

FORESTRY COMMISSION
BULLETIN No. 41

Forest Management, and the Harvesting and Marketing of Wood in Sweden

By B. W. HOLTAM, E. S. B. CHAPMAN,
R. B. ROSS and M. G. HARKER

FORESTRY COMMISSION

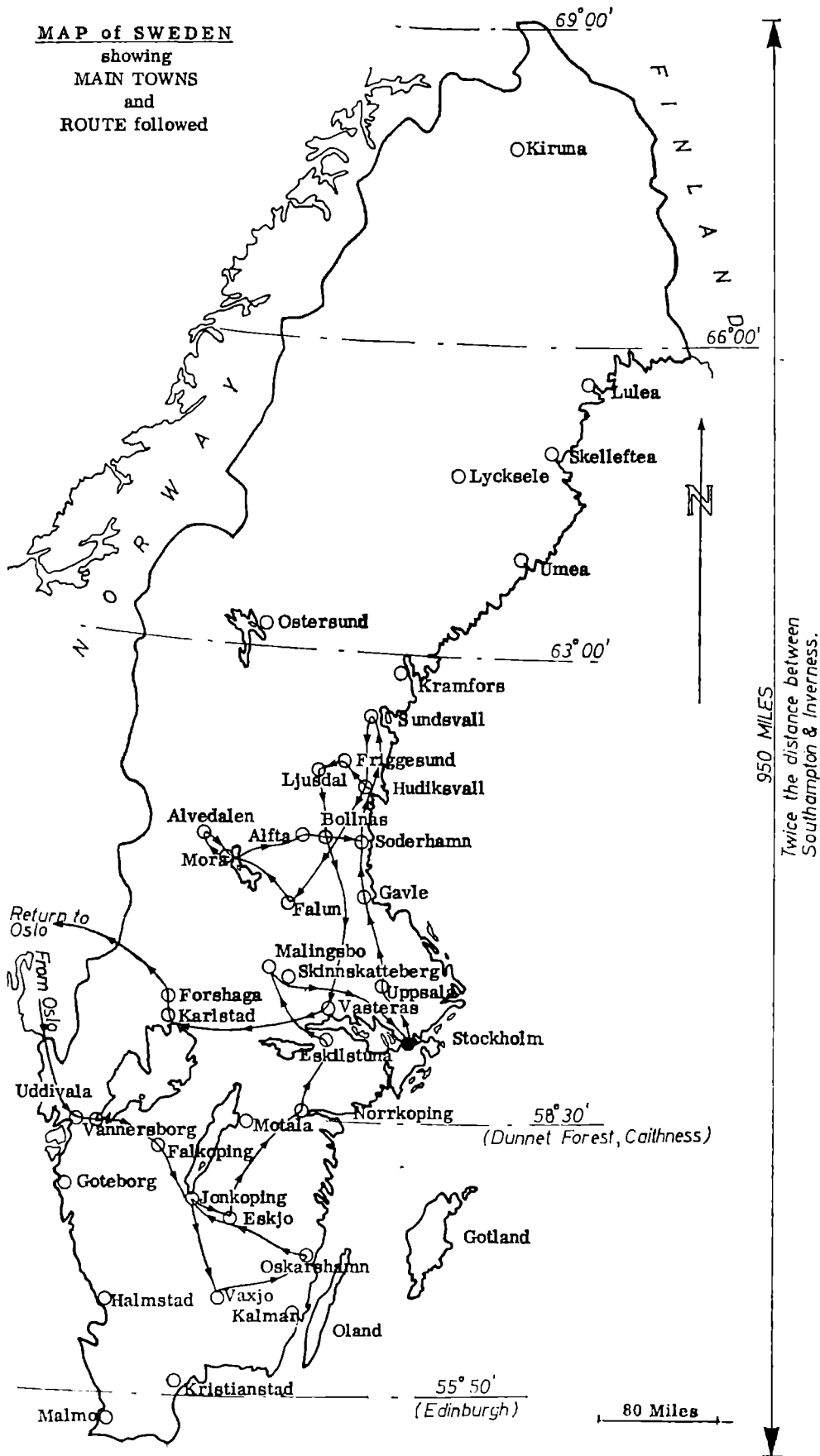


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Forest Management, and the Harvesting and Marketing of Wood in Sweden

REPORT ON A VISIT OF FOUR FORESTRY COMMISSION OFFICERS
TO NORWAY AND SWEDEN IN MAY 1965

By B. W. HOLTAM, B.Sc., E. S. B. CHAPMAN, B.Sc.,
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FORESTRY COMMISSION

LONDON: HER MAJESTY'S STATIONERY OFFICE
1967

PREFACE

Members of the team

Mr. B. W. Holtam	Team Leader—Assistant Conservator in the Marketing Division at Forestry Commission Headquarters, London.
Mr. E. S. B. Chapman	Work Study Officer, Edinburgh.
Mr. R. B. Ross	Machinery Officer, Work Study Section, Edinburgh.
Mr. M. G. Harker	Sales and Utilisation Officer, East (England) Conservancy.

Period of Visit

The team was in the southern half of Sweden from the afternoon of Monday, 3rd May to the afternoon of Monday, 31st May, 1965; Tuesday, 1st June and the morning of Wednesday, June 2nd were spent in Norway in and near Oslo.

Terms of Reference

The team was given the following terms of reference:—

The main object of the visit to Sweden is to study managerial, organisational and technical practices which seem likely to assist in promoting greater efficiency in the creation and maintenance of state and private woodlands at home and in the harvesting and transport wood to consumer industries.

The emphasis must be on problems likely to be of some practical importance in Britain rather than on problems which may be interesting but not significant under British forestry conditions.

Particular Terms of Reference

(i) *Utilisation and Marketing*

To study the management aspect of the utilisation, harvesting, transport and marketing of production which (a) arises in many individually small woodlands but which (b) can only be utilised economically in large processing factories.

The study should cover the role played by the State Forest Service in assisting in the marketing of timber from such private woodlands; the overall marketing policy of the State Forest Service; the day-to-day organisation of the State Forest Service (at district level) in this context. Co-operative marketing by woodland owners and co-operative buying by processing plants should also be covered in the study.

(ii) *Harvesting and Engineering*

To study harvesting (logging and transport) methods, road lay-out and forest machinery.

The study will involve obtaining up-to-date information on current trends and discernible trends in forest road lay-out, logging methods (including extraction and road transport) related to our present thinning practice and to future exploitation of mature crops. Partial conversion at stump or roadside, loading methods and devices, types of transport, types of equipment and machines.

The above terms of reference were supplemented by the following guidance which was given both to the team and to those in Sweden who arranged the tour:—

The main object of the visit to Sweden is to study from the

Managerial	}	Aspects
Organisational		
Technical		
Economic		

practices and ideas which might help to promote greater efficiency in the marketing, harvesting, and transport of wood to industries (pulpmills and sawmills).

Problems of Special Interest to Mr. Holtam and Mr. Harker (as Timber Marketing Officers)

Overall marketing policy of State Forest Service; organisation of log auctions; trends in marketing, that is trends towards more or towards fewer auction sales? Role and influence (if any) of State Forest Sales policy on private sales.

Organisation of Swedish State Forest Service at conservancy and district level.

Organisation of private forestry, etc. County level with special reference to (i) planning and to (ii) marketing, harvesting and transport of wood from relatively small wood lots.

Organisation of marketing, harvesting and transport of wood by private owners co-operatives at national and regional level.

Planning and execution of logging operations in large (share capital) companies.

Wage agreements.

Sawmilling industry (problems of rationalisation and log supplies to smaller sawmills).

Road spacing problems and practice.

Problems of Special Interest to Mr. Chapman and Mr. Ross (as Work Study Officers)

Harvesting methods (logging, skidding, conversion, transport).

(a) Present Practices	}	In thinning and clear cutting.
(b) Future Trends		

Types of equipment and machines used in harvesting (logging, skidding, conversion, and transport), especially tractors and tractor mounted devices.

FORESTRY COMMISSION,
25 Savile Row,
LONDON W.1.
March, 1967.

ACKNOWLEDGEMENTS

The excellent arrangements for the tour in Sweden were made by Mr. Ingemar Örhn of the logging Research Foundation in Stockholm, under the guidance of Mr. Kjell Kilander, Research Manager, and of Mr. H. G. Lindberg, President of the Association and with the help of others of his staff. It is difficult to express adequately our thanks and sincere appreciation of the careful preparations that were made for our tour, not only by Mr. Örhn and his colleagues in the Logging Research Foundations, but also by many others in the organisations which we visited and all of whom gave us such friendly welcome, kind hospitality and much of their time, to make the whole of our tour as interesting and as enjoyable for us as it could possibly have been.

The equally excellent arrangements for our brief visit to Norway were made by Mr. Ragnar Strømnes of the Norwegian Forest Research Institute.

Our hosts were not only outstanding in their respective fields of knowledge but, without exception, all were patient, kind and forthright in answering our endless questions. We offer to each one of them our warmest thanks for all their generous and friendly help.

They are not all mentioned in the text, but the appendix to Part I gives a list of the firms and organisations which we visited with the names of those whom we met.

The British Motor Corporation very kindly lent us an Austin 1800 saloon car for our travels in Norway and Sweden. We are grateful to the Corporation for this and to Mr. G. Clarke, the Commission's Chief Purchasing Officer, for having made the arrangements for the loan on our behalf.

Mr. J. R. Aaron made a thorough survey of literature not only in relation to Norway and Sweden but also in relation to other selected European countries before this tour began. His survey has since been printed for departmental use as Forestry Commission Research Branch Paper No. 28, *A Survey of the Literature on the Management Aspect of Large Scale Utilisation in Selected European Countries*. Mr. Aaron's help is gratefully acknowledged.

We also want to thank Mr. R. A. Palmer for having prepared the maps and Mrs. A. W. Meyer for her patience and help in dealing with the many papers, for assembling the final text and for reading the proof.

Photographs

Plates 1 and 27 to 43 are by B. W. Holtam; Plates 2 to 19 and 22 to 26 are by E. S. B. Chapman; and Plates 20 and 21 are by R. B. Ross.

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Sweden, showing main towns and route followed	<i>Inside front cover</i>
Sweden, showing Lan or County boundaries, and Regions	<i>Inside back cover</i>

INTRODUCTION

In our terms of reference we were told to emphasise problems which are likely to be of practical importance in Britain rather than problems which might be interesting but not significant under British forestry conditions. This we have tried to do; but it would not be easy for those who read the report to assess the likely implications for British forestry of Swedish trends, developments, methods and machines and ideas, without understanding the background to Swedish forestry and appreciating the main differences and similarities between Swedish and British conditions and problems. This background is given in Part I of the report.

For the remainder, the report deals in separate parts with the main subjects which were named in our terms of reference; each main subject is considered in the separate fields of state forestry, private forestry and industrial or company forestry. No mention is made of forestry as practised by the church or by the communes.

Our visit to Norway was too short for us to write about Norwegian forestry and forest organisations as we have done in writing of Sweden. Nevertheless, the brief visit to Norway was of great interest especially to see new logging techniques and machines which were being used in conditions which resembled some of our own forest conditions more closely than the general conditions in Sweden. The report deals with Sweden except where otherwise stated in the text.

Apparent discrepancies sometimes appear as, for example, in presenting details of the performance of machines. Such discrepancies are due to the fact that different operators gave their own assessments of performance to various members of the team.

Where appropriate the main implications for, or ideas which might usefully be applied to British forestry are summarised. These are the views of the members of the team and are not necessarily the views of the Forestry Commission.

Appendices, where they occur, are included in the individual parts of the report.

Conversion factors

At the time of our visit the exchange rate was about 14.25 Swedish Kroner, or 18.85 Norwegian

Kroner to £1 Sterling. It could be misleading, however, to attempt or make comparisons of, for example, prices of commodities in Britain and Sweden, by applying the above conversion factor. The standards of wages and costs of living in Britain are different from those in Sweden.

Volumes of timber in the round are quoted in this report, for the most part, in "hoppus feet". The hoppus foot is the traditional British unit of volume for timber measured in the round, such as logs or billets, and is equivalent to 1.273 cubic feet.

Other conversion factors which might prove useful in reading the report are:—

1 hectare	=	2.47 acres
1 cubic metre	=	27.73 hoppus feet or 35.32 cubic feet
1 standard of sawn timber	=	165 cubic feet

Application of the findings of the team

Many of the new lessons learned on this tour were applied by the Forestry Commission immediately the team returned home, and the most promising types of equipment which appeared to have good application in British conditions were ordered, in some cases, before the team left Sweden and Norway. Equipment and methods, modified where appropriate to improve their suitability, have been tried out in Commission forests. Private growers and members of the home timber trade have been kept informed of such developments, as far as has been possible, by means of practical demonstrations as well as by discussions at various meetings. Practical application of the findings of the team has not, therefore, awaited the delays in publishing this bulletin.

Members of the team hope that publication of their individual reports in this one volume will lead to much wider appreciation of the urgent need to plan for, and to practise, more rational and more economic management, harvesting and marketing in British forestry.

BRIAN HOLTAM,
25 Savile Row,
London, W.1.
22 March, 1967.

Part 1

SWEDISH CONDITIONS AS THEY AFFECT FORESTRY

BY B. W. HOLTAM

General

Sweden lies between latitudes N. 55° and N. 69°. (Dumfries is just south of Lat. N. 55°, and the N. Coast of Scotland is at Lat. N. 58° 30'). From the northernmost part of its boundary with Finland to its southern tip it is almost one thousand miles and it measures from 140 to 200 miles from its boundary with Norway to its eastern coast. It is the third largest country in Europe (173,000 square miles); although it is twice the size of Britain (87,500 square miles), it has a population of only 7½ million (less than that of London). It has 44 inhabitants per square mile compared with 573 per square mile in Britain. Fourteen per cent of the population is engaged in agriculture, forestry or fisheries.

The mainland of Sweden is divided, for local government ("*lan*") purposes into 23 "*landskap*", counties, or provinces. The island of Gotland is also a county. The nine northernmost counties, when grouped together, are referred to as *Norrland* or North Sweden; the six counties in mid Sweden are together referred to as *Svealand* or mid Sweden, and the eight southern counties are referred to as *Gömland* or South Sweden.

Topography

It is not a mountainous country. Its mountains, which are of little forestry interest, are confined to the country between 61° and 69° latitude north, in a region along the Norwegian border, about 50 to 100 miles wide.

The greater part of the forests of Sweden lies on flat or gently undulating land and a relatively small proportion of forest is found on steep slopes.

Its many rivers flow in a general south-easterly direction except in southern Sweden where they flow southwards. They have a fairly well regulated flow. Despite the relatively flat nature of so much of the country, flooding is uncommon. The many rivers often provide excellent means of transport from and through the forest area, especially in central and north Sweden, to a large number of points on the coast where industries can be located and provided with water supply, land and sea communications, and easy effluent disposal. The rivers have, in fact, helped in transport, water supply and effluent disposal. The many inland lakes

have also helped in water transport and in providing assembly points for log supplies, and their shores have provided suitable sites for the establishment of industries.

Soils

The forest soils consist almost exclusively of glacial drift or morain, often with a great mixture of particle sizes varying from silt or clay to large boulders. True clay soils are rare and particle sizes are usually large. The ground surface is frequently strewn with glacial boulders, usually so distributed that tractor ways can be found between them with or without the aid of blasting. For the most part the forest soils are fairly well drained to a reasonable depth, often by vertical drainage, although ill-drained peat areas occur and the underlying smoothly glaciated impermeable rocks often maintain a high water table. Ploughing would rarely be practicable. Usually the forest soils are young, cold, and little weathered, covered with a more or less thick layer of raw humus, which is particularly well developed in the northern parts of the country. Large areas of iron pan occur. Weathering of soils is slow in the south of Sweden. On the other hand rooting depth is usually adequate and the many boulders provide excellent root anchorages even when rooting depth is shallow. Because the glacial soils are young and the Swedish climate is dry, the extensive peat formations that have been established in past centuries in Britain have not been established in Sweden. For this reason the Swedish soils, though young, are nevertheless better weathered than the unexposed glacial clays which underly peat formation in Britain.

Climate

Annual precipitation (including snow) is remarkably uniform throughout most of the forest area, and is low. Relative humidity is also usually low. Sweden, compared with Britain, is a dry country. Snow contributes a high proportion of the precipitation especially in the north.

The growing season is short (only 140 days or so in north Sweden), but the daylight hours during the growing season are long.

Snow lies long in northern Sweden. It makes felling more expensive but extraction more easy. The freezing of lakes and rivers and of boggy land

TABLE 1. CLIMATIC FIGURES FOR SOUTH, CENTRAL AND NORTHERN SWEDEN

Region and Climate Station 1	South Sweden Lund 2	Central Sweden		North Sweden Malmberget 5
		Bluråker 3	Sveg 4	
Latitude North	55° 43'	61° 51'	61° 02'	67° 11'
Height above sea level in feet	215	240	1170	1470
Mean annual temperature degrees F.	46	39	36	32.4
Mean temperature in July degrees F.	63	61	58	57
Vegetative growth period in days with 37 degrees F. +	236	183	167	142
Annual precipitation in inches	23	20	22	22
Permanent snow cover, in days per annum	a few	118	176	181

makes extraction and preparation for floating of logs relatively easy in central and north Sweden. In the south repeated snow and thaw make working conditions in the forest and on forest roads more difficult, especially in late autumn and in early spring. Snow is also of particular help in extraction over very rough, rocky or boulder-strewn ground.

The Gulf Stream, helped by prevailing westerly winds, has a marked beneficial effect on growing conditions throughout most of Sweden, although not to the same extent as it has in Britain, and, in the south, oak and beech and other temperate hardwoods grow well on the better, more weathered and older soils, although the areas of hardwood forest are relatively small and are likely to become smaller. Much of Sweden is in latitudes which in less favoured parts of the world have little or no tree growth and sometimes permanent snow. The tree line in Sweden (sub-alpine birch forest) is about 3,000 feet above sea level in the south and 1,200 to 1,500 feet above sea level in the north.

Severe gales appear to be rare in Sweden, or at least they are confined to the winter when the ground is frozen and trees are held firmly in the ground. This, together with usually adequate drainage, good rooting media, and good root anchorages (boulders), and with relatively slow growth rates throughout Sweden, probably accounts for the fact that serious windblow is rare. The stability of much of the forest is also helped by its usually mixed nature of spruce, pine and some birch.

Protection

Fire and insect damage are slight compared with the rest of Europe. Only 0.1% of the forest area has been damaged by fire in the past ten years. Conditions are so different from those in Britain that it is worth explaining. In Britain we are creating new coniferous forests and we have a high propor-

tion of young forest. Sweden has her long established forest in all age gradations; the density of population is low and the Swedes are traditionally forest minded and careful not to start fires. The growing conditions, compared with those in Britain, are poorer. Vegetation therefore grows less vigorously; there is practically no fire danger while snow covers the ground; after felling, lop and top is often burned under control in order to burn the raw humus to give better seeding or planting conditions. If it is not burned it is laid nowadays along the tractor cutting tracks. In one month's visits to southern and central Sweden's spruce and pine forests only one case of fire damage was seen, and this was of very limited extent.

Fire protection is a municipal responsibility.

The relative importance of agriculture is low (there are more than five acres of forest for every one of farmland) and domestic farm animals are few. Areas which are afforested or re-afforested by planting or by seeding, natural or artificial, are not fenced. The responsibility for keeping grazing animals under control and for preventing damage to the forest rests with the owner of the animals. Rabbits are not a problem. Damage from elk (*Alces alces*) (to pine usually) and from hares is tolerated, but these animals are controlled by shooting. Even forest nurseries are usually unfenced. (Seed orchards, which have to be sighted in agricultural areas to minimise the risk of cross pollination, are about the only forest areas which are fenced.)

Communications

By Road, Rail and Water

Sweden has an excellent national road and rail network, and the road network is being re-planned and extended rapidly. She also has excellent means of log transport by floating on her many rivers and

lakes and along her extensive coastline. During winter rivers and lakes in the north are frozen hard enough to serve as excellent flat roadways for tractors and lorries and as stacking grounds, with no construction costs. Many of the roads, including many fast main roads, are made and surfaced with local glacial drift which is more often than not an excellent well drained road making material which forms good roads and compacts well. Gradients are rarely more than one in twenty and one can drive for hundreds of miles without encountering slopes of more than one in twelve. Usually the road making material is merely scooped by mechanical shovel from the roadside drains. Rainfall is so low that road drainage is no problem. Similarly constructed roads in many parts of Britain would be washed away in a short time. The main problem on the roads is frost lift, which results in temporary and localised deterioration. Such roads are easily re-graded, however, especially as the material from which they are constructed is so suitable for this treatment. The surfaces of roads are frequently bound with waste liquor from the sulphite pulp mills. This liquor is sprayed on to the surface in summer when the snow has disappeared. Lorries and trailers are of excellent design and construction. Most road transport is new or nearly new. Wood of one sort or another provides by far the greatest weight and greatest bulk of any material transported in Sweden. Consequently the national forest authorities and the forest owners' associations have a bigger interest in, and influence on, road planning and construction than anyone else in Sweden.

By Telephone

Practically every house, including remote farm houses, has a telephone, and the telephone is used to conduct routine business over long distances to a much greater extent than is customary in Britain.

The Forests: Some Comparisons with Britain

The area of productive forest is over 54 million acres (15½ times that of Britain's 3·6 million acres). This is 16% of the forest area of Europe excluding the U.S.S.R.

The growing stock is	—56,846,500,000 hoppus feet overbark or nearly 26 times that of Great Britain.
Annual growth is	—1,875,640,000 hoppus feet overbark.
Annual cut is	—1,386,500,000 hoppus feet overbark or 14 times the annual cut of about 100 million hoppus feet in Britain.

Potential annual yield is —2,218,400,000 hoppus feet overbark.

In large parts of Norrland and Dalarna, the average annual increment is less than 45 hoppus feet overbark per acre, whereas in Skåne, in southern Sweden, the average is about 84 hoppus feet overbark. As much as 48% of all Swedish forest has a potential annual yield of less than 34 hoppus feet per acre. In Britain such land would be considered uneconomical for forestry.

The present estimated annual increment of 1,875,640,000 hoppus feet is equivalent to 85% of the estimated potential of 2,218,400,000.

The age class distribution is unbalanced and there is a lack of young stands and too big an area of medium aged and old stands. Many old stands have been thinned too heavily, kept for too long and should be felled and re-stocked. It is estimated that annual felling should be increased from 1,386,500,000 hoppus feet overbark to 1,802,450,000 hoppus feet. With increased mechanisation and more co-operative effort this might be practicable; Swedish wood using industries have a good possibility of increased wood supplies on which to base future expansion. In addition there is a movement towards shorter rotations which will be helped by more rational thinning and by the extensive use of artificial fertiliser, so that the permissible annual cut in the next ten to fifteen years could be increased even more.

Most of the pulp mills have plans for expansion. As in Britain, one of the obstacles to increasing production is the problem of how to co-ordinate the efforts of the many owners of comparatively small areas. It will be necessary to do this to make the best use of mechanical equipment, to rationalise management and to persuade the farmer foresters to cut more.

This draws attention to one other major difference between problems in Britain and in Sweden. Sweden has had and still has relatively big forest resources and the gradual development of industry which could use these resources has depended mainly upon the development of overseas markets for the end products of sawn timber, pulp and paper. Sweden has valued her forests for a long time and has practised some form of management for sustained yield for 300 years. She has been engaged in no war for over 150 years. Britain had destroyed most of her forests long before the end of the last century and the remnants have since been devastated in two world wars. In Britain we have, on a small scale, young developing and expanding forests whose production is gradually increasing. The big problem in Britain in recent years has been to determine the location, size, nature and phasing of new wood industries whose homegrown wood

supplies are precariously small, and whose needs for wood are relatively great and have to be met as soon as mills are ready to operate.

Species

The total volume of the growing stock is made up of:—

45%—Scots pine	} Pure and mixed, usually mixed in varying degrees with more Scots pine on high and poor sites and in the north.
40%—Norway spruce	
15%—Broadleaved trees	—Of which birch is the main species, spread throughout Sweden, and usually mixed with spruce and pine. Oak and beech only occur in the south, often in mixture with the two conifers. Aspen occurs but is in short supply; the best have been felled for the match industry.

Swedish forestry and the development of wood using industries in Sweden have been based mainly on Scots pine and Norway spruce. This has made possible such simplifications in management, harvesting, marketing and forestry practice, compared with the complex problems presented by seven coniferous species and as many hardwoods in Britain that it is essential to keep this in mind in considering the possible application of Swedish methods, machines and techniques in British forestry.

Other Points of Comparison between Swedish and British Practices

Although general forest conditions in Sweden are not uniform, and although there are big differences in conditions between north and south Sweden, changes in conditions are usually gradual. Conditions of topography, soil, species and species mixtures, growth rates, rainfall, roads, and most other factors which affect forestry operations, are much more uniform over much greater areas than they are in Britain, where rapid changes in most of these factors are common. Even in labour relations, one trade union speaks for all Swedish forest workers.

Estates are either managed by their owners or by their appointed farm managers and forest managers. It is almost unknown, in Sweden, to find a man employed in the position which a land agent or a firm of land agents holds in Britain. The proportion of bigger estates in Sweden is small and, in the main, the owners prefer to manage their estates themselves; many of them are highly qualified foresters and farmers. Alternatively they join

forestry and agricultural co-operative associations or they engage the bigger companies to manage their forests.

Most private owners in Sweden depend mainly on their forests, rather than on their agricultural holdings, for their main source of income. The reverse is true in Britain.

Although sporting interests are keenly preserved (it is dangerous to go into the woods on the first day of the elk shooting season!) sporting does not interfere with the efficiency or with the rational development of commercial forestry in Sweden as it sometimes does in Britain.

These points are also important to bear in mind when considering new methods which are referred to later in this report; they are of especial importance when considering the possibilities of using, in Britain, the new Swedish machines and methods for harvesting and for branching, for barking and for converting trees, and of using new thinning regimes which are designed to afford maximum economic advantage from these machines and methods, and when considering possible developments in co-operative forestry.

The forest conditions in the two countries are very unlike.

Economy

Sweden has no coal or oil. She has forests, iron ore, and water power and highly trained labour. Forestry and wood industries play a dominant role in Sweden's economy and contribute 40% of all Sweden's exports. Britain imports 90% of her requirements of wood and wood products. The forest authorities, wood using industries and associations of forest owners have, understandably, great influence.

Extent of Forests

The productive forest area is about 54-55 million acres or about 49% of the total land area (173,000 square miles equals 110,720,000 acres), and the whole forest area of Sweden, productive and unproductive, covers more than 50% of its total land surface, compared with just over 7% for all forests in Britain. Sweden's forests could cover England Scotland and Wales.

Ownership of Forests

This forest area is owned by private owners as farm forests, (where each owner has farm and forest), by private owners who have estates comprising forest and perhaps several farms, by big industrial companies who have acquired forests in order to provide themselves with a part or all of their wood supplies for pulping and sawmilling, or who owned forests to provide charcoal for their former iron ore smelting interests, and who have since invested

TABLE 2. OWNERSHIP OF FORESTS IN SWEDEN

(areas in millions of acres)

	Total area of productive forests	State owned forests	Church and other public forest including communal forests	Privately Owned Forests			
				Farm forests	Estate forests	Forests owned by industrial wood processing companies	Total privately owned forests
Area	53.38	10.1	2.7	25.6	1.6	13.4	40.6
Percentage of total forest area in Sweden	100%	19%	5%	48%	3%	25%	76%

in wood processing, by the state, by the church, and by the communes, as shown in the above table.

The Swedish economy has been built up through private enterprise and this is particularly true in forestry. About 95% of the value of products of wood industries is obtained from companies and privately owned enterprises.

The table above shows that of the productive forest land 76% (including 25% which is owned by industrial wood processing companies) is in private ownership while the state forests amount to 19% and church and other public forests to 5%.

The private forests belong to farms, estates and companies. These categories account for 48%, 3% and 25% of the total area respectively. Communal forests included in column 4 of the table belong to various counties and parishes and total about 1.7 million acres of productive forest land. They have a strange position because, although they are reported as community forests, they are actually owned by individual landowners in the county or parish where they occur.

The proportions of forests owned by different categories of owners shown in the above table vary greatly between different parts of Sweden. The forests in the south are predominantly owned by farmers, while the forests in north Sweden are mostly owned by the state and by the big industrial wood processing companies. The pattern of forest ownership has not changed very much during the past 50 years. Until the early part of this century the companies acquired their forest land and increased their acquisitions; further acquisition of land by the companies was abolished by law in 1906. A new land purchase law which has just been passed by the Swedish Parliament, and which came into effect on the 1st July, 1965 has made it possible for the companies and others to purchase forest land in future. The effects of this are uncertain but most people in Sweden seem to think that the cost of forest land has now become so high that it is unlikely that the new law will be used to bring about

any great changes in the pattern of land ownership; at least the changes will not be rapid and they will be designed mainly to bring about better rationalisation of land ownership especially for the purpose of improving the shape and size of forest holdings. The law does not allow fragmentation of holdings.

Private Forestry

Farm Forests

Forests around cultivated land were originally regarded as common land: They were subsequently divided between villages and parishes but, relatively early, they were again distributed among homesteads. Demarcation boundaries were necessary. These forests stimulated the farming economy as new wood using industry developed, especially from 1800 onwards. It became possible to manage them on a sustained yield basis. Farming and forestry became complementary branches of the same enterprise and this is characteristic of farm forestry today.

The average area of farm forests is about 134 acres for the 190,000 farm units which have more than 25 acres of forests (excluding estates). The farm forest areas are larger in the north than they are in the south. Sixteen thousand farm units have less than five acres of fields and more than 123 acres of forest, so the forests are, in these cases, the main sources of income for the farmer owners. In many cases fields and forests have become separated by tenancy conditions. Many farms are owned by absenteees (this applies to 10-15% of the area of private forest). This tendency continues but the number of farm units decreases yearly with structural rationalisation. The farmers are still owner/occupiers for the most part and work their farms and their forests themselves with or without the help of casual labour. Many of them also work for their neighbours.

The division of land into farm lots in past times has left very serious difficulties in many parts of Sweden. In order to give the owners of the land an equal distribution of good, bad and indifferent soil

and of growing conditions generally, the land was divided into long narrow strips which followed the undulations of the ground and whose boundaries were straight parallel lines. Further sub-division of these holdings has in certain cases led to extraordinary shapes of individual holdings. Some of these strips are several miles long now, divided along their length perhaps into several ownerships; in extreme cases they might be only half a chain or less in width. We were told of one extreme case in Dalarna region where one such strip was only 15 inches wide! The problems of co-ordinating the efforts of owners and rationalising the management of forest land divided in such a pattern presents uncommon difficulties. Such small areas of long narrow shape are included in the forest holdings of farmers, estates, companies and the state forest service and others in varying degree. It is largely with the object of making it possible to improve this position that the new land purchase law has been passed.

Estate Forests

Estate forests account for about 1.6 million acres or about 3% of the total forest land in Sweden and about 5% of the privately owned forest land. (The national survey 1950-1959 classified all properties with more than 500 acres of forest in Götland, or with more than 1,000 acres of forest in the major part of Svealand, as "estates"). In the province of Kopparberg, in certain parishes in the northern province of Varmland and in Norrland, no forests have been classified as estate forests. Estate forests had working plans for sustained yield as early as 1870. A high proportion of the estate forest is in Södermanland and Malmöhus, where they make up 30% and 36% respectively of the total forest area. The organisation and management of private estate forestry is similar to that of large scale forestry, as practiced by the big industrial companies and by the state forest service. A tradition of sound management continues and the estates often set the pattern for others to follow.

Company Forests

25% of the productive forest in Sweden is owned by companies. (This compares with 7% in Finland and 9% in Norway and practically nothing in Britain). These company forests occur mainly in south and central Norrland and in certain parts of central and west Svealand, and in the latter two cases the forests were derived from those owned by iron ore interests, which gradually changed by supplementing their activities in iron smelting with wood processing interests. Otherwise the company forests are of relatively recent date.

Fifteen enterprises possess as much as 80% of the company owned forest lands. Mergers have taken place and more can be expected.

A Comparison within the Private Sector in Sweden

Variability in the yield per acre, and in the extent of the interest of individual owners, and variability in all factors including intensity of management, is greatest in the farm forests. This greater degree of variability makes for great difficulties in attempts to co-ordinate the efforts of the many individual owners to a common rationalisation of their forest management, their harvesting and marketing as it does in Britain. Nevertheless most of the forest farm owners have become accustomed to earning the main part of their livelihood from their forests. They work in their forests themselves and they are in a varying degree willing to co-operate with each other, partly because they recognise that in so doing they have the only means of preserving the private ownership pattern of land in Sweden, and partly because they recognise this is the only way of preventing the state and the big companies from replacing the small farmer. There are in Sweden some 240,000 owners of land (forest or farm or both); 40,000 are tenants. There has been a long history of co-operative effort among these owners and the greater part of their effort has been devoted to preserving the pattern of private enterprise as represented by this large number of owners, usually owner occupiers, but with a gradually increasing number of absentee owners.

Part II

ORGANISATIONS AND THEIR ACTIVITIES

By B. W. HOLTAM

The English names only are used in this note. The correct Swedish names for the various organisations referred to, together with their addresses, and the names of those representatives of the various organisations who were met by members of the team during the month's tour in Sweden are given in Part II, Appendix I, Page 30.

Two National Forestry Boards

Forestry is administered in Sweden by two national boards. The National Board of Crown Forests and Lands administers the state-owned forests and agricultural land held with those forests. The National Board of Private Forestry administers the forest laws, deals with all matters relating to private woodlands, is responsible for most training and for control of timber measuring (which is regulated by law) and is generally responsible for the oversight of private forestry in Sweden; it has no marketing function. These two national Boards have no formal inter-relationships nor is either formally represented within the other's administration. The heads of both Boards are separately and directly responsible to the Minister of Agriculture. Both Boards work through their own separate headquarters, supported in each case by their own separate regional organisations and staff of university trained forest officers and of school trained foresters. The work of these two Boards is described in more detail below.

The National Board of Crown Forests and Lands

This Board consists of the Director General as head of the state forest service, his Director in Chief and the heads of his seven main administrative divisions including his Sales Director. It includes no representatives from outside the state forest service. The Board administers the crown or state forests and supervises certain other public forests. It is a commercial board deriving revenue from selling timber, leasing land to tenants, etc. The Board is responsible for the economic management of all forest under its administration or supervision. It has no responsibility for private woodland matters and therefore considers that the forests under its charge can be managed in as highly competitive a way as practicable. While it has a responsibility for showing a lead to the remainder of the country in sound

forestry practices, it regards itself as being free to compete, unimpaired by any of its other responsibilities, with the private owners and with the company forests. At the same time it has an important role to play as an independent balancing and stabilising influence in the wood markets.

The Board employs permanent employees in accordance with a personnel list which is sanctioned by the Government. The Board also might employ temporary staff.

The Board itself comprises seven divisions: sales division, first forestry division, second forestry division, technical forestry division, agricultural division, fiscal and accounting division, and personnel division.

Among the various tasks that the divisions have to perform are the sale of standing timber, and the marking, measuring, floating and sale of felled timber from state forests. These activities are carried out by the sales division. The first forestry division in addition to general supervision in the six northern administrative regions, attends to management, silviculture and drainage. The second forestry division deals primarily with management of forest land in the five southern administrative regions, as well as handling certain matters relating to dwellings and rents. The technical forestry division supervises road construction, real estate, assessment for compensation claims, land valuation, forestry regulations and mapping. It is mainly concerned with the purchase and sale of land, real estate accounting, land surveying, forest mensuration and regulation of yield.

The agricultural division, to which the office of works is attached, attends to business in connection with agricultural demands and the construction and maintenance of buildings and, within the state forest service, is mainly responsible, under the supervision of the National Board of Crown Forests and Lands, for the management of the agricultural holdings and for attending to business relating to tenancies, legal inspections, construction and repair of buildings of agricultural holdings of the state forest service. The personnel consist of five agricultural commissioners and clerical staff.

The fiscal and accounting division comprises the cash office, the accountant's office, the data processing office with punch card section, the statistical office, the auditing office, the purchasing office, the

library and records. The work covers finance, accounting, auditing and taxation.

The personnel division deals with questions concerning labour, wage agreements, salaries, rationalisation of work, workers' protection, appointment to offices, pensions, and personnel welfare; it includes the personnel office, the section dealing with salaries, section for wage agreements, the training section and the work and machine development section. The juridical section deals with legal matters, and the section for management of natural preserves and outdoor recreation also attends to the preservation of natural scenery, national parks, wildlife management including hunting and fishing and leisure activities in connection with the crown forests.

Finally the Director General's own secretariat deals with questions of organisation, economic research and public relations.

Regional Organisation of State Forestry

The country is divided into eleven administrative regions, each of which is headed by a regional forest officer helped by an assistant regional forest officer and usually an assistant forest officer.

