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Woodworking Machinery

Vienna, 19-23 November 1973

THE CONDITIONS AND NEEDS OF THE FOREST CONVERTING INDUSTRIES IN WEST MALAYSIA, PAPUA NEW GUINEA AND FIJI[1/]

by

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Forest Conversion Engineering Group, Division of Building Research,
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Melbourne, Australia

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SUMMARY

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PART 1 - WEST MALAYSIA

Forest industries, based on the conversion of tropical hardwoods, are of major importance to the economy of West Malaysia.

The main commodity is high quality sawn boards of well-known species, which are produced principally for export. However, although the country is well-endowed with forested land, much that is readily accessible has now been selectively logged and a proportion of the already established mills will have to accept, over the years ahead, a reduction in the size and quality of industrial logs and an increase in the range of species to be utilized. This is likely to focus greater attention on secondary processing.

Although there are already several large sawmills, the industry is basically made up of a great number of small to medium sized sawmills that are under-equipped andhighly labour-intensive. On the other hand, the recent opening-up of several large concessions, which is associated with the clearing of land for increased agricultural activities, is resulting in the establishment of large integrated complexes producing fully processed wood, plywood, and building components.

Future development is likely to be concentrated in mills converting between 80 and 200 cubic metres of logs per shift and most will be operated in conjunction with seasoning and machining facilities.

There is currently a lack of highly skilled labour to operate and maintain the most modern, highly productive equipment, but personnel capable of rapid training are becoming increasingly available.

Detailed descriptions of the types of equipment considered suitable for this region are provided.

PART 2 PAPUA NEW GUINEA

Much of the commercially exploitable forest of Papua New Guinea is lowland rain forest containing a mix of about 200 species, most being tropical hardwood which are not, as yet, well known on international markets

and which do not occur in concentrated volumes as single species.

The main forest industry is logging for export, the volume of which has increased dramatically in recent years, with approximately 60% of the annual harvest currently being exported. The sawmilling industry has not yet developed to anywhere near its full potential, at the present time there being very few medium sized mills and small mills servicing local communities. 85% of the sawn product is consumed domestically.

It is anticipated that over the next 10 years the area of forest being utilized will more than double and that log export is likely to be discouraged in favour of the establishment of conversion industry within Papua New Guinea. These will undoubtedly be of medium to large scale and designed to produce for the export market. The main problems to be overcome in this development will be those associated with the general absence of infrastructure, the dearth of skilled labour and the identification and establishment of markets for the wide range of species in use groups.

The types of equipment suited to the local conditions are discussed.

PART 3 - FIJI

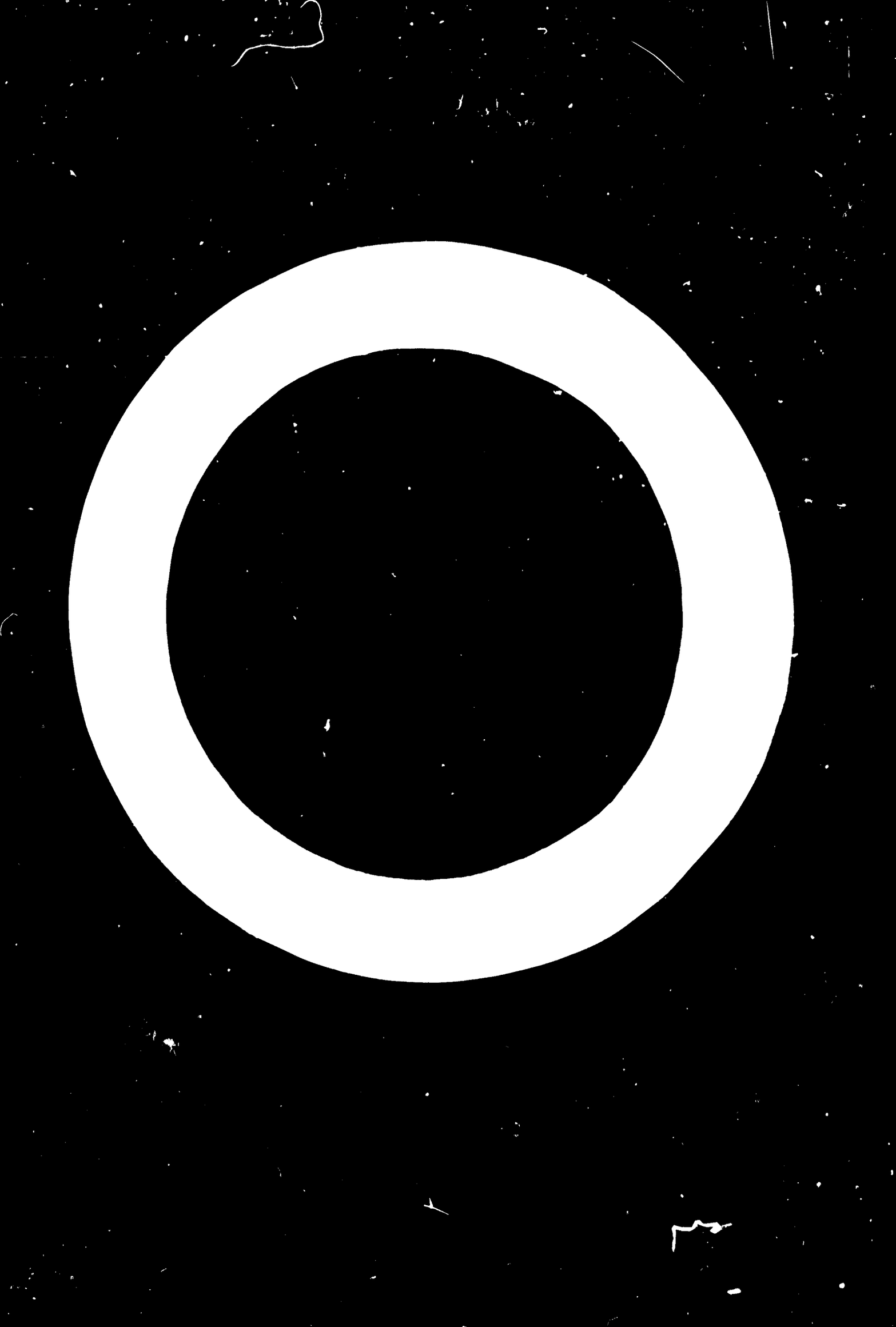
The tropical rain forests of Fiji have recently been studied in detail, in order to assess more accurately the size and nature of the resource. Currently these forests support a conversion industry which is basically sawmilling and which provides 93% of the country's requirements for sawn timber. These requirements have been increasing steadily over the last 20 years but during this period there has been a corresponding increase in the output from the sawmilling industry. This industry, which contains a high proportion of small, part-time mills, produces a full range of products from some 20 species, many of which are highly decorative.

Regeneration of many of these species is difficult and slow and to ensure the country's future timber supplies the Forest Department has been replanting worked-over areas with exotic hardwoods, as well as

establishing exotic and tropical plantations on the poorer sites. In the past there has been some difficulty in obtaining land for this purpose.

Although almost the complete output of the industry is consumed locally, the fragmented nature of the production has resulted in a lack of coordination between production, marketing and use, which has reacted against the best interests of the sawmillers.

Future development is likely to be in mills converting between 2300 and 33,000 cubic metres of logs per year and the types of equipment suitable for the timber species, products and workers' skills are suggested.



