory.

The economics of eucalypt utilization can be greatly improved by integration of industries. For example, if sawmilling and pulping are integrated, low recovery in the sawmill is not of major importance because the supply of pulpwood is accordingly increased. There is a tendency often to regard a forest as a source only of sawn timber. If it is regarded as the basis of a group of industries it can often be much more effectively utilized. In this connection the pilot industrial plant of Huelva, Spain, will enable the complete utilization of 30,000 ha of Eucalypts of the province as timber, essential oils, tannins, charcoal and distillation products in completely integrated industries. Planning of integration is only possible where there is full knowledge of the raw material for the range of uses involved.

XI. Research Needs

It is not proposed to list here detailed research projects. These are covered later and the importance of them will naturally vary from country to country. It is hoped that the Conference will be able to give some indication of their order of importance. It may consider also how future research needs which arise can fit into their rightful place and be given their appropriate priority. Where and how such work can be carried out will require consideration.

It is too much to hope that any large sum of money will be available to expand the requisite research, but even if this Conference makes everyone aware of the scope and diversity of the problems it will serve a great purpose in making workers approach their research with the broadest conception. It may lead also to some rationalization of research activities to avoid overlap and to permit the carrying out of particular investigations where the greatest facilities exist.

It will become evident that there is a great amount of information already available on the eucalypts. These data, with a sound technical background, can be applied to give an initial approach to a local problem. This Conference will meet a much needed want in bringing all this information together. The Conference should decide on means whereby the fullest exchange of information can take place so that developments in one country may be speedily and rapidly reported to other countries concerned.

TABLE OF USES OF EUCALYPTS

Note: This Table shows the versatility of the eucalypts and the wide range of uses in which they have been successfully employed. The uses of a particular species will of course depend on its characteristics.

ROUND TIMBER:

Posts (structural and fence), poles (transmission, flag, hop field), piles, house stumps, mining timber (underground, poppet legs, surface buildings), bed logs, bridge and wharf timbers, heavy engineering structures, cranes (gantry, jibs, posts and legs), waggon poles, swingle trees, farm structures.

HEWN AND SPLIT:

Sleepers, crossing timbers, mining timbers, beams, decking, heavy structural timbers generally, wharf timbers, split fence timbers (posts and railings), palings and shingles, ship timbers (keels, keelsons, knees).

SAWN:

Heavy Construction - Foundations, mining timbers (tunnel and shaft timbers, chutes, mine guides), beams, posts, trusses, joists, purlins, etc., bridge and wharf decking, bracing, under-pinning.

House Building - Stumps, posts, plinths and other pieces in the ground, framing timbers (bearers, joists, plates, studs, hangers, rafters, purlins, ties and battens), flooring, weatherboard, lining, fascias, barge boards, mouldings, joinery, interior trim, built-in furniture and fittings, fencing timbers (posts, plinths, rails, pickets and palings).

Transportation and Transmission Equipment - Sleepers and crossings, rail waggons and carriages (solebars, headstocks, bearers, flooring, framing, side planking), road vehicles (body framing and flooring), ship building (structural members, planking, and decking), small boats, aircraft (spars and bearing plates for light aircraft), agricultural implements.

MANUFACTURED:

Furniture - Kitchen settings and mass production lacquered lines, dining and bedroom settings, fine period and display pieces, shop, bank and office fittings.

Turnery - Brooms and brushware, bobbins and reels, bungs and pegs, handles (axe, pick, adze, hammer, shovel, spade, rake and hoe, chisel), furniture parts and light fittings, kitchenware, novelties.

Cooperage - Slack and tight casks.

Sporting Goods - Bats, horizontal bars, spring boards, oars.

Patterns, Coffins, Bentwork, Carved Work.

Miscellaneous - Bearings, machine parts, etc.

Joinery - Windows and door frames, including sashes and doors, staircases (including stringers, treads, newels, and balustrades).

Packaging - Crates and boxes for butter, eggs, cheese, fresh fruit, dried fruit, canned food, bottled goods, explosives, and miscellaneous manufactured goods.

PLYWOOD AND VENEERS:

Rotary and sliced veneers, plywood for furniture, lining, etc., heavy plywood for concrete form work, flooring and structural uses, match splints, punnets.

DISCUSSION

The discussion covered a wide field in utilization and dealt with subjects of interest to all countries. This included wood used in round and sawn form as well as pulpwood and charcoal.