Each forest region is sub-divided into forest districts varying from eight to twelve per region. At present there are 110 forest districts. A medium sized district in southern Sweden (the four southern regions) comprises about 26,400 acres. The corresponding figures for central Sweden (Gavle-Dala, Ostersund and Solleftea regions) is about 79,200 acres and for northern Sweden (the four northern regions) about 175,200 acres. Some forest districts are considerably smaller than the usual pattern. A forest officer is in charge of each forest district usually helped by an assistant forest officer who might be a forest ranger with special training in certain cases. Each forest district is sub-divided into a number of forest rangers charges headed by a forest ranger. There are at present 478 rangers charges. In addition to the permanent staff of forest rangers, 240 assistant forest rangers are also employed. The administrative personnel include road and building construction technicians, agricultural inspectors, fishing overseers and clerical staff.

A considerable part of the clerical and technical personnel of the local forest administration is concentrated in ten large regional offices. In addition to this, there are at present eleven forest district officers with joint staff and 64 with their own staff.

The main responsibility of the local administration officers is, under the supervision of the National Board, to take charge of the direct management of the state forest land with its forest farms and crofts. The main responsibilities of the regional district

officers and the forest rangers is to deal with the planning, management, execution and control of work in the state forests. This work is very largely concerned with planning production, with production itself, and with sales of the planned production. In considering the relative responsibilities of the different grades of forest officer and of forest ranger and especially in making comparisons with conditions in Britain the following points should be kept in mind.

Points of Comparison between State Forestry in Sweden and in Britain

- (a) The Swedish state forest officers have nothing to do directly with private forestry.
- (b) They have little to do with training except through informal discussions with the County Boards of private forestry which are mainly responsible for training and with their own training officers. (Although the National Board of Crown Forests and Lands does have its own forester training schools).
- (c) Little land draining is done compared with the amount of such work in Britain.
- (d) No ploughing is done; screefing only is done prior to natural seeding or to replanting and the machine which is used for this works very much more rapidly than does a plough.
- (e) Relatively little weeding is done. The rate of vegetative growth in Sweden is low and weeding is not usually necessary. When it is necessary it is usually done by hormone spray.
- (f) Foresters and District Officers have the minimum to do with pay and nothing to do with receiving or paying cash except for fishing licenses. Workers are paid every 4 weeks, through the Post Office by money order delivered to their houses. This has been done for twenty years.
- (g) No fencing is done.
- (h) Practically no fire protection work as we know it in Britain is done. (Spotter aircraft are used and the fire brigade liaises closely and responds to calls, and workers are obliged to respond to fire calls).
- (i) The foresters and forest officers are themselves more free to give time for their own training.
- (j) They usually have nothing to do with nursery work. (Nursery work cannot proceed when the ground is snow covered).
- (k) Because they have no big afforestation programme, and because they have mature forests, the relatively small proportion of planting and replanting they do is supplemented by natural re-generation, and beating up is usually not required. Planting, which involves the work of

plant allocation and supply and organisation and supervision of labour for these jobs is a relatively small proportion of most foresters' and district officers' activities in Sweden. It is done in late spring or during the summer, and in most parts of Sweden harvesting is the only practicable operation in winter.

- (l) They usually have only two coniferous species to deal with and one hardwood (birch). In southern Sweden they might have oak and beech to deal with also. Aspen is now relatively unimportant since the best has been felled.
- (m) They usually have good forest road systems, although the roads often need replanning. Road alignment is rarely difficult. Road construction is relatively easy. Roads are often unnecessary when winter snow makes extraction easy; this is of special value on very rocky areas and on wet areas where road construction and harvesting would otherwise be expensive. Road and building engineers relieve them of all responsibilities for road and building construction.
- (n) Peat bogs, when they occur, are left untended as "impediments", or, if they grow forest crops, these are harvested only when the bogs are frozen.
- (o) They do not have to provide for "wet time" for their workers. A low precipitation, a considerable part of which falls as snow which is a help rather than a hindrance in logging operations, rarely creates conditions in which workers have to stop work.
- (p) Piece work rates are provided for the guidance of the forester and the district officer according to various classified working conditions. They are agreed at national level. The forester has to interpret the rates and classified conditions and apply them to the conditions in his own forests.
- (q) The pattern of markets and marketing has evolved during a long period of development and most of the marketing and related work is routine and well understood.
- (r) In applying new techniques in harvesting, the field staff have the help now (in two regions only at present but probably this will be practised throughout Sweden) of liaison officer experts, recruited from experienced forest officers who have been specially trained. They are outstationed members of the Stockholm Headquarters Staff.
- (s) Field staff are helped by many modern aids such as extensive use of aerial photographs,

photographed maps, punch card systems and so on.

- (t) They are encouraged to use the telephone rather than to write letters, when possible.
- (u) They are encouraged to be independent of their headquarters and to have complete responsibility for all work within their territories. District Officers have complete control of silviculture and this is considered to be of great importance if they are to make maximum application of mechanised harvesting.
- (v) They have full help from Stockholm in the preparation of their ten-year plans.
- (w) They are not concerned with acquisition of land. (There has been very little acquisition of land for fifty years).

The implications are that the field staff in Sweden in the state forest service are relatively free to perform their primary and more specialised function of planning for harvesting and marketing* and for making the best use of machines and of men in these operations. They are free to attend to very detailed planning of expensive machines and the results obtained in reducing costs and increased productivity seem to justify this. One possible way of achieving the same objectives in British conditions could be to give field staff functional responsibilities (along lines already proposed) and at the same time to introduce every possible simplification; at the same time we should recognise that our foresters in Britain are dealing with much more variable conditions and much more variable tasks and they have to be much more adaptable. We had the impression that forest rangers and district officers in the Swedish state forest service are allowed ample time to devote to the careful planning of those profitable operations which are likely to pay best by careful attention to planning of detail. In Britain we would have to remember that if the attention which is now paid to fencing, draining, ploughing and fire protection were withdrawn and devoted to logging operations, for example, we could lose a great deal of money through inadequate supervision of these operations. The conditions under which the field staff work in the two countries are so different that comparisons could be misleading.

Marketing in the State Forest Service

(1) Policy. We were told that there is no clear statement of marketing or sales policy, nor is a need for such a statement envisaged unless, for example, a major change were intended. The pattern of marketing, which takes account of the needs of the

* There is a trend towards greater headquarters' control of marketing and this is considered to be necessary to rationalise marketing for the supply of those bigger industries which might best serve national interests.

state-owned forest industries and of some other markets, has evolved over the years and has now become established. Cutting plans are agreed in the spring of each year, although it is known that the prices for wood that will be produced under those plans will not be agreed until the autumn. It is believed that technological advances and other factors can change markets rapidly in future and that consequently it is unwise to tie the forests to any one industry for too long.

The state forest service has nothing like a monopoly position as a seller. Moreover, the state forest service is not a party to annual price negotiations. It is in a healthily independent position and in a fairly strong bargaining position as the biggest single forest owner in the country. It has an important stabilising and balancing role to play in the wood market and with this role in mind it aims not at maximum profit or highest prices but at reasonable prices with the long term needs of the country as the main guide.

(2) Sales Trends. Before the second world war most of the production from state forests was sold standing. At that time most labour was temporary. During the war 60% was sold felled. Now 80% of sales are on a felled basis and the proportion is increasing. It is considered to be most important for the silvicultural well-being of the forest, as well as for the purpose of making the quickest and best application of mechanised harvesting and the greatest economies in road construction, for all harvesting operations to be done by the forest service. This line of thought is being carried further—to control of transport from the forest—and to increasing sales on a delivered basis.

All operations are carried out at much greater speed than hitherto, and the speed of change itself is great, especially in harvesting, in transport, and in arrangements for log handling at sawmill and factory. Close co-ordination of all harvesting and transport operations is essential if the fullest advantage is to be taken of improved methods. Experience has shown that only direct control of all operations makes full co-ordination practicable. Those most directly concerned with increasing productivity in harvesting and marketing seem convinced of the need for the state forest service to sell more on a delivered basis.

These are thoughts that we will have to heed in Britain especially in forests where the provision of adequate stacking grounds is more difficult than is usually the case in Sweden.

The greatly increased productivity in the big companies who do exercise such direct control in their own forests is taken as a clear guide to this need.

(3) Marketing Arrangements. The state forests sell on standing, felled and delivered bases to private industry; about 30% of their production is sold to A.S.S.I. (the state-owned forest industries); A.S.S.I. do not buy standing. Arrangements are made between headquarters in Stockholm and the District Officers, in all cases via the Regional Officers. Headquarters decides what each district is to produce. It is left to the District Officer to decide what to fell and thin and when, what to sell standing and what to sell felled, and to prepare the sales plan. The District Officer can also question any unreasonable levels of production requested by Stockholm. There is no co-operation at any level between the state forest service and others over marketing.

(4) Felling Contractors. Sales, standing or felled, to contractors or round timber merchants who have no sawmills or other wood processing factories of their own, are almost unknown. Felling contractors who would buy, fell, extract and market went out of business in Sweden forty or fifty years ago. There has been talk of encouraging such contractors to return to forest work, but this would be resisted by the workers' trade union. The state has enough workers to deal with all its own work, but many of the workers are old. They are permanently employed and are guaranteed a full year's work. There is no difficulty in selling each year's cut, so there is no need for the help of contractors in searching out markets. Buyers like to deal with the state forests directly because they are confident of being given good service.

(5) Season of Felling. In the past both pulpmills and sawmills required their wood to be partly seasoned, especially as this tended to reduce the resin content of the wood. Wood used to be delivered up to the 1st May to sawmills and up to 1st September to pulpmills. Now both pulpmills and sawmills realise that they must accept fresh-felled wood and that they must accept deliveries all the year round.

(6) Marking for Thinning and Felling. Trees are marked in state forests one year before they are cut. For example marking would be completed by September 1965 for felling which would begin in October, 1966. 50% of the cut is in thinnings.

(7) Standing Sales. Every tree is measured for breast height diameter and top height. Sample trees are felled and measured. The number of sample trees to be felled in standing sales is decided by the Board of Crown Forests and Lands. Volumes, by diameter categories, are given to intending buyers, but only as a guide, and the buyer must satisfy himself as to all measurements. Volumes are determined from separate species' volume tables for North and South Sweden.

(8) Sales of Felled Wood.

Most standing sales are made by tender; only a very small proportion is auctioned. Standing sales are more common where there are many small sawmills and other wood using industries, as in Southern Sweden. Small industries tend to buy standing. Big industries do not like to engage in logging in state forests and they buy felled.

(9) Sales by Tender. *Sawlogs* are usually sold by tender. The interested merchants confer among themselves quite freely but the Board of Crown Lands and Forests is satisfied that buying is nevertheless as competitive as it would be if they did not confer. Sawlogs are not sold by auction. It is intended to introduce more negotiated sales. The Board of Crown Forests and Lands decides each year for different regions what will be the standard sawlog. For example, in West Region for 1965 the standard was a sawlog of 8 inches under-bark top diameter. In Northern Sweden three standard sizes of 6 inches, 7 inches and 8 inches are usually decided. Fixed percentage increases and decreases are prescribed for larger and smaller logs—and these are notified in all sale particulars. Tenderers then tender for only one size of sawlog and accept that, in so doing, they are binding themselves to accept the prescribed proportional increases or decreases for logs of larger or smaller size. Every sawlog is measured in Southern Sweden. In Northern Sweden sawlogs are measured by sample. There seems no prospect of selling sawlogs by weight (although this is done by the companies selling logs from their own forests to their own mills).

There is a tendency for more sales of sawlogs to be made by direct negotiation with sawmills and District Officers can negotiate 2 year, 3 year or even 5 year contracts with sawmills.

Pulpwood is almost invariably sold by negotiation, at a price per stacked cubic metre at roadside or delivered mill, and is prepared in 3-metre lengths usually, with smaller quantities in 2-metre lengths. The Board has one or two 5 year contracts for pulpwood supplies in Northern Sweden and a few 3 year contracts in Southern Sweden, and it is believed that sales of sawlogs will have to follow this pattern. Sales contracts for pulpwood at roadside require the pulpmills to remove the wood within two months. If they fail to do so, the wood is paid for as though it were 98% first quality. Chemical sprays have been successful in controlling blue stain. D.D.T. in oil and hexachlorophenol have been used.

Most measurement for sale is done by professional scalers controlled by the National Board of Private Forestry but forest workers can be trained in this work for a week and are then accepted by the Board of Crown Forests and Lands, by buyers and by the Scalers' Associations.

The buyer pays the scalers. The pulpwood is usually measured at the pulpmills in Southern Sweden. In Northern Sweden it is measured in the rivers (it used to be measured stacked on the frozen rivers). The state service does sell some pulpwood by weight, supplemented by measuring sample loads for volume. Nearly all contracts for sales of pulpwood are negotiated by headquarters in Stockholm.

(9) Sales by Tender. Every tender is sent to headquarters in Stockholm for checking, recording, and for approval of the successful tender. One day in each year is allocated to each region for receipt of tenders. Each tenderer must stand by his tender for 14 days and must be told within that time whether or not his tender is accepted. About a month is allowed, after advertising, for intending buyers to inspect felled wood, and rather longer for sales of standing trees.

3% is sold by tender in North Sweden and 6% in South Sweden.

(10) Sales by Auction. Only standing trees are sold by auction and only a small proportion of all sales is made in this way. Auctions are not favoured by the state forest service; they are favoured by some buyers and especially by small sawmillers, who have grown accustomed to securing a part of their requirements in this way. A lot bought at auction can be a useful standing reserve which will last 12 months. In Southern Sweden lots are often made of very small size merely to provide for small sawmills.

The state forest auctions are held before the private growers' auctions always, and before the state sales by tender.

Auction sales indicate trends and set a pattern over the years, but they are of little use as indicators of prices that might be expected for the bulk of the year's sales.

Reserve prices are set by the Board in Stockholm but the District Forest Officer can adjust these within fixed limits.

In South Sweden bids are made as a lump sum for the parcel. In North Sweden bids are made as a price per tree. There are usually as many buyers as there are lots. Auctions are conducted in two stages, before lunch and after lunch. Lots unsold before lunch are re-auctioned after lunch. Any lots unsold at auctions are usually sold by negotiation within a few days.

The bigger sawmills are less interested in auction sales and they tend to buy more of their logs felled.

40,000 hoppus feet to 55,000 hoppus feet is a common size of an auction lot, but they are frequently much smaller in Southern Sweden.

Felling has to go on throughout the year. Other sales cannot be dealt with until the auctions have been held, otherwise auction sale prices would drop. This means that fellings have to proceed in anticipa-

tion of sales and in many respects this is considered to be unwise. Hence the auctions are considered to be something of a nuisance and unnecessary.

Auctions are held in October. A buyer at auction gives a security (bank paper) for the full value of the lot and has to pay the full cost value before 15th June following the auction. Any bought timber that is left standing later than June has to be paid for at 1 krone per cubic metre. Valuations for auction are done by only one officer per region and he guards his valuation in strict confidence. He also receives confidentially from Stockholm a serially numbered list of auction valuations for other regions.

A professional auctioneer is employed to auction the lots, but the Regional Forest Officer is in complete charge of the proceedings at auction.

Only 6% of sales is by auction in North Sweden, and 10% in the South. Buyers at auction are not typical. They are small and so auction sales are less important as indicators than they were at one time.

It is intended to reduce auction sales still further. The state forest service will do 90% of its own harvesting in future, and it is believed that this is the right thing for any big forest enterprise to do.

It does not follow that auctions in Britain should be viewed in the same light. We have timber merchants buying most of our production and many of the biggest of them are as interested in auctions as in any other forms of sale.

(11) Sales by Negotiation. More than 60% is sold by negotiation throughout the state forests.

(12) Market Research. No market research is done by the state forest service or by other forest owners as such in Sweden, nor is it considered necessary for them to do so. Market research is left to the big companies who export. What is being encouraged is work which is being done at the Royal High School of Forestry to assess how much of the trading profits of some of the big companies should be attributed to their forests and how much to their wood processing enterprises. The indications from this work are that prices paid for wood could be increased. The Board of Crown Forests and Lands cannot obtain from A.S.S.I. (the state-owned forest industries) information about profits and what A.S.S.I. could afford to pay for wood.

(13) Sales Intelligence. Statistical work on price trends is the main activity in this field, and this is done at Stockholm.

Acquisition of Land

Since 1906 when an Act was passed forbidding Companies to acquire more forest land it has been difficult for the National Board of Crown Forests and Lands to extend its forest area. In the meantime the Board has accumulated a substantial financial reserve in a special fund which has been increased

by regular annual receipts. The Board has not been allowed to apply this special land purchase fund to other purposes. A new Land Purchase Law will make matters easier in the future.

Training

Although most vocational training is supervised by the County Boards of private forestry, the National Board of Crown Forests and Lands has two forest workers' training schools and three forest ranger schools.

The National Board of Private Forestry

This Board, which was set up in 1941, has a Director-General and five members. The Director-General, as head of the Board, is directly responsible to the Minister of Agriculture. The Board engages in no commercial activities; it is a supervisory institution. Its object is to study the status and development of private forestry and to suggest to the appropriate Ministry measures which it considers feasible for the promotion of private forestry. In collaboration with the County Forestry Boards (described below), one in each county, it supervises the observance of laws and regulations in the field of forestry. Since the measurement of wood is controlled by law in Sweden (The Timber Measuring Act of 1947—due for revision in 1966) the administration and supervision of all measurement of wood comes under the authority of the National Board of Private Forestry. Even changes in methods of wood measurement which might be agreed between a buyer and a seller have to be approved by the National Board. The Board supervises the work of state-approved scalers. The supervision of forester training schools and of the state schools of forestry was transferred to the National Board of Private Forestry from the National Board of Crown Forests and Lands in 1963. The National Board of Private Forestry is now the main authority responsible for training in forestry in Sweden and co-ordinates the work of others interested in promoting this work. Under the supervision of the National Board the 24 County Boards of Private Forestry give free vocational training at 32 training schools where courses are regularly available to selected candidates for training as forest workers, machine operators, foremen, foresters, teachers and instructors. The curricula are agreed by all the main organisations which have an interest in forestry. The importance attached to training and to retraining at all levels in Sweden cannot be over-emphasised. So far as forest workers are concerned it is considered that in order to attract a fair share of intelligent workers the forestry industry must take and train young men as they leave school, otherwise they will be attracted t

other industries before they learn of opportunities in forestry. Then they must be trained to a level which will make them worth, and justify their being paid, wages that compare with those in other industries. From workers so recruited and trained it is also considered practicable to recruit and train good foremen and foresters.

All education and training is free of charge but, at forestry training schools, students pay for their board and lodging.

Regional Organisation of the County Boards of Private Forestry

In 1903 the first Forestry Act was passed. In 1905 the Provincial Boards or County Boards of Private Forestry were set up, one in each province or county, to see that the Act was adhered to. There are 24 such County Boards and each is responsible for the administration of the forest laws, and since the laws do not apply to the State Forests or to the Church Forests, the County Boards deal only with forests which are privately owned, including the Company Forests.

Activities of the Boards

Apart from informal liaison over training and teaching the County Boards have nothing to do with the State Forests. They maintain close liaison with the private owners' forestry co-operative associations and with those companies which own forests.

The Boards deal with the payments of grants for private forestry and they provide free advisory service and an agency service for marking trees for sale, also preparation of working plans for which the private owners pay.

Many of the County Boards own and manage nurseries. (The Board for the County of Kronobergs, centred on Vaxjo, produces 8 million transplants a year for private forestry). The Boards do not own forests, except in so far as this is necessary for demonstration and training, when adequate forests are owned in connection with forestry schools.

Ninety per cent of all forestry training in Sweden is now done by these Boards, and they exercise some control over other forestry training.

The Boards are responsible for regional forest road planning with the main object of developing roads which will minimise the cost of transport of wood to factories, on the accepted basis that road transport is cheapest. They also play an important role in highway planning, and are represented on a committee in each county which deals with highways. For example, in Kronobergs County, the Board's Technical Forest Officer, who is responsible for road planning, is secretary of the county committee which deals with the national road network.

Work on the planned forest roads in the private sector is executed by the private owners. Grant aid is available for primary forest roads, usually with the proviso that all the owners affected by the necessary work co-operate on a pro-rata basis, depending upon the estimated use each is likely to make of the roads. A yearly sum of 13 million kroner is available for approved road construction grants. The grant derives from motor tax revenue. Road grants might be paid up to 40% or 50% of the agreed costs. Loans (at 5.25% interest in 1964-65) are available for road construction from a fund of 1 million kroner. The fund is inadequate to meet all applications.

Planting grants of 50% of the approved costs are paid. Grants are not paid for replanting, but replanting costs are accepted in claims for relief from taxation.

Drainage grants of 25% of the approved costs are paid from the Forest Improvement Grant, and between 0.5 and 1 million kroner are made available annually.

If the farmers do the work themselves they can still receive grant aid based on the County Board's estimate of the cost. Companies that own forests can qualify for grants but usually they do not apply for grants and, when they do they rarely receive payment because their applications are considered last in the line and usually there are inadequate grant funds to meet all applications. Fixed sums are allocated yearly for grants and the grants are not "open ended". Gifts of plants up to a total value of 200 kroner are made in individual cases which involve small but particularly difficult regeneration.

Although the emphasis varies in different parts of Sweden, most of the County Boards devote much attention to the problem of how to persuade farmer forest owners to co-operate. No financial aid is given to forestry co-operatives but a great deal of time and effort is put into encouraging owners to co-operate. The County Board's ruling is absolute on matters of assessing costs of work for purposes of paying grants.

Management plans are compulsory for larger projects and then 50% of the approved costs of preparing the plan can be subsidised to a maximum of 600 kroner. The County Boards make plans at the request of owners for any size of project and such work is partly subsidised and the charges are decided by the National Board of Private Forestry.

Nowadays very little of the County Boards' effort is given to administering forest laws, and to seeing that private owners manage their forest in accordance with the laws. There is a sufficient awareness and acceptance of the forest laws to make it unnecessary

for the Boards to spend much time on this aspect of their work. The use of aerial photographs enables checks to be made in the office on whether stands have been illegally felled, or not replanted, and it is only when their attention is directed to such situations that the Boards spend time inspecting individual properties to check on the law*. In fact less than 5% of their time is devoted to administration and supervision of the forest laws. 40 per cent of their time is devoted to advisory work and other official duties and 60 per cent is devoted to agency work such as marking trees and preparing plans.

Federation of Provincial Boards

The Boards have their own Federation of Provincial Boards of Private Forestry which is a common forum for the Boards to safeguard their interests and to promote the work entrusted to them.

Financing the County Boards

The activities of the Boards are financed partly by a direct State Grant, partly by a special forestry fee; the special forestry fee is a state tax which every forest owner has to pay whether or not he takes advantage of the Boards' services. This annual tax is at the most 0.15% (now 0.10%) of the total value of the forest land and the timber according to the last property assessment. The Boards are also financed partly by payment for services given to the forest owners.

Each Board is composed of seven members of which three are elected by the King in Cabinet, and three are elected by Provincial Authorities, while the Head Forester, who is also Chief of the Board, is a permanent member. The activities of the Boards are supervised by the National Board of Private Forestry.

An Example from Kronobergs County Board

Kronobergs County Board, as a typical example, has 60 forest officers and foresters at the central office in Vaxjö plus 20 office staff, making 80 total headquarters staff. In addition the county is divided into 12 districts (other counties have up to 20 districts) each in charge of a forester who also has an assistant.

The Headquarters of the Board is divided into five sections:—

- Nursery, Seeding and Planting
- Conservation
- Drainage
- Roads
- Teaching or Training.

The Board's educational and advisory work has been highly successful and it is now a main function.

The management of nature reserves and sites of special interest is also in the hands of the Board.

The main function of the Board consists of paid-for services in forestry. Expert help and other services are given in stand management and in the planning of felling operations. Surveys in connection with forest valuation are also carried out by the Board, which also assists, on occasion, with advice on taxation. The Board is responsible for the supply of seed and seedlings within its own province.

It is rarely that the companies resort to the Board for help.

An Example from Kopparbergs County Board

One example of the way in which County Boards help and encourage farmers to co-operate in their forestry activities was explained by officers of the Kopparberg's County Board of Private Forestry, whose headquarters are at Falun, in Dalarna region in the County of Kopparberg between mid and north Sweden.

Dalarna is a more upland region than those in southern Sweden and its farmers are more independent and less co-operative in character than those in some other counties. The subdivision of holdings into narrow strips also continues to a greater extent here than elsewhere. The average holding is about 70 to 95 acres of forest.

The County Board of Kopparberg feels that it is essential to develop collective management and marketing. This is particularly difficult because many owners do not know precisely the boundaries of their properties, and few owners have any plans for managing their forests. Co-operation is therefore essential also for planning. The increasing need for mechanisation (there are very few tractors in this region) can only be met by increasing the size of areas to be treated at one time. It is often difficult to locate the owners of many of the properties. The need for planning was less urgent 10 years ago when prices were good, labour was cheap, horses were used for extraction and each farmer could fend for himself. The law can achieve little among an independent people such as these, although one proposed change in the law, which will make one owner responsible for management decisions, where a property is owned jointly by two or more, might help.

The County Land Surveyor has called upon all owners and has established details of ownership so far as practicable, resorting often to old records. Many of the owners are old and it is doubtful whether the next generation will continue the work that is now in hand.

* The Forestry Act of 1948 allows felling only when restocking or stand improvement will result.

Working plans are being prepared with maps to show the strips, and each owner is presented with a copy. The plans describe the forest as it exists and prescribe treatment over a ten-year period. Planning starts in a municipality which is sub-divided into map districts, rather than into individual ownerships. In choosing a map district in which to proceed with the work the Board considers:—

- (a) the degree of interest shown by individual owners in the district.
- (b) the proposals for dealing with unemployed labour.
- (c) the forest concentrations.
- (d) areas where investigations of rights and of ownerships are completed.
- (e) areas which are well mapped—with good supporting aerial photographs showing, superimposed, the boundaries of properties.
- (f) areas where lodgings are available.

Planning begins when the Surveyor's maps and visits are completed. The owners, who often do not know about their boundaries until they are shown the surveyor's maps, are called to a meeting in the district. The problems and broad proposals are explained to them and they are told that rangers will visit them to discuss their individual problems.

Sixteen rangers are employed solely in this work. They are sent to live among the farmers to gain their confidence. They work alone but maintain close liaison with the County Board Rangers. They prepare up to date stock maps and complete detailed field data sheets for each holding. When the field work is completed the rangers mark the maps with an identity number and areas are then calculated mechanically at head office and automatically registered on punched cards.

The management plans which are prepared from these data are prepared and printed by automatic data processing, and for this purpose time is hired on an I.B.M. 1401 machine using magnetic tape.

The forest ranger personally hands the plan to the owner. The owners are then called together, ten at a time, to discuss their individual plans and the plan for the district. If the big companies are involved (they often own small areas among the farmers' holdings) they are also represented. If necessary a road plan is also discussed, and always co-operation is discussed. There might be 50 or 60 owners concerned in one district plan but it is more usual to have 4 to 6. Any farmers' co-operative which operates for agricultural purposes only is also invited to be represented.

Discussions take place with groups of about ten owners on three evenings and this is followed by a one-day field excursion. Plans are then offered for sale to owners. 98% of them buy. They cost about 3/6d. per acre.

The availability of grants is used to persuade owners to accept proposals and to encourage individual owners to persuade their neighbours to participate in joint plans.

If, in the general district plan, one year's felling is in 2 or 3 separate ownerships, the trees are marked on a special list and are valued and recorded by ownerships before felling. In these joint schemes trees are sold standing only. The farmers are then paid by the company which buys the trees. Each owner advertises the sale of his own trees.

One owner is usually approached by a customer and that owner goes to the office of the Board which then sends its ranger to see the other owners concerned with that year's felling under the joint plan. It is left to the individual owners to make their own contracts with the customer. If two or more customers approach owners who have combined in a joint plan, those customers usually resolve matters by exchanging purchases. This is accepted by the owners.

It was hoped to survey and prepare plans for over 45,000 acres in this way in 1965, and to cover all privately owned forests in the county (nearly 2 million acres) in ten years.

This County Board also has a new forest worker training school which provides instruction for farmers and for workers of contractors and of the big companies. This school, at Alvalden, is of particular interest because the workers (or the companies) can take their own tractors and equipment there to receive instruction on how to use and to maintain them.

Associations of Employers

Swedish Employers' Confederation (S.A.F.)

This is the biggest employers' organisation in Sweden and has 25,000 members, many being large companies and representing manufacturing, trade, transport and mining. The members have about 1.2 million employees.

Outside this Confederation there are a number of smaller employers' organisations for trade, shipping, banking, insurance etc. The co-operative movement has its own organisation and so have the state and communal bodies. The Federation of Swedish Forestal and Agricultural Employers (S.L.A.) is also outside the Confederation, and is described below.

The Federation of Swedish Forestal and Agricultural Employers (S.L.A.)

This is an organisation primarily of employers in Swedish agriculture. Since agricultural enterprises so often include forestry, membership can also be held in respect of an employer's forestry interests. Since large scale agriculture is generally to be found

in southern and central Sweden, this Federation's activities are basically limited to those parts of the country. In Northern Sweden the private forestry owning companies have formed a separate organisation for the same purpose as this Federation serves. The Federation of Horticultural Employers is also affiliated to the Federation of Swedish Forestal and Agricultural Employers as well as undertakings connected with agriculture or forestry.

The Federation has four sections:—

- (i) An agricultural section with 6,500 members. This is only 3% of the 200,000 farmers in Sweden. Members cultivate about 1.4 million acres, 17% of the arable land of the country, and they have 20,000 to 30,000 employees.
- (ii) A forestry section with 1,300 members representing nearly 3 million acres of forest in central and south Sweden, where the Federation is the sole employers' organisation representing their forestry interests. Among its members are big forestry companies as well as farmers. Members have 10,000 to 12,000 employees.
- (iii) A horticultural section with 600 members who have 3,500 employees. Members represent market gardens, nurseries and forest farms.
- (iv) A general section comprising sawmills, brick yards and joinery works run in connection with agriculture and forestry, together with machinery stations, artificial insemination societies, fur farms and poultry breeding farms.

In addition to the above four sections the Federation has special divisions for time and motion studies in agriculture (at Bromns, outside Stockholm) and for research and rationalisation in forestry (at Katrineholm).

The main task of the federation is to negotiate collective agreements with organisations representing employees, notably those in agriculture and forestry, including foremen and other supervisors. It also helps to solve disputes, it looks after its members' interests in legislative and in legal matters, and supplies its members with information that concerns their status as employers. Much emphasis is placed on efforts to facilitate rationalisation of agriculture and forestry. It employs a staff of 35 and has offices in Stockholm, Örebro, Linköping and Malmö.

Associations of Owners

With the aim of encouraging better silvicultural practices, a large number of forest owners in South and Central Sweden grouped themselves into forest owner associations in the 1920's. The associations

were non-commercial; they held excursions, wrote articles and attended lectures.

When the prices and marketing possibilities for forest products worsened catastrophically around 1930, the forest owners found it necessary to establish a co-ordinating organisation which could also further their commercial interests. Many of the non-commercial associations were then re-organised into economic associations and new ones were formed. After the second world war they developed rapidly. They now have more than 130,000 members mainly representing farm forestry with a total of over 60 million acres of productive forest. Until a few years ago there were 23 such associations. More recently, in order to strengthen their commercial status, there have been amalgamations of some of these associations and this trend is likely to continue.

The associations have a central body to represent their interests at national level. This is called the National Federation of Swedish Forest Owners' Associations (commonly known as the S.S.R.) and is described below. This is followed by a description of farmers' forestry co-operatives, with an example.

The National Federation of Swedish Forest Owners' Associations (S.S.R.)

This is the national organisation of the local owners' associations. Its objects are to safeguard the economic interests of its 20 member associations, by marketing and processing timber, and to keep members informed of the latest developments in forestry. It regards itself as being responsible, on a national scale, for co-operation within the body of forest owners and has been actively engaged in the vertical integration of forestry with wood processing industries that has taken place in the private sector in recent years.

It is financed by annual contributions of 3% of the member associations' turnover and in this way receives 12 million kroner or £850,000 a year.

At its headquarters in Stockholm it employs 5 directors and a supporting staff of 20; five are professional forest officers and two are foresters.

It does not engage in sales in the home market but helps in the co-ordination of sales between member associations and it does negotiate and manage sales for its member associations for export.

The National Federation of Swedish Forest Owners' Associations is the body which negotiates with the National Board of Private Forestry on such matters as legislation, grants and related matters. It includes agricultural activities in its interests.

It is also the national body which negotiates, with the representatives of industry, the level of prices for roundwood, and reaches agreement in writing

on the price for each commodity. All such agreements date from September and last twelve months. Often negotiations are not completed by September, or even by the end of December; but it is always understood that supplies will continue with retrospective price adjustments. The industrial representatives from the North of Sweden represent pulp mills and saw mills jointly in the price negotiations. Those from the South represent saw mills and pulp mills separately. In addition to the nationally agreed prices, sawmills can make their own local price agreements. Mills owned by associations of forest owners pay the nationally agreed prices.

The State-owned wood processing industries (A.S.S.I.) are not represented at the price negotiations, nor is the State Forest Service (the latter used to take part up to 15 years ago). The nationally agreed prices are published. The annual meetings comprise 15 to 20 people.

If there is failure to reach national price agreement for any commodity then local agreements are made.

It is believed that there is no undercutting of nationally agreed prices except possibly by some few small industries which are not represented at the negotiations.

Nationally agreed prices are all on an "at roadside" basis for the South of Sweden; they are on a "free on water at river mouth" basis for the North. There is a "floating association" which represents buyers and sellers and which agrees costs of floating.

It is usually understood that spruce for ground wood will be sold at prices agreed for sulphite pulpwood. Although the State auctions of standing timber reveal the general trend in prices, the auctions represent a very small proportion of sales and their importance should not be exaggerated; it is the nationally negotiated prices which set the pattern. There is no similar central or national price negotiation in Finland; there is in Norway.

The member associations, and sometimes individual members of those associations are employers. As members of the Forest Employers' Association, and similar bodies, they can take part in wage negotiations also. Nowadays the National Federation of Swedish Forest Owners' Associations also takes part in wage negotiations with the Swedish Forest Workers' and Log Drivers' Union. Wage negotiations take place in the autumn each year. In a three-day session piece-rates are discussed for every job, on a regional basis, for application in North, South and Central Sweden respectively. One important principle, which is accepted by both sides in negotiating, is that savings in costs by rationalisa-

tion and mechanisation should be shared between the employers and the workers. The extent of saving in costs and the proportions in which the savings should be shared are disputed! The wage agreements are honoured throughout Sweden; any failure to observe the agreements is more often due to ignorance than to deliberate refusal to observe them. Wage changes take place on the 1st January with retrospective adjustment where necessary.

The National Federation also arranges courses in rationalisation of management and logging and mechanisation on behalf of its member associations. It is not itself a member of any research association or organisation, but it commissions research and buys the results of research. It owns no forest machines but maintains close liaison with the research organisations which deal with development of machines and mechanised forestry.

The Association also provides an important service for its members in advising on legal matters. It is very concerned about the possible effect of the new Land Purchase Law*. It feels that farmers may be pressed and persuaded (especially as land prices are expected to increase as one result of the Law), to sell out their forests to the State or to the big companies because, individually, the farmers are too small to buy modern and expensive equipment necessary to keep costs within bounds. The Association and its member associations are determined to support and to maintain the position of the farmer owners and to prevent their being swallowed up by the State and by the big companies. Although few of the farmers are ready to discuss it, the more enlightened of them and their leaders are ready to discuss the possibility of much closer co-operation than they have practised hitherto, even to the extent of abandoning the identity of their individual holdings, forming forest land holding companies in which the individual farmers would be shareholders, the value of their shareholding being in proportion to the value of their forests. If this could be accepted and practised it might be the best answer to the problem of how to rationalise land use, but tradition and sentiment are powerful forces and such changes would be difficult to introduce. At the same time there already exist jointly-owned forests, especially in the County of Norbotten. Since they accept joint or co-operative ownership of factories it seems worth their while considering ownership of forests on a similar basis.

Forest Owners' Associations; Farmers' Co-operatives

The large and small farmers who combine agriculture and forestry own about 48% of the forest area

* Hitherto it has been virtually impossible for the big Companies to buy more land. The State has also observed the existing law in this respect. The new Land Purchase Law will make it possible for anyone to buy land if they can show that by so doing they will rationalise the land and its management.

and 61% of the value of forests in Sweden. Their forests amount to over 25 million acres, divided into more than 240 thousand holdings with an average area of about 104 acres of forest.

The big development of Swedish sawmilling industry during the 19th century lead to the creation of a new category of forest owner, the large sawmill company. Because this development threatened to deprive agriculture of its support from forestry, a law was enacted in 1906 that limited the acquisition of forest land by the companies. Because big companies developed their forest holdings and dependent industries more in the North, the other owners there also found that these new industries provided big markets for their own forest production; in the South the farmer owners had less satisfactory markets.

Although the Company-owned forests include many small areas, they are, in the main, in large blocks, managed by experts for the purpose of supplying the company-owned industries. The farmers' forests on the other hand posed special problems on account of their small size, their difficult shapes, poor access, lack of skilled management, lack of capital to invest in modern machines and equipment, and lack of sure and steady markets. The latter applied especially in the South which had hitherto been given less attention by the big companies. These factors have given rise to the forest owners' trading associations.