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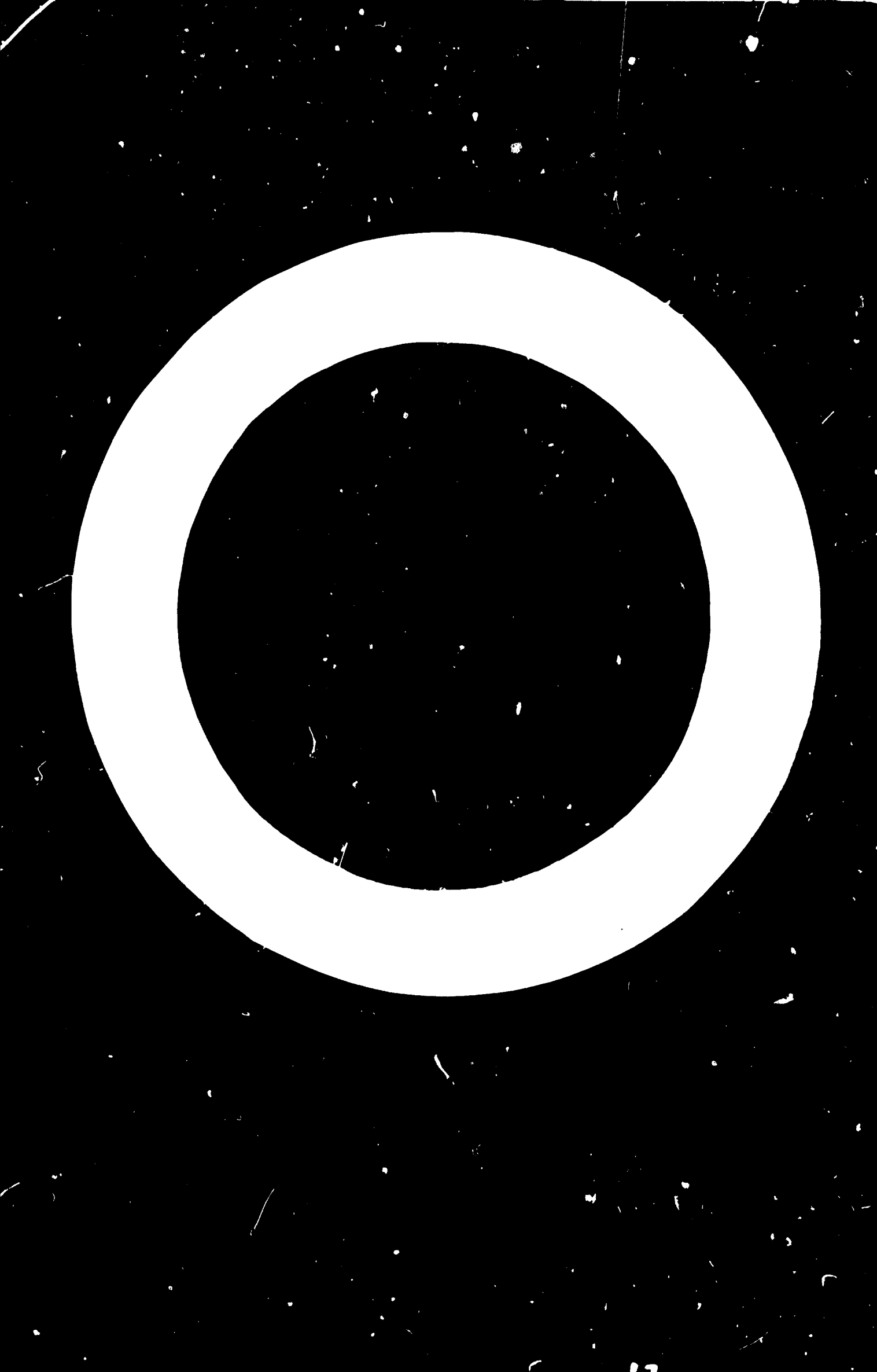


CHAPTER I
INTRODUCTION

1. The forest based industries are both economically and socially important to many communities, in countries which range in their degrees of development from the newly emerging, such as Papua New Guinea, to the highly industrialised North Americas.

2. Historically, the initial contribution of these industries has been related to the ease with which the forest resource can be worked and utilized by small, relatively low capital enterprises. In some regions the initial activities have been mainly logging for export, but in others small conversion plants were established at the onset to supply the market for vital and cheap building material, while at the same time fulfilling the social and economic need for employment opportunities.

3. However, these advantageous beginnings can create problems at later stages of development. Logging that is initially highly selective and not well controlled, whether for export or domestic use, can in later years result in a marked decrease in the size and quality of logs on which a viable conversion industry has become dependent. Likewise the issuing of small concessions or timber licences, to enable the establishment of labour-intensive, low cost conversion plants, while often desirable initially, can ultimately make plant modification difficult at the later stage when improved production methods become necessary due to rising labour costs and the market's demand for better manufactured timber. The capital cost of the accurate, high productivity equipment needed, can usually not be justified financially for mills with small log intakes.

4. Of the three countries discussed, two are now at the stage of development where they have a high proportion of small mills that are inefficient by today's standards, which impede orderly marketing and present economic problems in relation to modernization. In the third country, Papua New Guinea, some sawmilling has been conducted for over 30 years but basically its forest conversion industry is still in its infancy. The country is now approaching the stage where log export may be reduced and increased attention focused on conversion within the country.

PART I - WEST MALAYSIA

CHAPTER II
THE FOREST RESOURCE

5. West Malaysia is generously endowed with forests. Its timber stands constitute not only a major natural resource, but also contain important industrial and socio-economic potential. Already the forest utilization industry makes the third largest contribution to the country's economy.

6. The latest available FAO figures (1) indicate that roughly 60% of the total land surface of West Malaysia is forested. However, of this forest area of approximately 8.4 million hectares only 6.4 million hectares can be regarded as accessible commercial forest, with only 2.4 million hectares yet unexploited. The initial 4 million hectares have been selectively logged, but by no means clear-felled and it is the expressed intention of the forest authority to retain about 3.2 million hectares as Permanent Forest. From this area it is hoped to obtain an annual cut, on a sustained yield basis, of approximately 11.3 million cubic metres of round wood, although a significant reduction in the quality and size of industrial logs is anticipated over the decades ahead.

7. The forests of West Malaysia are typical of tropical hardwood forests, containing a wide range of species, not all of which are commercially acceptable. The Dipterocarps, predominantly merantis, are the main commercially acceptable species and comprise an estimated 43% of the total accessible volume. By comparison the non-Dipterocarps which are commercially acceptable comprise 20%, those species for which some markets are developing constitute 10%, while the other 26% remain neglected.(2)

8. The species currently used commercially range from light, general utility hardwoods of air dry specific gravity of 0.4 to heavy structural hardwoods having an air dry specific gravity of 1.1, the most popular dressing quality timbers falling in the range of from 0.6 to 0.8.

9. FAO have estimated (1) that the average gross volume of merchantable standing timber could be of the order of 140 cubic metres per hectare, which contrasts markedly with the average removal of only 24 cubic metres per hectare for the period 1966 to 1971, clearly indicating that the practice has been to take only the best trees of the most preferred species. Log export is banned in principle and in practice only about 2% of logs extracted for sawmilling and plywood purposes are exported overseas, however, a further 16% of high quality logs are moved into Singapore for processing.

CHAPTER III
THE SAWMILLING INDUSTRY

10. There has been a marked increase in the size of sawmills installed in Malaya during the last 5 years. In 1966 there were 432 sawmills which processed a total of 2.3 million cubic metres of logs, giving an average intake of 5300 cubic metres per mill per year. In 1971 the number of mills had risen to only 474, whereas the total log volume processed increased to slightly over 4.5 million cubic metres or an average mill input of 9,500 cubic metres per year, an increase in average size of 78% in 5 years. Obviously the mills installed in the last few years have been of considerable size, in fact a mill in the State of Pahang for which my own group is the design consultant, has a log intake of approximately 85,000 cubic metres per year and is to be part of an integrated complex that will process a total volume of 170,000 cubic metres per year.

11. However, the majority of the sawmills are still small, under-equipped, inefficient and highly labour-intensive. Approximately 50% of all sawmills convert less than 7,500 cubic meters of logs per year. An estimated 70% of the mills lack conventional breaking-down saws and carry out the log breaking down either with a portable chain saw rig or as happens more frequently, on a small, high column, narrow bandsaw at extremely low feed rates. In such mills timber is usually sawn on a contract basis, with the sawmiller providing the logs and the equipment and paying each bench crew a contract rate for the timber they produce. Under these conditions the man-day productivity is of less concern to the sawmill owner and in consequence light, hand fed equipment is used in mills which do not have powered conveyors or transfers between the benches, powered waste removal systems or mechanised facilities for sorting, stacking and bundling.

12. Many of these mills do not have their own logging concession but obtain their log requirements by purchasing on the open market. In the past a number of such mills have been profitable because they have had relatively high quality logs and have disposed of their products on a market hungry for dressing quality hardwoods. However, as labour becomes more expensive and as both log size and quality decrease it is apparent that the economics of

operating such mills will change significantly. Some of them will remain, mainly supplying domestic markets, but for the majority it is doubtful that they can continue on the basis of producing only rough-sawn and air-dried timber. To remain economically viable they will need to take advantage of the "added value" obtained from further processing. This will entail expansion into seasoning and machining and to justify economically the necessary financial investment these small mills will need to re-group or amalgamate into larger units. As already indicated the new mills currently being installed are of large capacity and it can be expected that an increasing proportion of the total sawn output of Malaya will be produced in the larger mills.

13. The area of most rapid development is in the east and north-east, where a number of large integrated complexes are planned. The sawmills of these complexes will be supplied from modern log yards in which long logs are first debarked and then graded and docked according to their suitability for various end uses. Sawmill logs will be transported into the mill on mechanised log decks equipped with fast loading and turning gear that will facilitate the orientation of the log, enabling the initial saw cuts to be placed so as to optimize grade recovery.

14. Log carriages are expected to be robust, remote-controlled, equipped with powered dogging, taper adjustments and fast, preselect setworks incorporating backstand sizing. Carriage feedworks will provide high acceleration and fast feed and return speeds to reduce non-productive times. Pony carriages will be used for the sawing of small logs and the re-sawing of flitches obtained from larger logs. In some instances these pony carriages may be of the linebar type, developed in Australia for handling timbers that spring during sawing.

NOTE: Spring is the tendency of the two pieces of a log or flitch to bend longitudinally when separated by a saw cut, the bend being towards the bark. It is caused by growth stresses and in severe cases can exceed 150 cms in 6 metres.