If countries are prepared to spend large sums of money on the establishment of Eucalyptus plantations they should be prepared to engage on utilization research. One point which came up in the discussions and not already covered in the technical papers submitted, concerned time studies on logging and other field operations, and it was indicated that such studies have already been initiated in Italy. Also in the discussions interest was shown in the utilization section which has been set up at Moshi, Tanganyika. This section has only recently been in operation, and comprises a sawmill, woodworking and wood-testing machinery, seasoning kilns, and a pressure impregnation plant.

RECOMMENDATIONS

A review was made of the existing activities and of the present and likely future problems of countries growing Eucalypts. Some countries are advanced in Eucalyptus utilization; in others uses are restricted to round wood because of difficulties encountered in sawing, seasoning, etc.

It seems clear that the Eucalypts can play a much more important part in wood economy of all countries if these difficulties can be overcome. Some of the problems will have to be studied where the Eucalypts are grown; others will require laboratory and pilot plant facilities. It is essential to avoid overlap and duplication and to make full use of existing facilities.

It is therefore recommended that:

1. A vigorous program of utilization research be pursued in all countries concerned, as a necessary adjunct to any Eucalypt planting program.

2. Coordination of such research activities is essential to promote interchange of information and acquaint workers with problems which arise. Such coordination could well be facilitated by FAO through its headquarters and its regional services, including bodies such as the Wood Technology Panel, and it is suggested that the maximum use should be made of the correspondence method.

3. At some future date when conditions justify it, a working party be called together to review the progress of Eucalypt utilization and to recommend the necessary further action to be taken.

4. FAO be requested to take the necessary steps to ensure the preparation and publication of as complete a bibliography as possible on the utilization of Eucalypts.

CHAPTER VII CONCLUSIONS AND RECOMMENDATIONS

Under each section the Conference made recommendations for future work, and in Chapter III on Problems Basic to Planting these covered the questions of site descriptions, mycorrhizal studies, dendrology, arboreta, and genetics. Also certain suggestions were made for IUFRO.

In Chapter IV dealing with Establishment, Management and Protection, recommendations covered such major problems as type of receptacles to be used, shading of young plants, spacing in the field; the effect of rotation length on yield and the importance of cultivation, fertilizers, irrigation; and the necessity of protection from insects, fungi and other destructive agencies.

The section on Protection for Farming and Soil Stabilization dealt with in Chapter V made recommendations for comparative studies of various species, and of structures of windbreaks, the influence of irrigation, the influence of plantations on erosion, and for research on the adaptation of methods to special conditions. Attention was also drawn to the need for comprehensive studies correlating agricultural production, grazing, yield of timber and wood products and the development of social milieu.

In the section on Utilization, Chapter VI, recommendations were made for a vigorous utilization research program wherever there was a planting program, coordination of research activities, a review of progress at some future date and the publication of as complete a bibliography as possible.

The full text of all the above recommendations is found in the relevant chapters. The Conference took cognizance of the document drawn up by the Secretariat on FAO activities in regard to Eucalypts, and on the means to be considered for their continuation.

It was of the opinion that it was preferable for the time being to develop such activities on the regional level and to reconsider them at the next world conference.

It therefore recommended:

I 1. that the Regional Forestry Commissions set up working parties on the model of that of the Joint Sub-Commission on Mediterranean Forestry Problems

2. that the Member Governments set up national working teams consisting of representatives of the sectors concerned, from production to consumption, or to appoint permanent correspondents with the regional working parties

3. that the Director General of FAO ensure the coordination of the work of the various regional parties, and organize the next World Conference that could take place after a suitable interval.

II The Conference, having taken note of the importance of Eucalypts in the Tropical Zones, recommended that this problem be given special consideration by the Regional Groups which will be set up in conformity with the first recommendation above.

In regard to matters concerning Africa which are not covered by the Regional Organization of FAO, the Conference requested that the Director General be asked to set up a special Working Group on Eucalypts for Tropical Africa, in liaison with CCTA (Commission for Technical Cooperation in Africa South of the Sahara).

III The Conference has also noted the special importance of the problems raised by the utilization of Eucalyptus wood and the necessity for the exchange of documentation between all countries engaged in research. The Conference therefore recommended that at the time of world conferences on Wood Technology which are held periodically under the auspices of FAO, a special Working Group be constituted to study problems relating to the utilization of Eucalyptus wood.