The first owner's associations were originally concerned with promoting good silviculture; they have been changed into trading associations which now cover the whole country. In 1960 there were 23 forest owners' associations. Recent amalgamations reduced this number and further amalgamations are expected. The principal functions of the forest owners' associations are to trade in, and also to convert, a certain part of the products delivered by their members. They work in various ways to bring about improved economic return from their members' forestry. They foster the joint work of the farmers' forestry and agriculture, and they cultivate a greater interest in forestry to improve production. In Northern Sweden the spheres of influence of individual associations are generally determined by the river floating systems, whereas in central and Southern Sweden they more often coincide with county boundaries.

Members notify their association of their proposed logging programme and the association afterwards combines the various parcels and arranges for their disposal. A member informs the association of what he intends to sell. The association fixes, by means of a contract, the terms of a calculated delivery. The association afterwards combines the various members' parcels into marketable lots. Once the trans-

action has been concluded the members are informed, by a statement of sale which accompanies the payment account.

A small forest owner who could only make insignificant deliveries is often not in a position himself to find a buyer. Even if a buyer might be willing to take such small parcels, their individual collection and transport would be unprofitable and troublesome to arrange especially if, as is often the case, the felling site were far from the mills. However, suitable planning, distribution and sales organised by the forest owners' associations allow such parcels to be combined to form larger deliveries. The small forest owner is thereby enabled not only to dispose of his timber but also to obtain a reasonable price for a quantity that might otherwise have not proved large enough to attract a buyer.

The forest owners' associations study the market and keep their members informed of the state of the Swedish timber market, and advise them on the types of timber in demand, quality requirements, specifications, etc. The associations keep their members informed through frequent circulars, articles and lectures on all relevant matters. This information and advisory service is a highly important factor in trying to ensure for their members the best return for their products. On behalf of their members the associations also handle the export of considerable quantities of sawn and round wood.

Members finance their respective associations by contributing funds in proportion to the benefits that they expect to derive from membership. The amount invested is based either on the area of the member's forest or holding, or on the officially assessed value of the forest. In some cases the sum is calculated as a percentage of the payments the member has received for timber delivered through the association. The capital is raised partly through the association's annual profit being divided amongst the members, and partly by deducting certain percentages from the proceeds of timber sales. The two amounts are then credited to each member's account. The money thus accumulated by the members in their associations, is used as working capital for investments. When a member ceases to be engaged in forestry and wishes to end his membership, the invested capital is re-paid to him by the association.

The greater part of the Swedish wood processing industry is owned and run by forest companies and by other large enterprises, but through their own organisations the forest owners have achieved the objective of getting at least a certain part of their forest products processed at their own factories. In recent years the forest owners' associations have built up a relatively large sawmill industry which produces for both the home and export markets. They have also established pulpmills, fibreboard

mills, timber yards, prefabricated house factories, joinery mills, impregnating works and a number of other industrial enterprises.

A good example of a forest owners' co-operative is the South Swedish Forest Owners' Association (S.S.F.). Notes on this Association and its activities are given below.

The South Swedish Forest Owners' Association (S.S.F.)

This is an owners' trading association which itself owns subsidiary companies for the purpose of managing and owning pulp mills or saw mills and other industrial processing plant. It has been formed by amalgamating the interests of four previously existing owners' associations. It represents the interests of owners who between them hold 4 to 4½ million acres of forest in South Sweden. Territorially the organisation is divided into 12 regions each with 10 districts. The Headquarters of the organisation is at Vaxjö; its Director General, Mr. Edstrom, has been a leading figure in co-operative forestry in Sweden since the very early days. There is no doubt that his personal enthusiasm has contributed very greatly to the movement in South Sweden. He has a deputy and the Headquarters' organisation has divisions for pulp and chemical industries, chipboard and fibreboard, sawmills, prefabricated buildings, etc. It also has a transport division and a marketing and market planning division.

Each of the 12 regions is under the charge of a Regional Chief Officer who has an assistant forest officer and each district is in charge of a forest officer or forester. In every district 5 owner members are employed as "contact men", and are paid a small retainer and expenses for carrying out such duties as signing contracts. The organisation exercises very strict price control over all commodities on behalf of its members and prepares yearly plans for work to be done in each district for the year beginning 1st September. Each Regional Officer estimates what the industries with which he deals require; he also estimates what is likely to be available from his members, and how much he can count on to include in contracts. All contracts that he makes for supplies to industry require 80% of the contractual quantity to be supplied as a minimum and a 120% to be accepted as a maximum. Each district exercises twice-monthly control over progress of contracts against quantities and assortments. Pulpwood supplies which involve all regions and districts are arranged from Headquarters. Regional Chiefs arrange the actual contracts for all supplies of wood to industries within their regions, even when supplies come from outside their regions. They arrange sales of trees, arrange technical advice, and make the necessary arrangements for County

Boards of Private Forestry to pay grants and give further help to their members, and generally act as co-ordinators for all marketing problems for their members. The Association employs no labour for operations other than felling and transport. They own no equipment other than saws, but they arrange contract hire of equipment. In future they will own tractors and hydraulic hoists for logging operations.

Each Regional Chief arranges for sales of standing timber by auction for members; such auctions are only of trees of sawlog size, with no big pulpwood element, and they are mainly confined to clear fellings. In future they will try to confine auction sales to stands for clear felling only. The buyers prefer auctions but the Association does not favour them. More and more of the sales of members' timber will be dealt with by direct negotiation with the consumer.

The finances of this particular Association are dealt with as follows. Four per cent of the sale value of members' timber sold through the association is retained by the association and credited to the member's account. Members are not paid interest on this. When a member's personal account amounts to 4,000 kroner (say £280) he pays no more. In addition each year, if it is possible, the Association places 3% of its trading profits to their members' accounts. Members' credit accounts are re-paid to them only when they leave the Association; to do so they must have good reason, as, for example, if they sell their farm, or genuinely cease to have an interest in commercial forestry. On the death of a member his successor may withdraw. A member pays nothing to join the Association. Running costs are paid for in part by charges on members. For example, for making a contract with the member for doing his logging, a charge of 3% of the gross cost is added. Members pay about £6 a day for the services of a forester. Machines and tools are charged for at cost. Forest plans are prepared for about £3 10s. 0d. per plan plus 4/3d. per acre. (A plan for a 100-acre forest would cost say £25). Costs of training courses, lectures and general dissemination of information are borne by the Association.

Owners co-operatives such as the S.S.F. receive no financial aid from Government nor do they seek such aid. They prefer to be financially and legally independent and viable commercial associations.

Each district employs the equivalent of 40 men. Some men work only two months, some only four months, and the forest owners themselves work in their forests so there is no complete or dependable figure; but the estimate is made that the equivalent of 40 men full-time would be required directly by the association in each district.

The Association employs a firm of American transport consultants, in America, receiving from them Telex replies to their enquiries. The administrative work of organising transport of many small lots from so many members is a major problem for the Association. Very detailed planning is necessary to make the whole of the operations run smoothly and to have a steady flow of material to the markets. Specially gridded maps giving co-ordinate references to farm lots are used. Orders to collect and delivery notes include these map references and lorry drivers use the maps in planning their routes to collect supplies.

One difficulty for the Association is to plan for the introduction and for the gainful employment of the latest and best machines and equipment. It is not only a question of learning how to use machines efficiently in many small and scattered areas, but also how to find gainful employment for the farmer owners who have hitherto worked most of their produce themselves. Mechanisation will make much of the farmers' own efforts redundant. The difficulties of mechanising farmers' forestry compared with those in State Forestry and in the forests owned by the big companies are great. The speed with which changes in modern techniques of logging are being introduced accentuates this problem. Under former conditions when horses and man-power were the main forces at work in harvesting, the farmers could compete very satisfactorily with State and Company Forestry provided their efforts were co-ordinated for marketing. The speed with which cost reducing machines and techniques are being introduced is making it more and more difficult to keep pace with modern developments in farm forestry compared with the speed with which State and Company Forests are able to profit from their application.

We visited a typical member of the Association, Mr. Bertil Johanson of Falla. He has 84 acres of forest plus 34 acres of farm land. He manages his forests with the object of working towards a 70 year rotation. Most of the forest is 60 years old. The standing volume is about 126,000 hoppus feet. 60% of the standing volume is Pine and 40% Spruce. He removes about 4,200 hoppus feet every year; in one year it will be from felling about 2½ acres and in the next year from thinning. He does all the work himself, which includes felling and crosscutting into 2 metre lengths of pulp wood and into saw logs, and extracting the produce to stacks at roadside. He has a Massey Ferguson Tractor fitted with a simple winch and crane. He is paid 2/7½d. per hoppus foot over bark for 2 metre lengths of Pine pulp wood stacked at roadside, and 2/11½d. for Spruce. We were told that his net profit from farming and forestry would be about £1,000 a year. He could pay up to 40% of his forest income into his bank and pay

income tax on it as he made withdrawals. He could also qualify for relief from income tax on his farming expenses.

At Kleveshult the South Swedish Forest Owners' Association has a barking depot where, working an eight-hour shift a day, they bark 2 million hoppus feet each year. The depot is equipped with a Cambio 54 to take pulpwood up to 20 inches diameter, and one Cambio 35 to take up to 14 inches diameter. The Cambios are fed with pulpwood by a moving platform which is loaded by a specially designed hydraulically operated tractor mounted grab (Plates 29 and 30). One foreman and four men operate the depot.

The Association also has a main financial interest in the measuring organisation which does most of the work of scaling and measuring in this region in which it operates.

The Association also maintains very close contact with the Logging Research Foundation in Stockholm.

The Association handles for its members 20 million cubic feet of saw logs and 3 million cubic feet of pulp wood annually plus other varieties of produce. Fourteen million pounds worth is being handled this year. One result of the Association's activities, and particularly of its investment in sawmills, in pulpmills and in boardmills and other processing industries, has been that the roundwood prices in South Sweden are now among the highest in the country. They first invested in sawmills, then in pulpmills, and then in boardmills. They own two of the largest pulp mills in Sweden; one in the north-east region produces 180,000 tons of sulphate pulp and a new mill at Morrum produces 140,000 tons a year. A new 200,000 tons a year capacity pulpmill is planned for the southwest coast. Another mill produces 40,000 tons a year of paper board and another two mills 50,000 tons of chipboard. They own the biggest paper sack mill in Sweden and they make 2,300 pre-fabricated timber houses yearly and aim to produce 5,000. In several sawmills (mostly small), they produce 32,000 standards of sawn softwood yearly. They employ 5,000 workmen and have a turnover of £35,000,000. Possible arguments among members about the location of industries have been forestalled by agreeing at the outset that a uniform "at roadside" price will be paid to all members for produce supplied to each of the Association's mills.

The capital for the various wood-using industries owned by the Association has been raised by the members advancing 4% of the cost and contributing approximately £3 per acre through the banks, the banks accepting the farms and woodlands as security.

The Association aims to keep private forests efficient, and in private ownership, believing that it is more logical for the owners of the private forests

to own the wood processing industries than vice-versa. A main problem is how to persuade the farmer foresters who regard their forests as standing reserves of capital, to fell adequate volumes so as to make for better distribution of age classes, and to show just how profitable forestry can be. Members are free to sell their saw logs to anyone. It is a problem to arrange for a steady income for owners of small areas but with 100 acres of forest plus 25 acres of farm it is considered in Sweden that an owner should be able to live comfortably with a yield of 55 to 65 hoppus feet per acre per annum and felling say 5,000 hoppus feet a year. Help is given in logging where necessary. A farmer who fells once every three or four years can put the proceeds in the bank and can draw annually on this and show on his income tax return his annual withdrawals as income. This is accepted in law.

One of the important functions of the Association is to try to arrange for gainful employment for its members throughout the year. The foresters in charge of the districts, in addition to their other work, supervise a labour "bank", and where a farmer has insufficient work on his own holding a forester can often arrange supplementary employment for him on a neighbouring farm or farm woodland. The forester supervises marking, cutting, labour, machines, production and procurement of timber, planting, thinning and other silvicultural work, road planning and construction and he is responsible for engendering "team spirit" by leading excursions. Between times he does his office work!

The large number of produce specifications is a bigger problem for the Association than it is for the Companies or for the State Forest Services. On any farm as many as 40 produce assortments might be prepared. The general aim is to standardise specifications and so simplify production, stockholding and marketing.

The administration and management of the association's affairs are done by a corp of highly trained and enthusiastic professional forest officers and foresters who have the confidence of their members. The importance of employing professionally trained men is emphasised by farmers, companies, estates and by the National Boards.

Some Implications for British Forestry of Developments in Private Co-operative Forestry in Sweden

The following are worth considering:—

- (a) Owners' Associations that do not undertake marketing on behalf of their members give less help than do marketing associations. Successful marketing by co-operative effort appears to offer the only prospect for the private owners to

continue to compete with state and company forestry in Sweden, and the same is probably true in Britain, especially so far as small owner-ships are concerned. Most owner-ships in Britain are small, and individual private woodlands are nearly all small. Co-operative marketing is unlikely to succeed without co-operative management.

- (b) In Sweden it is recognised that a central (national) organisation cannot effectively market produce for many private owners throughout the land. Regional marketing organisations (co-operatives) are regarded as essential especially because of the small size of individual owner-ships and the importance of local knowledge. Nevertheless the central organisation also plays an essential part. Development of existing co-operatives in Britain, accompanied by necessary changes in the private woodland owners' organisations could probably work if the owners so wished.
- (c) The success of Swedish private woodlands' marketing depends mainly upon the employment of university trained forest officers supported by school trained foresters. The employment of full time trained personnel is probably even more important in Britain where all relevant factors are more variable than in Sweden.
- (d) With the diversity of species that we have in Britain our need to standardise specifications (within the limits imposed by the need to make the best use of all the tree and of all species) is even greater than in Sweden.
- (e) The arrangements made in South Sweden to use gridded map co-ordinates to identify collecting points for produce could well be adapted to serve private woodland owners and the Forestry Commissions' needs in such a case as the supply of pulpwood to Fort William or to Ellesmere Port. Some such system would seem essential when many small woods are involved, each supplying a little.
- (f) On a proportionally smaller scale there would appear to be as good a prospect of British owners raising capital to start their own industries, if they are dissatisfied with existing or likely new markets, as there has been in Sweden.
- (g) Swedish forestry co-operatives have deliberately not sought financial aid from the state; they have preferred to raise the necessary capital themselves and to preserve their independence. British co-operatives could do the same.
- (h) The private owners in Sweden neither want nor seek help in marketing from the State Forest Service. There is keen competition between the

state and private sections, but excellent relations exist between them. It would be good for all concerned if private forestry in Britain would advance to the stage where it could offer healthy competition with the Forestry Commission in marketing.

- (i) The speed with which advances are being made in modern methods of logging, for example, in state and company owned forests, is such that it is becoming more and more difficult for private owners to keep pace on a competitive basis without closer co-operation than ever. The same effects will be felt in Britain if changes in logging and other techniques in the Forestry Commission proceed as fast as they should.
- (j) The main source of income for farmer forest owners in Sweden is their forest. This is rarely so in the case of private owners in Britain, and the different response to co-operative schemes in the two countries is explained more by this than by any other factor.
- (k) Training and re-training have to be regarded as an essential part of the total continuing investment in forestry.

Company Forestry

Companies own 13.4 million acres or 25% of the forest in Sweden, which is a high proportion of the total compared with that owned by such companies in, for example, Finland, Norway and England with respective proportions of 7%, 9% and almost *nil*. Iron smelting companies, which owned forests to provide charcoal, gradually changed their interests by supplementing their activities with wood processing, and the origin of company ownership of forests is to be found in the old iron ore activities. Otherwise the company forests are of more recent date. The maximum term of felling licences in State Forests was reduced in 1899 from 50 years to 20 years, and in 1905 to 5 years, the present figure. This stimulated the wood using industries to procure forests. Most of this was done between 1870 and 1906 when the first act was passed forbidding companies to acquire land in country districts.

Fifteen companies possess as much as 80% of the company-owned forest land. Mergers have taken place and more will come.

Sustained yield management was practised in forests owned by iron works. Other company forests suffered an early period of over exploitation. Big capital investment in pulp mills required long term planning and sound management for sustained yield. Now the wood industries invest considerably in forest management and play a leading part in developing new techniques for improving efficiency and increasing yield. Some of the companies have

their own schools for training workers and supervisors and such schools are aided by a 10% state grant towards their costs.

In their own forests, and in logging areas which they fell under licence, the companies employ their own labour. The companies are in the forefront of the drive to greater mechanisation and rationalisation to cut down labour costs. Logging areas are made larger and work is concentrated. Where felling operations were previously carried out in 20 or 30 places this work has now been concentrated into three or four places. Rationalisation is not difficult in the large company forests; it is difficult in the many smaller forests that the companies have acquired, for they, too, have the problem of dealing with many small scattered areas.

The character of company forests is also influenced by integration of forestry with major industrial enterprises. The fact that the companies know which mills will receive the wood and in what quantities and at what rate helps rational harvesting and transport.

The major companies (the Swedish Cellulose Company) (S.C.A.) Stora Kopparbergs Bergslags A.B. and others own large forest areas (about 3.3 million acres and 0.8 million acres respectively in the case of the two named companies). Twelve other companies have more than 100,000 acres each compared with the biggest private estate, for example, which has 40,000 acres.

The companies' forests are managed by highly trained professional forest officers. Because they often have complete integration from standing tree to finished product they are in a better position than even the State Forest Service to rationalise all aspects of forestry, and it is therefore in the company forests that the most rapid developments are taking place in management, logging (including tree length and whole tree logging) and in silviculture, including the use of artificial manures on maturing crops.

Whereas in the early years of their acquisition of forests the Companies turned their attention to Northern Sweden, where acquisitions were easier, they now realise that forests in Southern Sweden have so much greater potential productivity that they are turning their attention more and more to the south, both for contract buying of wood and for acquiring land.

The companies do purchase considerable quantities of wood from private owners or from private owners' co-operatives and from the state. The law in Sweden allows, and the private growers and the State Forest Service accept, close collaboration between the companies not only on supplies of wood but also on the prices that they will pay, and there is regular consultation between the main companies

on these matters. One important consequence is that the companies find it relatively easy to exchange purchases among themselves; and this is done usually to minimise transport costs. This is done frequently and on quite a big scale. It is made more easy by the standardisation of pulpwood specifications particularly. The fact that it can be done readily also makes it easier for a sulphite pulpmill which wants spruce to purchase a lot containing spruce and pine; the pine can be exchanged with a sulphate mill for spruce; although the companies even discuss and often agree on purchases of standing trees so that each will purchase stands best located for its own purposes. There is now strong competition between integrated private forestry and integrated company forestry.

Not all private owners in Sweden favour co-operative forestry, and certain owners enter into agreements with the forest owning companies under which the latter undertake the management of forests for their owners. Many of the companies are keen to offer such a service.

Trade Union Organisation

The Swedish Forest Workers' and Log Drivers' Union

Mr. S. Backstrom, at the headquarters of the Swedish Forest Workers' and Log Drivers' Union at Gavle, explained that this union, which covered the whole of Sweden, was affiliated to the Confederation of Swedish Trade Unions and was alone responsible for negotiating forest workers' wages with the National Federation of Swedish Forest Owners in Stockholm once a year. Other organisations such as the farmers' co-operatives took no part in the actual negotiations (although they could have observers in attendance)—but they signed the agreements when negotiations ended.

The Union has tried to persuade employers to purchase hand tools and motor saws. Nevertheless 98% of workers own their own motor saws. Costs of motor saws are included in or allowed for in negotiations on wages, currently at something over £1 a day. Both sides in wage negotiations accept cost figures as provided by the Logging Research Foundation.

The Union accepts that mechanisation of all possible forestry operations is essential, and although the Union has no influence over the farmer owners, it is fully in support of the co-operative efforts of farmers and recognises that much more has to be done especially in grouping of narrow strips in separate ownerships to allow of more rational management and more mechanisation. The Union also welcomes the new land purchase law which has been initiated by the Minister of Agriculture.

In fact the Union fully supports all developments in forestry which will enable employers to continue to pay increasing wages; the Union itself takes a part in rehabilitating men who become redundant as a result of mechanisation and makes grants of money to members who have to move house and make new provisions for schools for their children. It recognises that many forest workers now employed in Northern Sweden will have to move south. It does not usually interfere with methods of marketing so long as the employer plans his whole forestry work so as to give full time employment throughout the year to his workers. It is only by doing this that workers can be fully trained and become and remain thoroughly skilled, and so capable of earning high wages. The Union does feel strongly however, that the state and the other employers should fell and convert most of their timber, to be able to have better control over the work for the benefit of their workers. The farmer owners who do most of their own work can please themselves.

Lorry drivers do not belong to this Union. 90% of lorries in Sweden are owned by their drivers who have their own union.

The Union collects statistics especially those used for wage negotiations.

The average wage for combined time and piece work for all workers in Sweden was 8.4 kroner per hour. The employer contributed 18% of workers' earnings for holidays, pension fund and social services. The worker contributed between 500 and 600 kroner a year depending upon his earnings for sickness benefits, pensions and medical services. Pulp and paper mill workers earned about 7.52 kroner per hour—and had more shift work than in other industries. Workers in sawmills earned 7.04 kroner per hour of which 16 ore was overtime. Furniture industry workers earned 7.30 kroner of which 3 ore was for shift work and 6 for overtime. No such average figures are available for forest workers because they have been so many in number and they have been employed in such small units. Workers in the building industry were paid relatively high wages and this helped to put up the national average to 8.4 kroner per hour.

A wage index was based on day wage \times 45 hours a week divided by 6 days per week and based on workers in industry being given an index of 100 showed the following results:—

Industry	100	
Pulp and paper	100	
Sawmills	93	
Small industries		
(including furniture)	95	
Forest workers	90-95	(depending on whether or not motor saws are used for branching).

Forest workers' average earnings in 1963 were 51.31 kroner a day for 234 days in the year, less 5.75 kroner a day for motor saws (this was a 1960 figure when branching with motor saws was not practised). Branching with motor saws is now general practice and the allowance for saws is higher. Preliminary figures for 1964 showed the

average daily earnings to be 57.38 kroner (excluding motor saw costs of 5.74 kroner).

Mr. Backstrom emphasised the importance of providing full all-the-year-round employment and presented the following figures to show that men who worked more days in the year earned more per day than those who worked fewer days:—

TABLE 3. FOREST WORKERS' EARNINGS FOR NUMBER OF DAYS WORKED

	<i>Days Worked</i>				
	75-99	100-124	175-199	250-274	275-279
Earnings in kroner per day	40.14 38.31	44.51 42.36	44.82 43.81	49.29 49.26	54.81 56.06

The following figures for State forests illustrated the importance of full-time employment and the

need to help older men, said Mr. Backstrom:—

TABLE 4. YEARLY EARNINGS FOR FOREST WORKERS IN STATE FORESTS IN 1964

	<i>Total average income of forest workers, including motor saw costs but excluding costs of transport from home to work</i>		
	<i>Days worked in the year</i>	<i>Average Earnings in year, kroner</i>	<i>Numbers (of workers) on which average earnings were based</i>
	275-299 250+ 200-224	18,924 16,924 13,597	305 men 549 " 426 "
North Sweden			
South Sweden	275-299	17,373	273 "
	250+	15,194	319 "
	200-224	10,790	107 "

The average age of workers in Southern Sweden is higher than in Northern Sweden. The Union tries to help the older workers, whose output is less. Mechanisation makes lighter work so the solution to the problem will be helped by machines, provided the older men are trained adequately and allowed to operate them. The Union is active also in trying to dissuade the companies from dismissing their older workers; workers should be encouraged to continue working throughout life.

In Sweden men may turn up at work when they wish and leave at any time of day. The Union recognises that with increasing investment in mechanisation this will have to be controlled otherwise high capital investment in machines cannot be put to maximum effect.

A 45-hour week is normal. The Union aims to have a 40 hour week by 1975, but there is no intention to reduce this figure further.

In discussing the effects of different methods of paying workers, Mr. Backstrom explained that the

Union took careful account of the general welfare of the worker, the effects on his health and the effects on the length of his useful working life. Bonus systems which gave a percentage increase in wages for production above a certain level were not favoured by the Union because they encouraged workers to overwork and strain themselves, and payment by bonus alone is not practised in Sweden. The Union also hopes that in future employers will realise that payment by piecework alone, if carried too far, does not, in the long term, make for the highest level of production and that in the end a payment system comprising in part, time work, and in part bonus or piece work, might be the best. At present most work in the forests is paid for on piece rates.

The Union has 38 regional officers who act alone as paid representatives of the Headquarters in Gävle, although these men never meet at their Headquarters; instead they are visited in the regions by Headquarters staff. The regional branches of the Union

appoint delegates to Congress which meets as a decision-making body to brief Mr. Backstrom and his Headquarters colleagues before they go to Stockholm for piece-work rate negotiations. The Union Congress meets four times a year and comprises about 50 men, one third of whom are from Headquarters and two thirds active union members from the regions.

Other Forestry Organisations

State Forest Industries (*Aktiebolaget Statens Skogsindustrier*—Commonly known as A.S.S.I.)

Crown ownership of forests at the beginning of the nineteenth century was only about a quarter of a million acres. Since 1858, by establishing Crown forests in remote areas and by acquiring (especially during the 1920's and 1930's) private and company forests, the Crown has built up its forest estate to over ten million acres or nearly one fifth of the forest area of Sweden. The Board of Crown Forests and Lands was set up to administer the state forests. Its original role of managing forests gradually gave way to more commercialised activities and in 1923 it set up a commercial department which later extended its activities into the industrial field. State-owned forest industries such as sawmills and pulp-mills were set up in the 1930's partly to help alleviate unemployment and partly to provide markets for the state-owned forests. There was no criticism from private enterprise of these developments.

In 1941 a separate state-owned company, *Aktiebolaget Statens Skogsindustrier* was set up, to own and to further develop these industries. In 1957 the shares in the company were transferred from the National Board of Crown Forests and Lands to the Ministry of Trade, and A.S.S.I., as the company is commonly known, became independent of the Board, and has since been regarded as a normal trading company, although the Director General of the Board of Crown Forests and Lands sits on its board of directors.

There is now some criticism from private enterprise that A.S.S.I. is being supplied with subsidised wood at low prices. One suggestion has been that 40% of A.S.S.I.'s wood requirements should be bought at auction, and that the remaining 60% should be bought, whether from state or private forests, at the weighted mean of the auction prices.

In practice, A.S.S.I. purchases about 70% of its needs from the Board of Crown Forests and Lands (about 30% of the Board's production) and the remainder is purchased from private forests.

The state forests charge A.S.S.I., at least the market prices which are established by direct negotiations between growers and buyers. The state forest service does not participate in those negotiations. Although A.S.S.I. has a ten-year

contract with the state forest service, prices are agreed annually at headquarters level. Practically all A.S.S.I.'s requirements are purchased on a "delivered mill" or "at roadside" basis, and A.S.S.I. does not engage in harvesting. Sawlogs are often sold to private mills at lower prices than those charged to A.S.S.I.

A.S.S.I.'s requirements in northern Sweden are so great that they absorb practically the whole of state forest production there.

Because there are too many sawmills in Sweden, the State has the problem of deciding how many A.S.S.I. sawmills should be closed, if any. Equally the state forest service has the problem of deciding who much of its sawlog production to supply to A.S.S.I. sawmills and how much to supply to private enterprise sawmills.

A.S.S.I. has expanded considerably since it began and has placed increasing emphasis on fibre production in the form of wallboard, bleached and unbleached pulps, kraft linerboard and paper. Sawn timber remains an important product.

The company owns eight modern sawmills with a total production of about 120,000 standards. Four mills are situated in north Sweden and four in mid Sweden. They are all modern and highly mechanised, and the whole of their production is kiln-dried.

In addition A.S.S.I., has a pre-fabricated house factory, a joinery, a sulphate mill with bleaching plant and paper mill, a kraft liner mill, two wall-board mills, a mineral wool factory and a steel shot factory. Its head office is at Stockholm and it has a research laboratory at Djursholm.

The Swedish Sawmill Employers Association

Membership, aims and functions. This national association has 257 sawmill owner members each of whom pays an annual subscription. Formerly, to become a member, a sawmiller had to employ a minimum of 50 workers. No such qualification is imposed now. Originally the Association was set up to represent the interests of twenty of the biggest Swedish sawmills. Now the tendency is for all sawmills to join. Some of the farmers' forestry co-operative associations also belong. A.S.S.I. (the state forest industries), does not belong.

The main aim of the Association is to maintain peace on the labour market. The Association helps in settling conflicts and in negotiations between the Confederation of Employers and the trades unions. It helps in arranging for the training of sawmill workers, for work study and work simplification. The Association has no contracts with anyone, but it encourages technical developments in sawmilling. It carries out no research, but it could commission

research or development work to be done on its behalf. It maintains a careful study of all sawmilling research and especially of developments which might be of interest to its members and puts any promising developments to commercial test at the earliest opportunity. It does this by engaging the co-operation of a willing and interested member and using his sawmill for demonstration purposes. The results of introducing, for example, a new type of frame saw blade, are published and circulated to members, with details of increases in profitability, and the Association is confident that this is the best practicable way of encouraging its members to adopt the best of the latest technical developments. In addition the small Association staff pays frequent visits to members' mills.

Attitude to integration of sawmilling with other wood processing industries. The Association has not encouraged integration of sawmilling with other wood processing industries, probably because it has been concerned solely with sawmillers. Shortly after our visit the Association was due to discuss for the first time integration with other industries in order to help to promote developments in whole tree and in tree length logging, and this was anticipated as an historic occasion, and the first time that the Association would have stepped outside its own domain to discuss anything of importance in the field of industrial development. The decision to take this step would call for a new Association rule.

Attitude to co-operation and amalgamation. The Association recognises that co-operative sawmilling ventures must develop and that more amalgamations of smaller mills must be speeded up. At the same time there are local problems of providing village employment in remote areas. There is also evidence that many smaller mills (say of 4,000 standards a year) are relatively more efficient and more profitable than some very much larger mills of say, 20 to 30,000 standards yearly output.

In the two northern counties of Sweden 967 sawmills produced 227,000 standards in 1958. In 1964 only 349 sawmills remained but these produced 244,000 standards. 12,000 standards had been cut by circular saws in 1958 but only 2,000 standards in 1964. The greater part is traditionally cut by frame saws. Between 1960 and 1964 nearly 1,000 sawmills closed in Southern Sweden, but production of sawn timber increased during these five years.

Frame saws and circular saws are both important, frame saws for mass production and circular saws for mills of lower output which need more rapid versatility in changing cutting sizes, whether this is because of cutting to fulfil special orders requiring various sizes or because segregation of log grades for long production runs is not practicable.

Attitude to the drying of sawn timber. The Association estimates that 70% of all sawmill production in Sweden is kiln dried and that 100% must be kiln dried in future. This is the practice and the attitude in a country whose natural atmospheric drying conditions at all times of the year are usually better than the average drying conditions in Britain at any time. Blue stain in pine is controlled largely by kiln drying immediately after sawing, especially in the south where logs go directly from forest to saw. In the north logs still go from forest to water. If they are left for any time out of water they are sprayed with water.

The economic lower limit for the employment of kilns is considered to be 2,000 standards a year, whether for drying pine or spruce or both.

Modern developments. Keen interest is taken in log handling developments and in the employment of electronic and X-ray devices for automated grading and recording of information about logs as they pass in the production lines to the saws.

Electronic devices have been developed and are being tried out on a commercial scale for identifying and assessing the extent and incidence of defects such as knots as well as the presence of metal in logs as they proceed in line towards the saws. Automatic recording of the information so collected is also being developed. These devices, together with automatic measuring of diameters and lengths, provide the basis for future sawmill practice in automatic grading of every log or of sample logs as may be required. Analysis of the results in comparison with analysis of sawn out-turn will, it is hoped, lead to much clearer understanding of costs and of the relative economics of sawing logs of different sizes and other properties—or logs of different grades.

Integration. There is, as yet, little integration of sawmilling on the same sites as other wood using industries. With new developments in log handling and with the new awakening of interest on the part of the Swedish Sawmill Employers' Association to the possible benefits of integration, more rapid changes in this direction can be expected in future.

Band saws are making their appearance in Sweden, although the Association is uncertain about their future success.

There was only one band sawmill in Sweden in 1958 and this produced about 8,000 standards a year. The Association realises that new possibilities for bandsawing have been created by the use of modern band saws with double blades, electronically controlled and capable of producing in one mill 15,000 standards yearly. Nevertheless it considers that to produce 10,000 to 30,000 standards a year frame saws are usually needed. One frame saw could

produce 6,000 standards a year on one-shift working.

All of Sweden's sawn softwood could be produced in 400 frame sawmills but, because of the need to provide local employment, the Association considers that 3,000 sawmills should be kept in production for some years at least.

The Association views packaging of sawn goods as a necessary but added expense, and considers that it is unlikely that more than a substantial proportion of sawn goods will be packaged.

The Association is not concerned with price fixing, but in one demonstration mill prices and costs are carefully recorded and analysed and the results, which are properly related to the particular working conditions, are circulated to members for general guidance.

Shift Working. On the subject of shift working the Association does not have strong views although it considers three-shift working would not be practicable in Sweden. About 10% of sawmills work two shifts. None work three shifts.

The Logging Research Foundation

Three privately financed organisations (one for northern, one for western and one for central and southern Sweden) which had engaged in work study and nationalisation of logging amalgamated in January 1964, to form one new organisation, the Logging Research Foundation, centred on Stockholm, and now guided by Mr. H. G. Lindberg, its Managing Director.

The main aims of the Foundation are to further logging by developing equipment, machines and working techniques through research and experiment and to provide a basis for establishing sound payment systems for logging operations.

Up until the 1950's it was relatively easy to establish and adjust piece-work rates for manual work and horse extraction, because the rate of change of methods of working and of costs was relatively

slow. With the introduction of mechanised harvesting, the rate of change in methods and costs has become rapid, and the need for a central organisation which can examine rapidly the changing factors necessary for assessment of costs and piece work rates is generally accepted as essential.

The large private companies, most of whom belong to the Foundation, have their own sections for such work, and so do the State Forest Service and the associations of private owners and of employers. All of these are guided by the Foundation which encourages them to apply work study and time study to logging operations and to provide the Foundation with results. In this way the Foundation obtains detailed information from the whole country which is representative of a wider range of methods and of working conditions. The results are analysed by automatic data processing. Members are also encouraged to make local arrangements for practical application of research findings, and they are advised of the results of cost analyses carried out by the Foundation.

The Foundation has three main divisions, a technical division, a division of economics and a special division for the dissemination of information. It is financed by fees based on acreage of productive forest. The Government contributes about 30% of the total fees. The Foundation collects, screens and develops new ideas and methods which appear to have worthwhile application in Swedish logging.

As a relatively new organisation it is already the recognised authority on logging in Sweden, and it has already achieved international repute. The importance which it attaches to sound dissemination of information and to rapid and extensive application of tried new machines and methods accounts for a great part of the success of the Foundation. We also need to consider and pursue this aspect of work in Britain more than we have done.

The work of the Foundation is dealt with in more detail in Part IV, Page 41.

Part II Appendix IA

TABLE 5. NAMES AND ADDRESSES OF ORGANISATIONS, COMPANIES AND PERSONS MET IN SWEDEN IN MAY, 1965

<i>Name and Address of Organisation or Company</i>	<i>English Equivalent Name</i>	<i>Names of Persons Met</i>	<i>Remarks</i>
Forskningsstiftelsen, Skogsarbeten, Pipersgatan 29, Stockholm, K. Telephone 08/54 09 40 08/25 26 86	Logging Research Foundation	Mr. H. G. Lindberg, President Mr. C. E. Malmberg Mr. Kjell Kilander Mr. Ingemar Öhrn	Organisation is usually referred to now simply as "Skogsarbeten". Mr. Lindberg was formerly Vice-Chairman of the Woodlands division of Nova Scotia Pulp Ltd., of Canada. Mr. Malmberg manages the Technical Division. Made the general arrangements and planned the tour. Made all the detailed arrangements for this visit.
Kungl. Domänstyrelsen, Birger Jarls Torg 5, Stockholm Telephone 08/22 50 40 (Now frequently referred to simply as "Domänstyrelsen")	The National Board of Crown Forests and Lands	Mr. Folke Rydbo, Deputy Director General Mr. Algavere—seconded to Sales Division of the Board from the Royal School of Forestry in Stockholm. Mr. Nordzell, Assistant to Mr. Radholm, Sales Chief (who was in London during the team's visit)	The National Board administers the State Forest Service or the Domänstyrelsen.
Domänstyrelsen, or, Domänverkets, Kontor, Växjö	State Forest Service Regional Office	Mr. B. Brynte	Mr. Brynte is on the headquarters staff out stationed at the Regional Office at Vänersborg. He is a liaison officer who specialises in harvesting techniques.
Domänstyrelsen, or, alternatively, Domänverket Drottninggatan 36, Vänersborg, S. Sweden	State Forest Service Regional Office	Mr. O. R. Lindblad, Assistant Regional Forest Officer Mr. Valinger, Forester i/c Falköping Revir or Falköping District Mr. Josephsson	Mr. Josephsson showed us road plans and construction at the Kronoparken or State Forest of Furubacken.
Domänverket, Malingsbo Revir, Bergslagen		Mr. C. E. Janlöv, District Forest Officer and Mr. G. Gustafsson, his Assistant Malingsbo District of the State Forest Service	Mr. Janlöv is the Jägmästare.
Domänstyrelsen, or, Domänverkets, Oskarshamn	State Forest Service District Office	Mr. Haglund, District Officer Mr. E. Möller, Assistant District Officer	Mr. Haglund had been for 25 years in a remote part of N. Sweden. Expert on sales. Mr. Möller had just arrived from the North.