15. Bandsaws are being preferred to circulars for log sawing because of the higher volumetric recoveries they can produce and their ability to provide wide sawn faces. The trend is to larger bandsaws that will permit accurate cutting at high feed speeds.

16. Bandsaws are also preferred as resaws, although here again they will be considerably wider than those used in the past and the machines will have shorter columns to reduce excessive vibrations. These resaws will be equipped with powered infeed tables and powered hobs, will use mechanised roundabouts for returning flitches to the sawing position and have linebar gauging and preselect setworks. At the present time no cant frames are used as resaws but as a high percentage of production is in boards, it is likely that these machines may be effectively employed in the near future.

17. Board edgers are not widely used as main production machines, possibly because some species of meranti spring badly and the Japanese, who are large buyers, have a preference for quartersawn boards in these species. However, 2-saw edgers will most certainly find a place as recovery units.

18. In the older mills very little docking[1/] is performed, and this practice is likely to be continued in the newer mills, the main docking being reserved until after seasoning and machining. As log quality decreases in the future undoubtedly it will become necessary to do more docking on green boards. In the older mills dockers have been of the hand-operated pendulum type but in most of the new mills now being erected and planned many dockers will be pneumatically operated.

19. Whereas in many older mills material was transferred manually from one sawing machine to the next, the higher production capacities of equipment in the new mills will necessitate powered transfers between benches. Similarly automatic waste and residue removal from the machines will be necessary. In the two plants recently installed the mill residue is used as fuel to raise steam for other processes, namely seasoning and veneer and plywood production. In both cases the waste is removed by a belt conveyor beneath the level of the mill floor but an interesting feature of the latest mill is that lateral transfer of waste to this central conveyor is achieved

1/ Docking equals defect trimming

on vibrating chutes, working on the jog-trough principle.

20. As these newer mills are part of integrated complexes, more sorting and grading of green timber is to be carried out than has been normal in the past. At these mills mechanised sorting facilities are installed and are housed under cover to permit sorting to continue during the monsoon periods. At the latest mill an 18.3 metres diameter circular sorting table is to be installed which will permit the output of the mill to be grouped into about 40 different sorts, according to species, grade, section or length.

21. These newer installations will also incorporate seasoning facilities, permitting controlled drying of the light hardwood species without prior air seasoning. Although an increasing number of drying kilns have been installed in Malaysia in the last few years, the bulk of the production is still sold either green or in an air-dried condition, while much of it is kiln seasoned in Singapore.

22. The main product from Malayan mills is dressing quality rough sawn boards, these constituting an estimated 75% of the total production; the remainder being scantling and construction timbers cut from the heavier hardwoods. Almost 50% of the total production is exported, principally in the rough sawn state.

CHAPTER IV
SEASONING AND MACHINING

23. Although there has been a rapid increase in the numbers of both drying kilns and dressing and moulding mills installed in West Malaysia in the last 5 years, most of the sawmill output is still sold rough sawn and either green or air dried. The largest customer is Singapore, where the timber is dried, machined and re-exported. Singapore also purchases 92% of the logs exported from West Malaysia.

24. In the past much of the drying and machining that has been carried out in West Malaysia has not been done by the sawmillers, but by companies that purchase rough sawn boards from a number of sawmills for drying, machining and marketing, mainly through export outlets. The timber is air seasoned for periods of up to 6 months, the aim being to reduce the moisture content to about 30%. At this stage it is transferred into kilns, frequently of Australian design, and dried over a period of about 5 days down to a final moisture content of about 15%. Generally no high humidity stress relieving treatment is given at the conclusion of drying.

25. The kiln dried timber may be sold in its rough sawn condition or either square dressed or run into mouldings before sale. Machining is almost universally on a one-knife finish basis, irrespective of whether it is carried out on a square head machine or one with circular, cartridge type heads. Consequently feed speeds seldom exceed 0.3 metres per second and for mouldings are generally at 0.2 metres per second.

26. At the latest installations, where frequency changers are employed to achieve high head speeds, the operators claim that it is not possible to successfully joint knives at these high head speeds and as a result even square dressing is performed on a one-knife finish basis. On moulding work the operators rightly claim that the runs are too short to warrant the lengthy time required to joint the profiled cutters.

27. In the large, integrated plants already referred to, seasoning and dressing facilities are included. At the latest plant, drying from green

off-saw to 30% moisture content will be carried out in Australian designed predriers in a period of from 3 weeks to 1 month. Final drying from 30% to a moisture content of from 12 to 15%, depending on intended end use, will be in Australian designed kilns and occupy a period of approximately 5 days for 25mm stock. The associated moulding mill will be capable of machining approximately 70% of the output of the sawmill, the products being square dressed boards, flooring and mouldings. All machines will be of the 6-head type carrying circular cutter blocks and all products will be docked and graded following machining.

28. A pressure impregnation plant is also being installed for preservative treatment of low durability species, thus permitting their use in exterior joinery and other uses of potential decay hazard. It is anticipated that there will be increasing demand for treated timber in West Malaysia.

CHAPTER V
OTHER WOOD BASED MANUFACTURING INDUSTRIES

29. There is very little joinery, cabinet or furniture manufacture in West Malaysia, these being activities requiring special technical skills, which in the past have not been readily available. On the other hand, plywood production has increased dramatically in the last decade and currently exceeds 70 million square metres, on a 5mm basis, and utilizes slightly in excess of three quarters of a million cubic metres of logs per year. Present production is mainly low cost, urea bonded interior plywood, however the plywood mills of the new integrated complexes will also produce phenolic bonded sheets for use in external applications.

CHAPTER VI
MARKETS

30. The major product from Malayan sawmills is dressing quality boards, approximately 50% of which are exported. Malaya is the world's largest exporter of non-coniferous sawn wood, the main countries to which she exports being Singapore, Australia, Japan, the United Kingdom, the United States and the Western European countries of Belgium, France, the Netherlands and Germany. Malaya also exports about 70% of its plywood production, the major markets being the United Kingdom and the United States.

31. The potential to increase these markets is tremendous at the present time as there is a growing world shortage of hardwoods and the price offered by major log importing countries for high quality logs has increased by 2½ times during the past 12 months. At the same time the standard of living in West Malaysia is steadily rising and an increased local demand for timber can be expected, particularly for heavy hardwoods for domestic dwelling construction.

CHAPTER VII
FUTURE TRENDS IN THE INDUSTRY

32. The main factors likely to influence future trends are:-

(i) an anticipated serious reduction in the availability of good quality logs of preferred species over the next decade;

(ii) the opening up of several large concessions in the east and north east regions;

(iii) World market conditions.

33. A forest inventory, carried out jointly by the Federal Department of Forestry and the U.N.D.P. - F.A.O. Forestry and Forest Industries Project, has indicated that the forestry resource is considerably smaller than had been previously assumed and that over the next decade there will be increasing difficulty in maintaining the current rate of supply of high quality logs of preferred species.

34. The situation is being further aggravated by the clearing of some areas of lowland forest for agricultural purposes. This clear-felling will increase the quantities of logs available in the short term, but the need to use as much of the clear-felled timber as possible will reduce the overall average log quality. In the long term it may also shift the reliance of the industry on to areas that are perhaps less suitable for forestry.

35. The mills most affected will be those that need high quality logs to produce export grades and which purchase these logs on the open market. In future such mills will have to accept lower qualities and a wider range of species and perhaps a reduction in total volume. To maintain profits by selling the whole of their output at adequate prices, such mills will need to engage in "added value" activities. This will necessitate the installation of kilns, dressing and moulding mills and perhaps factories to manufacture components. To justify financially the expenditure on these facilities there may be amalgamation of small mills into larger, more economically viable units.

36. In the east and north-east the opening up of substantial concessions will permit the planned, long-term development of large integrated complexes, in which the sawmill will merely be the first unit in a manufacturing process producing ready-to-use timber items such as flooring, mouldings, panellings, and furniture components, some of which may be prefinished. In addition, these solid timber activities will be integrated with other forest conversion processes such as veneer and plywood manufacture, the manufacture of composite panels and perhaps ultimately pulp chip production. One complex consisting of plywood manufacture, sawmilling, drying and machining has already been installed, another is in the course of construction and several more are planned.

37. The standard of living in West Malaysia is steadily increasing and as large rural communities are being established, particularly for oil palm production, an increased demand for domestic dwellings can be anticipated. It is likely that sawmillers, especially those associated with the larger integrated complexes, will become involved in the production of low cost housing, using both solid timber and wood-based panel products.

38. The decreasing availability of high quality logs plus the increasing high cost of low volume,selective logging, at present averaging only 20% of the standing volume, will encourage the harvesting of smaller trees and more of the minor species. This will ultimately result in a changed pattern of production, in which high speed log handling and sawing methods are employed. Marketing will be by species groups, rather than individual species and the move to "added value" activities will be intensified.

CHAPTER VIII
SPECIFIC PROBLEMS

39. The major long term problems will undoubtedly be associated with developing the utilization of the minor species. Firstly, it will be necessary to establish the uses for which each species is most suited and then to classify those possessing like characteristics into use groups for marketing purposes, as these species do not occur in a sufficient volume in any one region to permit their marketing as individual timbers. It is envisaged that this work will be undertaken by the Forest Research Laboratories, working in collaboration with industry.