Domänstyrelsen, or, Domänverkets, Eksjö	Eksjö District Office, of the State Forest Service	Mr. E. Bexell Mr. P. Almberger, District Officers	With these two officers we visited the forest of Solabo to see, among other things, the sachen Winch operating.
Kungl. Skogsstyrelsen Stockholm (Now usually referred to simply as "Skogsstyrelsen")	The National Board of Private Forestry	Mr. Plym Forshell, Chief of Section; Mr. Linne, his Assistant	Mr. Forshell has been conducting a nation wide survey to compare the results obtained in restocking by natural regeneration with results obtained by planting.
Skogsvårdsstyrelsen, Kronobergs Lan Kungsgatan 12, Växjö Telephone 0470/14990	Kronobergs County Board of Private Forestry	Mr. Wilhelm Ros, the County Officer Mr. Johansson, Deputy to Mr. Ros, and Chief of the Conservation Section of the Board	Mr. Ros took us to see the Board's training school at Asa, and to a research foundation administered by Mr. Ros at Tagel, Mohedr.
Skogsvårdsstyrelsen, Kopparbergs Lan Parkgatan 3, Falun. Telephone 023/18680	Kopparbergs County Board of Private Forestry	Länsjägmästare Gunnar Carlberg, the County Forest Officer, Jägmästare Sigurd Lundberg, 2nd i/c to Mr. Carlberg Mr. Abe Liljeberg—Forest Officer responsible for education and training in Kopparbergs Lan. Jägmästare Ingemar Persson—Forest Officer Skogsvårdskonsulent (Game Keeper) Rune Hermansson Miss Birgitta Sjöström	Mr. Carlberg took us to see the Country Forestry Training School at Rankhyttan an old (1803) manor house. This is in Dalarna—a more upland region where the biggest problem is to develop co-operative forestry. It was here that Erikson Vasz raised the army which ousted the Danes in 1520. He became King of Sweden in 1523 Mr. Liljeberg took us on Saturday May 22 to see the new training school at Alvdalen where students bring their own tractors for instruction. Who deals with planning and individual plans for private forestry. —despite his title, Mr. Hermansson is really an electronic data processing expert who has designed computer programmes for preparing private woodlands plans of operations. —Draughtswoman—who prepared the maps.
Skogsvårdsstyrelsernasförbund, Växjö Telephone 0470 49 90	The Federation of the Provincial Boards of Private Forestry	Mr. Wilhelm Ros, Secretary	This federation was not visited, but when we met Mr. Wilhelm Ros at Kronobergs County Board of Private Forestry, he explained its functions.
Sägerskorsförbundet, S. Blasieholmshamnen 4A, Stockholm C Telephone 24 31 80	The Swedish Sawmill Employers' Association	Mr. Carl J. Lundberg, Study Chief (Rektor) Mr. Bengt Blom, Head of the Technical Department	Aims at peaceful relations between employers and workers. Deals, in a paternal way, with conflicts between employees and the Unions. Arranges training, work study, work simplification. Engages in no contracts but disseminates technical information and aims at increased productivity. Has begun to take part in discussions on integration of sawmilling with other industries. This is a remarkable new trend which might be of the greatest interest.

TABLE 5 (cont.)

<i>Name and Address of Organisation or Company</i>	<i>English Equivalent Name</i>	<i>Names of Persons Met</i>	<i>Remarks</i>
The S.S.R. or, in full, Sveriges Skogsägareföreningars Riksförbund, St. Eriksgatan 20, Stockholm Telephone 08/22 09 80 (Not to be confused with:—Sveriges Skogsägareförbund which is an Association of Swedish Forest Owners—and represents the larger forest owners).	The National Federation of Swedish Forest Owners' Societies known as the S.S.R.	Mr. W. Wessén, a Director, and head of the Organisation Department Mr. S. Thulin, an agricultural economist	Mr. Wessen is, himself, an agriculturist. The Managing Director is a lawyer. The Federation helps its member organisations in legal matters, among its many activities Mr. Thulin belongs to the Agricultural Economic Research Institution (Jordbruks Utränningsinstitut) in Stockholm and came to the S.S.R. to help on this occasion. The S.S.R. is responsible, on a national scale, for co-operation within the private forestry sector.
Södra Sveriges Skogsägares Förbund, (Known as the S.S.S.F. or, simply, as Skogsägarna) Växjö	The South Swedish Forest Owners' Association	Mr. Patrick Henig Hamilton, a director i/c progress and public relations Mr. Eric (Sam) Samuelson, a director Mr. Pele Hadders, Forest Officer i/c West Jönköping Region Mr. Bertil Johansson—a farmer member, at Falla, near Jönköping	Mr. Hadders explained the operations of the Association in his region and showed us the Association's barking depot at Klevshult. Mr. Johansson showed us his farm woodlands and production methods.
S.A.F. or Svenska Arbetsgivareföreningen	The Swedish Employers' Confederation		Has 25,000 members representing manufacturing, trade, transport and mining. Employer members have about 1.2 million employees.
S.L.A. or, Skogs och Lantarbetsgivareföreningen Telephone No. 0150/162 10	The Federation for Swedish Forestal and Agricultural Employers	Mr. John A. Söderland, Engineer, the Federation's Chief at Katrineholm	Mr. Söderland is an engineer with a full knowledge of harvesting techniques. He joined us on our visit to the forests of Holmens Bruks och Fabriks Aktiebolag. His Federation disseminates latest information on rational forestry, logging techniques, and organises training.
Aktiebolaget Statens Skogsindustrier, or:—A. B. Statens Skogsindustrier Stockholm —known as A.S.S.I.	State Forest Industries Ltd.	No personnel of A.S.S.I. were met as part of formal visits on this occasion (Mr. Olov Rynell, Managing Director, and Mr. Fritz Malmström, Managing Director of the A.S.S.I. sawmill and integrated hardboard mill at Skinnkatteberg had been met on a previous visit)	Own 8 sawmills, 2 wallboard factories, a sulphate (kraft) pulpmill, a kraft paper mill and a kraft liner board mill; also joinery factory, mineral wool and steel shot factories, prefabricated house factories, and other works.

Svenska Skogs-och Flottningsarbetareförbundet, N. Centralgatan 11B, Gävle Telephone 026/11 52 75 Known as the S.S.F.	The Swedish Forest Workers and Log Drivers' Union	Mr. S. Bäckström, Secretary of Mr. Troidsson, Jagnästare of Korsnäs Marma A.B., Gävle, 2 (Telephone No. 192000) acted as interpreter	Affiliated to the L.O. or Confederation of Swedish Trade Unions. This Union covers the whole of Sweden and has 32,500 members
Statens Maskinprovningar, Uftuna near Uppsala	State Agricultural Machinery Testing Institute	Mr. Bengtson	Mr. Ross alone visited this Institute
Holmen Bruks och Fabriks Aktiebolag, Knapporgsgatan 9, Norrköping Telephone 011/29440	The Holmen Bruks Company	Mr. Stig Hedberg, Jagnästare, Deputy Chief of the Company's Forestry Division (Mr. Gunnar Devadter is Chief) Mr. G. Lagercrantz Mr. Stig Lundquist Mr. Roland Jonsson, forester Mr. John A. Söderland, Engineer, of S.L.A. also present.—Federation of Swedish Forestal Employers	Very up-to-date—ready to make rapid and bold changes in management techniques to allow modern harvesting methods to be used effectively.
A. B. Iggesunds Bruk, Friggesund Telephone 000/20800	Iggesunds Bruk Company	Mr. Gunnar Dahlberg	The Company makes sulphate and sulphite pulp (will only make sulphate in future) at Iggesund and at Hudesval where it also has a sawmill producing 32,000 standards yearly. Owns 600,000 acres of forest. Mr. Dahlberg has 8 foresters in the field plus two in the office plus 3 men+1 typist+1 accountant in the office to administer and manage this forest estate. Very progressive in logging techniques and management.
Soderhamns Verkstäder, Soderhamn	Soderhamn Works	Mr. Stig Hammarström, Public Relations Manager Mr. Maths Ohlson, who deals with exports	This firm has recently been taken over by Kockums of Malmö, who have also taken over Stig Morenius A.B. They make the Cambio barkers, frame saws, and other equipment which requires individual production. Designing machines and marketing various chippers, the latest being their spiral chipper which is of great interest in applying the principle of chipping off slabs as well as making high grade chips for pulping.

THE MAIN COMPANIES VISITED

TABLE 5 (cont.)

<i>Name and Address of Organisation or Company</i>	<i>English Equivalent Name</i>	<i>Names of Persons Met</i>	<i>Remarks</i>
Ingenjorsfirma Stig Morenius, A.B., Storgatan 16, Sundsvall Telephone 060/15 79 95	Stig Morenius Company, Engineers	Mr. Erik Lindquist, Engineer Mr. H. Waagen	This is a small firm of engineering consultant designers who have designed tree length logging equipment which has been installed in several places in Sweden. Recently bought up by Kockums of Malmö, this is a very effective and go-ahead firm with great enthusiasm and many good ideas for mechanical development in harvesting and log handling.
Svenska Cellulosa Aktiebolaget, Sundsvall, 1 Telephone 060/155500	Swedish Cellulose Company	Mr. Sven Embertsen, Forest Engineer i/c Logging Operations Mr. Gustof Nenzell	Produces 100 million cubic feet a year. Operates 70 Timber Jacks and Tree Farmers and operates the Sund whole tree branching machine which has been made by one of this Company's subsidiaries. The biggest and one of the most progressive of the Swedish forest owning companies.
Mölnbacka-Trysil A.B., Forslaga Telephone No. 054/70600	Mölnbacka-Trysil Company	Mr. V. Sibbern, Forest Officer Mr. Evind Thune-Larsens, Assistant Forest Officer Mr. Oskar Grundstrum, Forester	Mr. Sibbern (a Norwegian) thought the Isachsen Winch best for extracting thin-nings. Working conditions closer to some found in Britain. Company is planning ahead to year 2064.
Östberg Fabriks A.B., Alfta Telephone 0271/10475 Commonly known as the O.S.A. Company	O.S.A. Company	Mr. Aspman	Make hydraulically operated equipment for tractors and lorries; also make trailers and other equipment.
Hydrauliska Industri A.B., Hudiksvall Telephone No. 0650/15100 Known as the H.I.A.B. Company	H.I.A.B. Company	Mr. Forsgren Mr. Lüne Bäckström Mr. Hans Bostedt and the firm's Italian representative, Mr. Enrico Malacarne	Make various hydraulically operated lifting and loading cranes and other equipment.
A. B. Nyköpings Automobilfabrik, Nyköping Telephone No. 0155/1770	Swedish Representative of Ferguson Tractors	Mr. L. Fudstrom (at Nyköping) Major L. Cassler (at Eskilstuna)	Also at Eskilstuna (Tel. No. 17700).

Part II Appendix IB

TABLE 6. NAMES AND ADDRESSES OF ORGANISATIONS, COMPANIES AND PERSONS MET IN NORWAY IN MAY, 1965

<i>Name and Address of Organisation or Company</i>	<i>English Equivalent Name</i>	<i>Names of Persons Met</i>	<i>Remarks</i>
Det Norske Skogforsøksvesen Vollebek, Norway Telephone AOS 631	Norwegian Forest Research Institute	Mr. Ragnar Strømnes. Deputy to Professor Ivar Samset Mr. Lisland, his engineer assistant	Mr. Strømnes very kindly made all the arrangements for our visits to his own and other organisations in Norway. At the Institute's forest training school at Hurdal he showed us logging equipment including the Holder tractor extracting thinings.
Jo-Bu Salgskontor A.S., Holteгатen 28, Oslo Telephone 62 26 90	Jo-Bu Sales Organisation	Mr. A. Skuterud Mr. Ole Wigen	Apart from their chain saws, a good deal of the equipment made by Jo-Bu has been designed by Mr. R. Nestestog of Aamot, Vinje, Telemark, S.W. Norway, including the Vinje Winch. The firm also works in liaison with Ingeniørsfirma Stig Morenius A.B. of Sundsvall, Sweden.
Eikmaskin, Eiketun, Alnabru, Oslo	Eikmaskin Company	Mr. Elle, Managing Director	Apart from excellent heavier extraction equipment this firm makes smaller and lighter extraction equipment such as the Tunby Winch of which they sold 1,500 last year. It is easily fitted to any tractor with a power take-off, and costs only about £25 in Norway. The firm works in close liaison with Mr. Ludvig Isachsen who designed the Isachsen double drum winch, and a more recent adaptation of this. The firm also produces an excellent draining machine, snow ploughs of a very practical and new type with revolving spiral blades on a front roller.

Part II Appendix II

Grant Aid for Private Forestry in Sweden

The annual investment in private forestry in Sweden each year is estimated to be about 150 million kroner or over £10 million.

Grant aid for the fiscal year 1963/64 was 23 million kroner or about £1.6 million or say 15% of the total estimated investment.

The grants were made up as follows:—

	<i>Kroner (million)</i>	£
Forest Improvement Grant	6.5	0.46
Road building in private forests	10.0	0.7
Grant to promote increased forest production in Norrland	6.5	0.46
Total	23.0	1.62

Subsidies from the Forest Improvement Grant and from the Road Building Grant are made for regeneration work (50% of cost), forest drainage (25%) and forest road building 25%–50% depending on the type and owner category. The main part of the Forest Improvement Grant is used for seeding and planting in poor farm land. It might be interesting to compare the grant aid from the Forestry Commission to private forestry in Britain; in the year ending 30th September 1964, it was £1.337 million.

Part III

FOREST MANAGEMENT & SILVICULTURE

BY B. W. HOLTAM

Management

General

All forest management in Sweden is primarily concerned with the commercial production at minimum cost in the shortest time of the maximum quantity of wood for industry in the sizes required by industry. Net discounted revenue (N.D.R.) calculations are heeded very little. The National Forest Survey* provides the basic data about the forest estate, species and age class distributions, standing volumes and yearly volume increment, and this data is heeded in all forest management, but, understandably, its effect is greater in the state forest service than in private or in company forestry. Recreational and amenity interests are playing a more important part than hitherto and provision is being made for these interests in management aims.

Importance of the Felling Plan

In Sweden, as in nearly all countries with relatively large reserves of standing forest, the annual felling plan is the main part of any management plan in state, private or company forestry. All other aspects of management depend upon the felling plan. Thinning and planting plans follow, as do plans for road alignment and construction, which, of course, take account of new and anticipated logging techniques.

Management Trends

The main needs which influence management changes that are taking place in Sweden are:—

- (a) the need to make the most potentially productive forests as productive as possible.
- (b) the need to have large volumes of wood of any one kind produced on one location during any one felling or thinning, or combined felling and thinning operation, if the fullest possible advantage is to be taken of high cost, high capacity machines which must be worked to the full and with the minimum number and duration of interruptions.

Illustrations from State Forestry

When horse extraction was almost universal, labour was scattered; much of the labour was part time but adequately skilled to operate satisfactorily in

conditions where the whole tempo of logging operations was geared to manual effort and horse extraction. Under such conditions the felling areas were often scattered, and necessarily small too; so were the thinning and planting or regeneration areas. Felling was often restricted to the winter months, especially in the north.

With the coming of high capacity logging machines it is necessary to:—

- (a) economise on road construction,
- (b) make felling and thinning areas as big as practicable, within the other requirements of management,
- (c) employ skilled full time labour; often transported to the work site and rehoused in more comfortable circumstances and in more convenient locations,
- (d) produce the largest volume per acre from every thinning,
- (e) minimise supervisory and other overheads by concentrating supervision at a limited number of work places,
- (f) harvest throughout the year, and work two shifts in summer to make full use of high cost harvesting machines.

It is therefore necessary to rationalise management to achieve these ends. Because developments in mechanical logging are so rapid it is essential to plan to make machines and equipment pay for themselves in the minimum of time. It is general to find costs and stumpages calculated on the basis of a two year write-off period for logging machines, on this account.

Rationalisation of management is relatively easy in large forest blocks. It is relatively difficult where forest blocks are small and where, for many years, work has been planned as much to make the best use of plentiful but scattered labour as for any other purpose.

The State forest of Frojared in Falkoping District, for example, which consists of many small separate blocks is being divided into "units of treatment" which have their boundaries shown on the map but not on the ground. The units of treatment are grouped into work areas for groups of workers and their machines. Each unit of treatment might be capable of producing a minimum of about 60,000 hoppus feet in a clear felling. The work for 10 years would be prescribed for all operations in each unit of treatment. The management plan for 10 years is

* This is a continuous and nation-wide survey conducted on a sampling basis by the Royal High School of Forestry at Stockholm.

made by the District Forest Officer together with the Forest Ranger, and is based on survey information provided by headquarters staff from Stockholm. The whole plan is based upon the thinning and felling programme. The procedure usually is that the District Forest Officer prepares a cutting (thinning and felling) plan by volumes and areas, which he passes to the Chief Regional Officer for approval, and he, in consultation with the District Officer, decides where the approved volumes shall be produced in each district. The plan is really one for marking trees, prescribing areas to be felled and areas to be thinned and volumes to be produced in each case. Control over total area and total volumes is exercised by Headquarters in Stockholm but the decisions as to what shall be thinned and felled is left to the Regional Officer and District Officer. The plan also suggests what parts of the volumes should go to each market, and what should be auctioned, sold by tender, standing or felled and what should be sold by negotiation.

The units of treatment include all the work for one year for all operations. Work for the year would thus be concentrated in one unit. Priorities would be given to each unit of treatment for each year of a 10 year plan. Considerable flexibility is allowed to the District Forest Officer to modify the plan. One unit of treatment in this forest was set aside for special prescriptions to allow for the one remaining horse and its owner being gainfully employed. The decisions as to what shall comprise a unit of treatment have to be bold, and relatively small areas within the unit might be included in the thinning or felling plan either before or after the year which would be prescribed for them if they were considered alone. In this way it is intended to plan for more efficient use of labour, machines and supervision.

The other management changes which are being introduced at this and other forests are:—

- (a) to introduce shorter rotations—70 or 80 years in place of 100–120 years or more,
- (b) to make fuller use of the application of chemical fertiliser, especially towards the end of the rotation,
- (c) to reduce the number of thinnings to three, or to two, or even to one, in a rotation.

There is no uniformity about the management plans at present. District Officers are encouraged to plan on the above lines. In future it is likely that more standardisation based on National Forest Survey information will be introduced, but whatever form the plans might take, it is certain that their prescriptions for concentrating, thinning and felling will have to be bold. Small areas and small volumes cannot be dealt with economically on their own.

Illustrations from Private Forestry

Reference is made in Part II of this bulletin, in dealing with private woodland owners' associations, to the strenuous efforts being made to persuade private owners to co-operate and to so rationalise their forest management as to enable them to keep pace with mechanised techniques. It is difficult for the State Forest Service and for the Companies to do this in the many small and detached forest areas that they own. When such small and detached forests are in many separate ownerships the problem is much more difficult to solve. Nevertheless the co-operative forestry associations are determined that management of their members' forests must develop along the lines being practised by the State and by the Companies. The main difficulties that they face are the unwillingness of the individual owners to fell enough at any one time and the difficulties of providing alternative employment for farmer owners much of whose time will be unoccupied if modern mechanisation is to play its full part. The longer this is delayed the more difficult will it be for the private sector to compete with State and with Company forestry. Similar thoughts apply to the situation in Britain. There is, in fact, an urgently growing need, where forest ownerships are small, not only for co-operative effort in marketing, but equally important and urgent, for co-operative effort in planning and management so that from a group of adjoining areas a worthwhile volume of wood of like kind can be produced at any one time that felling or thinning is prescribed, to make it economically practicable to employ the latest machines and equipment and to employ the necessary highly skilled labour and supervision that must go with them. The greater variety of species that is produced from private estates in Britain makes this need all the more urgent.

Where co-operative forestry does not apply in Sweden, the County Boards of Private Forestry do all they can to persuade owners to group their forests together for management planning. One good example of this work was referred to in Part I of this report when describing the work of the County Boards of Private Forestry, with special reference to Kopparsberg County.

Illustrations from Company Forestry

It is much easier for the big companies to rationalise the management of their forests in order to reap maximum benefit from big capital investment in mechanised forestry because:—

- (a) they own vast tracts of forest,
- (b) markets are assured for a large part of their production,

- (c) they can plan for rehousing and rehabilitating redundant forest workers—often within their own processing industries,
- (d) they can plan for training of supervisors and labour,
- (e) they can afford to by-pass or to ignore the many small detached forest areas that they own either until they have been able to add to their size and improve their shapes or until such time as they can exchange them for areas adjoining their main forest blocks.

In fact, because the Companies have complete control over all aspects of planning and of work in their forests and in the dependent wood processing industries, they are freer to plan boldly, and to make changes quickly, than either the private sector or the state forest service. Because of this and of the speed with which future techniques seem likely to be introduced, the bigger companies are already leading the field in rational management. The gap that already exists in relative intensity of rationalised management as between the Companies, and the State on the one hand and the private sector on the other seems likely to widen.

The management plans for Holmen Bruks, for example, aimed at having clear felling areas of about 250 to 500 acres, and at thinning once in the rotation—and on areas of a size which compared with clear felling areas; areas which could only be logged when the ground was frozen in winter were grouped together so far as practicable, or at least they were so grouped with other areas that machines could be worked continuously and with maximum output. Chemical fertilising and reduction of rotation age to 70 years (from 120 years) would be the rule in future.

A. B. Iggesunds Bruk at Friggesund aim to have clear felling areas not less than 30 acres at present and 75 to 100 acres in future; they will reduce the rotation from 100 or 110 years to 80 years with two thinnings only, one at 40 and a second thinning at 50–60 years. They will also apply chemical fertiliser. They are rehousing their workers and concentrating work and reducing the number of places where work proceeds at any one time.

Svenska Cellulosa A.B. are proceeding on the same lines. All three of the aforementioned companies are dealing with small detached forest areas only if their treatment fits in with the economic use of machines and equipment, otherwise they are being by-passed until they can be exchanged or added to, to make them economic units. Svenska Cellulosa has already applied fertiliser to 50,000 acres and will treat 100,000 acres a year in future.

Implications for Britain

It would seem therefore that there is an urgent need for the Commission to plan the future management of its many small and detached forest blocks on a rational thinning and felling plan—to anticipate mechanical developments (and save on road construction and other aspects of expenditure), and there is an even more urgent need for the private woodland owners in Britain to co-operate to the same end. There is an urgent need to plan roads in the light of mechanical harvesting techniques and methods and this will be difficult because of the speed with which changes are likely to take place in machine design in future. One man and a horse can extract 50,000 hoppus feet a year. Several of the Swedish one-man logging systems which employ a tractor and trailer can extract 150,000 to 200,000 hoppus feet a year. If timber merchants in Britain can adopt such methods then two alternatives might be used. Either extraction equipment will have to be transportable and move from forest to forest and possibly be jointly owned or standing (or felled) sales should be big enough, where practicable, to give economic working conditions for such high capacity equipment.

Silviculture

The influence of silviculture on management can be seen in traditional thinning cycles of 3, 4 or 5 years, which are still practised to a considerable extent, and in the favoured position which has traditionally been given to Scots pine, largely because of its better natural durability than that of Norway spruce, as sawn timber. Elk damage pine more than spruce, and this together with the greater shade bearing properties of spruce would have made Sweden a country of spruce without deliberate control of elk and of spruce—to favour pine. The natural succession is birch, pine, spruce. Traditional silviculture has less influence on management now.

Sweden has only two coniferous forest trees and these, together with birch, are alone considered in most of Sweden's forests. The silvicultural needs of these two species are well understood by all Swedish foresters. The requirements of good silviculture guide the forester in choice of species. Apart from this silviculture exercises little influence on the main changes which are now taking place in forest management in Sweden. Changes in management methods are on the other hand, having marked effects on silviculture, and are themselves being brought about by the rapid changes that continue to take place in harvesting methods.

Natural Regeneration or Planting?

Hitherto natural regeneration has played an important part in restocking and in extending the forest areas on abandoned farm land. This has resulted in largely mixed forests of pine, spruce and birch, which under former standards of productivity, and with rotations of 100 to 120 years and more (many clear fellings are now of stands of 150 years of age and over), produced satisfactory forests. The need to intensify productivity, to improve genetic properties and to shorten rotations, has cast doubts on the value of natural seeding as a method of restocking (Plate 1).

Under the guidance of Mr. Plym Forshell, the National Board of Private Forestry has conducted, in the past two years, a national survey of 5,000 clear fellings which have been replanted and of 4,000 clear fellings which have been re-stocked from natural seeding. 87% of the planting proved satisfactory* but only 53% of the natural regeneration proved so. On the better soils, which hold the most important potentially productive forests, natural regeneration was poor. In northern Sweden 4 out of every 5 farmers relied upon natural regeneration alone. The Companies depend on natural regeneration and on planting in about equal proportions. On some soils the percentage survival of planted trees was low, on others the number of naturally sown trees was too high.

The outcome of the survey is likely to be a strong recommendation for greater reliance to be placed on planting, with wider spacing to reduce costs, and to accept such natural regeneration as occurs to fill up gaps. A reasonable time to allow before final assessment of a restocking might be 5 years, at least in South Sweden. Sowing is also likely to be recommended. The costs of natural regeneration appear to be comparable with planting costs, if due allowance is made for the need for early and uneconomic thinning. A further recommendation on planting will be to plant among the brash immediately after felling. Screening will be recommended as standard practice whether for sowing, planting or for natural regeneration.

Controls were applied in 10% of the cases examined in the survey. The results will be published.

One important benefit that would accompany replanting or sowing would be that seed trees would not be required, and this would mean both more profitable harvesting of the final felling and the avoidance of what is usually uneconomic harvesting of the seed trees after restocking. This is an essential improvement if modern harvesting techniques are to be used.

The officers of the State Forest Service are convinced that planting machines will be developed soon which will be capable of planting satisfactorily even on the rough stoney and boulder strewn soils of Sweden, and work is proceeding on the design and testing of suitable machines.

Effect of Commercial Aspects of Forestry on Silviculture

It is uncertain to what extent commercial aspects of forestry will force simplifications in silviculture. It seems likely that, in many cases, pure forests of pine or of spruce will be created, depending upon soils, but it is equally likely that extensive forests of mixed spruce and pine will continue with birch interspersed. The need to produce as large a volume of each specification at any one harvest will be met partly by other means. The number of specifications will be reduced, the number of thinnings will be reduced, the rotation will be reduced and the volumes removed at each harvest will be increased.

At the same time, in considering the prospects of reducing thinning cycles in Britain we need to remember our heavier rainfall, milder climate, more rapid growth, and more exposed forests and different soil conditions. In Sweden they will be helped to succeed in "one thinning" or "no thinning" by the freezing of the ground in winter, which reduces damage of windblow and by their slower rates of growth as well as by the mixed nature of forests. This might be the strongest reason for retaining mixed forests in Sweden.

Pruning is little practised in Sweden, nor is it considered seriously, except in rare circumstances in some state forests.

One other important silvicultural difference between Swedish forests and British forests is that in the case of Norway spruce and Scots pine respectively, one had a clear impression that the crowns of trees were much smaller in Sweden than in Britain. The felling of a given volume of wood in Sweden produces a smaller amount of branch wood than in Britain. In considering the higher proportion of spruce and of shade bearing species in British forests account will have to be taken of this. It could be an advantage in Britain where branch wood might be required to line tractor ways over wet or rocky ground. It could be a relative disadvantage if ever we practice whole tree logging.

* i.e. complied with legal requirements for restocking.

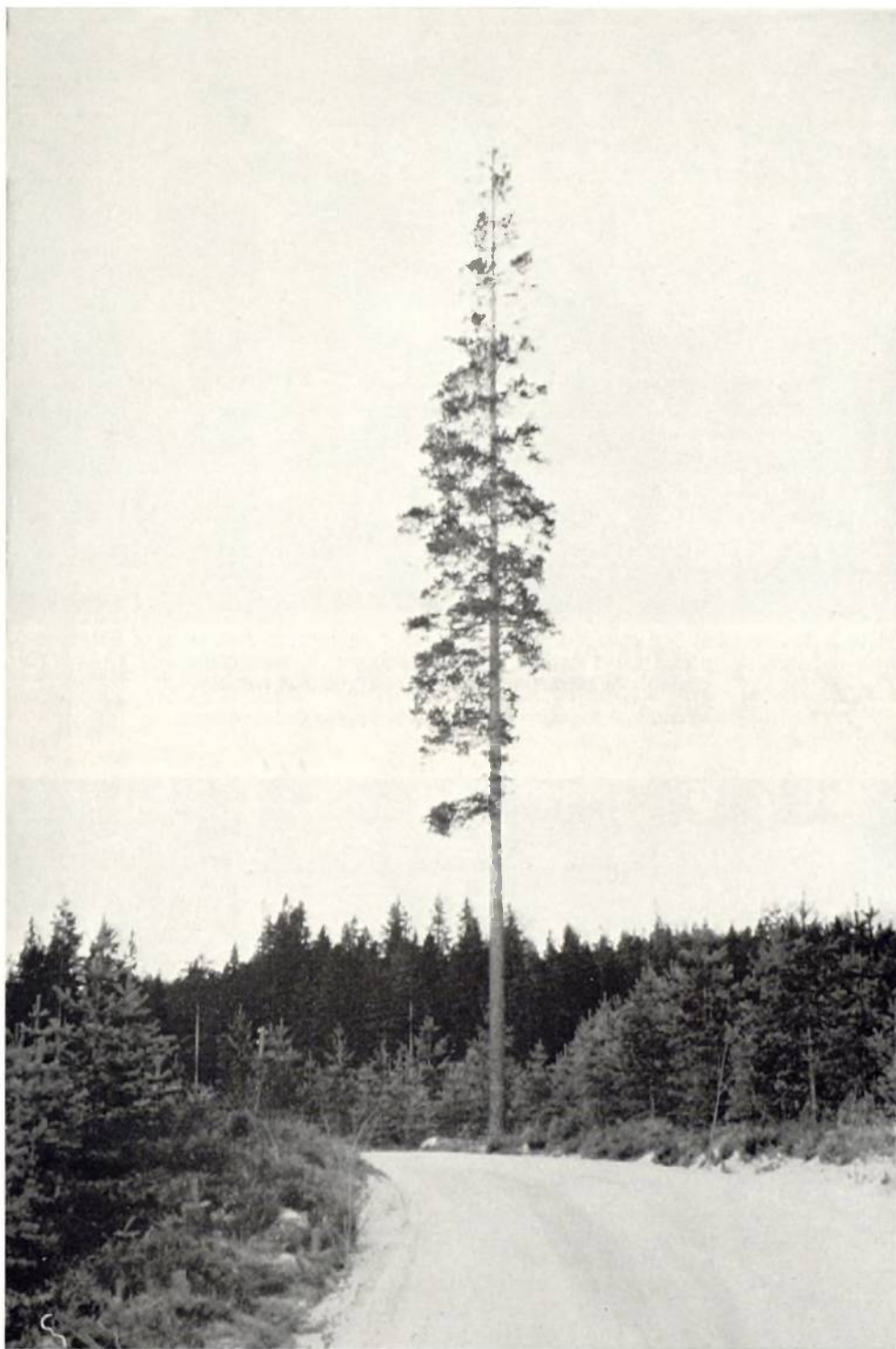


Plate 1. A very fine "Plus" tree of Scots pine retained in Malingsbo District. Seed orchards have been established throughout Sweden and great interest is shown in improving the properties of forest trees.



Plate 2. The simplest and cheapest Massey Ferguson equipment, consisting of Ferguson 35 with radiator, sump and valve guards, wheel chains, winch, wire crane and 3 ton trailer. Capable of extracting about 500 hoppus feet per day.



Plate 3. The second simplest equipment, capable of about 700 hoppus feet per day is a Ferguson 35 with half-track, wire crane with hydraulic slewing and 6 to 8-ton trailer.



Plate 4. A Bolinder Munktell tractor with Osa half-tracks, Osa 69 grapple crane and 6 to 8 ton trailer. Note the hydraulic ram at rear of tractor to make the tractor and trailer rigid for loading; also the front-mounted winch and cable control (white drum on bonnet). The capacity of this outfit is about 1,000 hoppus feet per day.



Plate 5. Massey Ferguson "Robur" tractor with three-quarter tracks, Hiab 172 crane, front hydraulic winch and 10 to 12 ton trailer, capable of extracting 1,400 hoppus feet per day.



Plate 6. The Osa 169 grab crane mounted on the tractor safety frame, giving a clear view to the rear for loading. The tractor is a Volvo "Nalle" three-quarter track with tail steering to a 10 to 12-ton trailer.



Plate 7. The Osa junior crane mounted on a trailer to give longer reach, better stability and enable 3-metre pulpwood to be extracted by a skidding tractor, such as the Timber Jack.



Plate 8. The Osa hydraulic grab with horizontal piston, which saves about 18 inches in height.



Plate 9. The V.S.A. Brunett with Hiab 176 crane is an articulated frame-steering tractor capable of carrying 9 tons and extracting 1,400 hoppus feet per day. The rear wheels are hydraulically driven when necessary.



Plate 10. The Drivax with Hiab 176, capable of carrying 12 tons and extracting 1,500 hoppus feet per day. The rear wheels are driven by a knurled wheel which is pressed hydraulically onto the two tyres. Steering is by hydraulic rams and the trailer brake is a plate pressed hydraulically against the front of the trailer wheels.



Plate 11. The rear-wheel bogey of the Drivax, showing the rigid or knurled driving wheel which is pressed onto the tyres by hydraulic ram when necessary.

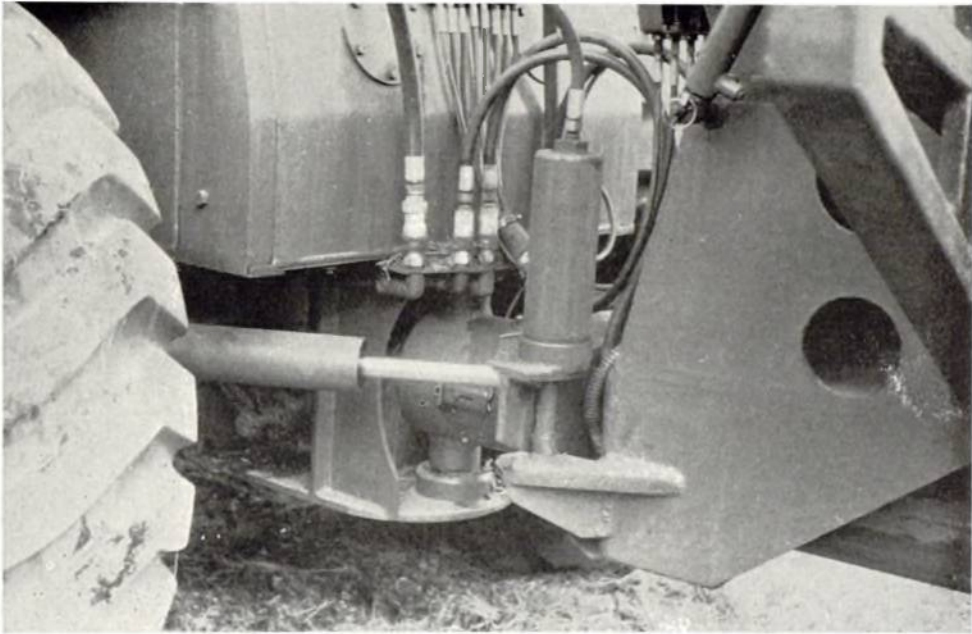


Plate 12. The hydraulic ram steering of the Drivax. The vertical ram is used to lock the machine rigid for loading.



Plate 13. The Garret Tree Farmer (similar to the Timber Jack) used to pull a screeding machine used for preparing rocky ground for natural regeneration or planting.



Plate 14. Hauling-in full trees to the Timber Jack, using sliding choker hooks. Note wheel chains. The capacity of the Timber Jack is 1,000 to 1,500 hoppus feet per day on full-tree logging up to $\frac{1}{2}$ mile; or 1,500 to 2,000 hoppus feet per day in normal clear felling of 10 hoppus foot trees and distances of 400 to 600 yards.



Plate 15. The Sund debranching machine with control cab on the left.



Plate 16. The outfeed side of the Sund debranching machine, showing the feeding tractor with Foco grab. Branches are carried away by a conveyor at the upper left of the photo. Output is limited by feeding and handling problems and is 4,000 to 6,000 hoppus feet per day at present.



Plate 17. The Igland 4-drum winch used for tractor skidding with half-track tractor capable of 1,000 hoppus feet per day over distances of up to $\frac{1}{2}$ mile.



Plate 18. The Holder articulated tractor, with Jo Bu winch and Norwegian horseshoe type chains, travelling empty on rough ground. It is capable of extracting 600 to 700 hoppus feet per day in thinning.



Plate 19. The Holder tractor extracting thinnings in the forest by multiple-choker skidding.



Plate 20. Hydraulic stabilising ram (A) for loading. In action.



Plate 21. Hydraulic stabilising ram (A) for loading. Out of action.

Part IV. Appendix No.1

Production Method




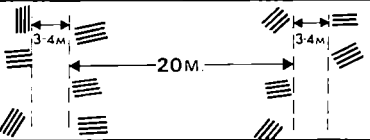
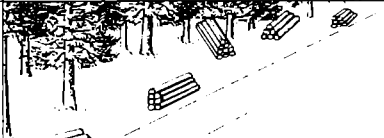
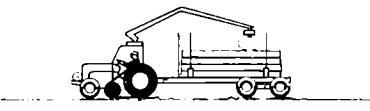
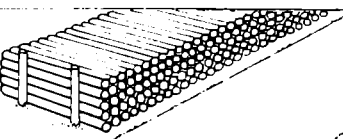
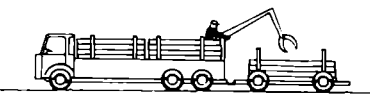


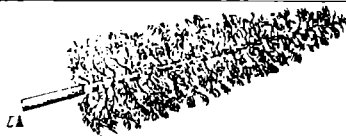
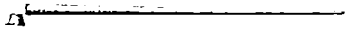



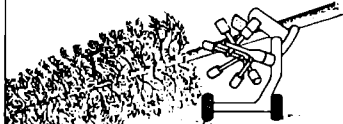
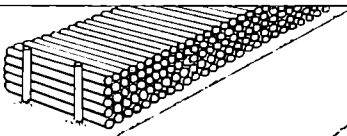
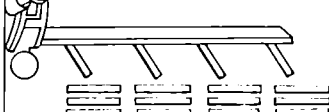
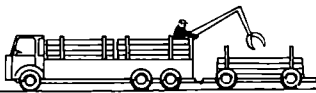
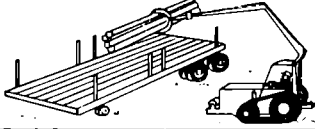

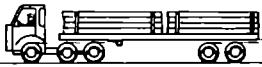
WORK PLACE	METHOD I (THINNING OR CLEAR FELLING)				METHOD II (ROADSIDE LOGGING)	
WOOD	○	FELL BY CHAINSAW (ONE MAN)			○	FELL BY CHAINSAW
	○	SNEED BY CHAINSAW OR AXE			○	SNEED BY CHAINSAW OR AXE
	○	CROSSCUT TO LOGS AND 3M. PULPWOOD WITH CHAINSAW				
RACK	◁	HAND EXTRACT TO WITHIN 3½ M. OF RACK				
	▽	PILE WITHIN 3½ M. OF RACKSIDE				
ROAD	◁	TRACTOR EXTRACT TO ROAD			◁	SKID LOGS WITH SKIDDER TRACK
					○	CROSSCUT WITH CHAINSAW TO LOGS 3M. PULPWOOD
	▽	PILE AT ROADSIDE			▽	PILE AT ROADSIDE
	□	LOAD ON TO LORRIES			□	LOAD ON TO LORRIES
	◁	TRANSPORT TO MILL			◁	TRANSPORT TO MILL

Plate 22. Diagram illustrating three production methods

Methods in Sweden

METHOD II (CLEAR FELLING ONLY)			METHOD III (CLEAR FELLING ONLY)											
			○	FELL BY CHAINSAW										
														
<table><tr><th colspan="3">KEY</th></tr><tr><td>WORK</td><td>▽</td><td>PILE</td></tr><tr><td>MOVE</td><td>□</td><td>LOAD</td></tr></table>			KEY			WORK	▽	PILE	MOVE	□	LOAD			
KEY														
WORK	▽	PILE												
MOVE	□	LOAD												
			◁	SKID OUT WITH SKIDDING TRACTOR										
			○	DEBRANCH WITH DEBRANCHING MACHINE										
			○	CROSSCUT WITH CHAINSAW TO LOGS AND 3M. PULPWOOD										
			□	LOAD ON TO LORRIES										
			◁	TRANSPORT TO MILL										

tion methods currently used in Sweden.



Plate 23. Half-track BM Volvo Tractor with Igland 4-drum winch and skidding plate, ground skidding.



Plate 24. Completed transformation of agricultural tractor (Massey Ferguson 65) to timber extraction machine.



Plate 25. Weight-transfer equipment on Massey Ferguson 35 Tractor and Trailer.



Plate 26. Kombi Double-Drum Winch, skidding plate, half track, safety frame, etc. on Massey Ferguson 165 Tractor.



Plate 27. Three-quarter-track BM Volvo Nalle extraction machine. Note the hydraulic crane mounted on top of the safety frame and the rugged undershielding on the tractor unit.



Plate 28. In the Kronopark or Crown Forest of Hamersbo—rocky outcrops, restricted road widths and few good landings. A sawn heartwood-of-oak frame made of 6 inches by 5 inches and 5 inches by 5 inches cross-section members, chained together and with steel straps at the end of each member, was laid on the roadway to provide a landing. This frame allowed tractors to pass over it, and to deposit their loads on it. Tree lengths were then left clear of the ground and this made cross cutting, measuring and removal of the log and pulpwood assortments more easy. The speed with which loads were measured, cross-cut and removed was remarkable. Picture shows Timber Jack delivering its load of tree lengths to the landing.



Plate 29. Special equipment for handling 2-metre lengths of pulpwood. Designers were Ingenjörfirma Stig Morenius A.B. The equipment was being used to unload lorries and to bring pulpwood from stacks to a moving platform which fed two Cambio barkers at Kleveshult barking depot, owned by the South Swedish Forest Owners' Association.



Plate 30. The same tractor unloading a lorry. The hydraulic grab, top right, is part of the crane on the lorry.



Plate 31. At Skinskatteberg Sawmill the logs are taken from the log pond and barked in Cambio barkers. They are then returned to water runways and graded for size and bundled. The picture shows a grab lifting about 10 tons weight of logs from the pond to the sawmill floor.



Plate 32. Kleveshult barking depot. A lorry which was no longer roadworthy was fitted with a concrete block as counterweight and a hydraulic crane, to load lorries and (as in this photograph) to load railway wagons with 2-metre lengths of peeled pulpwood. Note the crane operator's control seat on the crane's king post.

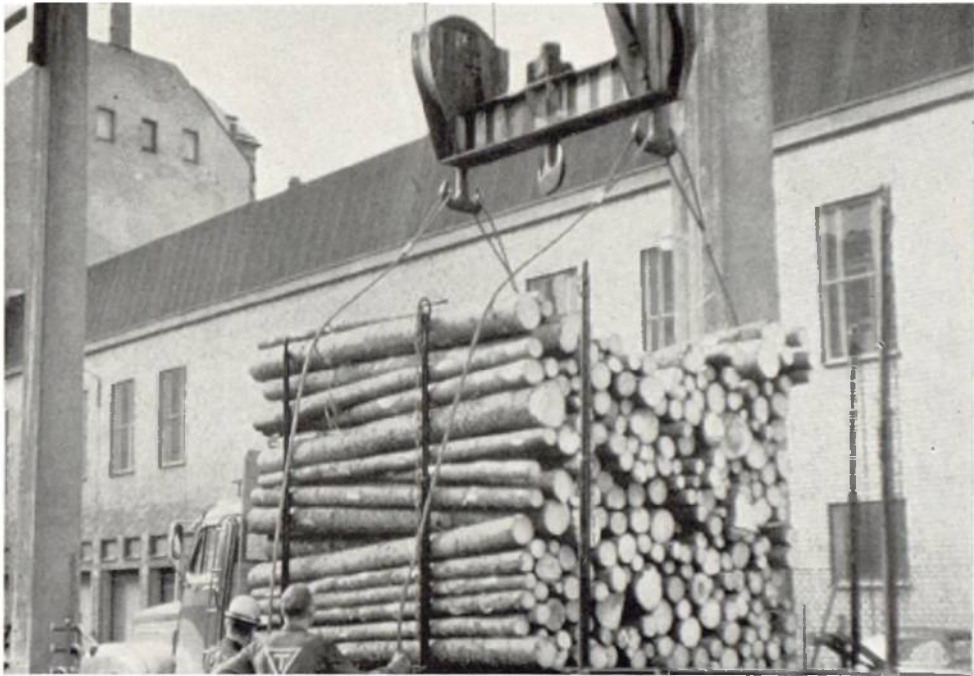


Plate 33. Unloading spruce pulpwood in 3-metre lengths at the groundwood pulpmill of Holmen Bruks och Fabriks, Norrköping.



Plate 34. The spruce 3-metre lengths moving, by chain drag, automatically towards two circular saws (not seen in picture) set at ground level, one behind the other, which cross-cut the pulpwood into one-metre lengths.



Plate 35. A Bolinder Munktell (B.M.)-Volvo 225 tractor equipped with hydraulic grab unloading 40 feet to 50 feet poles from a pole wagon at the log handling depot of Wistavarfs A.B. near Sundsvall. The weight is transferred to the large driving wheels—which are the front wheels of the tractor when used for this purpose. (The driver faces backwards and it is driven backwards. It is equipped with an excellent safety cab.) A similar tractor was used by the Swedish Cellulose company to feed trees to the Sund barker.



Plate 36. Tree lengths—delivered by the tractor shown in Plate 35, to the conveyor chains, being moved forward towards the operator and to the single line conveyor belt for cross cutting. The cross-cut saw can be seen on the right.



Plate 37. The beginning of the single line conveyor belt. One tree length at a time is moved forward mechanically—by push-button control—to the conveyor belt.



Plate 38. The push-button control box. The two engineers who designed this equipment are standing behind the controller. The single-line conveyor belt is on the left.

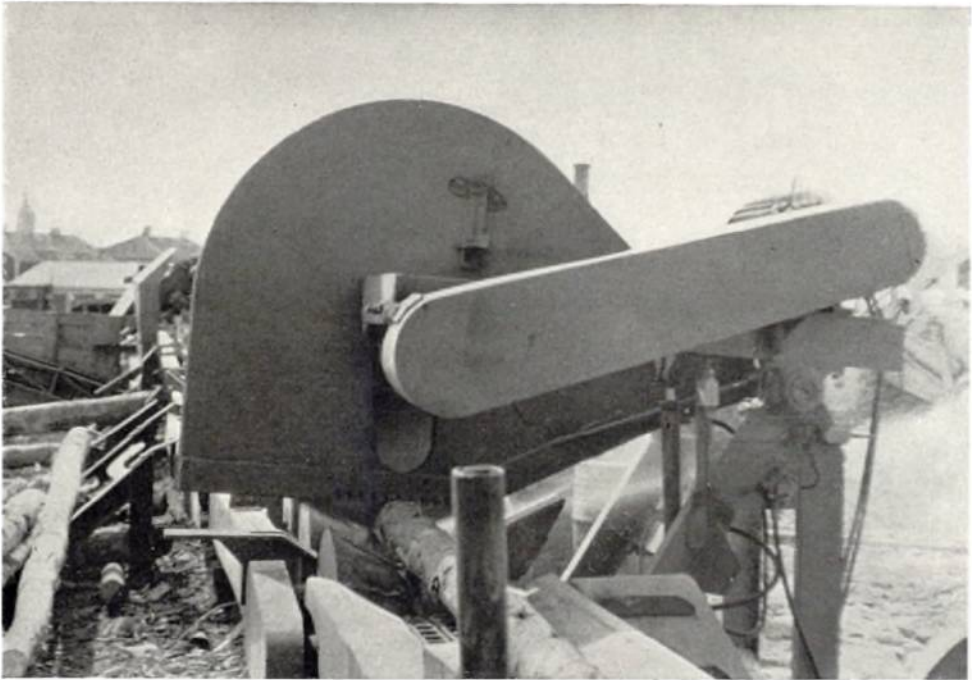


Plate 39. The cross-cut saw.



Plate 40. The cross-cut saw in the background, left; the electrically driven hydraulic pump in box in left foreground; five hydraulically operated "flags" in centre—which can stop a tree or log length for cross cutting at any one of five predetermined lengths—all push-button controlled.



Plate 41. A log being cross-cut.



Plate 42. The end of the production line at the log handling depot of Wistavarfs A.B. near Sundsvall. Cambio barker in centre of picture—with conveyor belt removing bark to a clearance bay on right. Note that each side of the end of the single line conveyor belt is a steel cradle—one on each side. The near cradle collected pine pulpwood; the remote cradle collected spruce pulpwood. Pine and spruce sawlogs had been kicked off to either side in similar fashion before reaching the Cambio.



Plate 43. Mobile Cambio barking unit in a state forest. Weighs 17 tons and is therefore too heavy for some forest roads. Peels 5,500 hoppus feet in an 8-hour day with 2 men on machine and 2 helping. This is a trailer-mounted, tractor-drawn set of equipment. Lorry-mounted versions are used more frequently.

Part IV

PRODUCTION METHODS AND ORGANISATION

By E. S. B. CHAPMAN

Introduction

The organisation and methods of production which are used in Sweden must be viewed against the background of topography, soil conditions, crop and climate. Although these have been mentioned in the introduction in Part I of this report it is worthwhile re-emphasising those factors which have an important influence on the methods of production.

Although about 40% of Sweden's land area consists of mountains above the tree line and lakes, most of the mountainous country is in the northern part where tree growth is very poor, and the bulk of the better timber producing land is in central and southern Sweden. 24% of the land area has an altitude variation of less than 50 metres (164 feet) which means that in central and southern Sweden probably half the land area falls in this category. To the traveller the country appears undulating with few steep slopes or high mountains and with frequent lakes and waterways.

The soil consists to a large extent of moraine of fairly fine grain and also sediments. In many areas there are boulders and rock outcrops which make the going very rough for tractors. Peat areas and swamps do occur but are not common due to the climate.

The average yearly precipitation is 16 to 28 inches and while the northern part of the country is snow covered for 5 to 7 months of the year, southern Sweden is only snow covered for 1 to 3 months. The average temperature in January is 6 degrees Fahrenheit in the north ranging to 32 degrees Fahrenheit in the south and in July, which is the warmest month, the temperature ranges from 57 degrees Fahrenheit to 63 degrees Fahrenheit. This has a considerable influence on logging methods as any wet areas can be left till the winter when they are frozen solid by 25 degrees or more of frost and very rough conditions can be dealt with in the winter when they are covered with 1 to 3 metres of snow.

About 50% of the total land area is forest and the annual output is 1,470 to 1,747 million hoppus feet and this comprises 36% Scots pine, 50% Norway Spruce and 14% Birch. The average increment is 37 hoppus feet per acre and although 60% of the total output comes from thinning and 40% from clear cutting it is usual to carry out only 2 or 3 thinnings during the life-time of the crop.

Terrain Classification and Planning

The production programme of many districts may be 2 to 3 million hoppus feet per annum and in

many cases the whole of this is extracted by 4 or 5 high capacity machines. It is clear, therefore, that very detailed planning must be carried out to eliminate delays and to ensure that the programme is achieved.

The first stage in this planning work is to classify the areas to be worked in a particular year and in most cases at present this is done fairly broadly by type of machine and season of the year. For example, the first division of the thinning areas would be into the following categories:—

- (a) Those that can be worked at any season.
- (b) Those that can only be worked when there is a covering of snow.
- (c) Wet or boggy areas which can only be worked when they are frozen solid.

These areas can then be further sub-divided into those which can be extracted by wheel tractor, those that will require a tracked tractor and possibly small areas where some sort of winch or cableway may be necessary.

With the help of maps and aerial photographs detailed plans can then be drawn up for each machine which will be used in the operation. Roads, access routes and skidding tracks are marked out on the map together with position of stacking sites, landings and conversion or peeling sites if any. Finally, a week by week programme and target output is drawn up for each machine.

It is, of course, essential that the output of each machine is recorded week by week and progressed against the target so that steps can be taken immediately if the plan is falling down.

Discussion and application to Britain

Detailed planning is essential in the large State and Company forests which often produce about a million hoppus feet a year to be extracted by four or five high-capacity machines. This does not apply to the small farm forests where the annual output of individual holdings may be only a few thousand hoppus feet. Here extraction is still by horse or by a simple tractor and trailer as illustrated in Plate 2. The disappearance of the horse is gradual, and in some of the larger districts a small part of the extraction work is still allocated to the one or two remaining horses. The need for very detailed planning will arise in harvesting small farm forests in individual ownerships. The farmers' forestry co-operatives intend to use modern machines, equipment and techniques. The problem of making economic use of high-cost equipment is great in the small forests.

High-output extraction machines cannot be automatically introduced to Great Britain because our conditions are so different and are so variable. Adequate supplies of timber must be available to make them economic and although we may find sufficient quantity in a group of forests this must be on suitable terrain for the particular machine concerned. This is more difficult for us than in the fairly uniform conditions in Sweden and where they can rely on hard frost and a covering of snow in the winter.

There is some scope however for planning our extraction on a seasonal basis and this is already done in some areas on clay soils where extraction is limited to the driest month of the year.

Harvesting operations must be planned in detail from the outset and controlled throughout to ensure that they proceed according to plan.

Methods of Working

The main methods of working are illustrated in Plate 22 and are self-explanatory. Crosscutting at stump into 3-metre pulpwood as shown in method 1 is most widely used at present but there is a trend towards methods 2 and 3 where whole trees are dealt with for clear felling areas. Although in the past one-metre and two-metre pulpwood has been cut in Sweden this has largely died out and most production is now to 3-metre pulpwood and saw logs. The standardisation of the products from the forest has simplified the methods used and these now are largely standardised also.

Horse extraction has been dying out rapidly over the past few years particularly in the northern part of the country and especially in the forests of the big producers such as the timber companies and the State Forest Service. No figures are available but it is safe to guess that, taking the country as a whole, only 25 to 30% of the production was extracted by horses in 1964. Winches and cableways are only used to a very limited extent.

The felling is all done by chainsaws and it is usual for one man to work on his own. As May is the planting season we did not see any felling in progress but we were told that a large part of the branching work is now done by chainsaw and that the majority of chainsaws are worker owned.

In method 1, which is still the most common method and is universal in thinning, planning of the operation and laying out of the skidding tracks is the first essential. A booklet entitled *Skid Road Felling for Tractor Extraction* (free translation) has had a wide distribution and the principles outlined therein are widely used. A translation of this booklet is now available.

The essential points are that skid roads of 3 to 4 metres width are marked out prior to marking the first thinning by using coloured plastic tape tied round the trees and different coloured tapes are used for main and subsidiary skid roads. These skidding tracks are usually 1 chain apart in thinning and 10 to 15 yards apart in clear felling. If necessary, some blasting is done to remove large boulders.

The trees are felled towards the racks, cut into 3-metre pulpwood and hand extracted to within 3 or 4 metres of the rack. Some logs which are too big to move are left at stump.

Extraction is by tractor and trailer, the type varying with the ground conditions and size of the production programme. Half-track or three-quarter track tractors with 8 to 10 ton trailers are the most common machines used. (See Plates 3, 4 and 5). Every tractor has an overhead safety frame by law and they are all equipped with hydraulic wire cranes or grapple cranes and a winch. The method used is for one man with his tractor and trailer to travel along the racks or skid roads and to load his trailer using a grapple crane from the small piles on the rackside without leaving his driving seat. Any pieces of timber which are out of reach of the grapple are winched into the tractor and in many cases the driver can operate the winch by a remote control cable which he pulls out at the same time as he pulls out the winch rope. When fully loaded with anything up to 12 tons he proceeds out of the forest to the stacking site which may be 200 to 300 yards away from the felling area in some cases. It is usual to see large concentrations of produce at one stacking site rather than small heaps piled at frequent intervals along forest roads as the additional cost of travelling an extra 100 yards or so in order to concentrate the produce is negligible when a large load is being carried.

Private Forestry Methods

This small wood system is the one commonly used in the small farm and estate forests. As the felling and crosscutting at stump is done by one man using a chainsaw the system can be adapted to any size of operation and it is only necessary to alter the method of extraction which is used according to the quantity involved. A horse can extract up to 50,000 hoppus feet a year but in many cases this quantity is being dealt with by small agricultural tractors and trailers equipped with a simple boom crane. Where the quantity is about 50,000 hoppus feet per annum this can be extracted under favourable conditions by a simple tractor and trailer in about a hundred days. The tractor can then be used for the remainder of the year on farm work.

Method 2 illustrated in Plate 22 is tree length logging and there is a trend towards this method of extracting clear felled areas. The advent of articulated wheeled tractors of the Timberjack and Garratt Tree Farmer type (see Plates 13 and 14) has given impetus to this trend as these machines can carry a big load, travel at about double the speed of tracked tractors and are cheaper to run. Other advantages of this method of working are the elimination of hand extraction and more efficient crosscutting when the produce is concentrated at a landing. This method of working goes part of the way towards mechanisation of the whole operation which becomes more desirable year by year as labour costs increase in relation to machine costs.

Method 3 is the next step in mechanisation of the production process and the object is to eliminate the hand branching and get this done centrally by a debranching machine. This system of working is only in its early stages of development at the present time and one of the biggest timber companies, Svenska Cellulosa, has introduced and is developing the Sund system of full tree logging (Plate 22).

The Sund System of Full Tree Logging

This system employs 16 to 18 men and the following equipment:—

	£
1 Feeder tractor ..	5,600
Crosscut table ..	6,300
Branch conveyor ..	1,750
Generator	3,160
Debrancher	11,200
4 Timberjack tractors at £5,600 each ..	22,400
	<hr/> £50,410 <hr/>

The trees are felled by chainsaw, one man felling for each Timberjack tractor. He is able to keep up with the machine quite easily as he has no branching to do. The 4 Timberjacks use the sliding choker system to gather up their load of 10 or 12 trees and skid these out to the debranching machine. They are then fed into the debranching machine by a feed tractor equipped with a Foco grab. (See Plates 14 to 16.) The trees emerge one by one from the debranching machine and are carried by a conveyor to a point where they are tipped off to one side where several men are waiting to cut them into logs and pulpwood using chainsaws. This part of the operation will be further mechanised in the near future by fitting up a crosscutting table. After crosscutting the pieces are loaded by tractor with a front hydraulic grab on to articulator trailers. The output of the system is 4,000 to 6,000 hoppus feet per day at present and the

cost per hoppus foot is greater than by more conventional means but the Company expect the costs will break even with conventional working in 1967 if the present trend of labour costs continues.

The next stage in the mechanisation process is to cut the trees using a Vit Feller Buncher which would simply cut the trees and stack them ready for extraction by Timber Jack tractor.

Implications for British forestry. The small wood system of working, where crosscutting is carried out at stump, is particularly applicable to thinning and where there are not more than about two products (e.g. pulpwood and logs). We have already adopted this system for production of pulpwood for Scottish Pulp and Paper Mills and for Thames Board Mills Ltd. The main disadvantage of the method is that it cannot be completely mechanised as hand piling remains necessary.

It is interesting to note that there is a trend in Sweden towards tree length logging which is traditionally a British method of working in small conifers, (i.e. extracting the tree in the full length by horse, and crosscutting at roadside). Hitherto it has been difficult to mechanise this method of working in thinnings, but new possibilities of doing this have emerged e.g., by using a small tractor such as the German Holder which we saw in Norway: this is a small frame steering tractor like a miniature Timber Jack (See Plates 18 and 19). Meanwhile in Britain a double drum winch for ground skidding has been developed at Crychan Forest in South Wales Conservancy.

It is clear that we must resign ourselves to the disappearance of the horse. This leaves us with two alternatives as follows:—

either:—

- (1) to adopt the small wood system and extract by tractor and trailer or, where the country is too difficult for this method, to use a cable crane or skyline system.

or:—

- (2) depending upon terrain conditions to extract tree lengths by (a) wheeled tractors equipped with tongs or draw bars (See Forestry Commission Booklet No. 11, Extraction of Conifer Thinnings, H.M.S.O., 5s. 0d.) (b) multiple choker skidding with skidding tractors. (c) double drum winches in a ground skidding role, e.g. the "Crychan" winch (the double drum winch developed at Crychan Forest and referred to above).

In all these systems a prime requirement is careful directional felling to racks. In later thinnings tractors are, of course, able to enter the stand and this requirement might be modified.

When we come to clear felling there seems little doubt that tree-length logging and extraction by rubber-tyred skidders such as the Timberjack will be the most economical method costing about 2½d. to 3d. per hoppus foot.

Except in the Border forests there seems little prospect, at the moment, of our being able to adopt a full tree system such as the Sund as this is only applicable to clear felling and requires about one million hoppus feet a year to keep it going, (say 350 acres per annum). An alternative might be to use one of the combine harvester type of machines which are being developed in Canada and elsewhere and which fell, debranch, crosscut and extract the produce. Our chief difficulty is the debranching operation which, by hand methods, accounts for about 60% of the felling and processing costs. It is the most difficult job to mechanise and most of the existing debranching machines need a million hoppus feet a year to make them economic. The Vit Feller Buncher is a machine which fells and extracts bundles of unbranched trees and is used to feed a Bombardier Processing Unit (B.P.U.) requiring one million hoppus feet or more a year for economic working. As four Vit Feller Bunchers are required to feed the B.P.U. the scale of working and the capital costs are similar to those of the Sund system.

One useful technique which has been evolved largely in Scandinavia and developed in Britain is that of branching by lightweight chain saws. There is now considerable evidence to show that it is cheaper to remove branches in this way from trees whose average basal branch diameter (measured along the long axis of the typically elliptical cut) exceeds ¾ inch than by conventional axe work. The technique is not easily acquired and it needs training and practice if proficiency and safety are to be achieved.

Loading and Transport

All the loading is done mechanically and where there is a large concentration of produce in one place, such as a clear felling, an independent loader is sometimes used. This is often an old lorry chassis on which has been mounted a Hiab Elephant with hydraulic grab (No. 176 or 177) with the controls at the top of the king post and a seat for the driver where he can see to carry out the loading operation. In some cases the driver who does the delivery loads his own lorry using the independent loader when he arrives at the felling site. This avoids having a man hanging about waiting for lorries to arrive. The advantages of an independent loader are that one can serve a number of lorries and the lorries can carry a greater load as they do not have to carry the weight of the crane. Another alternative is the use of a rear-mounted

Hiab No. 177 which can be detached from the lorry and left behind in the forest and can be used by a number of lorries.

Where an independent loader is not used each lorry is equipped with a Hiab Elephant and the most common type is the rear mounted one (No. 177) with pillar mounted controls and a high seat.

The most common lorries used for timber transport are Scania-Vabis, 3-axle lorries with two-axle trailers and these usually carry about 24 tons of pulpwood. As there are no return loads for most of these lorries they are constructed so that the rear wheels of the lorry can be lifted for the return journey. This reduces tyre wear, cuts down fuel consumption and improves traction on the driving wheels. It can also be used when loaded to transfer load to the driving wheels for short periods to aid traction in difficult conditions.

Implications for British forestry. The use of an independent loader is more difficult than at first sight appears. Even where there is a concentration of enough produce in one place to keep the independent loader fully employed the queuing problem must be borne in mind. Three or four lorries may be queuing up to be loaded at eight o'clock in the morning and again at two o'clock in the afternoon whereas they can load themselves in their own time and wherever necessary if they are equipped with their own cranes.

We are accustomed to seeing small piles of produce, many of which only contain two or three tons on our forest roads. This is due to our methods of extraction. When we come to the use of large capacity machines which carry 10 tons or more there is little extra cost in concentrating the loads at suitable loading points and loading and unloading costs are reduced. The quantities available for loading in one place in Sweden are very much larger than is customary in this country. This, of course, reduces the loading time considerably.

The use of lorries with the ability to raise one pair of wheels, as used in Sweden, might have little application in this country as we seldom have long return journeys (compared with distances travelled in Sweden) with no load. In many areas our contract transport relies on return loads to make it economic. Such lorries would have less advantages on our steep gradients where drive to all rear wheels would be required.

Floating as a Means of Transport

Sweden, especially in the northern part, possesses ample waterways suitable for floating and this form of transport was previously used to a large extent but in recent years it has declined considerably and

now accounts for only about 30% of the annual logging volume. This is primarily concentrated in the north part of the country where distances from forests to mill are considerable and there are numerous rivers which are suitable for floating; in some cases a three stage transport system is used in that tractors extract from stump to road, lorries carry the pulpwood and logs to the river, where they are tipped into the river and then the produce is floated down to the mill. In some cases there is an additional stage as the timber is made into rafts and floated by sea down the coast to the large sawmills and pulp-mills.

The trend is towards the use of lorries for transport of timber and pulpwood as this is a two stage system from stump to mill, there is less loss due to sinkage, and lorry transport is very much quicker. In most areas logging has now become an all the year round operation whereas floating is very seasonal, being possible only during the spring and summer, and in some cases it may take several months for the timber which has been tipped into the river upstream to emerge at the pulpmill or sawmill.

Work Study in Swedish Forestry

There are two main organisations concerned with research into operational efficiency in Forestry in Sweden and these are as follows:—

- (a) The Forest Research Institute of Sweden, Department of Operational Efficiency. This is a department of the University of Stockholm.
- (b) The Logging Research Foundation or Skogsarbeten.

The former organisation is concerned to a large extent with a fundamental approach to Work Study problems and many of their projects have a physiologic and ergonomic slant and involve, for example, the measurement of pulse rates and consumption of oxygen by forest workers when carrying out various operations in the forest. We had no contact with the Forest Research Institute during our visit to Sweden.

The Logging Research Foundation

The Logging Research Foundation, Skogsarbeten, was formed on 1st January 1964, by an amalgamation of V.S.A., M.S.A. and S.D.A. which were the three work-study organisations in the northern, central and southern parts of Sweden. Skogsarbeten is financed by its members who are the State Forest Service, the large timber companies who own forests and the Employers Association and details of the organisation are available in a concise paper produced by the organisation themselves. (Attached as Appendix II, p. 51).

Their programme each year is decided by a board which is composed of representatives of the individual members. The Workers' Organisations do not take part and although the State Forest Service is a member there is no state control. The annual budget is 2½ million kroner (£175,000).

An additional main function of the organisation is to increase the knowledge of efficient methods and to this end they run courses and publish approximately 15 editions a year of a leaflet called *Ekonomi*. They also publish a news sheet and occasional bulletins and manuals for courses are produced. *Ekonomi* is now available in English and there is no doubt it will prove very useful to us in this country.

Skogsarbeten is primarily concerned with the development of new techniques and the introduction of mechanisation to forestry and its main task is the improvement of efficiency in forest work. It does not regard the production of definitive standard times as part of this function and in fact little or no work is carried out to this end.

The main tasks of the organisation for 1965 are as follows:—

- (i) Mechanised conversion and snedding. A Tree Harvester is being imported from America and also a Vit Feller Buncher and the finance for these purchases is coming from a Foundation for Mechanisation of Forestry.
- (ii) Skidding of tree lengths and full trees.
- (iii) Further development of grip loaders and other machines.
- (iv) More intensive use of work studies by member organisations, particularly to refine per form and standards.
- (v) Service to members who have to negotiate piecework rates.

Specific projects are allocated to one or more of ten officers who are all men with academic qualifications such as civil engineering or mechanical engineering degrees, forestry or economics degrees, etc. The officer in charge of a project draws up a programme and considers what information he has to obtain in order to solve the problem and this will be discussed with the chiefs of the organisation. The actual data they require may be in a variety of forms e.g. records of output, memo, motion photographs, time study results, or cost and receipt figures. Generally these will be obtained from the companies or State Forest Service without any direct work from the officer in charge at all and Skogsarbeten only employ two time study men in the whole of the organisation. They may be sent out on specific projects but most time study results come from work study officers employed by the companies or by the State Forest Service. In some cases the organisation may borrow a tractor or other equipment from one

of the companies for some experimental work and in this case the driver will come with it from the company and they may well also borrow some labour for measuring or other study work. It may be necessary in some cases to compensate the company for reduction in earnings by the particular machine.

The results of any time studies and any other data required are sent in to Skogsarbeten at Stockholm where all the ten officers are based and they will then be worked up into a report. In many cases the officer concerned does not do the mathematical calculations himself but calls in such outside assistance from mathematicians, statisticians and computers. Rating is not used at all in studies.

It can be seen therefore that Skogsarbeten can be likened to a research organisation which carries out experiments or collects data in order to advise its members which machine to use or which is the most suitable method to carry out a particular job at minimum cost. The results of studies may incidentally provide some of the relativities for sound piecework schemes but not the actual level of payment.

The results of the investigations are distributed to the members of the Logging Research Foundation and training courses are also held to put over the results to all those concerned. The Forest Owners Associations and the State Forest Service employ officers whose main function is to put over the results of study to their members or officers and to advise them of the best methods of working and the best machines to use in particular circumstances.

The forestry companies and the State Forest Service have small work study departments of their own to carry out more detailed studies on their own particular areas and operations with a view to improving methods and calculating sound piecework schemes. Any of this information which is of general application or concerns a study which the Logging Research Foundation are carrying out will be fed back to them.

Comparison with Britain

It is interesting to compare the structure and function of Skogsarbeten with the Work Study Branch of the Forestry Commission. It is a co-operative association of the State, company and private forestry sectors and its programme is directed to the greatest benefit to all its members. The State Forest Service and the larger private companies in Sweden have their own sections for technical developments and for time study work, and Skogsarbeten can therefore concentrate on questions where time and money may be saved through co-operative research and development. A great deal of information is passed them by their members both as a result of enquiries on particular studies

but also in the normal course of operating experience. One result is that operating data are made available to Skogsarbeten for a large number of machines and these can be processed and worked up into reports and recommendations of use to a large sector of the forestry world in Sweden. In this country our scale of working is such that we can seldom study numerous machines working in similar conditions and thereby establish standard outputs. We must examine all the factors which influence production in order to assess the potential of a machine in our very variable crops and conditions. With only two coniferous species and more uniform terrain and climate in Sweden any study results and operating data have a much wider application.

Piecework and Wage Agreements

Since 1956 Sweden has had a co-ordinated wages policy as a result of co-operation between the Swedish Employers Confederation (S.A.F.) and the Trade Union Federation (L.O.). These two bodies meet from time to time and agree on a general wages policy for industry, agriculture and forestry but this policy is not absolutely rigid and leaves a good deal of scope for manoeuvre by the individual Unions and Employers Associations. For example, agreement was reached that in 1962 wages of industrial workers should rise by 4.57% and in 1963 by 4.95%. In addition to this there was expected to be a wage drift of 3%.

In a report in 1963 it was stated "It would be a delusion to believe that the Trade Union movement can ignore, in its wage policy, an economic policy which endeavours to balance the National Economy. Increased co-ordination and deliberate planning of wage policy form an essential condition for the security full employment offers to the citizens".

It is within this framework that forest workers' rates of pay are negotiated. This is done annually by the following organisations; on the employers side:—

- (i) The Federation of Swedish Forest and Agricultural Employers (S.L.A.) for southern Sweden.
- (ii) The Forest Employers Association for northern Sweden and
- (iii) The Board of Crown Lands and Forests for the State Forest Service.

On the workers side the main union is the Forest Workers and Log Drivers Union who have a hundred percent membership of full-time forest workers. Another interested party is the Swedish Farmers Union, as nearly 50% of the forest area is in private ownership.

Time work wages must be agreed as silvicultural work is carried out on this basis but all logging operations are done on piecework. The fundamental

difference between piecework in Sweden and piecework in this country is that the Swedish workers have no guaranteed minimum wage and they can attend work for whatever hours they wish and earn a wage at the end of the week according to the amount of work they have done.

Piecework

As far as the main manual jobs are concerned such as felling, the methods have long since been cut and dried and the relativities established by time study which has been carried out from time to time by the State Forest Service, the companies or by the Skogsarbeten. Piece rates for these operations are negotiated annually between the Unions and the forest owners organisations on a regional basis. It is simply a question of bargaining, using whatever data such as records of earnings either side have available. A basic price for the standard conditions is agreed and the agreement lays down what additions or subtractions should be made from this basic price according to variations in conditions. (See example in Appendix III, page 55). Some negotiation of these additions and subtractions is even possible at the annual negotiations.

In the case of new jobs, such as driving a Timberjack, the District Officer is responsible for setting piece rates for his district or for the company for which he works. There may be a little consultation at top level between companies but in theory the rate for the job could vary from district to district or from company to company.

When a new job is started the worker or operator is employed on day rate and during this period method study is carried out. After this initial period when the method is perfected and the driver is competent he will go on to a system where he is partly paid by time but with also some element of piecework and during this period further studies of one sort or another will be carried out to establish relativities. The studies will establish the main factors which govern the output. The length of time on time rate and the length of time on part time work and part piecework will vary according to the difficulty of the job and the time it takes to train the driver and perfect the method. During the whole of this period the forester or district officer will have been keeping records of output and, in the case of machines, there will be a record of machine usage from service record, and he will have by this time a pretty accurate idea of what is a satisfactory output for this machine or man. A piece rate is then simply negotiated with the man concerned.

Mr. Killander of Skogsarbeten is of the opinion that little improvement in the accuracy of piece rates could be achieved by lengthy time study and the establishment of standard times and that the cost

in terms of a work study man's time and money would not be justified by any findings. In his opinion the time study personnel could be much better employed in experimental work and developing new methods. He suggests that if district officers and foresters are doing their jobs properly they will have accurate records of output for each man and machine and if anything goes wrong they are in a position to call in some assistance. He suggests that one trained work study officer should be available as a service to a number of districts, the number depending on the quantity of work in each district, and when something has gone wrong with the output he can be called in to do some studies and find out what is wrong.