40. The second phase will be to develop the process technology that will enable products of a standard acceptable to world markets to be produced from these minor species economically. Techniques such as the prefinishing of mouldings and panels from species of similar texture and roughly the same colour,will unquestionably assist in the marketing of these species.

41. Many mills will need to take not only a wider range of species, but also a wider range of log sizes, and logs carrying a higher percentage of defects in order to maintain their intakes. In some instances the volumes of small logs available may be sufficient to warrant the establishment of mills specially equipped to handle small logs, but in many cases logs ranging from 25cm mid diameter to 180cm mid diameter, may need to be processed in the one mill. This situation will create problems in the selection of sawmilling equipment and in addition there will be the subsequent problem of finding markets for the resultant wider range of sawn sizes and grades, including many of small cross section. Seasoning requirements will differ for the various species, grades and sizes and these will need to be segregated.

42. The major current conversion problems relate to coping with increasing occurrence of undesirable characteristics in those species already commercially acceptable. The log defects most prevalent are large decayed hearts, areas of brittle heart sometimes difficult to detect visually, shakes that are probably the result of wind loading or falling, concentrated pinhole attack and excessive spring in some species of red meranti. The effect of

this latter defect is becoming vitally important, as Japanese purchasers specify that 80% of a shipment of these species should be quartersawn. The main market for the preferred species is in export quality boards, in as wide a width as possible, and the increased occurrence of defects is causing higher percentages of the sawn output to fall below export grade requirements. There have been difficulties in disposing of such material at adequate prices on the local market.

43. Initially there will be problems in obtaining sufficient numbers of skilled operators and trained maintenance personnel for the modern equipment in the larger integrated plants. Likewise there will be a shortage of people with the requisite management skills. The first two integrated plants have obtained overseas training for some key personnel and are also employing on short term contracts some experienced foreign people at the middle management level.

CHAPTER IX
SUGGESTED CONVERSION EQUIPMENT

44. I believe that the majority of equipment sales during the next decade will be made for two broad sizes of sawmills, which are the larger mills converting about 180 to 200 cubic metres of logs per shift and the medium sized mills converting about 80 to 100 cubic metres per shift.

45. At the present time there is a lack of skilled labour but this situation could alter fairly rapidly. Currently sawmill labour capable of effectively absorbing rapid training for skilled jobs costs up to M$12 [1/] per man shift, while labour for the less demanding sawmilling tasks can be obtained for as low as M$4 per man-day.

46. Personnel for highly specialised work, such as the maintenance of computer controlled quad-band rigs, will not be available at sawmilling centres for some time and such equipment should be avoided for the present.

Debarkers:

47. Because of the range of log sizes and the stringy nature of the bark of a number of species, the two debarkers most likely to be successful are the Rosser head and the hydraulic types, the latter where sufficient power and water are available.

Log decks:

48. These should be of the powered chain type and incorporate log storage under gravity behind pneumatically powered, semi-rotary log stops. These should be arranged to allow gentle delivery of the log by gravity to a position over or past the pivot point of the log loader arms.

Log loaders:

49. Hydraulic, pneumatic and steam loaders each have some undesirable characteristics. Hydraulic loaders are capable of accurate placement control but lack cushioning effect, even when fitted with accumulators, which

1/ M$18 = US$1 approx.

generally are not sufficiently responsive. In addition, when not operated by skilled personnel they can apply excessive loads to the carriage by the building up of high pressure when the arms are near their fully extended position. I have witnessed the breakage of a carriage axle caused by operation of the loaders repeatedly lifting the saw side carriage wheels from the rail and then allowing them to drop back into place.

50. On the other hand, pneumatic and steam powered loaders, while possessing a cushioning effect, completely lack placement control and can apply high shock loads to the carriage head blocks, particularly if the delivery pipe size is sufficiently generous to allow fast operation.

51. The best compromise is probably a pneumatic (or steam) operated loader but equipped with variable speed control, obtained by regulating the rate of flow of exhaust from the cylinders.

Log turners:

52. For large logs - Simonson hook arm type, steam or pneumatically operated with speed control.

For medium sized logs - Carriage mounted chain type nigger; electric or air motor powered.

For small light logs - Semi-oscillating nigger; steam or pneumatic powered with speed control.

The combination turner consisting of a Simonson type hook arm and a chain type nigger mounted side by side in the log deck, is a good compromise for many situations.

Carriage feed systems:

53. For large mills - If steam is available the shot gun cylinder is preferred, otherwise fully purging hydraulic pump and motor combination.

For medium sized mills - Friction driven winch and wire rope.

Log carriages:

54. As the maximum sawn timber length likely to be required is about 7.5 metres, carriages with 4 knees should be adequate.

Dogging - pneumatically or hydraulically operated and equipped with pull back mechanism.

Head block movement - via double roller chain with individual chain tensioning and hydraulic or electric taper adjustments.

Setworks - D.C. balanced circuit type. The electro-mechanical and master-slave motor systems, which depend on the closure of an A.C. micro switch for control of locations are perhaps simpler to service but are subject to greater possibilities of error. They may be suitable for some medium sized mills.

Carriage receders - pneumatically operated, manually controlled.

Suggested optional equipment - (i) pneumatic flippers of generous size to absorb log loading shocks and to facilitate flitch turning and carriage unloading. (ii) false log seats to reduce wear on head block ways.

Head saws:

55. Large mills - normal strain bandsaws with wheel diameters of from 2.1 to 2.5 metres, powered by at least 125 H.P. motors and carrying blades of a minimum width of 35 cms.

Medium sized mills - normal strain bandsaws with 1.8 to 2.1 metres diameter wheels, minimum power of 110 H.P. and minimum blade widths of 30 cms.

All band mills to be of the short column type and provide for blade speeds of from 33 to 38 metres per second.

Pony carriages:

56. These are recommended for use both as carriages for small logs up to about 0.8 metres in diameter, and also as resaws following larger carriages.

57. The preferred pony carriage is the line-bar type, known in Australia as the "semi-automatic". This machine can have 4 or 5 head blocks, of which 2 at either end may be moveable longitudinally along the carriage to facilitate dogging as near the ends of logs as possible when sawing springy timber. Dogging is pneumatically powered and each head block is independent and is moved by a separate pneumatic or hydraulic cylinder. Setting is against a linebar gauge, which is hydraulically controlled.

58. These carriages may be operated with either a 1.8 metre diameter bandsaw or 91 cm diameter circular saws.

Resaws:

59. Large mills - Either 1.5 or 1.8 metres diameter bandsaws, carrying a minimum blade width of 25 cm and operated with a powered linebar, infeed table, and roundabout. The infeed table should preferably incorporate a flitch turner and the roundabout a waste separator system.

60. Medium sized mills - Either 1.5 metre diameter bandsaws or 1.1 metre diameter circular saw benches, both equipped with powered feed rollers and hobs and manually or hydraulically operated gauges. In addition both benches should be equipped with either outboard, powered, flitch return rollers or a simple belt type roundabout.

61. For mills with the better quality logs capable of producing flitches for resawing into boards, a split feed roll, cant gang frame saw would be ideal.

62. Recovery or re-cut machines can be either 122 cm diameter bandsaws or 91 cm diameter circular saw benches, both fitted with powered feed rolls and either manual or hydraulically controlled gauges.

Edgers:

63. The use of edgers using more than two saws should be restricted to those timbers that do not spring during sawing, for which species multi-moveable saw machines can be employed for the production of both boards and

building sizes. For species prone to spring the use of multi-moveable saw edgers can result in much saw binding and in a high proportion of the production failing to meet the market specification of straightness, unless re-cut, particularly when producing quartersawn boards. In these cases the use of edgers is limited to two saw machines.

Docking: 1/

64. In board mills only a minimum of docking should be performed prior to seasoning and machining. However, as in the future sawlog quality is likely to decrease, the amount of green docking necessary could increase. On this basis defect dockers are favoured rather than the end trim type.

65. The preferred types are either the hand controlled, hydraulically actuated pendulum or straight line docker or the foot controlled, pneumatically actuated, up-jump docker equipped with top clamp-hood. A limitation of the latter type is that it is only suitable for a limited range of cross sections.

Sorting:

66. Very few mills in Malaya have adequate sorting facilities, in fact, the sorting operation is frequently so restricted in space and jumbled, that accurate grading must be difficult. As log quality decreases, as a wider range of species is milled and as the industry moves into seasoning and machining operations, more sorting and grading will become necessary.

67. Circular, rotating sorting tables are regarded as the most suitable. They provide considerable operational flexibility and while more labour efficient than sorting chains, they are still sufficiently labour-intensive to take advantage of the relatively cheap labour available. They should be installed under cover, in well lit working areas and in diameters to suit either the maximum length to be sorted or the maximum number of sorts desired. Irrespective of diameter the rim speed should not exceed 0.25 metres per second.