Comparison with Britain. Mr. Killander's views on the use of time study to establish piece rates apply to Swedish conditions and in particular to the work of Skogsarbeten but are not valid in this country. With limited resources they have to produce results which are of maximum benefit to company, state and private forestry and a concentration of effort on establishing piece rates for one particular job is likely to have little value for certain sections of their membership. Time study work for piece rate setting is much better done by the company or state forest district concerned who can concentrate their efforts on the particular problem to which they require a solution.

Although at first sight the Swedish approach to piece rates appears fundamentally different from our own, closer examination and discussion brings the two very much closer together. The experimental team of the Forestry Commission Work Study Branch makes a first evaluation of a new machine or system and establishes the best method of working and this is a similar function to that carried out by Skogsarbeten. Whereas we pass on the machine or system to a subsequent Work Study Team for more detailed study and the calculation of Standard Times Skogsarbeten publish their preliminary findings and certain of their members then follow up with more detailed studies.

The presentation of results is frequently in a different form, as a simple graph of output may cover the bulk of the fairly uniform Swedish conditions whereas we may require a more detailed table of Standard Times covering a range of ground conditions, species and sizes of tree.

All silvicultural work in Sweden is done on day work so that piece rates only apply to straightforward production work. With a long tradition of forestry methods of working are well established. There are only two coniferous species; terrain conditions and climatic conditions do not vary greatly within a region and the level of earnings does not leave much room for flexibility. Piece rates can

therefore be established by negotiation for the various regions and within the national incomes policy framework. Even if time study showed these rates to be wrong little could be done about it.

In Britain we have a large variety of conditions, seven major coniferous species and trees of variable size and no tradition of good working methods. In addition we have no national wages policy and so have much more scope for improvement in order to obtain efficient working and to relate payment to the work involved. Time study and the establishment of standard times is the best way of achieving these objectives.

Payment for Worker-Owned Chainsaws

Payment for worker owned chainsaws is included in the workers' piecework rate. How much of his piecework is for payment of the saw is not considered very important. Some data has been published however in *Ekonomi* on the cost of running the chainsaw for different operations and this is shown in Appendix IV, page 56.

Labour Productivity

In all the State Forest districts which we visited a productivity figure was quoted to us. This was man days per cubic metre produced or man days per 100 cubic metres and this figure included all the work in the forest from planting to the final felling and logging work. Since 1954 mechanisation has progressed at a remarkable rate, the main jobs mechanised being peeling and extraction. The trend in labour productivity from approximately 0.8 man days per cubic metre in 1954 to 0.3 man days per cubic metre in 1964 is shown graphically in Appendix V, page 57.

At the beginning of this decade most of the extraction work was carried out by horse and sledge, quite a large proportion of the peeling was done by hand in the forest and chainsaws had not yet become universal. At the end of the decade all the felling is done by chainsaws, all the peeling is done by high capacity machines (e.g. Cambio) either mounted on lorries or at the pulpmills or sawmills. Less than 25% of the extraction work is now done by horses, and tractors of various types have taken over so that one man with a tractor achieves as much as four men and four horses did in previous days.

In the past men worked part time in the forest and part time on farm work and the bulk of the logging was carried out in the winter. There has been a tendency over the years for all the year round logging to be done and in most cases men are now employed all the year round in the forest. This also reduces the number of men who are employed and the men who

work in the forest are more highly skilled than previously.

The difficulty in Sweden is resettlement of forest workers who have been made redundant through increased mechanisation.

The productivity figures from Sweden cannot be directly translated to this country as they include all forest work and the exact proportion of silvicultural work to logging work is not known but, of course, the bulk of the work is production. It is worth noting, however, that figures such as 200 to 250 hoppus feet per man day in clear felling were mentioned and some of the machines achieve a 1,000 or 1,500 hoppus feet per man day in extraction work and we should therefore be careful about increasing our labour force in those forests where production is becoming the major operation and this is likely to be fully mechanised in the near future.

The Private forestry problem. The increase in productivity creates a serious problem for the small farm forest where the farmer himself does most of his own forestry work. If he continues to work single handed he cannot afford the big expensive extraction machinery but if he does not do so his costs will go up and his income will go down and he will not receive adequate reward for his labour. On the other hand, if he manages to increase his productivity he will complete his forestry programme in a much shorter time and will be out of work for part of the year. These problems have persuaded many small farmers to abandon their forests and migrate to the towns where they can find more profitable work.

There are two alternatives for the small owner and these are as follows. He must mechanise as far as he can and this can be done reasonably well by adapting his agricultural tractor for use in the forest and purchasing an efficient trailer. In many cases he would then be able to spend more time on concentrated agricultural work and thereby improve his income. The second possibility is co-operation between a number of forest owners and the purchase of one or more of the new extraction machines. The South Swedish Forest Owners' Association will shortly be purchasing some of these new machines for use by their members and it is likely that other Associations will follow suit. Careful organisation is required to keep a machine fully employed and it probably has the best chance of success if done by an efficient Association or co-operative. A third possibility would be to sell standing to a customer or to employ an efficient contractor but neither customers nor contractors would be likely to be interested unless a fairly large quantity was involved. We did see one peeling contractor's team consisting of three men with a lorry-mounted Cambio peeler and this team was peeling three-metre pulpwood at roadside at a contract price of 2½d. per hoppus foot.

Any of these alternatives would mean that the farmer would have to find work outside the forest and this might not be easy in the remoter areas unless he had a good farm.

Forestry Training

Training of Forest Officers

There is only one College of Forestry for the training of graduates in Sweden known as the Royal College of Forestry and it is located in Stockholm. With effect from 1st July 1962 the former Forest Research Institute was united with The Royal College of Forestry. The College has three permanent training centres located in different regions of the country for practical training of students and one of these, Garpenberg, is used for the whole of the first year at College. The other two are used during the second and third terms.

Qualification for entry to the College of Forestry is equivalent to the advanced level of the General Certificate of Education but there is great competition for entry and the 36 places available annually are allocated on a points system. Up to 1961 ten months practical work in the forests was compulsory for admission but now practical work is given a certain number of points along with other factors. The length of the ordinary forestry course is 3½ years and during the summer terms each class is taken to a training centre for combined theoretical and practical training. During the first year the teaching is performed in the training centre at Garpenberg where students live in the College. Of the remaining two summer terms one is spent at Lycksele (northern Sweden) and the other Malingsbo (central Sweden). In addition to these training centres several study trips are undertaken such as one week on logging, three or four days on floating, two weeks on silviculture and a week visiting various forest industries. To gain his ordinary degree the student must pass all his exams and also carry out some independent study and present a thesis. A higher degree, roughly equivalent to an honours degree, can be obtained by a further two years study and a further three to five years is required to obtain a doctorate.

One of the departments of the Royal College of Forestry is the Department of Operational Efficiency and during the first year at Garpenberg the student is taught about labour relations, tools, equipment and mechanisation, work study technique, incentive systems and wage agreements, work physiology, occupational health and safety, and current methods of working and organisation of all the major forestry operations. The instruction consists of lectures and practical work and the students are given individual tasks on which they carry out a thorough work study investigation.

In the third year the students are taught about labour and work management, planning and the co-ordination of jobs and machinery with emphasis on cost analysis. Road planning and road construction are also included and they are given individual tasks to investigate certain problems and to make long term plans for the management of a forest district. This includes a road plan for the district including a cost analysis.

The teaching in the Department of Operational Efficiency comprises about 20% of the total time spent at the College.

Training of Foresters

The main qualification for entry to a forester training school is completion of the basic training course for forest workers, one year's work in the forest and entrance examination and interviews. Successful candidates are sent to one of seven training schools as follows:—

1. Alvsbyn in the County of Norrbotten.
2. Hallnas in the County of Vasterbotten.
3. Bispargarden in the County of Jantland.
4. Bjurfors in the County of Vastmanland.
5. Kollegerga in the County of Kristianstad.
6. Bjarka-Saby in the County of Ostergotland.
7. Ostad in the County of Alvsborg.

All these schools are run by the County Boards for private forestry under the control of the National Board for Private Forestry, and in addition there is a private forestry training school called Gammelkroppa in the County of Varmland. Each school is supervised by a local Board whose chairman is the Regional Forest Officer (the Forest Officer who is at the head of the County Board of Private Forestry) for the region and the school staff consists of a principal and a technical instructor of forest ranger rank. They also form the Council of the school.

The period of training is one year (in addition to the basic training) and the forester training schools turn out about 140 foresters annually.

Training of Forest Workers

The Swedish trade union movement actively supports the training of workers in Sweden and for this reason a joint committee was set up in 1947 between the Employers Confederation and the Confederation of Trade Unions (L.O.).

Forest worker training is under the control of the County Boards for private forestry and is on a residential basis as opposed to training of forest workers on their own forests. There are 18 forestry schools and there is one in each county except for some of the small coastal counties in the south-west and other similar areas where forestry is less

important or the necessary training can be covered by neighbouring Counties. The one year basic training course is for students aged 16 to 20 and its purpose is to give them a basic knowledge of forestry and forestry work.

The basic training course is organised for forest workers and future forest supervisors including those who will work in private forestry and students normally start the course immediately on leaving their ordinary school. The course comprises 22 weeks in the school and about 20 weeks of practical work, the school work and practical work alternating in periods of six to ten weeks. The student is taught both silvicultural and harvesting techniques and methods and their relationship to each other. Tool maintenance is included and the part played by forestry in the national economy is explained.

After completion of the first year's course a student can obtain work as a forest worker or he can carry on for a second year course. Students must be at least 18 years old and the course comprises 12 weeks at school and 20 weeks of practical work during which the students specialise in forest management or in mechanisation.

Three of the schools run courses for foremen, each course comprises 12 weeks at school and 20 to 30 weeks of practical work mainly concerned with labour management. There are advanced foremen's training courses of one to three weeks' duration and each of these courses deals with one specific subject such as supervision of work, logging plans or tractor transport, etc.

The schools turn out about 1,300 trained forest workers annually and the bulk of these will go to work as forest workers in the State forests, company forests and private forests but a small proportion will go on to forester training schools. There is a constant need for retraining of adult forest workers in new techniques and numerous short courses are run on chainsaws, logging by tractor and horse, and on silvicultural work of various sorts. These are usually short residential courses of 1 to 6 weeks at one of the forest workers' schools or a few days practical instruction at their own forests.

All timber measuring in Sweden is under the control of County Boards of private forestry and special courses are run at nine of the schools to train timber measurers.

Other Forestry Training

There are numerous short courses for forest owners and refresher courses for foresters and these are generally run by the County Boards of private forestry. In addition the various forest owners associations undertake a good deal of training of forest owners usually by holding excursions and discussions.

Skogsarbeten has an important function in training and spreading the information that they gain from their researches. Their courses are mainly of use to Forest Officers, Executive Staff, Specialists and teachers and are of primary interest to the State Forest Service and the larger companies. Mr. John Soderland of the Federation of Swedish Forest and Agricultural Employers does a considerable amount of work in spreading the results of research work among private woodland owners and encouraging them to undertake the most modern forestry techniques.

After they have been employed for about one year forest officers and foresters in the State Forest Service are given special introductory courses which mainly deal with the organisation and activities of the Service. Courses, conferences and excursions are also run to keep the staff up-to-date with modern methods. For foresters these are usually on mechanisation and planning of their own work while the forest officers the short courses often concern management planning and related subjects.

The State Forest Service works in close liaison with the County Boards in the training of forest workers and much of the practical work is undertaken in the State Forests under the supervision of their foresters. For training of some of their own forest workers the State Forest Service runs three schools which turn out 40 to 50 trained workers a year. They also undertake the training of forest workers to bring them up-to-date with new techniques or to acquire new skills in such operations as chainsaw work, blasting and tractor driving.

Part IV Appendix I

Diagram showing Production Methods in Sweden. See centre pages, Plate 22

Part IV Appendix II

Facts About the Logging Research Foundation

Facts About the Logging Research Foundation

A new research unit aimed at increasing efficiency as well as achieving technical developments in logging—Logging Research Foundation—was established on January 1st, 1964, in Stockholm, Sweden. The new unit is an amalgamation of the earlier logging work study institutions SDA, VSA and MSA. Mr. H. G. Lindberg, Swedish forester and former vice-president, woodlands of Nova Scotia Pulp Ltd., Canada, was appointed managing director of the Foundation.

Historical Background

As indicated above, Sweden had for a number of years three privately financed logging work study institutions (Figure 1), whose areas of activity were distributed over different regions:—

- SDA (established in 1936) for northern Sweden;
- VSA (established in 1939) for western Sweden;
- MSA (established in 1950) for central and southern Sweden.

The establishment of piece rates in logging was the primary reason for this work study on a regional basis. In the last decade, however, economical and technical developments have accentuated the need for co-ordinated research. The sponsors of the institutions felt, therefore,

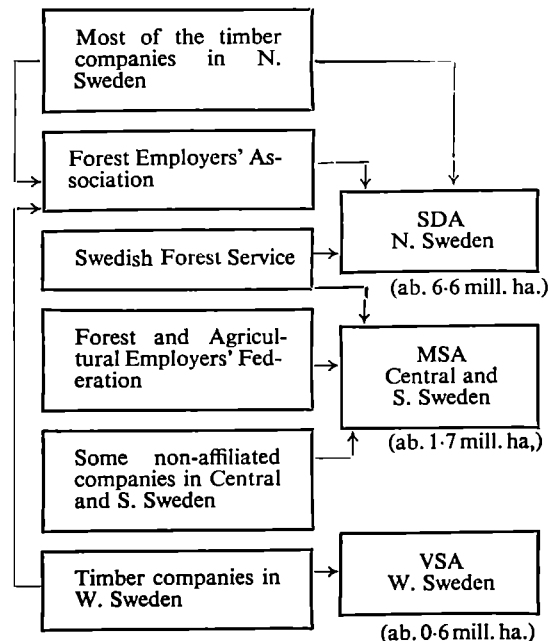


Figure 1. The earlier logging work study institutions.

that it was necessary to channelize their efforts into one joint body by reorganising SDA, VSA and MSA as the Logging Research Foundation.

Aim

As stated in the by-laws, the aim of the Foundation is:—
to further logging by developing equipment, machines and working techniques through research and experiments;
and also:

to provide a basis for the establishment of proper payment systems in logging operations.

Inasmuch as most of the larger private companies and the Swedish Forest Service have their own sections for technical developments, the Foundation will deal with questions, where time and money may be saved through co-operative research. It will also be a natural forum for the organised exchange of experience. The members of the Foundation are supposed to make their own arrangements for local communication and practical application of research findings.

Membership

The membership comprises the Swedish Forest Service, the Forest Employers' Association (most of the timber companies in northern and western Sweden), the Forest and Agricultural Employers' Federation (forest owners mainly in central and southern Sweden) and a number of non-affiliated companies. Together these members own about 10 million hectares of forest land or almost 50% of Sweden's forests.

Staff and Finances

The Foundation will have a staff of around 50 full-time members, of which there will be 17 with university degrees (mostly forest engineers, some with additional training in mathematics, economics and surveying). The annual budget is presently about 2½ million Swedish crowns.

Organisation

As shown in Figure 2, the Foundation consists of three divisions. Research and technical development work are carried out by a technical division and a division of economics. A special information division is responsible for the rapid communication of research results to members via courses and publications.

Technical Division (Manager: C. E. Malmberg). The main task of the technical division is to develop machines, equipment and working techniques. These developments may be grouped around questions concerning present and future methods. Emphasis will be placed on more advanced technical developments in hydraulics, electro-

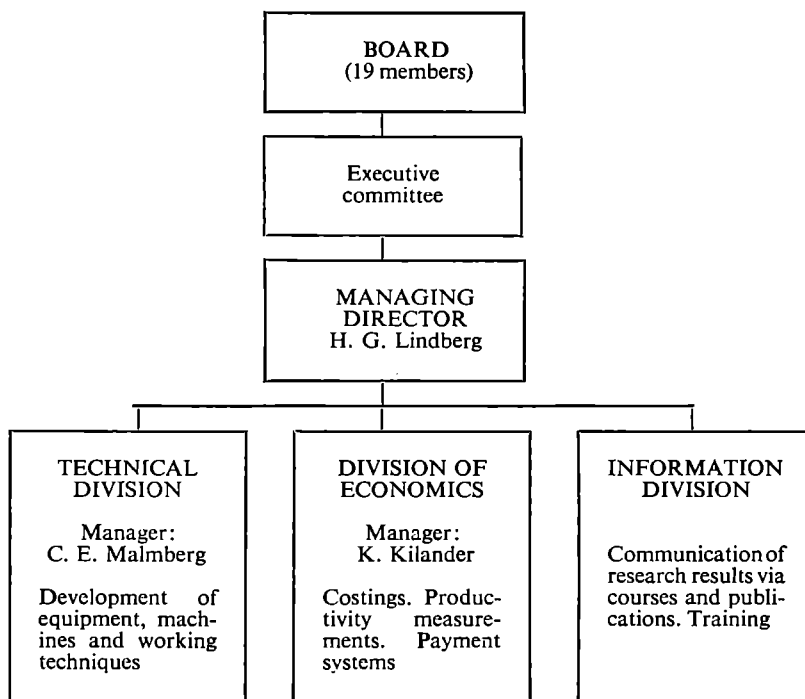


Figure 2. The Logging Research Foundation as organised on January 1, 1964.

technics, radio engineering and electronics, and their applicability to logging operations. Another important phase of research is to determine human behaviour in different work environments.

The choice between the present and the future development projects is made with regard to their potential applicability. At present, there is a distinct demand for the rapid mechanisation of the branching. Here organisational and technical aspects of mensuration will be studied. In the development of logging vehicles, consideration must be given to the proper balancing between on- and off-the-road transports and its consequences on the layout and standard of roads.

Division of Economics (Manager: K. Kilander). This division is concerned with the economic aspects of logging, its investments, etc. Questions to be dealt with here refer to decision-making, calculation techniques and control of the logging process. Increase of mechanisation in logging will result in a number of administrative problems relating to piece rate setting, cost control, etc. In this field, the division will develop basic principles and collect data of mutual interest to the sponsors. The division will also supply information to those involved in central bargaining on wages.

For work studies carried out by members, the division will offer advice in planning and assist in data processing.

Information Division. The task of the information division is to communicate research results to interested parties via publications, courses and information sessions, and also produce films, photos and slides.

Publications are divided into several series, each with different aim and circulation. Most of the series are concise and easy to read. Only one is more comprehensive and ambitious; as a rule, it is provided with a summary in English.

Courses are confined to forest engineers, executive staff members, specialists and teachers, while the other categories of personnel and smaller forest owners are taken care of by respective employers or other agencies.

Last but not least, the Logging Research Foundation is interested in establishing contact and in maintaining collaboration with similarly affiliated institutions not only in Sweden but throughout the world. Thus it would welcome an exchange of publications with these institutions. Inquiries about this new research unit should be addressed to Logging Research Foundation, Information Division, Postsack 20, *Bromma* 15, Sweden.

Work Programme 1964

TECHNICAL DIVISION

1. Unconditional research
Towards the end of this year a special group will be formed for an unconditional investigation of future logging methods.
2. New development of logging methods
In collaboration with the working groups set up by member companies for new developments of logging methods, the technical division will approach the following problems:—

21. Processing at the stump
 211. Different procedures for a mechanical processing system where branching of standing or felled trees is carried out at the stump.
22. Off-the-road transport
 221. Skidding of tree-lengths and full-trees; an inventory and description of present methods and machines with special regard to types of organisation.
 222. Brief review of an earlier inventory of different types of chokers used in skidding.
 223. Improvements of methods and equipment in one-man-skidding of tree-lengths and full trees.
 224. Transport of timber cut to length by wheeled tractors and comparison with conventional methods.
23. Processing at upper and lower landings
 231. Inventory, description and review of methods and production in processing tree-lengths and full-trees with power saw at landings (in connection with projects under heading 221).
 232. Processing machines for tree-lengths and full-trees, designed for operation at landings. A comparison will be made between now available machines, and data will be collected on different element times as a basis for the design of processing machines.
24. On-the-road transport
 241. Transport of tree-lengths and full-trees; a model study to illustrate road standards for different vehicle combinations and load lengths.
3. Further development of conventional logging methods
 31. Processing at the stump
 311. Continued studies of simplified logging techniques by using power saws for branching and other aids.
 312. Testing of new power saw models, adapted to the techniques above, in collaboration with the National Swedish Testing Institute for Agricultural Machinery.
 32. Off-the-road transport

In attempts to adapt the available machines and equipment to a larger transport capacity, the division will concentrate upon a rapid communication of method and machinery improvements to members. Films (8 mm.) and other efficient visual aids will be used to a larger extent than before.
4. General technical questions
 41. Experts will be appointed for the development and standardisation of tyres and tractor tracks.
 42. Different kinds of measuring instruments and testing devices are required for functional tests of machines and equipment, and also for a certain type of data collection in connection with studies and practical operation. The technical division is responsible for the development and testing of devices which are assumed to become valuable aids for development and control. One of the divisions' technicians will specialise in this particular field. Among the apparatuses of current

interest are dynamometers and various instruments for recording vehicle activity in off-the-road transport by tractor and in integrated mechanical processing at landings.

5. Other questions

Earlier investigations to be concluded or reviewed refer to power saw felling, horse haulage, loading on to trucks, mechanical barking, off-the-road transport by tractor and transport by winch.

DIVISION OF ECONOMICS

1. Production in felling and skidding of full-trees and tree-lengths

The results will be used as a basis for piece rates and also for various types of costings.
2. Production in transportation of logs by tractor

The results will be included in the training material at courses on piece rate setting but they may also be used for planning of operations.
3. Mechanised branching

Organisational questions, investment costs versus output required, etc., will be studied.
4. Machinery investments in Swedish forestry

Need of investments, batch sizes of machines, etc. will be discussed.
5. Machine maintenance in mechanised logging

Organisational problems, need of standardisation, etc. will be investigated.
- 6-7. Methods of planning and control of logging operations

Mechanisation will result in a number of problems relating to piece rate setting, cost control, etc. In this field, the division will develop basic principles and collect data of mutual interest to members. The possibilities of using modern calculation and data processing techniques will be considered.
- 8-9. Wage agreements

The division will supply the employers associations with basic information to be used in central bargaining on wages. The main task in 1964 will be to change existing agreements in parts of Central Sweden in order to achieve administrative savings.
10. Work study

For work studies carried out by members, the division will offer advice in planning and assist in data processing.

INFORMATION DIVISION

1. Publications

Nytt från Skogsarbeten, flygblad (Logging Research Foundation News: Leaflet):
notes on the current activities of the Foundation and other news items of interest to members.
Nytt från Skogsarbeten TEKNIK (Logging Research Foundation News: TECHNIQUES):
brief research reports from the technical division.
Nytt från Skogsarbeten EKONOMI (Logging Research Foundation News: ECONOMICS):
brief research reports from the division of economics

Nytt från Skogsarbeten REFERAT (Logging Research Foundation News: ABSTRACTS): reviews and notes compiled from world literature.
Redogörelser (Reports): detailed accounts of investigations intended for limited circulation.
Meddelanden (Bulletins): comprehensive and ambitious accounts of larger investigations, usually with summaries in English.

Manuals, instructions, guides, etc. for training purposes.

2. Training

Courses for forest engineers, executive staff members specialists and teachers.

3. Training aids

Production of photos, slides, films and other training aids.

Part IV Appendix III

TABLE 7.

POINTS TABLE FOR WINTER LOGGING

<i>Difficulty factor</i>	<i>Degree of Difficulty</i>				
	<i>S1</i>	<i>S2</i>	<i>S3</i>	<i>S4</i>	<i>S5</i>
<i>F1</i> Branchiness	Very short crown with fine branches -4	Short crown with fine branches -2	Normal crown with normal branches ± 0	Long crown with hard or thick branches +2	Very long crown with hard thick and/or dense branches +4
<i>F2</i> Length and form	Very long and well-formed forest -2	Long and well-formed forest -1	Normal length and form ± 0	Short and poorly formed forest +1	Very short and poorly formed forest +2
<i>F3</i> Terrain and soil conditions	Flat or slightly undulating terrain -1	Somewhat undulating or stony terrain -1	Terrain with normal undulation and stoniness ± 0	Steep or very stony terrain +1	Very steep or very stony terrain +1
<i>F4</i> Undergrowth and/or other obstacles for felling	No obstacles -1	Some obstacles -1	Normal in regard to obstacles ± 0	Difficult obstacles +1	Very difficult obstacles +1
<i>F3</i> Volume of the marked trees in cu. metres per hectare	Very dense marking 76 cu. m. or more -1	Dense marking 51 to 75 cu. m. -1	Normal marking 34 to 50 cu. m. ± 0	Scattered marking 21 to 33 cu. m. +1	Very scattered marking 10 to 20 cu. m. +2
<i>F6</i> Condition of the forest	Sound forest -1	Only slightly damaged forest -1	Slightly damaged forest ± 0	Damaged forest +1	Badly damaged forest +1

TABLE 8.

CONVERSION OF POINTS INTO DIFFICULTY CLASSES

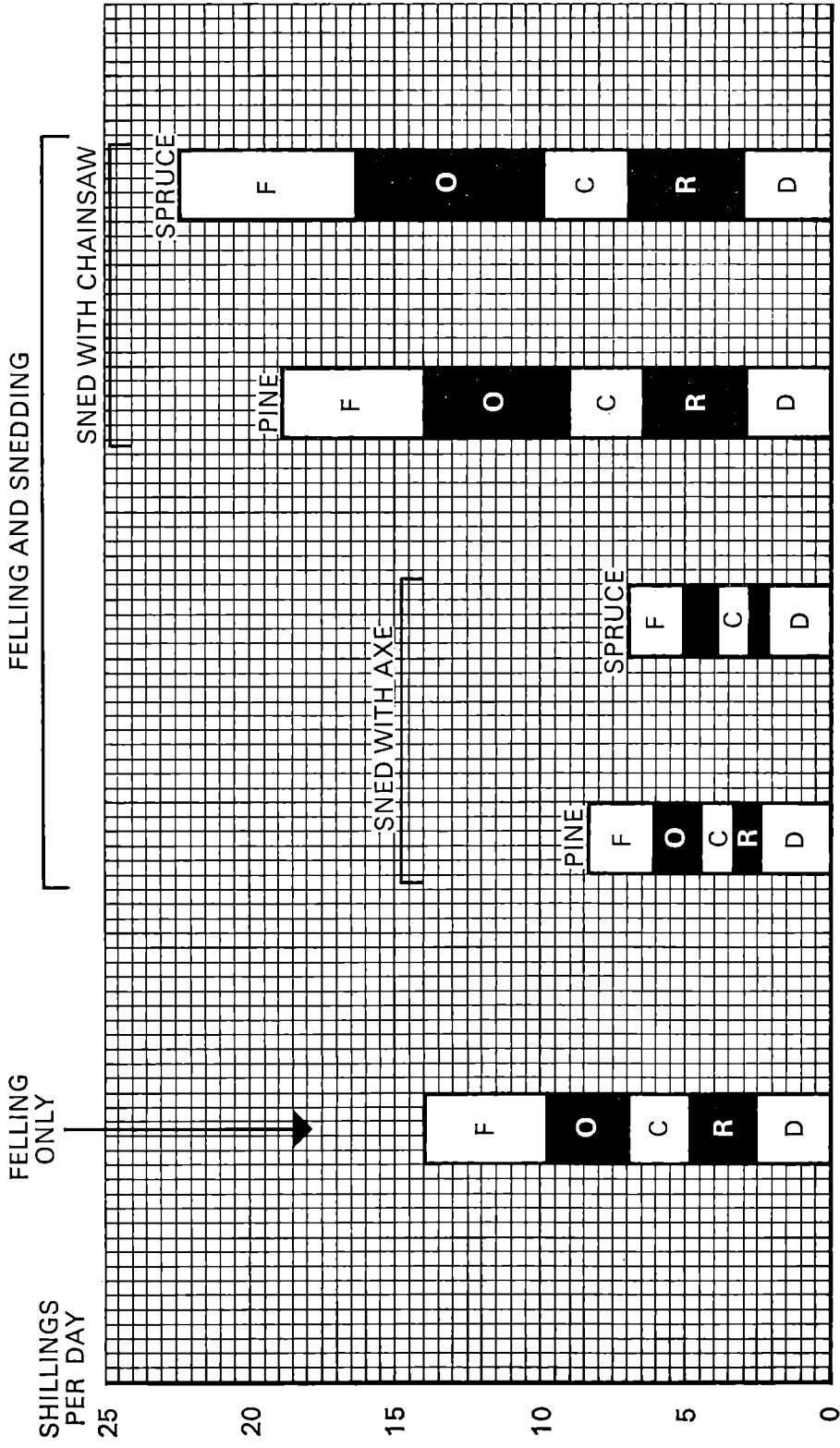
	<i>Difficulty Class</i>			
	<i>AB (90)</i>	<i>BA (95)</i>	<i>B (100)</i>	<i>C (113)</i>
<i>A (86)*</i>				
-to -6	-5½ to -4	-3½ to -2	-1½ to +1½	+2 to +4
				+4½ to +6½
				+7 to +9

Note * Numbers within brackets refer to wage differences in per cent.

Part IV. Appendix No.IV

Chainsaw Costs

From Swedish Data Published By Skogsarbeten



F = FUEL

O = OIL

C = CHAINS

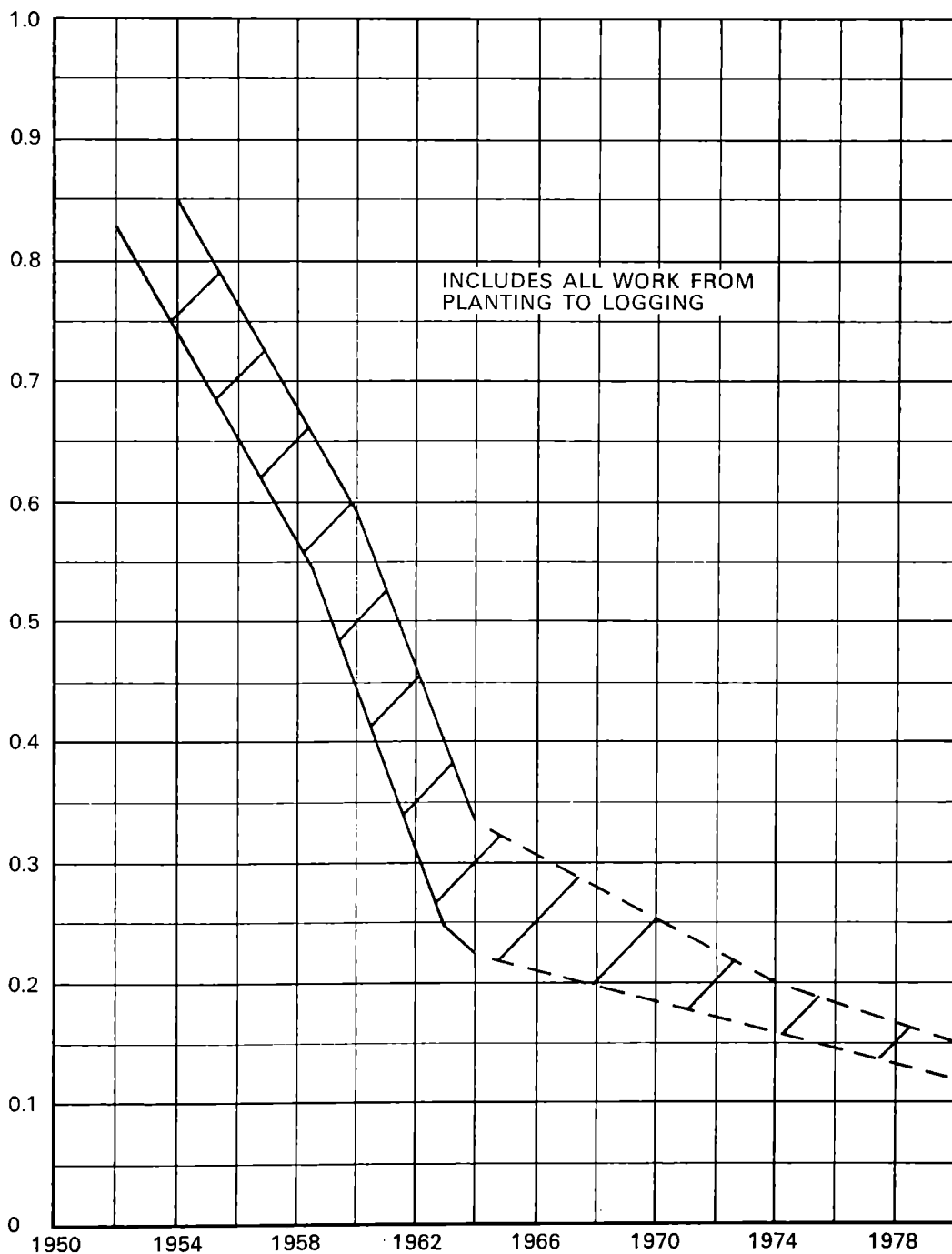
R = REPAIRS AND
MAINTENANCE

D = DEPRECIATION
AND INTEREST

Part IV. Appendix No.V

Labour Productivity in Sweden

MAN DAYS
PER M³



Part IV Appendix VI

Timber Measures and Abbreviations used in Sweden

Common Measures

M^sSK = *SKOGSKUBIKMETER* = Solid cubic meters over bark, usually of standing trees = 27.74 hoppus feet.

M^sf = *KUBIKMETER fastmatt* = Solid cubic meter under bark = 27.74 hoppus feet under bark.

M^st = *KUBIKMETER travatmatt* = Stacked cubic meter = .65 — .7 M^sf = 18 — 19½ hoppus feet.

f^str = *KUBIKFOT topprotmatt* = True cubic foot = .785 hoppus feet.

Less Common Measures

f^sto = *KUBIKFOT toppmatt* = Cylinder cubic foot using top diameter and length and ignoring taper.

f^sfl = *KUBIKFOT flottningskubik* = Cubic foot used in floating.

Other Terms

hb = *helbarkad* = fully barked (every particle of bark removed).

ob = *obarkad* = unbarked.

tb = *randbarkad* = barked in strips.

pb = *pä bark* = overbark.

ib = *inom bark* = underbark.

Part V

MACHINES AND EQUIPMENT USED WITHIN THE FOREST

By R. B. Ross

Introduction

In Sweden the cost of labour is high, therefore in the past decade emphasis had been placed on mechanising every possible forest operation, especially in harvesting and thereby increasing productivity per man.

Nearly every senior forest officer we met showed us a graph roughly similar to that in Appendix II, page 68, showing how labour costs in most forest operations and especially in harvesting are increasing at a faster rate than machine costs and forecasting probable trends for the future. All were agreed that a high degree of mechanisation is required at present and a still higher degree will be required in the future to keep production costs down.

It will be seen from the description of the Sund System given in Part IV that the present cost is higher than for more conventional methods, but on present trends of labour costs, the Sund System should break even by 1967. This emphasises how the Swedes take a long term view of their mechanisation policy.

The graphs shown in Appendix II, page 68, show the average labour costs and machine costs in North Scotland and South Scotland over the years 1960 to 1964 inclusive. The machine costs show the average rate of increase in costs using a variety of machines over the same period. The trend is shown in the same manner as the Swedes show it but it is interesting to note that in the past they have under-estimated the increase in labour costs.

Six Basic Types of Extraction Machines

The extraction machinery used in Sweden falls roughly into six basic types as shown by the simple line sketches in Appendix III, page 69. An attempt has been made below to show daily average outputs of these machines but obviously this varies greatly with conditions, length of haul etc., but the figure will give a guide to the relative outputs of the various machines. We should try to forget any preconceived notions that we may have about half tracks and three quarter tracks as we know them in Britain. These modern Swedish machines, when used in conjunction with the appropriate trailer, and suitable hydraulic equipment for steering, weight transfer and linking of tractor and trailer, have a better cross country performance than the writer would have thought possible. Types 1 to 5 are used for one man operation of loading, hauling and unloading of timber in thinning or clear felling. Type 6 is used largely in clear felling with a choker man to assist the driver in loading.

Type 1

This is an agricultural tractor of about 35 BHP fitted with a simple boom loading crane and tyre chains, usually coupled to a single axle trailer, often fitted with hydraulic weight transfer from trailer to tractor to assist tractor wheel grip when necessary and a hydraulic ram to lock tractor and trailer for stability during loading. An example is shown in plates 20 and 21. Plate 20 shows a large log being lifted with the crane with the hydraulic ram at arrow A in use stabilising the tractor. Plate 21 shows the result when the hydraulic pressure is released from the ram at arrow A.

This type could be useful for those who need to use a tractor for agricultural purposes for part of the year and for timber extraction at other times during the year.

Carrying capacity 3 to 4 tons.

Approximate average daily output 700 hoppus feet.

Type 2(a)

This type consists of an agricultural tractor fitted with half tracks and bogie trailer, hydraulic rams to transfer weight to front wheels and to lock tractor and trailer for stability during loading, and sometimes fitted with a hydraulic winch, usually with remote control, and hydraulic slewing is fitted. The more common type of remote control is through an electric cable, the cable being on an automatic spring loaded reel mounted on the tractor so that the operating switches at the running end of the cable can be attached to the operator's belt. He can then do his own hitching, ground skidding, hauling and unhitching without moving to and fro to the winch controls on the tractor. An alternative but not so popular method seen was radio control but this is more expensive and less reliable. This would generally work on more difficult terrain than type 1.

Carrying capacity 6 to 10 tons.

Approximate average daily output 750 hoppus feet.

Type 2(b)

This is just the same as type 2(a) but a hydraulic grapple crane is used instead of a cable crane. There is usually a remote controlled hydraulic winch also, largely used for bringing timber within reach of the grapple. Output is usually appreciably higher with the grapple crane.

Carrying capacity 6 to 10 tons.

Approximate average daily output 1,000 hoppus feet.

Type 3

In this type a 50–65 BHP tractor extensively modified, strengthened and shielded, is fitted with three quarter tracks. These tracks are usually fitted with hydraulic rams to each idler, interconnected so that track equalization can be achieved and arranged so that the nose of the tractor can be raised or lowered at will. The steering is by hydraulic tail steering, this permits most of the available power to be applied to the tracks while steering, whereas a normal crawler tractor with clutch and brake steering has only about half the available power transmitted to the tracks while steering. Additionally the tractors can sometimes be “waggled” over an obstruction or out of a bog. The machine is also fitted with hydraulic grapple crane, front mounted hydraulic remote controlled winch and hydraulic lock to a bogie trailer. Tracks can be fitted over the bogie trailer wheels if required for soft conditions.

These are rugged machines able to achieve high output over very rough terrain.

Carrying capacity 8 to 12 tons.

Approximate daily output 1,300 hoppus feet.

Type 4

An extended articulated frame steering machine of about 55 BHP with a hydraulic motor drive to the rear wheels which can be engaged at will. It is fitted with a hydraulic grapple crane. Chains are sometimes fitted to the tyres. Output on rough terrain is similar to that obtained with type 3, but it is probably not so good on very soft conditions.

Carrying capacity 9 tons.

Approximate daily output 1,300 hoppus feet.

Type 5

This is a further development of type 4. This type of machine is of about 65 to 90 BHP with hydraulically actuated friction drive to rear bogie. The bogie makes for better stability on rough terrain; this is necessary because the centre of gravity is high when a full 12 ton load of 3 metre lengths is carried. This is a first class machine with very high output and good stability. We understand only 5 have been produced so far and a lot of development work is still taking place. We in Britain should watch this development and get further information as development proceeds.

Carrying capacity 12 tons.

Approximate daily output 1,500 hoppus feet.

Type 6

This is an articulated frame steering, ground skidding tractor of about 60 BHP usually used for full length or full tree logging on clear felling. Chains are sometimes used on the tyres. Able to negotiate very rough terrain.

Approximate daily output 1,800 hoppus feet.

A further type not shown in the type 6 is that of a normal crawler tractor fitted with open spaced linked tracks and bogie suspension. This is vastly superior to a normal crawler for negotiating rough terrain and when fitted with a grapple crane has the advantage over the three quarter track types in that it can be used also as an independent loader without trailer. It does not however have the advantage of the three quarter track with tail steering which allows full power whilst turning.

It is understood that two of these machines have been tried in Ireland on peat ploughing without the complete success that had been hoped for. See Appendix III, page 60.

Isachsen Skaukatt

(See Appendix IV, page 70.)

This is a means of modifying a standard No. 3 Isachsen winch, such as the Forestry Commission normally uses, to extend the range from 180 yards to 320 yards. The Skaukatt (Flying Cat) is a carriage for use with a Skyline. One is ordered for comparative testing with other skyline developments.

Description

So that the standard Isachsen winch drums can accommodate more steel wire rope, the wire rope size is reduced and a third heavier skyline wire rope is used to carry the load, the haul-in and haul-back wire ropes are merely used to move the carriage. However, as the haul-in wire rope has normally to be used to lift the load and haul-in from the side the lighter wire rope would not be strong enough to do this.

The carriage has therefore been designed so that it has two bollards (A and B in diagram, Appendix No. IV) arranged so that when bollard A (which holds 120 metres of haul-in wire rope) unwinds, the 3:1 reduction chain drive provides nearly 3 times the pull on bollard B which holds 40 metres of slightly heavier wire rope to pull the load in from the side and support it, this pull being transmitted via the carriage to the heavier skyline.

The set-up is as shown in the upper sketch in Appendix IV, page 70.

Hydraulic Cranes**Grapple Cranes**

The two main makes of cranes we saw were Hiab (Hydraliska Industries A.B.) and Osa (Östberg Fabriks A.B.). We have experience with Hiab cranes in this country but we have not used Osa cranes here. Osa cranes are made largely for mounting on tractors or trailers.

Mr. Brynte, a logging machinery expert of the Swedish State Forest Service thought that for mounting a crane on a lorry and loading from large piles, the Hiab was more suitable, but for mounting on a tractor loading from small piles in the wood the Osa was probably preferable.

Note the mounting on top of the safety frame and the design of the grapple with its horizontally mounted hydraulic actuating ram. This permits higher loading height for equivalent boom length. While the Osa crane lifts less per load it operates at a faster rate and is more suitable for loading from small piles.

Wire Rope Cranes

There are a number of these cranes made by several manufacturers used in Sweden, the Osa 39 is typical of these. (See Plates 20 and 21 for an example)

On this type the lifting is done from a front mounted winch and the slewing is by hydraulic ram. These cranes are usually one man operated, commonly with remote electric cable control, or occasionally with radio control. A device on the underside of the boom enables the operator to put the tongs at a reasonable distance between the centre of gravity of the log and the butt, instead of having to find the exact centre of gravity which would be more time consuming.

Winches

There is a number of different manufacturers of these, the more common types being hydraulic—which makes for easier remote control. Simple and cheap friction drive winches have also been devised for use on agricultural tractors particularly in Norway.

Light Frame steering Articulated Tractor

The Holder Tractor, which was seen in use in Norway, is a light 20 BHP frame steering articulated machine. The Forestry Commission has purchased one of these tractors. It is of German manufacture.

Roads

Although there is plenty of rock in Sweden which could be quarried and which would be suitable for road construction, road construction is made easier by the fact that abundant supplies of suitable coarse and fine gravels are usually available and often at roadside or close at hand. There is a tendency, owing to ground conditions, to do more filling and less cutting than in British forest roads. An average

road spacing used in Swedish forests is of the order of $1\frac{1}{2}$ miles to the square mile (9 kilometres per hectare).

The following formula is used by the Swedish State Forest Service:—

$$a = \sqrt{\frac{y}{p t_o}}$$

Where: a = average extraction distance in metres

$$y = \text{road cost} = \frac{\text{Capital cost}}{12} = \text{average}$$

annual maintenance cost over a 10 year or a 12 year period

p = M.A.I. (Mean Annual Increment) in cubic metres of roundwood per square kilometre

t_o = Cost of transport within the wood in Swedish kroner per cubic metre of wood per kilometre

Need for Trained Machine Operators

Swedish extraction machines are generally fairly versatile, complex, of high capacity and expensive but are designed to minimise the manual labour element in work which they do. It is essential therefore that the operators be highly skilled in order to make best use of machines. To this end schools have been set up to train machine operators. Courses are usually of about six months duration and, apart from being taught the best methods of machine usage for high output combined with adequate safety, operators are given a very thorough course on machine maintenance. A used machine of common type is completely dismantled and overhauled under supervision.

Safety Regulations

Swedish regulations lay down that all tractors, wheeled or tracked be fitted with safety frames and that all who work in the forest wear safety helmets. The development of one-man logging systems means that the one man driving a tractor and performing all logging operations is alone. The noise of a tractor's engine would mask his call for help in emergency. Swedish employers and workers trade union agree, however, that it would be most dangerous to have a second man moving about the machine and who would be liable to be injured by moving logs, steel wire rope, crane or tractor, than to have one man who alone would be in complete control.

Sweden

The main trend is to develop and use high quality rugged machines suitable for all year round use in

forests, having high output and giving high productivity per man. The tendency is for small forest owners to combine to share a high output machine or to employ a contractor with a high output machine.

Agricultural tractors are also modified for dual purpose use partly in the forest and partly in agriculture but this is not the general trend.

Cable extraction is not commonly used in Sweden. The future trends would appear to be to develop combine harvesting types of machine (Sund, Vitt and Beloit) and larger more powerful timber carriers (Drivax) and skidders (Timber Jack, etc.). Swedish machines are relatively expensive to buy but if fully used with highly skilled operators who are given sound and adequate incentives, can give very reasonable extraction costs.

Norway

The trend in Norway is to use less complex, smaller and cheaper machines which can be used in the forest and also in agriculture. Although cable extraction is used extensively the trend is to use tractors wherever possible as extraction costs are then generally much less. Although Norway is mountainous, Norwegian foresters tend to work on the principle that if the tractor can get up the hill empty it will get down loaded.

It is difficult to evaluate Swedish and Norwegian machines in a short visit even when seeing them under their own working conditions; it is even more difficult to know how effectively they would perform, and at what cost, under British conditions. The Scandinavians, for example, do not extract over soft bog conditions; they just leave these areas until the ground freezes over in winter. Their forest soils generally are more freely drained than ours, and the need for artificial drainage is less.

Conclusions and Recommendations

One of the most common methods of extracting timber in Sweden is that shown in Method 1 of Appendix No. 1 in Part IV. The Forestry Commission has had a limited success using this method on the Black Isle in Scotland with a County Super 4 with a Hiab hoist and trailer, but the Swedish equipment appeared to be better suited for this method, so various Swedish machines have been considered for trial under British conditions.

Four machines appeared to be worth considering, the Drivax, the B.M. Volvo Nalle, the Brunett and the Massey Ferguson Robur. These are referred to below.

The Drivax (Type 5)

This has the highest carrying capacity and possibly the best cross country performance of the four machines. It is, however, a new machine; only five had been produced to our knowledge at the time of our visit. As substantial changes were still being made to the design of the machine (larger engine, etc.) it was felt we should wait a while longer until this machine was fully developed and had got past the teething trouble stage. It is important to keep abreast of developments of this type of machine as it holds out great promise.

The V.S.A. Brunett (Type 4)

This is a good machine, well tried and tested, but it was felt that, under conditions in the coniferous forests in Great Britain, tracks would be advantageous, and that the lack of a rear bogie would make a fully laden machine more susceptible to overturning when operating on a side slope.

The B.M. Volvo Nalle and Massey Ferguson Robur Tractors with Trailers (Type 3)

These are two very similar machines doing the same job. The Nalle possibly has the more suitable crane for loading the trailer but the Robur's advantage in having its engine and most of its transmission based on British tractor parts probably outweighs the possibility of the Nalle having a more suitable crane, at least so far as the Forestry Commission is concerned.

The Commission has ordered a Robur tractor and this will be tested.

Holder Tractor

Another method which might be suitable for extracting thinnings is that of using a small articulated frame steering tractor fitted with winch which can replace horses for extracting tree lengths or the longest practicable lengths. We saw the German Holder A.20 tractor doing this job in Norway. The Forestry Commission arranged a loan of one of these machines from the British distributor and it was found to be promising enough to justify buying one. Initial trials in the Border forests indicate that it will perform in conditions where a horse might be used, with considerably higher output than a horse and at lower cost. Further cost reductions should be attainable once all other related operations have been designed to suit the machine.

Isachsen Skaukatt

Another Norwegian development seen was the Isachsen Skaukatt (Page 3 and Appendix IV). The Skaukatt equipment increases the range of the standard No. 3 Isachsen winch from 180 yards to

320 yards. As the increase in range could affect decisions on road spacing, we thought it essential to have one of these machines (cost about £100 above the normal Isachsen No. 3 winch) for testing in a Commission forest as soon as possible; a machine was therefore ordered. Mr. Isachsen has been modifying the Skaukatt further so that the carriage can pass over a support shoe if required, and further developments will be watched with interest. The Commission has meanwhile developed a promising skyline which will be compared with the Skaukatt.

Other Machines

Other machines which were considered worthy of trial in Britain have just been delivered and include the Norwegian Isachsen Kombi double drum winch and a set of Swedish tractor half tracks with hydraulic control, forest fenders, and tractor safety frame. They have been mounted on a Massey Ferguson 165 tractor for initial trials at Kielder Forest. The principle of operation is as follows:—

The machine is largely intended for ground skidding, the double drum winch being better than a single drum winch, especially when hauling smaller trees. Norwegian type chain chokers are fastened to the felled and snedded trees which are winched up to a hydraulically controlled back plate on the tractor. The tractor then drives off along a tractor track to the road. To deal with difficult parts of the forest which the machine cannot reach, the same equipment can be used as a normal Isachsen cable crane with a range of nearly 90 yards. This machine will also test the Swedish $\frac{1}{2}$ tracks and hydraulic controls under our conditions.

Adaptation of Agricultural Tractors

Another field where we can learn a lot from the Scandinavians is in the best use of an agricultural tractor, suitably modified, and fitted with ancillary equipment so that it can perform a dual purpose role. This should be of particular interest to the private sector in Britain. To this end we are modifying a Massey Ferguson 35 agricultural tractor by making and fitting items as follows:—

- (a) A bogie trailer with a 5 ton carrying capacity.
- (b) A simple boom crane worked from a winch mounted on the tractor.
- (c) Hydraulic control, so that the tractor and trailer can be stabilised during loading; also so that weight transfer can be made from the trailer to the tractor driving wheels.
- (d) Fit "Sharp" shoe type chains to tractor driving wheels.
- (e) Fit guards to tractor wheel valves, radiator, sump etc., to enable the machine to stand the rough usage it would inevitably get in the forest.

If such a machine proved to be of practical use to private woodland owners, it could be moved to different parts of the country to demonstrate what could be done with simple equipment suitably modified and used correctly, as in a country where "farm forestry" has been, and is, successfully practised.

Improved Loading of Vehicles

Some recommendations which might contribute to improved loading of vehicles are made below.

Mount an O.S.A. crane on a suitable forest tractor, and test it in British conditions.

Independent Loader

When an independent loader is needed it will be worth copying the Swedish idea of mounting a hydraulic crane on an old lorry. The actual work performed by the vehicle itself would be very little and a tipper lorry, say, which might no longer be economical for hard work as a tipper could perform adequately when used as a crane carrier.

Some General Observations

Once the Commission knows its future felling programme in a region it should be decided whether an articulated frame steering machine would be best for this job. If it is decided that such a machine is needed the first question is "what power of machine?". Modern Swedish thought suggests 60—70 B.H.P. Available Scandinavian machines are:—

The Swedish Timber Jack, the Swedish Flexor, and the Finnish Valmet. (This is only about 50 B.H.P.).

Additionally there are Canadian and American machines to be considered. A prototype of the British County Tractor which is being tried by the Forestry Commission as similar but of lower power.

Further investigation is needed to decide which machine would be best. Some thoughts which occur are:—

Even with its low power of 37 B.H.P. the County should be considered if it is to be produced. The Canadian International Hough 90 B.H.P. has just arrived in Britain. It would be interesting to try this machine, although it appears to be more powerful than is needed and it costs over £5,000.

Of the Scandinavian machines the Flexor (67 B.H.P.) is based on a British Massey Ferguson 175 tractor, and for that reason spares should be easier to obtain. It is, however, less developed as yet than the Timber Jack or the Valmet.

As a general observation, tyre chains are seldom used in Britain on pneumatic tyres on wheeled tractors, whereas in Scandinavia they are in common use and they have been found in many cases to make

the difference between "go" and "no go". We should therefore emulate the Scandinavians and try tyre chains wherever conditions are difficult.

Machine Operators

When we start using expensive, high output extraction machines in Britain, we will have to give a lot more care and thought to operator training and to ensuring that these men are given sound incentives. The number of men employed on timber extraction will be significantly less with high output machines but those that remain will have to be well paid and carefully selected for their aptitude for the work.

We will also have to plan extraction in much greater detail than has been done and ensure that there is an adequate programme of work ahead for

these machines so that they are as gainfully employed as possible. We will also have to decide what terrains are suitable for summer use only and what terrains can be worked all the year round. The saving in costs when using these machines, where they can work efficiently, are so great that a bold experimental programme to determine their capabilities in British conditions would seem to be well justified.

Need to Adapt British Methods to Suit Swedish Machines

We would have to adapt our silvicultural, management and harvesting methods to suit these machines. It would not be practicable to adapt the machines to any great extent to suit British forestry conditions.

Part V Appendix I

Output of Swedish Extraction Equipment

(See Tables 9 and 10 on pages 66-67)

Introduction

Typical Swedish extraction equipment usually consists of a tractor with crane and trailer but this is considerably adapted and modified for the special function it has to perform. It would be an illusion to expect an agricultural tractor and trailer to do the same work.

The simplest modification shown at A on Table 10 on page 65 is the addition of guards for radiator and sump, tyre chains, overhead safety frame, wire crane and a bogey wheel trailer of 5 ton capacity. B, C and D are progressively more elaborate with $\frac{1}{2}$ or $\frac{3}{4}$ tracks, better wire rope cranes or grapple cranes and larger capacity trailers. All machines have weight transfer equipment and many have tail steering to the trailer. E and F are specially built extraction outfits on large wheels and the Timber Jack is an articulated tractor suitable for skidding tree lengths from clear felling areas.

It should be noted that the figures of output that are quoted include a mixture of pulpwood and logs, a pro-

portion of clear felling and a variety of conditions. Each machine is allocated the work for which it is most suited and it would obviously not be possible to interchange them at random. Extraction distances are generally 300 yards average (i.e. 0 to 600 yards).

Columns 1 to 12 of Table 9 give the actual times run and volumes extracted of 10 extraction outfits for the year 1964 operated by one of the large timber companies, Holmens Bruk. They include some overtime and there is a variation in the number of weeks worked in the year. Columns 13 and 14 show what the outputs might be if the machines worked 8 hours per day and 200 days per year (i.e. a fair average in our conditions in Great Britain, allowing for wet time, holidays, etc.).

Items A to D in Table 10 are based on Table 9 and estimates have been made of the outputs and costs for items E, F and G. The output and cost for an Isachsen winch has been added at H for comparison but it should be noted that this cost is for an average distance of 75 yards (0 to 150 yards) not 300 as in the case of the tractors.

(Mr. E. S. B. Chapman has helped in the preparation of this Appendix).

TABLE 9. OUTPUT OF SWEDISH EXTRACTION EQUIPMENT, YEAR 1964 (From actual records kept by Holmens Bruk)

Tractor Type	Crane Type	Trailer Type	Weeks Worked	Effective Time, Hours	Idle Time		Total Time at Work Place		Volumes in hoppus feet Over Bark				
					Hours	%	Days	Hours	Extracted per Effective Hour	Extracted per Total Hour	Total Vol. Extracted in 1964 (Actual)	Estimated output in Normal hours worked in Great Britain Per day (8 hours) Per annum (200 days)	
1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.
46 HP ½ Track	Osa 59 Wire Crane	Osa 96 10 Ton	50	1849	364	16%	267	2213	114	95	210,000	760	152,000
46 HP ½ Track	Osa 59 Wire Crane	Osa 96 10 Ton	53	2182	364	14%	288	2546	127	109	278,000	875	175,000
46 HP ½ Track	Osa 59 Wire Crane	Osa 96 10 Ton	45	1635	477	25%	243	2112	125	97	205,000	775	155,000
46 HP ½ Track	Osa 79 Grapple	Osa 126 12 Ton	49	2234	513	19%	243	2747	152	124	340,000	990	198,000
46 HP ½ Track	Osa 79 Grapple	Osa 96 10 Ton	48	1422	814	36%	256	2236	169	107	240,000	855	171,000
46 HP ½ Track	Osa 69 Grapple	Osa 96 10 Ton	48	1790	433	19%	262	2223	130	112	233,000	895	179,000
46 HP ½ Track	Osa 69 Grapple	Osa 126 12 Ton	17	714	91	11%	94	805	147	124	105,000	990	198,000
56 HP ¾ Track	Osa 69 Grapple	Osa 126 12 Ton	30	1431	290	17%	174	1721	153	127	219,000	1015	203,000
56 HP ¾ Track	Osa 69 Grapple	Osa 126 12 Ton	32	774	495	39%	153	1269	169	103	131,000	825	165,000

TABLE 10. ESTIMATED EXTRACTION COSTS WITH SWEDISH EQUIPMENT

(The capital costs in Column 2 are very approximate and are probably low in all cases, as guides to costs in Great Britain)

Tractor Make or Type, Crane and Trailer	Capital Cost £	Estimated Hourly Costs			Estimated Average Output in hoppus feet		Cost Pence Per
		Machine Shillings	Driver Shillings Piecework plus Labour Overheads	Total Shillings	Year	Hour	
1.	2.	3.	4.	5.	6.	7.	8.
(A) 35 HP Tractor with Wheel chains, etc. Wire Crane 5 Ton Trailer	545 680 116 211						
(B) 46 HP $\frac{1}{2}$ Track Tractor Wire Boom and Crane Winch and Controls 6 Ton Trailer	1,007 1,173 153 424 245	6.7	11.25	17.95	100,000	62	3.5
(C) 46 HP $\frac{1}{2}$ Track Tractor Grapple Crane Winch and Controls 10 Ton Trailer	1,995 1,173 780 365 450	12.5	12.5	25.0	160,000	100	3.0
(D) 56 HP $\frac{1}{2}$ Track Tractor Winch and Control Grapple Crane 12 Ton Trailer	2,768 2,625 365 780 613	16.7	12.5	29.2	186,000	116	3.0
(E) VSA Brunett with Hiab 176	4,383 6,055	27.3	12.7	40.0	200,000	125	3.8
(F) Drivax	7,000	37.8	12.5	50.3	260,000	162	3.7
(G) Timber Jack	5,600	43.8	12.7	56.5	300,000	187	3.6
(H) Isachsen No. 3 winch for Comparison	545 450	35.0	12.5	47.5	350,000	219	2.6
	995	6.3	(2 men)	28.8	120,000	75	4.6

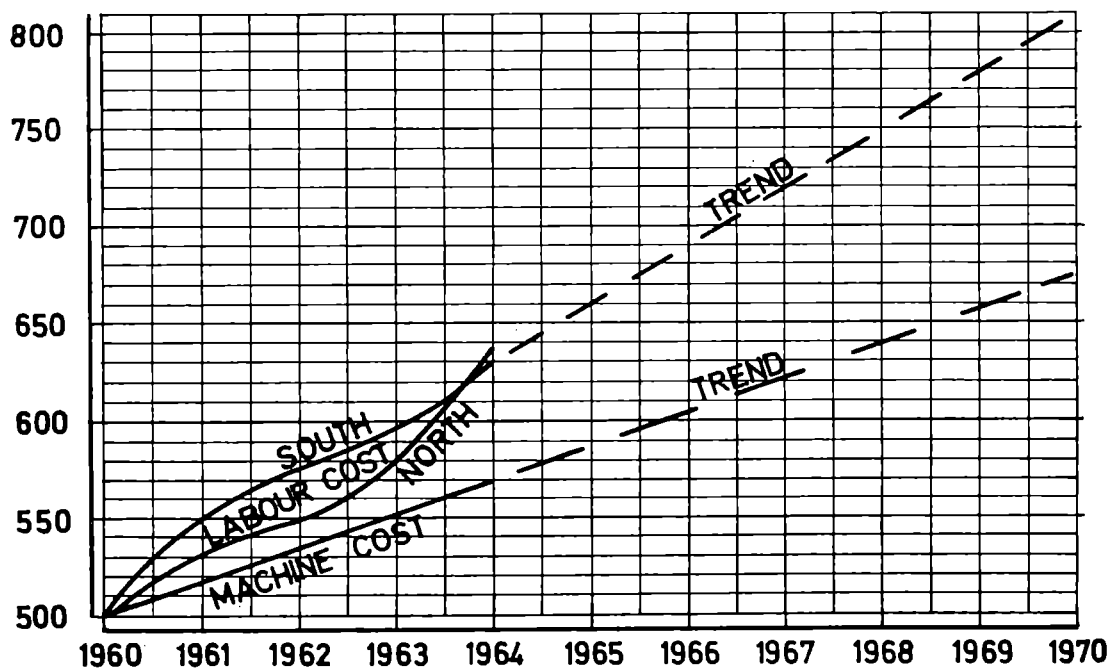
NOTES

- Col. 1. Machines fitted with sump and radiator guards and safety frame.
 Col. 2. A to D and H are actual or quoted prices. E, F and G are tentative.
 Col. 3. Includes depreciation on the capital value of the plus machine operating costs.
 Col. 4. Includes piecework pay + 20/- per day overheads on labour.
 Col. 5. = Col. 3 + Col. 4.
 Col. 6. Based on figures from Table 1 and other data collected in Sweden.

N.B. The estimated outputs are for suitable conditions for each machine and machines are generally not interchangeable in a specific site condition. (e.g. A tracked tractor can be used instead of a wheeled tractor, but not vice versa).

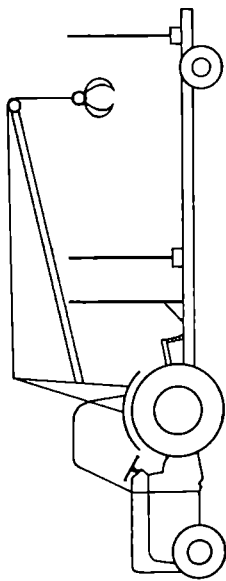
Part V Appendix II

Labour and Machine Cost Trends in Scotland

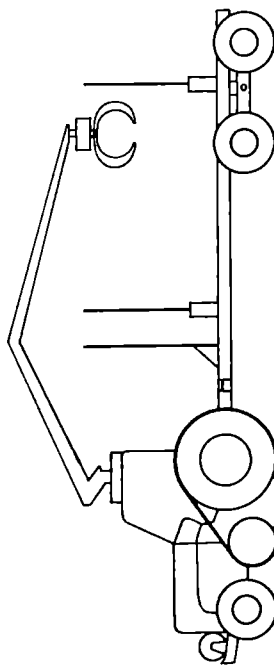


Part V. Appendix No. III **Six Basic Types of Extraction Machinery**

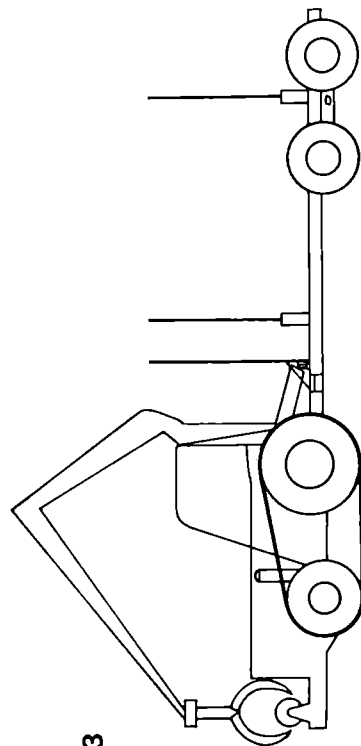
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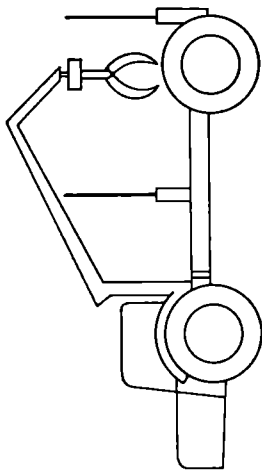
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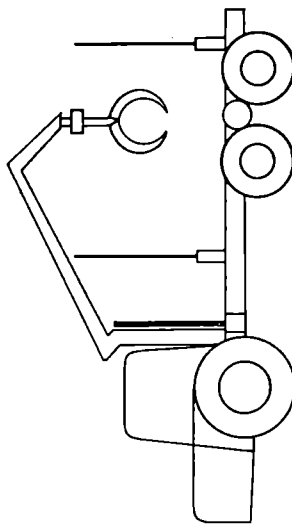
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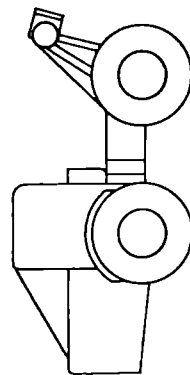
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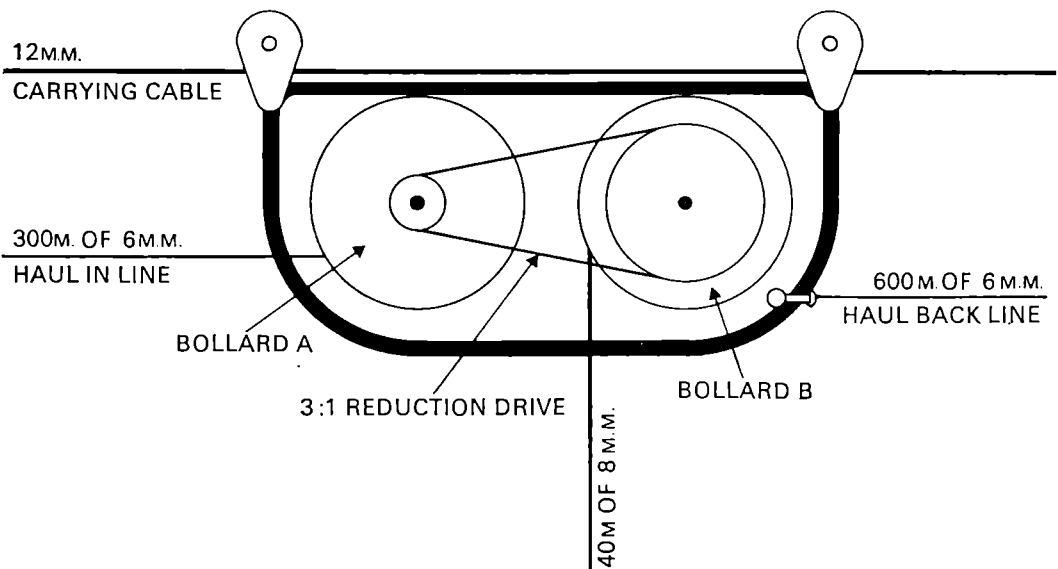
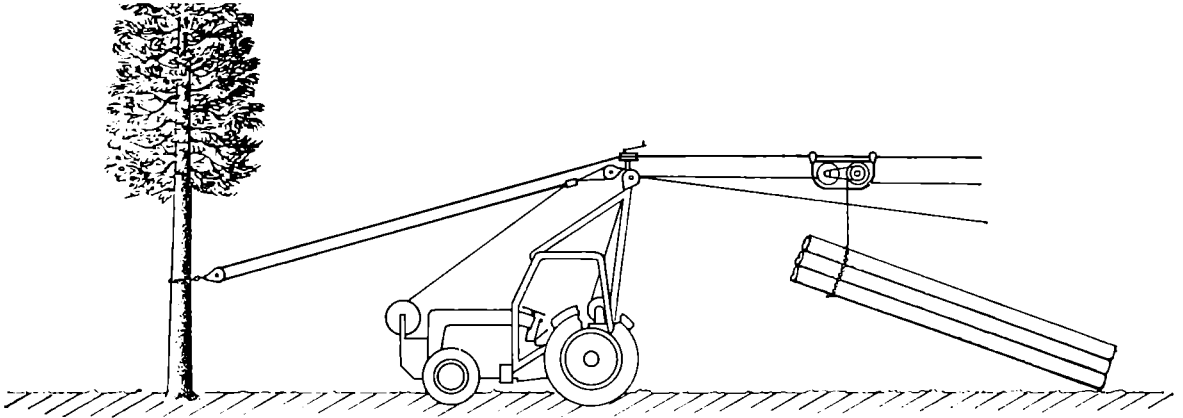
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Part V. Appendix No. IV

Isachsen Skaukatt

Range 300M.



Part VI

DESIGN AND DEVELOPMENT OF MACHINES AND EQUIPMENT USED OUTSIDE THE FOREST

BY B. W. HOLTAM

Introduction

Nearly all work done within the forest has been relatively expensive. If current developments in mechanical harvesting are to have maximum effect in increasing productivity and in reducing costs then the harvested wood must be removed from the forest as rapidly as possible. The speed of harvesting is becoming so great that close co-ordination of harvesting and transport of wood away from the forest is essential. Time and money spent on cross cutting in the forest, at roadside or in stacking grounds at the forest are considered to be relatively wasteful, and delays at stacking sites disrupt the smooth flow of wood to consumers. The benefits of whole tree and of tree length logging could be greatest if the tree lengths could be transported from the forest to the consumers, who would then need to integrate more closely for receiving, cross cutting and using the trees. This is what is happening in Sweden.

The main developments that have already taken place have been made by those companies which have both pulpmilling and sawmilling interests and which own forests.

Log Handling Equipment

A small but well known firm of design and consulting engineers in Sundsvall, Ingenjörfirma Stig Morenius A.B., (recently taken over by Kockums of Malmö, who have also taken over Söderhamns) has designed log handling and cross cutting equipment that is of great interest in this connection, and is already installed in 10 places in Sweden. The first such equipment was installed in 1962 and many improvements have been made since; we were shown one of the latest installations at a yard which received tree lengths and despatched spruce and pine sawlogs and pulpwood of both species. The yard near Sundsvall was owned by Wistavarfs/A.B. who also own sawmills and sulphate pulpmills in the vicinity. They first leased and then bought the log handling equipment and now require two more installations. Plates 35 to 42 illustrate this installation which is described below.

A Modern Log Handling Depot

Tree lengths arrive in the yard on a well designed pole wagon which is unloaded by undoing the securing chains and bolster pins on one side, when a Bolinder Munktell 225 tractor fitted with a hydraulic grab pushes the load off the lorry in one operation. The tractor can work well into the load

between the bolsters. The whole operation takes only a few minutes.

The tractor also transports loads of trees 12 to 15 metres long, (say 39 feet to 50 feet) to a moving platform on which single logs are then moved sideways by five chain drags—each operated by a separate electric motor—which has independent control. The logs are thus moved into the single line conveyor for cross cutting, sorting and barking. Logs up to 20 metres long (say 66 feet) can be handled.

Tree lengths are moved sideways to the conveyor line by the only other man, apart from the tractor driver, in the yard; he also controls all subsequent operations by pushbutton control from a cabin which gives him a view of the logs at a time when he can decide where they should be cross cut. Trees are stopped momentarily as they are cross cut at pre-determined points by a hydraulically controlled pendulum saw; push button control of hydraulic arms also enables the operator to throw out of the line to either side logs of the different species, pine, spruce and birch. Pulpwood lengths continue in the line to a Cambio 35 barker which is capable of handling lengths up to 27 feet and diameters up to 12 inches. The Cambio also is under push button control, and logs which find difficulty in entering the Cambio machine can be made to do so by remote control. Sawlogs are not required to be barked until just before they are sawn, otherwise they split and check; pine logs develop blue stain more easily if barked too soon before sawing.

Cross cutting can deal with 60 metres lineal through-put in a minute and the Cambio 35 (which only receives the pulpwood) can deal with 48 metres a minute. The plant can deal with 1,000 whole trees in 8 hours. It cost 200,000 kroner, about £14,000.

Another similar plant installed at a cost over £21,000 was capable of putting through some 12 to 18 kilometres of logs in 8 hours allowing a space of 2 to 3 metres between logs, (say 7½ to 11 miles of logs with 6 feet to 10 feet between logs), again occupying only two men. The man controlling the conveyor system can pre-set his controls and so provide for production to continue while he goes home for lunch!

The erection of the plant requires no nuts and bolts and no concrete foundations; logs laid horizontally are used instead. The plant can be dismantled, transported 20 miles and be re-erected and begin operating again within one and a half days.

There is no reason why, if necessary, a chipping machine should not be fitted into the production

line after the Cambio barker, and chips could then be fed by pipe or other means to mill or loading bays. Subsidiary lines could also be built in to deal separately with individual species, or for chipping the slabs of sawlogs.

The operator also records the whole of his throughput by species, log lengths and pulpwood.

Other firms are developing similar equipment.

It is thought that one of the best prospects for speeding up the throughput might be to design and develop saws for cross cutting batches of 20 to 40 trees at a time.

Another plant of somewhat similar design was seen at the sawmill and sulphite pulpmill of Kosnas—Malme, Malmaverken, where trees were cut into 5 metre saw logs and 3 metre pulpwood lengths.

Branching Machines and a Tree Harvester

One of the interesting observations made by Mr. Lindquis and Mr. Waagen of Ingenjörssfirma Stig Morenius was that machines for forestry have been designed as being bigger and better following the examples of the United States of America and of Canada. They felt that there is now scope for smaller and better machines. For example, because the Sund barking machine is so big it has limited application in Sweden and in many other countries, these engineers are designing a branching machine, a 'Dyналog' based on the Cambio barking machines. They propose to weld chisel blades about 40 mm. long on to the infeed side of the Cambio blades. These blades would meet the branches as the tree moved through the machine and sever them close to the trunk. The Cambio so equipped would both branch and bark trees at slow feed speeds. At high feed speeds it would branch only. (Soderhamns are designing and developing a branching machine (an 'Arbomatic') to work on a different principle based on their Cambio machines. The engineers of Stig Marenius A.B. also intend to design a tree harvester of a type which can be operated by hydraulic motors and fitted to any suitable tractor with a hydraulic system. If such a tree harvester is developed successfully it should be of the greatest interest to us in Britain.