1/ Docking equals defect trimming

Seasoning:

68. The air drying of 25cm thick Malayan hardwoods to 16 to 18% moisture content can be achieved in about 6 months, provided the drying is carried out under cover. This time can be reduced to about 1 month in a simple oil-heated predrier, operating at about 49°C and with control of only the dry bulb temperature. Such a system could be ideally suited to small and medium sized mills producing for the domestic market, except that timber intended for use in air conditioned environments would require drying to a lower moisture content.

69. On the other hand, for mills producing for the export market and of medium to large size, kiln drying from green to 12 to 15% moisture content in either steam or oil heated kilns can be achieved in 2 to 3 weeks, depending on species. The advantage of oil heating is lower capital cost, as a boiler is not required, while the benefit from steam heating is that it permits a stress relieving high humidity treatment to be given at the conclusion of drying.

70. At the first large integrated plant established in the east and at the second currently being constructed, a typically Australian system of combined predrying and kiln drying is employed. In these cases the predrier is steam heated and fully controlled and reduces the moisture content of green 25 cm material down to 25% to 30% in about 2 weeks. This is followed by drying in steam heated kilns for 4 to 5 days to reduce the moisture content to about 12%.

Machining:

71. Moulding and dressing activity is concentrated mainly in Singapore, where there is a preference for relatively light, high head speed machines. Consequently jointing is not practised and a one-knife finish is accepted. Thus to achieve a standard of 1 cuttermark per 2mm, slow feed speeds of from 0.2 to 0.3 metres per second are usual.

72. It is accepted that the jointing of moulding cutters is time consuming and not warranted for short runs, but a reasonable percentage of the output is in items such as flooring and square dressed boards, on which the main face is square dressed. For such production a heavy, slow speed, 12 to

16 knife head machine would permit feed speeds in excess of 1 metre per second.

73. Admittedly such machines are expensive to manufacture but an acceptable compromise would be a machine having high rotation speeds for all heads except the main finishing head, which would carry at least 10 knives and rotate at about 2500 to 3000 revolutions per minute. For example, a machine having 2 bottom and 2 side high speed heads and 1 top slow speed head would be an acceptable configuration.

74. Alternatively, a machine on which one of the second horizontal heads is replaced by an abrasive head and which is used to clean up a surface of about 1 cutter mark per 8 mm, would permit considerably higher feed speeds.

CHAPTER X
COMMERCIAL OPPORTUNITIES

75. As indicated in Chapter VI, Malaya is the largest exporter in the world of sawn hardwood. At present the world market for dressing quality hardwood appears to be insatiable and prices have been rising rapidly.

76. It is predicted that in the long term Malaya will suffer a shortage of prime quality hardwood logs and that sawmillers will have to accept lower qualities and may be forced to reduce exports of the higher grades of sawn timber. However, current exports are predominantly as rough sawn boards and excellent opportunities exist to increase substantially the value of these sales by carrying manufacture to the further stages of dried and dressed products. The ingredients necessary to do this profitably are there; the raw material is still relatively cheap, labour is capable of fairly rapid training and cheap by world standards, the technology is available, management skills are being attained and transport and shipping is being improved.

PART 2 - PAPUA NEW GUINEA

CHAPTER XI
THE FOREST RESOURCE

77. Applying the F.A.O. definition of "forests" to Papua New Guinea results in almost 90% of the total land area being so classified. However, about 75% of the 40 million hectares of "forests" is in broken and mountainous terrain, to much of which access is difficult. In fact, current opinion [3] is that the maximum area that can be regarded as commercially exploitable is only 8.5 million hectares.

78. A high proportion of the commercially exploitable forest is lowland rain forest, containing a mix of some 200 species, most of which are hardwoods unfamiliar to world markets and in which volumes are not always concentrated. At present the forest based industries are operating on some 900,000 hectares, from which the average sawlog removal would be of the order of 23 cubic metres per hectare. Assessment of those areas not currently being worked indicate that average availability of commercial trees of at least 48 cm diameter above the buttress, is about 54 cubic metres per hectare[4].

79. It is anticipated [3] that during the next 10 years the operational area will increase to about 2 million hectares, but it has also been suggested that exports of sawn wood may be limited to about 30 timber types.

80. In the past the operation of the Department of Forests in promoting the development of large scale industry has been somewhat impeded by the extremely fragmented ownership of the forested land. The Government now purchases rights to harvest and remove timber and other forest products from the indigenous owners for periods of up to 40 years. At the present time the forest area available to, or under the control of, the Department of Forests amounts to about 2 million hectares, 31,000 of which is Permanent Forest Estate and approximately 1,800,000 hectares on which timber rights have been purchased.

CHAPTER XII
THE FOREST BASED INDUSTRIES

81. The forest converting industry currently harvests approximately 720,000 cubic metres of logs per year, of which 90% are non-coniferous species. Log export is the largest single activity and currently 60% of the harvest is exported annually, all of which is non-coniferous.

82. From the remainder the local industries produce 64,000 cubic metres of non-coniferous and 27,000 cubic metres of coniferous sawn wood, as well as 17.5 million square metres of veneer and almost 4 million square metres of plywood, the bulk of which is coniferous. 15% of the sawn wood and 63% of the plywood is exported. Minor quantities of veneer are also exported.

83. In the early 1940's there were only a few sawmills in Papua New Guinea. But in the immediate post-war period the urgent need to repair the war-caused devastation and to develop the country, created a greatly increased demand for sawn timber and the industry developed rapidly to meet it. Today there are 91 sawmills, ranging in size from small service mills converting about 200 cubic metres of logs per year, to large mills with log intake capacities of over 65,000 cubic metres per year. While the average daily sawn output per mill is only about 4 cubic metres, there are a number of important mills producing about 40 cubic metres of sawn timber per shift.

84. A feature of sawmilling in Papua New Guinea is that 61 of the 91 sawmills are licensed to use the CSIRO patent dip-diffusion process for the treatment of sawn timber with preservative salts. This remarkedly high percentage of mills engaged in preservation results from a government ordnance of 1964 which made it compulsory for all the timber used in building construction and in manufacture of furniture for government to be preservative treated. This requirement has considerably increased the range of tropical hardwoods that can be used in construction, and today Papua New Guinea has the most highly developed wood preservation industry in the tropics.

85. A wide variety of sawmilling equipment is used throughout the Papua New Guinea industry, the main factor apparently influencing selection being the size of the operation.

86. In small mills log breaking-down is carried out by either chain or circular saw portable units or on flat top carriages with twin circular saws. In larger mills knee type carriages are used, in most cases rider operated but in at least one fairly recently constructed mill a remote controlled carriage has been installed.

87. Resaws are predominantly the Australian breast bench type of open, 42" circular saw bench with horizontal powered feed rolls, although a limited number of mills also have circular saw benches with twin powered feed hobs and simple roundabouts. In a small number of mills gang frame-saws are employed for the resawing of flitches.

88. The most usual docker is the hand-operated pendulum type, while sorting is achieved simply by moving timber manually to various stacks in the case of small mills,or from a chain or wire rope sorting table at larger mills. At plants carrying out preservative treatment, the timber is dipped either as individual boards and then block stacked or a block stack is immersed in a dipping tank. Subsequently the dipped and block stacked timber is held either in a sealed chamber or under sealed plastic sheets for about 3 weeks.

89. From the wide mix of species converted, the Papua New Guinea mills produce a full range of sawn products, including construction timber, scantling, dressing quality boards and stock for moulding, joinery and furniture. Production is intended primarily for the domestic market and is estimated to comprise 60% scantlings, 30% boards and finishing quality and 10% construction and other sizes.

90. The cost of unskilled and semi-skilled labour is cheap but of lower productivity than in Malaya or the Philippines and requires a higher degree of supervision. The wages for sawmill labour in urban areas have recently risen by 35% and relatively steep increases generally throughout the industry are likely during the next few years. Currently sawmill labour outside of urban areas costs about A$1.50 per man-shift.

91. There is a considerable dearth of skilled operators, qualified maintenance and foreman level personnel, and because of the general lack of

infrastructure foreign labour is expensive. The inadequate infrastructure also causes plant establishment costs to be high.

92. Very few (2 or 3) sawmills have kiln drying facilities, the usual drying practice being to air-dry, without cover, for periods of from 3 weeks to 2 months and down to an estimated moisture content of 25 to 30%. The equilibrium moisture content over much of coastal Papua New Guinea would be approximately 18 to 20%.

93. Dressing and moulding is a one knife finish carried out at slow feed speeds, usually on square head machines. Due to the high moisture content and the cross-grain nature of some of the dressing quality species, much torn and lifted grain results. While this quality is acceptable on the domestic market, it is not of a good export standard.

CHAPTER XIII
MARKETS

94. The major market for logs is export, some 60% of the annual log harvest being sold to Japan and Australia, with Japan being by far the dominant buyer and consuming 99% of the export supply.

95. Log export has increased dramatically in recent years, rising by about 550% in the 5 year period from 1966 to 1971. This intensification is largely the outcome of the need to clear substantial areas of rain forest for expanded agricultural and forestry activities. However, it can only be regarded as unlikely that log exports will be permitted to continue at their present high levels for a prolonged period.

96. By comparison to the log market, about 85% of the sawn timber production is consumed domestically and, of the 15% exported, 84% is coniferous, all of which is exported to Australia. Practically all of the remaining non-coniferous 16% is sold in the South Pacific region, only very minor quantities reaching the United Kingdom.

97. As coniferous species are scarce and as the volume permitted to be removed form the Araucaria forests is strictly controlled, any increase in the sawn export will be in hardwood species.

98. The domestic market has been relatively static for some years and is not expected to increase at a rate greatly different from that of the Gross National Product. Consequently, as log export is progressively discouraged and further forest areas are made available for utilization, a substantial export drive for the sales of sawn and perhaps processed non-coniferous wood can be expected. Japan and Australia are likely to be the main markets.

CHAPTER XIV
FUTURE TRENDS IN THE INDUSTRY

99. The pattern of the future development of the forest based industries will be tempered by the interplay of the following economic targets, social needs and technical achievements.

(i) The present government is anxious to foster commercial activities based on the country's natural resource, where such enterprise improves the long term economic and social status of the community. Current indications are that such operations will be relatively large scale and achieved through joint ventures between suitably qualified foreign investors and the indigenous people.

(ii) Land clearance for an expanded agricultural industry will increase log availability in the short term but may reduce the long term potential of forest resource.

(iii) In order to provide expanded employment opportunities and to increase export earnings the government is most likely to phase out log export and require companies operating the forest resource to process in Papua New Guinea a reasonable percentage of the logs that they harvest. Such requirements are currently being imposed in Malaya, Indonesia, and several South American countries which were previously large exporters of logs.

(iv) Combined research between the Australian and Papua New Guinea Forest Products Research Laboratories have established the economic and technical viability of kraft paper pulp production from mixed tropical hardwoods. Commercial utilization of this development is rapidly becoming a reality and pulp chip export at the rate of 305,000 metric tons, green weight, per year is scheduled to commence late in 1973 from one area near Madang, while two further ventures are in the planning stage.

(v) The success of the dip-diffusion treatment in extending service life has increased the usefulness of a considerable range of species and has improved the potential for developing export markets for

processed wood of mixed tropical hardwoods.

100. The very small sawmills at present servicing local and sometimes isolated communities are likely to continue, in fact their numbers could increase slightly after independence, as the Papua New Guinea people develop their life-style and require increased quantities of sawn wood.

101. The medium to large existing mills, producing 40 or more cubic metres of sawn timber per shift will modernize in order to produce a better quality product and also to improve the productivity of the limited number of skilled operators. They will undoubtedly endeavour to become integrated with pulp chip operations, so as to improve profitability both by utilizing mill residue and perhaps more importantly by reducing the cost of harvesting sawlogs. At present logging roads cost between A$1900 and $6500 per kilometer, depending on terrain, while the volume of sawlogs harvested averages only about 20-25 cubic metres per hectare. Experienced local people estimate that the addition of pulpwood harvesting would at least double the total volume removed per hectare and in some cases increase it by up to 200%. Hence the roading cost component in log costs would be drastically reduced. In addition, the overall quality of logs delivered to sawmills would be improved because of the alternative profitable outlet provided for logs of marginal or doubtful quality.

102. There is a considerable shortage of hardwood sawn timber on the world markets and after independence there will undoubtedly be moves for the formation of joint venture companies for the purpose of expanding the sawmilling, veneer and plywood industries to supply this demand. While the basis for the expansion will be hardwood exports, the vehicle will be the utilization of logs made available by agricultural development and the need to convert the present large log export industry into one providing a much greater economic and social return.

103. New sawmills of this type will probably be based on a log input of at least 28,000 cubic metres per year and be integrated with veneer and/or plywood production and also with pulp chip activities, which later may develop into the manufacture of pulp and perhaps even paper.

104. The principal export markets will be Japan and Australia. Sawn timber will be preservative treated and dried and provided the import regulations of the recipient countries permit, it may also be machined and further processed.

CHAPTER XV
SPECIFIC PROBLEMS

105. The principal problem in the further development of the forest converting industries of Papua New Guinea will be the processing and marketing of the minor species. In Papua New Guinea the problem is intensified because the country does not have any species that are widely known on international markets or are available in volumes similar to the main Shorea spp. of Malaya, the Philippines or Indonesia. In fact, the currently available information suggests that the number of Papua New Guinea species that occur in sufficiently concentrated volumes to permit their marketing as individual timbers may be strictly limited, as also may be the annual volume of each available.

106. The solution to expanded exports then lies in the successful marketing of the mix of some 200 hardwood species. This in turn depends on there being available enough technical information on each species to enable its processing characteristics and end uses to be determined sufficiently to enable each to be placed in a group of species, each group containing species sufficiently alike to enable them to be sold together and used for the same purpose.

107. The determination of the properties and potential uses of the various species has been proceeding for a number of years and results have been published. Sufficient information is available to suggest end-uses for some 200 species, while detailed shrinkage and movement data is provided for over 60 timbers.(5) Certainly sufficient information is available to permit use grouping of the more available species and the problem remaining is to promote their marketing.

108. Successful long-term export marketing will require manufacture to a higher quality standard than has been acceptable on the domestic markets. At present the skilled personnel required to achieve this improvement are not readily available in the region and an intensive industry training programme will be necessary to enable the quality of the overall production to be sufficiently reliable to win and sustain market confidence.

109. Lack of infrastructure remains a serious barrier to sawmilling expansion but this problem should be alleviated to a marked degree if pulp chip export projects prove viable.

CHAPTER XVI
SUGGESTED EQUIPMENT

110. I consider that the principal equipment requirements for Papua New Guinea during the next decade will be for mills having a log input of at least 100 cubic metres per shift. At the time of writing we are advising two companies in the modernization of two sawmills of about this size and anticipate that most new mills will be much larger.

111. In spite of the present lack of skilled labour I consider that semi-automated equipment, similar to that suggested for Malaya, will be preferred in Papua New Guinea; mainly because the accuracy and quality of timber sawn on such equipment is less affected by the personal skills of the operator than that sawn on simple benches. The major problem will be in obtaining skilled people for maintenance and repair work and for some time such tasks may have to be undertaken by imported technicians.

Debarkers:

112. Rosser head type,or hydraulic type where sufficient water and power are available.

Log decks:

113. As per PART 1, CHAPTER IX. Page 15

Log loaders:

114. As per PART 1, CHAPTER IX. Page 15

Log turners:

115. As per PART 1, CHAPTER IX. Page 15

Carriage feed system:

116. For units of less than 150 H.P. friction driven winch and wire rope systems are preferred because of their simpler maintenance requirements.

Log carriages:

117. As per PART 1, CHAPTER IX. Page 15

Head saws:

118. Normal strain, short column machines with wheel diameters from 2.1 metres to 2.5 metres and carrying blades of a minimum width of 35 cm at speeds of from 33 to 38 metres per second.

Pony carriages:

119. As per PART 1, CHAPTER IX. Page 15

Resaws:

120. Resaws should be either 1.8 metre diameter wheel bandsaws with 25 cm wide blades or 1.1 metre diameter circular saw benches, both equipped with powered feed rollers and hobs and manually or hydraulically operated gauges, preferably manual. Benches should be fitted with either outboard, powered, flitch return rollers or a simple gravity slide and belt roundabout.

121. In mills where good quality flitches can be produced for sawing into boards or framing sizes, a split feed roller, cant gang frame saw could be an excellent choice.

Edgers:

122. As per PART 1, CHAPTER IX. Page 15

Dockers:

123. To be designed primarily for defect removal and of the pendulum type either manually operated or hydraulically operated and manually controlled. In many cases the former will suffice but for all applications where joinery or large sizes are being produced for export, it is essential to provide either a mechanical or powered means of turning flitches for inspection.

Sorting:

124. Circular rotating types, particularly at mills producing for export. Details as per PART 1, Chapter IX. Page 15

Seasoning and machining:

125. As already indicated in paragraph 93, the general surface quality of machined products is not of a high export standard, mainly due to the lack of seasoning facilities. The comments and suggestions made regarding seasoning and machining in Malaya in paragraphs 68-74 apply equally to Papua New Guinea, except that there may be less local demand for seasoned timber.

CHAPTER XVII
COMMERCIAL OPPORTUNITIES

126. At present slightly less than 1 million hectares are being worked by the forest converting industry. however, the Department of Forests of Papua New Guinea has indicated that the forest areas available for operation will increase by 100% during the next 10 years[3]. It should also be appreciated that, given a profitable market and adequate finance, expansion could continue beyond that time or in fact be more rapid during this period than now indicated.

127. Forest areas to be made available in future are likely to be large scale units; for instance, one area currently being offered is of 52,000 hectares and is stated to contain 2.4 million cubic metres of saw logs plus lesser volumes of pulpwood. However, the key factors to commercial success generally in the region are likely to be those just stated - profitable markets and adequate finance.

128. Profitable markets are stressed because the forests contain a wide range of mixed species for which continuing export markets have yet to be identified and then established. I also suggest adequate finance because the new areas will have little or no infrastructure and in addition the considerable dearth of indigenous management expertise, trained operator personnel and financial structure will require such enterprise to have substantial foreign investment and assistance, at least initially.

129. To sum up, firstly the logs will be available, secondly I believe that there already exists sufficient technical knowledge on which to base marketing groups for most of the species and thirdly there are expanding export markets for sawn and processed wood. What is now needed to develop the commercial opportunities is a sufficient number of people with the necessary operational expertise, ability to identify accurately and realistically the markets that can be supplied on a continuous basis and finally adequate financial resource and intrepedity.

PART 3 - FIJI

CHAPTER XVIII
THE FOREST RESOURCE

130. Enumeration studies of the forest estate were commenced in 1953 by the Fiji Forestry Department and subsequently completed, in 1969, by the Land Resources Division of the Directorate of Overseas Survey of the United Kingdom. Their report has not yet been received but general understanding is that about 50% of the land area is forest but that much of this 908,000 hectares of forested land is of low quality, consisting of creepers, bamboos and rattans and that a substantial proportion of what might have otherwise been regarded as virgin areas, have already been subjected to village garden culture.

131. Over 80% of the forested land is owned by the Mataquali, or indigenous Fijian communities, and less than 10% is State Forest. As Fiji is a net importer of sawn wood, the acquisition of land for forestry purposes to meet the increasing demands for sawn wood has been of continuous concern to the Forestry Department. Land that is acquired is rented from the Mataquali at a current rental of about 25 cents (Fijian) per hectare. At the present time only about 3% of the forested land is classified as productive forest, because of the combined effects of:-

(i) the difficulty of obtaining suitable land;
(ii) the rugged nature of the terrain;
(iii) the lack of roads in the interior and
(iv) decision not to allow further long-term concessions until the enumeration results have been evaluated.

132. The Fiji forest is a tropical rain forest consisting of two broad types:-

(i) the lowland tropical rain forest, in which about 80% of the important species are hardwoods, and
(ii) the Montane rain forest, in which about 50% of the main species are coniferous, the principal softwood being Fijian kauri (Agathis vitiensis), locally known as dakua makadre.

133. Current annual production from these forests is about 52,000 cubic metres of sawn wood and 400 cubic metres of veneers, just over 70% of the sawn wood being hardwoods. Whilst about 90 species are utilized commercially, many of them contribute very little and over 90% of the sawn wood production would be obtained from not more than 20 species.

134. Many of these species are decorative, suitable for a range of end uses and readily marketed locally. However, the country needs to import a small percentage of its requirements, mainly softwoods. Further, as the volume of indigenous species removed per hectare is low and their regeneration is regarded as difficult and slow, the Forestry Department is planting hardwoods in areas already exploited and establishing softwood on the poorer grassland sites. The main hardwood being established is mahogany (Swietenia macrophylla), while the plantation conifers are P. caribaea and P. elliottii. To date slightly over 10,000 hectares have been planted with hardwood and about 7,300 hectares of pines established. One estimate [6] is that by 1975 the annual availability of plantation softwood thinning logs of 13 cm top diameter and above, will be about 23,500 cubic metres.

CHAPTER XIX
THE FOREST BASED INDUSTRIES

135. Sawmilling is the principal forest conversion industry, there currently being only one veneer mill, which has only recently commenced production but for which the long term plans include extensions into plywood manufacture.

136. The majority of sawmills are very small, as shown in Table 1, with 84% of mills producing not more than 1500 cubic metres of sawn timber per year. Many of the owners of these small mills regard sawmilling as a part-time occupation, providing short term employment during the regular slack periods in other agricultural activities. These mills fill a social need by providing alternative employment but only for a very small number of workers, in fact less than 1% of the total work force[6].

Table 1

Size distribution of Fijian sawmills

Annual sawn output m^3	No. of mills	Percentage of total number %
500	30	60
501-1000	11	22
1001-1500	1	2
1501-5000	5	10
5000	3	6

137. The equipment in these small mills is extremely simple, often antiquated, the work is arduous and inefficient and the sawn product not well produced or graded. However, the total volume of timber produced by the very small mills is not great and is likely to become a smaller percentage of the total, as living standards increase and better employment opportunities are created.

138. At the present time the combined output of the seven largest mills is 70% of the total output of all Fijian sawmills, while the biggest of the seven mills is relatively small, producing slightly less than 10,000 cubic metres of sawn timber per year. If the ten largest mills develop the full potential of their sawlog availability, then their combined intakes will account for 84% of what is currently understood to be the potential total log availability.

139. Access to sawlog supplies is obtained by either:-

(i) a concession for a 30 year period, with both a maximum and a minimum annual cut specified;

(ii) long-term licences for periods of from 5 to 10 years;

(iii) annual licences which are granted for an area, not a specified volume, and with trees marked at a rate sufficient to get the operator through the area in 12 months, or

(iv) licences for a specified number of trees.

140. In 1966 the Forest Department decided that no new concessions would be approved until the results of the forest enumeration had been analysed. In their report for 1970, at which time the enumeration results were not available, it was stated that during that year there were eleven concessions, three long-term licences and 220 annual licences operating.

141. Sawn output from the forest based industry has been increasing at an average rate of about 5.5% per year for the last 10 years, but the country has not yet reached self-sufficiency in its wood product requirements; the imbalance of imports over exports costing approximately F$500,000 per year. Exports are small and mainly to Australia and the neighbouring Pacific Islands.

142. The sawmilling industry uses circular saws almost universally for both log sawing and resawing, in some cases employing inserted tooth saws removing kerfs of from 4 to 8mm in width even when producing 25cm thick boards. In the very small mills log sawing equipment consists of light, narrow carriages and small diameter circular saws, which limits the size of logs

that can be processed. In the larger mills, heavier and wider carriages are used with twin rig circular saws, but of 42 mills visited by the author late in 1969, only 5 were equipped to produce sized flitches at the log saw.

143. Circular saws predominate for resawing, but both bandsaws and gang saws are used and an increasing percentage of the circular resaws are of a modern type having pneumatically actuated powered hobs and hydraulically controlled gauges.

144. At the smaller mills very little docking or grading is carried out, at some of them none at all, such mills disposing of their output on a single price basis to merchants who sort, grade and re-sell. In the larger mills docking is usually by hand-operated pendulum dockers located on idle roll cases, while sorting and grading is manual and on to trolleys.

145. Government regulations require that most species be treated with preservative before sale, the most common treatment being by dip diffusion.

146. Artificial drying at the sawmill is uncommon, although some mills have established air drying areas. As the equilibrium moisture content in Fiji is high and since over 90% of the sawn production is used locally, air drying is usually sufficient. Seasoning in heated driers to lower moisture contents for the more exacting uses is normally carried out by merchants, who buy in green timber.

147. Labour in the larger sawmills costs about F$2.50 to $3.00 per shift. The Fijian is proud of his strength and ability and is a good sawmill worker, particularly on resaw work where rhythm and team-work are important.

CHAPTER XX
MARKETS

148. The domestic market dominates the forest industry scene in Fiji, consuming 97% of local sawn timber production and in addition needing to import 6.5% of its total timber requirements.

149. The volume of exports is low, amounting to only 1400 cubic metres. Paradoxically, 93% of the timber exported is softwood while the bulk (91%) of the timber imported is also softwood.

150. The local industry provides sawn timber for almost a complete range of uses, from formwork to heavy construction timber, domestic framing, flooring, interior trim, joinery for shops, offices, hotels and the like, as well as materials for furniture and turnery. In addition, decorative veneers and match-sticks are manufactured locally.

151. The domestic demand for sawn timber has increased at an average of 4.75% per year since the early 1950's and the rapid growth of tourism should result in these buoyant market conditions being maintained for some years.

CHAPTER XXI
FUTURE TRENDS IN THE INDUSTRY

152. The results of the forest enumeration should have a considerable bearing on future trends, as they will form a basis for decisions on the size and conditions of future concessions and licences. Also, acceptance by industry of logs smaller than 48 cm dia. would substantially increase the volumes available per hectare and make possible the establishment of larger operating units. Increased volumes per hectare would also reduce log extraction costs.

153. It is likely that the very small mills will decrease in importance, both on a volume of production basis and as an impediment to orderly marketing. Wage rates have been steadily increasing and as greater employment opportunities occur and living standards improve, the operation of these small mills could become increasingly unattractive.

154. The most probable development will be a decrease in the number of mills producing less than 1000 cubic metres of sawn timber per year and an increase in those capable of producing between 1000 and 5000 cubic metres. These increases in mill size could be achieved by amalgamation and take-overs.

155. The availability of substantial volumes of pine thinnings in the near future should encourage the manufacture of blockboard, the low capital cost and labour intensity of which will suit Fijian conditions. The local availability of decorative veneers would markedly assist the marketing of veneered blockboard panels.

CHAPTER XXII
SPECIFIC PROBLEMS

156. Acquisition of land for forestry purposes has been a serious problem, impeding plans to ensure the country's future timber supply. Government policy has been that dependence for this supply will be partly on plantations rather than wholly on indigenous forests and so concern for the future has been heightened by the disappointingly poor form of some of the young planted pines and a recent FAO suggestion that existing plantations may be best suited for pulpwood uses rather than the production of sawn timber. Manufacturing trials of blockboard from thinnings, conducted by CSIRO Australia, revealed low sawn recovery due to this poor form.

157. Important immediate problems for the sawmilling industry are the relatively high cost of log extraction and insufficient coordination between production, marketing and end use. High log costs are due, in the main, to the small size of operations, the low volumes harvested per hectare and the difficulty of building and maintaining adequate roads in high rainfall, mountainous terrain.

158. Lack of coordination between production, marketing and the actual end use requirements frequently lead to timber purchases being in sizes and lengths greater than actually required and which are stored and subsequently recut to smaller sizes when needed. Concurrently the same smaller sizes that occur naturally in production at the sawmill are either discarded or sold at depressed prices.

159. A long term problem could be the labour intensity of operation in a rising wage structure. Although new mills will be larger, they will still be small by modern standards and consequently unable to justify high production, labour saving equipment. This resultant labour intensity is no doubt desirable at the present stage of Fiji's development and should not create a very serious problem while the domestic market can consume total production.

CHAPTER XXIII
SUGGESTED CONVERSION EQUIPMENT

160. The main requirements for new equipment during the next 5 to 10 years will be for mills converting between 2,300 cubic metres and 33,000 cubic metres of logs per year, most of these mills not having annual log intakes larger than about 11,500 cubic metres.

161. For those new mills with yearly log intakes of less than about 4,300 cubic metres, the only types of equipment that can be justified economically will probably be either:-

(i) a mill consisting of a rider, knee-type carriage with hand-operated setworks and dogging, friction type feed works and with log loading and turning achieved by a cross hauling winch. Log sawing by circular saws, either single or twin-rig depending on maximum log size, and resawing on open circular saw benches with powered horizontal feed rolls and operated by 3 men.

(ii) Portable sawmills of the type used extensively in Kalimantan and consisting of a combination of a horizontal and a vertical circular saw, powered by an internal combustion engine, supported above the log by columns and beams and arranged so that a powered feeding device causes the saws to traverse the log longitudinally, with provision for accurate indexing of the position of the saws, which enables sized pieces to be produced.

162. Mills with available annual intakes of the order of 11,000 to 12,000 cubic metres will be the smallest for which modern, automated, sawmilling equipment of the permanent mill type can be economically employed, and even at this size the economic viability is marginal.

163. Such mills should have powered log decks, as described in Part 1, Chapter IX, riderless sizing carriages with knee openings up to 1.4 metres depending on maximum log size, and log saws of either the twin circular rig type with bottom saws up to 1.8 metres diameter or band head rig with 2.1 metres diameter wheels and saws at least 35 cm wide.

164. The above log sawing equipment should be used in conjunction with a powered flitch storage area, located immediately following the headrig in the production pattern and capable of storing flitches and later returning them to the carriage for further sawing. Such a system produces best results when a band headrig is employed, as it enables this narrow kerf machine to be re-employed as a resaw, without serious loss in volumetric recovery. For this reason band headrigs are preferred.

165. This system requires a final resaw to deal with the pieces which the carriage cannot reduce to required sizes and this role can be fulfilled by either a circular saw bench carrying a 1.1 metre dia. saw or a bandsaw having wheel diameters of 1.5 metres, both equipped with powered, horizontal feed rollers and operated by 2 or 3 men.

166. One hand-operated pendulum docker is sufficient in a sawmill of this size, provided the average size of sawn product does not fall far below 0.03 cubic metres per metre of length. This size of mill cannot attempt to achieve an adequate return on invested funds unless it sells its timber in a graded or sorted form and so achieves maximum value for its production. Consequently, I believe a simple green chain or circular table to be a worthwhile investment for mills in this situation.

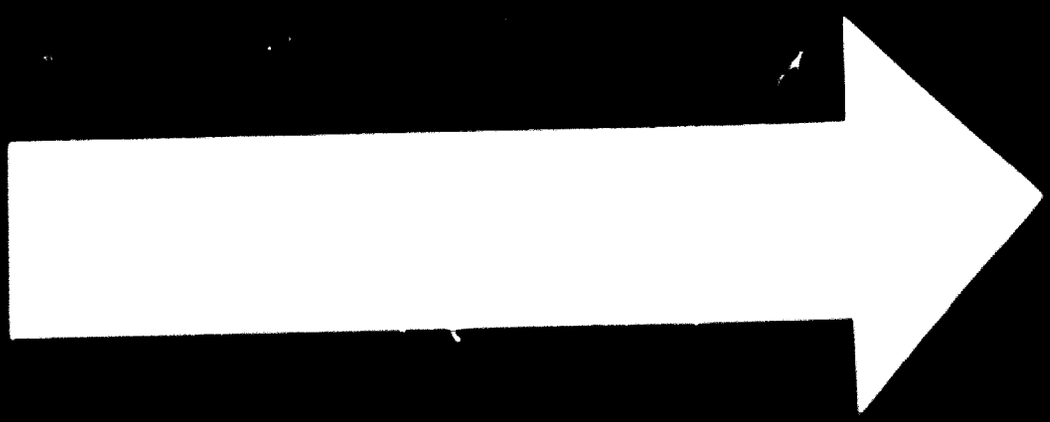
167. The economics of establishing artificial drying facilities at mills of this size are governed by the percentage of the sawn output that is suitable for seasoning and dressing. As a general guide a volume of 16 cubic metres per week may be necessary to warrant a kiln and 40 cubic metres per week to justify a predrier. For those mills with lower volumes, the high ambient climatic temperatures should permit economic drying of materials suitable for use in the relatively humid conditions by air drying under any cover that prevents rain wetting but permits free air circulation.

168. Mills with log inputs substantially above 12,000 cubic metres per year will be relatively few during the next decade, but several mills of this size will be built or expanded and rebuilt during this period. For mills in this category, and where log intake is predominantly from the lowland rain forests, the types of equipment specified for the same size of mill in Malaya

(paragraphs 44-67) are preferred. On the other hand, for mills of this size for which the intake is substantially softwood, the use of multi-saw edgers as major production units should be seriously considered.

169. The comments relating to seasoning in paragraphs 68-70 apply equally to this size of operation in Fiji, except that for many of the uses for which most of the seasoning quality is produced, a moisture content of about 18% is adequate.

170. Equipment for converting the exotic pine thinnings will not be discussed at this stage, as the ultimate avenue of their utilization appears to be still under consideration. However, our experience with a very limited volume of thinnings during the blockboard manufacturing trials, indicate that the poor form of a high proportion of the stems would seriously limit the choice of log sawing equipment. Chipper-canters and chip-and-saw techniques would undoubtedly handle these logs, but as for some years the volumes likely to be available are small compared with machine capabilities, there currently exists no local use for chips or flakes and the volumes are too small to encourage either profitable local use or attract the special shipping required for export.



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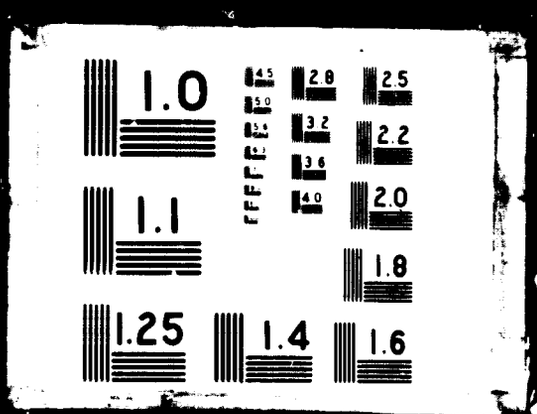

CHAPTER XXIV
COMMERCIAL OPPORTUNITIES

171. The commercial opportunities for the industry at its present overall size seem excellent; in fact, in the current world forest products environment, the opportunities would favour industry expansion at a rate greater than that of the average annual increase in domestic use, provided the forest enumeration shows such an expansion to be sound on a long-term basis.

172. As tourism in Fiji is rapidly becoming a major industry and assisting the continued improvement in living standards, there seems no reason to expect that domestic consumption will not continue to rise at the average rate of at least 4.75% per year experienced since the early 1950's. The local industry has difficulty in supplying the domestic market with long length timber required for some structural applications, because many logging roads pass through mountainous terrain and it is not economic to build roads to permit a relatively small percentage of logs to be hauled in special lengths. Consequently, the country will continue to depend on imports for this small volume, but apart from this minor market the producing industry could expect to expand at a rate of about 4.5% per annum and depend entirely on local sales, at least for the next 5 and perhaps the next 10 years.

173. If sufficient logs were available to enable the producing industry to expand at a rate much greater than that of the local demand, then markets in Australia, Japan, U.S.A. and Europe would readily absorb the exportable surplus, provided production is to internationally accepted standards. Achievement of such standards is easily possible in Fiji.

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