A Log Sorting Drum

They have designed, among other things, a log sorting drum for use in line production, cross cutting and barking such as has been described above. The drum revolves on its own axis which is at right angles to the direction of movement of the logs. It is mounted on gimbals so that its axis can be tilted under push button control to left or right. Logs which are to proceed further in the line go straight over the drum. Other logs could be tilted off to left or right. They also designed equipment for a barking depot at Klevshult owned by the South

Swedish Forest Owners' Association. (See photographs, Plates 29, 30 and 32).

Chippers

Soderhamns have developed several chippers but two recent machines are of particular interest. One has a chipping disc to replace a saw for cross cutting pulpwood which is intended to be fed in shorter lengths into other chipping machines; it thus makes chips instead of sawdust, and produces chips which are cut parallel to the grain.

The other is their spiral chipper which comprises two shallow cones in each of which there are inserted 17 hollow cutters in a spiral arrangement. The cones, mounted horizontally can be adjusted to receive logs of varying diameters. The chipper can also be adjusted to reduce whole logs to chips, or to reduce to chips only, two adjacent faces of the log at right angles—or to remove as chips two adjacent slabs. If the log is then repassed through the machine or passed through a second similar chipper in line it can emerge as a squared baulk ready for sawing. The chips actually pass through the hollow cutters. They are cut parallel to the grain, are produced with remarkable precision for length, breadth and thickness, and with an excellent finish to their cut surfaces.

It is claimed that the chips will give higher yields of useful fibre than chips which are produced by existing machines and that pulping could be speeded up, and that the chipper would make practicable the closer integration of pulping and sawing on the lines of developments which have already taken place in Canada and Germany, through the Chip-N-Saw and similar equipment. Push button operated hydraulic controls for the spiral chipper were being designed so that it could be set to deal with logs of different sizes. Provision was also being made for sharpening the cutters in situ. The chipper could deal with logs up to 18 inches diameter and it was hoped that it would be able to deal with bundled slabwood. Knives would last for 30 hours without sharpening, which was much longer than knives on conventional chippers.

It was not expected that this chipper would need any heavy foundations. Most pulpmill chippers do. This, together with its low power consumption and lack of vibration would commend it for line production of chips from sawlogs and pulpwood; it would be especially valuable for easily erected and easily transported sawlog and pulpwood production equipment such as has been designed by Ingenjörssfirma Stig Morenius A.B. and referred to above.

Cross-cutting Equipment at a Groundwood Pulpmill

Nearly all pulpwood in Sweden is supplied in three-metre lengths. The groundwood pulpmill of Holmen

Bruks at Norkoping uses metre lengths of spruce but accepts delivery of three metre lengths. There is storage capacity at the mill for only twenty six hours wood supply. The cross cutting of three metre lengths to 1 metre lengths has therefore to be very carefully co-ordinated with intake.

A gantry crane delivers bundled 3 metre pulpwood to a platform where a chain drag carries individual 3 metre lengths sideways to two circular saws—one stepped behind the other. The resulting 1 metre lengths are carried by the chain drags beyond the saws to a conveyor belt, which takes them to the wet drum barkers.

12 cubic metres (about 190 hoppus feet) at a time were being lifted off lorries to the storage yard by the gantry crane, in chained bundles. Similar loads were delivered by the gantry to the saws. (Plates 33 and 34).

The sawing equipment was made by Babco Brenco A.B. of Karlstad, Stockholm and Sundsvall.

Equipment of this type would no doubt be used in Britain if it proves practicable to deliver longer lengths of spruce pulpwood to Ellesmere Port, for example. The Swedes considered that, in future, groundwood made by the latest process of defibrating wood chips would replace grinding of billets; if this happens the longer lengths could be delivered and passed to chippers without cross cutting.

Lorries

Most lorries in Sweden are owned by their drivers. It is rare to see a lorry that is used for transport of

wood that is not fitted with a hydraulic crane usually rear mounted. Lorries frequently have trailers; they are well designed, robust and usually with three axles—when the rear most wheels are retractable—so that empty lorries returning to the forest travel on four wheels, instead of six. Trailers usually have two axles and are of a type which can be loaded in readiness to be taken away by any lorry. Load carrying capacity of lorry plus trailer is normally about 24 tons. It is rare for these vehicles to encounter gradients of as much as 1 in 12. The few occasions when they do are usually within the forests, and tractors then help them up the short lengths of steeper gradients. They are not subjected to the heavy work that lorries regularly perform on the hill roads of Britain, where power drive to all rear wheels would normally be required.

Rail Transport

Rail transport is used to a considerable extent for roundwood, slabwood and for sawn timber and for wood chips. The speed of modern harvesting is such that trains can be loaded with roundwood in a very short time. Many sawmills are so large that train loads of slabwood and of sawn timber are regularly available. Railroad journeys are relatively long and simple in Sweden where hold ups in rail journeys by level crossings, junctions and other impediments are few. The development of hydraulic cranes and the equipping of individual lorries with these means that trains can be loaded at any point that is accessible to both railway wagons and lorries. (Plate 32).

Part VII

TIMBER MARKETING IN SWEDEN AND THE SWEDISH SAWMILLING INDUSTRY

By M. G. HARKER

TIMBER MARKETING

Introduction

On the first page of the text of one of the excellent publications in English on Swedish forestry is the phrase "skill based on great inventive activity and research". This phrase can be said to sum up the impression made by Sweden in general and the forest industry in particular. To it might be added however the remark that the Swedes have a flair for, possibly an addiction to, organisation.

Organisations proliferate and can be confusing, and therefore it has seemed necessary to tabulate the main ones concerned with the forest industry (see Appendix I, page 83). These organisations, however, must to a certain extent be considered against a territorial background which because of regional peculiarities or loyalties determines the way in which affairs are managed in different parts of Sweden.

Territorial Divisions in Sweden; Local Government

23 of the old historical provinces which, as their name "Landskap" suggests have, or like the counties of England are supposed to have, their own special appearance and identity, make up the mainland of Sweden. One gets the impression these provinces still have a significance; one might equate Dalarna ("The Dales") with Yorkshire and Småland with The West Country.

The provinces are broadly grouped into three main regions, *Norrland* "The North", consisting of the 9 Northernmost provinces, i.e. those facing on to the upper and lower Gulf of Bothnia; *Svealand* (Sweden=Sverige=Svea-Rik) Mid Sweden consisting of the 6 provinces north of the general line of the lakes Vänern, Hjälmaren and Malaren; *Götaland* South Sweden consisting of the 8 southern provinces.

In forestry matters Dalarna, the start of the uplands, is often grouped with Norrland; as Gustav Vasa country and hence the cradle of modern Sweden Svealand claims it.

On a more mundane level the mainland is divided into 23 units of local government ("län") which can best be described as counties. The island of Gotland is the 24th; Öland however is added to Kalmar on the mainland. It is on this county basis that, for the purpose of the Forestry Act, private forestry is organised.

The Importance of Private Forestry; The Farm Forests

A booklet *Private Forestry in Sweden* published by the Federation of Provincial Boards of Private Forestry, the headquarters organisation of the County Boards describes concisely the structure and scope of Swedish private forestry. The fact that it uses the term "farm forests" as its standard name for what is the biggest class of privately owned forest is perhaps a key to the study of Swedish forestry. 76% of the total productive forest area is in private ownership; 25% is owned by timber-using industries, referred to as "the companies" and generally owning forests ranging from $\frac{1}{4}$ to $3\frac{1}{2}$ million acres, 3% by large estates owning upward of 7,500 acres, and 48% by "farmers".

1956 figures give an idea of the composition of these farm forests. The most frequent size category, which contains a quarter of the total number of farms, is that of 25 to 125 acres of forest land plus 5 to 25 acres of agricultural land, while nearly a third of the farms have less than 25 acres of forest and nearly half of these have less than 5 acres of farmland.

For most Swedish farmers their forest and their labour as forest workers are their main sources of income. The productivity of their forests is slightly better than that of the companies' forests which are mainly in Norrland/Dalarna, and considerably below those of the estates which are mainly in mid Sweden and the south. Rotation age at present is somewhere between 80 and 120 years, and as the average growing stock is only just over 1,000 hoppus feet per acre the amount of timber a farmer can afford to fell each year is small. To complicate matters further, and this is a problem that also applies to company and crown forests though to a lesser degree, properties are often in narrow strips of as little as a chain or even less in width and possibly of as much as a mile or more in length. Furthermore any one property may be comprised of several such strips scattered throughout one or several parishes.

In these conditions the problems of concentration of operations, mechanisation and marketing are obviously great. A dwindling and ageing rural population and rising wages add to the problems.

The County Boards of Private Forestry

These are problems which the *County Boards of Private Forestry* are tackling, for it is their function

to foster private, and particularly farm, forestry though their responsibilities only extend so far, in that they do not undertake the marketing of timber. That is left to the individual owner, most frequently through a Forest Owners' Association.

Though they are not directly involved in this important part, virtually the *raison d'être* of forestry, the County Boards' activities contribute strongly towards it. For in addition to their duties of administering the Forestry Acts, they are responsible for general supervision and for forest road planning, in the private sector, and for forest education and the control of timber measurement. Though only exceptionally do they undertake harvesting of timber, the planning of felling operations and marking of trees for felling form an important part of their paid-for services which, together with cultural and establishment operations (including supply and sale of seed and plants), are their main functions.

Because of the variations in size, social structure and outlook of the counties the approach of the various Boards of Private Forestry differs but having only visited two such Boards it is difficult to say to what extent. In particular the paid-for services they offer could not very well be demonstrated in the short time available and in any case these are being provided on an increasing scale by the forest owners' associations.

A short description of some of their specialised activities as demonstrated by the Kronobergs (South Småland) and Kopparbergs (Dalarna) County Boards should give an indication of their role in rationalising and modernising private forestry.

The Contributions of the County Boards to Marketing in the Private Sector.

Kronobergs County has approximately 1.17 million acres of privately owned forest of higher than average productivity, an average growing stock of 1,200 hoppus feet per acre, a preponderance of Spruce and a fairly satisfactory distribution of age classes. At present only about 75% of its allowable cut is being felled.

The County Board has 12 forest districts each under a forester who, with the help of an assistant, is responsible for advising and assisting about one thousand forest owners owning approximately 100,000 acres. Marking of thinnings and felling areas forms the greatest part of these foresters' work.

At the headquarters in Växjö there are 5 sections each under a graduate forest officer:—

1. Cultural operations
2. Conservation
3. Roads and draining
4. Forest education
5. Management planning

Road Planning

Road planning has recently been given special emphasis and an overall plan for the county has been prepared.

The first step is to divide the county into areas bounded by good public highways. Within these areas all the existing roads are classified and a rationalised plan is drawn up allowing for primary forest roads spaced 2 to 3 miles apart. Where additional roads are required their alignments are mapped and where superfluous or badly sited roads exist they are designated as such. In addition to the primary roads a system of feeder roads at about half-mile spacing is planned.

It is on the basis of this road planning that grants for the building of forest roads by private owners are made. Generally grants (50% of the cost) are paid for the primary roads but not for feeders. If the roads are of more than purely forest value extra grants can be claimed.

Education and Training

On the forest education side there is a forest vocational training school giving a first year basic training course for farmers and forest workers aged 16—20. This course consists of 22 weeks of practical and theoretical work at the school plus 20 weeks of practical work under skilled instructors. In addition there are short courses of 2 to 3 days or longer ones of up to five weeks. These are for experienced workers and forest owners and are of a more specialised nature, for example on tractors and the planning of haulage operations.

In these ways in that particular county, either by planning or by training, steps are being taken to harvest timber more economically. In Kopparbergs County, with nearly four times Kronoberg's acreage of forest and the start of mountain conditions, there are two training schools capable of taking five times as many pupils. A recently opened forest workers' training school at Älvdalen is exceptionally well equipped for instruction in tractor operation and maintenance and, in fact, in all types of forest machinery. Pupils may bring their own tractors! This is an impressive example of education at the practical level to satisfy a need created by recent very rapid developments in forest mechanisation, and a practical contribution towards helping private forestry to remain competitive.

Forest Management

In the field of forest management the Kopparbergs County Board has been equally imaginative and has been early in the field in the use of data processing techniques to cope with the problem of private woodland collaboration, which is made extremely

complex due to the fragmented ownership of land already mentioned. In the south of the county forest properties average 75 acres but in the north they vary from 25 to 200 acres.

The approach of the Board has been to embark upon a survey of all properties in the county which it is estimated will take ten years to complete and which will supply the basis data which by the use of automated data processing can be rapidly assembled into working plans that are available just as soon as any particular owners decide to make use of them.

This work began in 1962 with a staff of 3 or 4 foresters who in two years surveyed and enumerated 25,000 acres. It was realised that in a county of 5 million acres this was slow progress and by 1965 the staff has been built up to 16 and it is the aim to survey a quarter of a million acres per year. The office work involved in collating the data and transferring it into working plans by traditional methods would be enormous. Using A.D.P. (automatic data processing) it now occupies 3 or 4 persons.

The location of the surveys on a parish or municipal basis is decided on such factors as:—

- Interest of the various forest owners in collaboration
- Demand for employment
- The possibility of rationalisation of forest properties
- Established rights of ownership
- Completed aerial mapping

From a combination of stock maps and topographical maps, logging or exploitation regions are defined, a tentative 10-year management plan drawn up and proposals for collaboration are put to the individual owners, to the local forest owners' association and to any companies concerned. By means of discussion meetings and 1 day excursions the implications of the scheme are explained. This is followed by offering to each owner the completed working plan which is presented to him as far as possible by the person who has been responsible for the survey of his particular property. The plans cost the owner between 3/- and 4/- per acre; most owners buy them but there is no obligation to do so. This in fact only represents half the cost of preparation and planning the other half being borne by the county to which the plans are of some general administrative use. In some cases the forest owners' associations have contributed but the extent to which future work will be financed by the Government appears to be a matter of some concern. The financial help given to owners in Kopparbergs County is exceptional—because of exceptional circumstances.

The main use of the plans is to induce a degree of rationalisation and collaboration which will overcome the severe difficulties that the present pattern of land ownership and labour shortage impose. A direct result of its success would be increased efficiency in harvesting and marketing. The view has been expressed that such surveys and planning involve a great deal of technical and administrative effort of which only a small proportion may ever be put to any use and it is much more practical and economical to start by building up "forestry areas" of co-operative forest management and marketing, and by concentrating the more detailed planning where it is definitely going to be used.

Certainly on first acquaintance the system seems very complex and possibly rather academic. The field form which is used in the survey contains 45 items of data and the code system for automated data processing 94. However it has been adopted by "several other County Forestry Boards and some Forest Owners Associations".

Timber Measurement Control

The control of timber measurement is exercised by a comparatively small section of the Royal or National Board of Private Forestry. The technical staff consists of two forest officers in Stockholm and four foresters in outstations. Their authority is based on the Law of Timber Measuring of 1947, due to be revised in 1966, and is exercised through a number of Circulars somewhat resembling the Forestry Commission's Forest Records, which lay down the measuring procedures for the various assortments of timber.

Though anyone is entitled to measure timber in accordance with these instructions about $\frac{3}{4}$ of the timber which is sold is measured by the 12 Timber Measuring Associations which operate throughout Sweden. Nine of these Associations are territorially based on the river floating systems north of the Lakes and the remaining three are responsible for Mid, South East and South West Sweden.

Though no special legal significance is accorded to the measurement records supplied by the Associations the fact that these define accurately the commodity being sold renders them of importance from the point of view of the passing of ownership.

The County Boards' concern with measurement is mainly incidental to their timber marking activities in connection with stand management.

Timber measurement is still elaborate and makes our own practices seem reasonably simple; practices vary from one part of the country to another. However both the State and the large companies are

seeking simpler measuring methods and a report on Rational Timber Measuring has been prepared. This is another field in which automated data processing gives scope for economies.

Measurement of Sawlogs by Sampling

A development which may simplify matters is the measurement of a sample of logs at the sawmill instead of measuring all logs at roadside. At present only the companies and the Forest Service adopt this method. It is not yet acceptable to private owners delivering through their Associations as the individual lots vary so much in quantity and quality it is not easy to convince the owners that a satisfactorily representative sample can be selected. As, however, the seller is paid promptly after measurement, i.e. after receipt of his timber at the sawmill, there is a strong incentive for early delivery. The trend to road delivery is of course an integral part of this development.

Forest Owners' Associations and their Marketing Arrangements

The Swedish Forestry Association and the Forestry Society of Norrland, the Forest Owners' Associations (Skogsägarna), were in the 1920's concerned mainly with the improvement of forestry practice from a silvicultural point of view. Economic conditions in the 1930's, however, caused the latter to become the foremost timber marketing organisations in Sweden, though they maintain their original objective of promoting good forestry.

They are in a special position in that they represent the individual private owner and as such are subject to political forces and social pressures to a much greater extent than the other two great marketing organisations, the National Board of Crown Forests and Lands and the companies. In these circumstances their progress in timber marketing is all the more remarkable.

When considering their organisation and harvesting and marketing activities it is perhaps best to start at the farm forest and work back to the central organisation, The National Federation of Swedish Forest Owners (SSR).

As has already been indicated the overriding problem of Swedish private forestry has been the very small size of the individual ownerships. Since the 1930's when the slump forced timber-prices down to very low levels the co-operative marketing of timber became the main function of the Forest Owners' Associations. Such co-operation and the rationalisation essential to it has been approached in various ways in different parts of the country. In its simplest form it consists of assembling through local representatives described in one case as

"contact men", details of the quantities of timber that the individual members have available and on the basis of these figures organising sales to various consumers. According to local custom the Association either buys the felled timber and processes it or resells it, or else merely acts as a functional middle man.

The more advanced form of activity consists of local collaboration on approximately a parish basis. Round a nucleus of interested owners the local district inspector builds up a "Forestry Area" or "Combine" agreeing with the various owners on an annual plan of harvesting and selling which, while meeting their needs for a steady income and conforming with sound management, will permit as far as is possible a concentration of road building and use of labour, machinery and transport.

The Jämtland Forest Owners' Association which pioneered this type of organisation is divided into 3 Districts based partially on the natural division of river floating areas and composed of 23 Forestry Areas or Inspectorates. It has a total of some 7,400 members owning 1,420,000 acres of productive woodland. Of these 1,200 members owning 445,800 acres have become members of "forestry combines". They sign a form of agreement which is in force for three years and is thereafter automatically renewed each year unless the member withdraws. The forestry combines (SKO for short = Skogsbruksområde) are self-financing, members being charged 1% of the gross value of the round wood, $\frac{1}{2}$ % of the gross value of the sawn timber and 2% of the selling price of the standing timber sold. With these funds the combines buy any particular items of equipment they require. These charges are over and above the normal charges for membership of the Association which amount to 2% of the gross annual income of each member in respect of his woodland plus 1% of the officially assessed value of the area of woodland. For all logging carried out by the Association a commission of $5\frac{1}{2}$ % to 4%, according to the quantity of timber handled, is charged. Other services are charged at a daily rate and the technical services of an inspector (e.g. for planning or marking) at 80 kroner (£5 10s. 5d.) per day. The yearly income of the Association is nearly £500,000 and in the autumn when advances for work and payments for timber are made, as much as £860,000 may be paid out to members.

Two special activities of the Jämtland Forest Owners' Association should be mentioned. The first is a *log peeling depot* which undertakes peeling of sawlogs and pulpwood to be floated and is therefore situated on a 12 acre site beside the Indal river. This is a new undertaking and consists of a semi-mobile Cambio peeler and a tractor fitted with a front-end timber grab. It is handling at present 700,000 cu. feet

of timber per year; 400,000 cu. feet from the Association and 300,000 cu. feet from non members. The peeled timber is accumulated on the site and launched into the Indal during the period July to September. At present a high proportion of the timber in Jämtland is floated to the mills on the coast after delivery to riverside by lorry. However, the main companies have declared that they will cease transport by this method over the next four years and, because of the cost of maintaining the river and the floating organisation, the farmers will have to follow suit.

In the field of *sawn timber* the Association owns a sawmill at Bräcke producing about 4,000 standards per year of which 30% is exported through agents in Norway to U.K., Denmark, Switzerland and Spain. In addition there are about 50 small sawmills, mainly producing less than 1,000 standards yearly.

The assembling, grading and selling of the very diverse products from the smaller mills constituted a considerable problem which has now been very effectively overcome by the setting up of a central sorting yard at Östersund which trims and bracks 15 standards daily.

The airdried ungraded sawn timber from these mills is brought in by lorry sorted only with regard to thickness. This is fed onto a bracking table operated by one man carrying out the grading, and his assistant. The assistant merely trims one end of each board which is then propelled forward and across the table to the grader who after trimming the other end grades it according to species, grade and width.

By an ingenious but simple device the individual boards are positioned so that, when carried forward from the bracking table, they are dropped automatically onto the appropriate trolleys where they are steel strap banded and removed to the despatching yard.

In the course of being so positioned each individual board operates a counting device which records its specification and length. There are about 24 different specifications (species/grade/width).

The ownership of each load of incoming timber is known and the supplier is paid according to the results of the grading. This, coupled with inspection of the standard of sawing and seasoning at the mills ensures that a high standard of sawn timber is produced.

The general marketing activities are concentrated at the headquarters of the regional forest owners' associations. These consist of the collating of the information on quantities and assortments locally available as supplied by the out-stationed inspectors or contact men, the negotiating of sales to local sawmills or in conjunction with adjoining Associa-

tions, to the companies, i.e. the large sawmilling and pulp and board making firms or to the industries owned by the associations. The associations also take part in the annual price negotiations and publish price lists including specifications and special conditions of delivery etc. In addition they maintain contact with the measuring associations and, in the north, with the timber floating associations.

Creation of Markets

In order to strengthen the marketing power of the private owner or to create markets for otherwise unmarketable timber, the Associations have in some parts of the country acquired and developed existing industries or started new ones. In southern Sweden, where timber supplies exceeded the industrial capacity there have been rapid developments in this respect over the last 10 years, and with four associations in the south combining to form the Association of South Swedish Woodland Owners (SSSF) further new industries are planned. Their industrial undertakings include about 20 sawmills producing 6% of the sawn timber in South Sweden, pulpmills which by contrast account for 60% of the southern sulphate pulp production, as well as particle boardmills, paper and paper board mills, the manufacture of prefabricated houses, packaging factories and an engineering works.

More recently in the North similar developments have occurred, nine of the Associations having supported the formation of Norrlands Skogsägares Cellulosa A.B. (N.C.B. or The Norrland Woodland Owners' Cellulose Company). Here there is not the need for new industry because the present capacity exceeds timber supplies, but it was felt that it would be wise to anticipate the eventual increased productivity of the forests which would result from improved management by securing, modernising and developing timber using industries. Five mills, including sulphate, sulphite and mechanical pulp elements, two sawmills and a paper mill requiring jointly 57 million cu. feet of timber have been acquired since 1961. The forest owners backing the group control 8½ million acres of forest and the group itself owns a further 140,790 acres. This is two and a half times the acreage owned by the largest timber company in Sweden, the Swedish Cellulose Company (S.C.A.). The benefits to the forest owners of these assured markets is considerable, and in the context of the new land purchase law, would appear to give the farmers some hope of retaining land in private ownership. Doubt has been expressed in some quarters, however, on the one hand as to the efficiency of industrial groups owned by large co-operative undertakings as compared with purely industrial concerns and on the other as to whether the selling power of the farmers isn't somewhat

diminished; forests earning 5% on invested capital tend to be the weaker partner when linked to industries which are expected to earn 20%.

Price Negotiations

The associations of forest owners, controlling as they do a very considerable part of the round timber supplies, and owning or dealing with the major timber-using industries, have, as one of their major tasks, annual price negotiations. These are carried through on the one side by representatives of the central organisation (SSR) of the Swedish Forest Owners' Association together with members of the various regional associations and on the other by representatives of the buyers' organisations, the sawmillers, the pulp and the boardmill manufacturers.

These negotiations tend to be lengthy and hard-fought. Two catch phrases are "it is the duty of the seller to obtain as high a price as he possibly can", and from the buyers' side, in fact SCA, "1 öre more per cubic foot can mean 1 million kroner per year". The negotiations are by price districts; because in the case of sawlogs difference in quality is taken into account while in the case of pulpwood it is the difference in delivery distance which has to be allowed for. Negotiations usually start locally over such matters as specification and delivery conditions, those in the north starting in the spring. By mid summer such matters have usually been agreed and there remain the questions of price and, equally important, quantity. In Värmland, however, where there are large industrial concerns and adequate timber supplies quantity is not subject to negotiation.

As negotiations proceed a deadlock may be reached in one or more of the 5 price districts and the matter referred to the central negotiating bodies. Generally it is said that if agreement can be reached in the northernmost district general agreement will follow fairly easily. If however negotiations prove very difficult it is usually in Värmland that agreement is first reached.

The tendency now is for a national scale of prices to be agreed for pulpwood, but for sawlogs prices are still agreed by price districts, and in South Sweden, where there are a large number of small sawmills local price agreements are the rule.

General agreement on prices is usually reached in November or December as the negotiating parties take into consideration the results of the auctions of standing timber which take place mainly in September and October, though in the North they may be as early as August. Though only about 10% of the total volume of timber is sold by auction, (in the North where there are fewer sawmills only 6%) these are still considered to be important market indicators. The SSSF auctions 5.6 million hoppus feet annually.

Generally, however auctions are not favoured and are said to be declining in frequency. They are the traditional means by which the small sawmills buy a proportion of their timber supplies and as a result the lots are small, often only of 8,000 to 40,000 hoppus feet per lot. As the rural population decreases and the smaller mills close so will the justification for auctions diminish. At present there does not seem to be any suggestion that in some way they should be rationalised or retained in order to preserve a fully competitive means of sale. The attitude of one forest owners' association was that auction was a lazy way of marketing and they tried to instil into their members the attitude that the best price for their timber could be obtained by selling it felled and in its best assortments. (Auctions are restricted to standing sales). The general feeling seemed to be that buyers formed rings even where the companies as well as the small mills were buying.

It is difficult to determine the importance of the independent private seller or of the freelance timber buyer acting as a middleman. It seems that some farmers and small estates have traditionally sold to certain companies and sawmills and a fair amount of this still goes on. The association considers this sort of activity a nuisance and detrimental to their marketing efforts, but say that it only represents about 5% of sales and in view of the weak position of the seller will tend to die out. However the very large state-owned sawmill at Skinnskatteberg still buys by tender 15 to 20% of its timber from private individuals, employing a number of buyers for this purpose.

The Swedish State Forest Service and Timber Marketing

The Forest Service regards itself as a business enterprise with the duty of managing its forests and marketing their products to the best advantage. It is therefore in competition with the companies and the farm forest owners but regards itself as a stabilising influence in the general timber market, the "instrument of competition" being the volume of timber sold rather than the price obtained. About 80% of its forests are in Norrland where the growing stock and productivity of the land is relatively low with the result that only just over half its annual cut is from the North.

Forest management throughout Sweden at the beginning of the century had left much of the forest in a low productive state—the larger timber often having been removed and the smaller trees under-thinned. The first concern of the State Forest Service has been to improve the yield of its forests by silviculturally sound management. The second major task has been to modernise and rationalise harvesting

methods in order to decrease costs, giving a lead to private forestry in this respect. During the 1930's 80% of the yield was from thinnings, a costly form of exploitation, but since 1945 clear felling of what came to be recognised as generally mature or over-mature timber has increased and in such operations the possibility of introducing intensive mechanisation has already increased. During the same period, particularly as a result of the setting up of A.S.S.I. (State Forest Industries Ltd.) in 1941, felling and logging gradually took the place of sale standing until today 75% is felled by the Forest Service and an increasing amount is also being delivered to mills particularly in the North where A.S.S.I. take 90% of production from state forests.

Control of Marketing in State Forests

The overall control of marketing naturally rests with headquarters in Stockholm. The allowable cut for every forest, district and region has been determined from forest surveys carried out by the special forest survey section. The prescribed cut must depend on such matters as the age class distribution and is laid down in the working plan which is prepared by the District Officer.

A production proposal (Leveransuppgift) is prepared each Spring by the District Officer stating by forests and by assortments what it is proposed to produce during the following calendar year and what shall be sold standing, depending on the labour available and known local markets. These proposals are summarised by Conservancies and sent on to headquarters in Stockholm who, with their knowledge of the requirements of the large buyers such as A.S.S.I. and of the companies collates the proposals, and carries out negotiations on the basis of them.

A provisional allocation of quantities to the various buyers is notified to Conservancies in the early summer and on completion of negotiations details of quantity, price and conditions of sale are confirmed in the autumn.

Auction Sales in State Forests

The prices obtained for standing timber at State auctions are traditionally regarded as an indication of trends in the timber market though these only represent about 3% of the total sales for the country as a whole. As in the case of private marketing these auctions predominate in the South (10% of State Forest sales in the South are by auction) being the means whereby the small sawmillers buy a high proportion of their requirements. The decline in the number of smaller sawmills and the need for larger mills to have a more assured supply of sawlogs makes it doubtful to what extent the State auctions will survive or maintain their importance.

The auctions of standing timber are still the opening activity of the marketing season. The auction catalogues are prepared at District level in June or July and show by lots the number of trees by species and breast height diameter category and the estimated total volume. 20 to 40 lots seems to be a normal number per District in the South though in the north, where lots are larger and a higher proportion of timber is sold felled (and not by auction) only a few lots are offered.

The auctions are advertised in the press about two months in advance and are so timed that they all take place in the respective Districts within about one week in late September or early October.

The auctioning is carried out by a professional auctioneer but the appropriate forest officer presides. In the South the lots are fairly small averaging about 25,000 hoppus feet but quite frequently down to as little as 7,000 hoppus feet with 40,000 hoppus feet as the maximum. Bidding is on a lump sum basis in Southern Sweden and on a per tree basis in Northern Sweden.

The successful bids are held to be binding for 14 days in order to give time for them to be approved by Headquarters. The results are published in the press and any unsold lots may then be sold by negotiation. The bidders are usually the local sawmillers, though in the north the large companies also bid. The general practice is for the sawmillers to buy a proportion of their requirements by auction as a basic reserve and the main part of their requirements as felled timber by tender.

Negotiated Sales

In dealing with rationalised and large scale timber industries it seems that the dominant role of negotiated sales will be extended, probably in the form of long term agreements. The Forest Service maintains a close contact with industry and both sides are strongly organised and therefore sale by negotiation forms a very important part of marketing practice. For the state forest industry as a whole it is estimated that 60% of timber is sold by negotiation.

The technical Staff in Headquarters handling these negotiations which amount to only about 20 contracts per year is comparatively small consisting of one senior forest officer and two (shortly three) assistant forest officers. There is no sales intelligence organisation as such, (or so we were told) this sort of information is obtained from academic sources such as the Royal College of Forestry or the Wood Research Centre. The Forest Service being largely concerned with the production and sale of timber, has very close contact with the timber industry and as a matter of course is well informed of market trends. It would seem, however, that the Service's data processing organisation could be most valuable

for collating information obtained from the results of auctions and general trade.

Sales of Felled Wood

Sales of felled logs, normally at roadside, are by tender, usually shortly after the auctions. Tenders may often be invited before the trees are felled, thus giving prospective buyers the opportunity of making special offers for logs felled in long lengths, i.e. as transmission poles. Normally Spruce logs are cut to 14 feet lengths but the more valuable Pine is cut in lengths of 10 to 18 feet. The actual felling in these circumstances does not take place until after a contract has been signed and as a result, the trees can be logged to the maximum financial advantage.

The conditions of sale are detailed, laying down conditions as to removal and use of roads and defining exactly the assortments so that price is related to the quality and size of log. Offers are based on a mean log-length (e.g. 13 feet in the case of pine and 14 feet in the case of spruce in one particular instance) and a top diameter of say 8 or 8½ inches. Percentage price increases or decreases in 5% steps are agreed for top diameters over or above this and with regard to length there is a 1% increase for every 1/10 foot of the actual length of a log above the agreed mean length. Similarly there are percentage increases or decreases varying with species according to whether the logs are above or below unsorted quality. For example pine of "special" grade attracted 125% of the unsorted price, V grade 75% and VI grade 60%.

Measurement of the logs is usually done by the local Timber Measuring Association but may be done by the seller at stump if it is more practicable to do it as part of the logging operation. This latter option permits simplified measuring to be introduced. These measurements are the basis of the sale and the measuring is paid for by the buyer though the seller must, where necessary, supply the labour to move the logs for measurement.

As with auctions bids are binding for 14 days to permit time for higher approval of the offers. Within 10 days of acceptance of tender the buyer must provide a security either from a bank or from two private persons and the security has to be accepted and countersigned by the Conservator before the sale is valid.

In valuing standing timber to be sold by auction a procedure resembling in its detail the measurement of felled assortments is used. A basic valuation per cubic metre based on species and diameter class, is first made of all trees to be felled and then corrected on a percentage basis as a result of detailed assessment of felled sample trees. This assessment takes into consideration the height, bark allowance, grade of butt-log, felling cost, and degree of butt rot. Though

to a certain extent such a valuation is based on personal judgment it is done in considerable detail and, it is claimed, with considerable accuracy.

In local sales therefore, whether by auction or tender, the principle appears to be to allow the local staff discretion in lotting and terms of sale to meet their managerial requirements, and at the same time to attract the best prices in what is currently a sellers' market. All sales over a stated value, however, are subject to Headquarters approval.

Measurement and pricing are carried out in considerable detail and to fine limits. Whether the work and expenditure involved in this can be justified it is not easy to judge but it is rooted in trade practice and has as its background periods in the not distant past when a buyers' market existed and timber fetched very low prices. In the present phase of rationalisation and simplifying harvesting operations there are already moves to simplify measuring, but, in the case of sawlogs it appears that the practice of exact measuring and pricing will persist during the lives of the present generation of sawmillers and forest owners.

THE SWEDISH SAWMILLING INDUSTRY

The Supply of Logs to Smaller Sawmills

As in other aspects of Swedish forestry sawmilling presents a picture of a large number of small units of marginal profitability rapidly dwindling in numbers and being replaced by large industrialised and somewhat more profitable enterprises.

(On several occasions it was said however that a medium-sized mill producing 1 to 4 thousand standards and of low capital cost (300,000 kroner) and small overheads and sufficient flexibility of operation to obtain maximum production from the sawlogs operated at a higher profit than the larger mills of 10,000 standards and up).

In 1958 there were in Sweden 900 frame-saw mills producing 65% of the total sawn timber and 3,000 circular-saw mills producing the remaining 35%. 3,000 of these mills had an annual production of less than 300 standards per year while a further 700 produced less than 1,000 standards each.

By 1965 the numbers of frame-saws had fallen to about ¼ of their 1958 numbers but their total production had gone up 5% to 10%. In place of an average annual production of 3,000 to 3,500 standards they are now producing about 4,500 to 6,000 standards each. In that circular-saw mills are of less importance to the Swedish economy the Swedish Sawmill Employers' Association provided less up to date statistics about them. Considerable numbers of them are in existence however but they are of low productive capacity and of even lower actual production, being only operated part time. To a

certain extent this is due to their owners having alternative employment, but quite frequently it is due to lack of sawlogs.

The small size of the average lots and the numbers of individual buyers at the auctions in South Sweden are evidence of the piecemeal buying by the mills. Many of the logs are of a quality and size that an English timber merchant would not accept. An average size of log in one part of mid-Sweden was 5 hoppus feet with top diameters down to 4½ inches in Spruce and 5 inches in Pine. At one medium sized mill (4,000 standards) 2/3rds of the pine logs sawn during the first half of the logging season were in the 5/5½ inches and 6/6½ inches top diameter categories. The keen pricing of felled logs in sales by tender is a further indication of the competition for sawlogs at present.

In Jämtland, where the lack of assured supplies of logs restricted the development of medium-sized mills, the Forest Owners' Association has encouraged members to sell their sawlogs to it rather than individually to individual mills, and is moving towards a situation where it can guarantee mill owners who are members of the Association (they must also be forest owners) their full requirements of logs. The Association however also markets the sawn timber from about 50 members' mills of which only about 5 have an annual production of more than 1,000 standards and they have therefore to be careful not to prejudice the supplies to the smaller mills by diverting them to the larger ones

The Importance of Markets for Sawmill Residues

The demand for peeled slabwood or chips by the pulp mills and unpeeled slab by the boardmills has introduced a new factor in saw-milling and it is said that the income from slab is the only guaranteed source of profit of a small or medium sized mill. Certainly, large amount of bundled slab can be seen being transported by road and rail.

This has now become such an established part of the sawmillers' sales that, in the last two or three years, a company (S.Å.B.I.) has been formed in South Sweden as an offshoot of Svenskasågverks-

foreningar to organise the sale of slabs and chips from the small sawmills.

A further subsidiary company, A/B Sågverks-intressenter (A.B.S.I.), has been formed to co-ordinate the supply of sawlogs to the smaller mills. Time did not permit a visit to this concern so fuller comment on its activities is not possible.

Developments in Sawmilling

In sawmilling techniques there are of course also certain developments. The bandsaw, which in England would by now have replaced the circular saw in most of the small sawmills that were seen appears to be looked on with some suspicion. The arguments against it are cost and inaccuracy of sawing, particularly in knotty wood, and the lack of experience in, or alternatively facilities for, maintaining bandsaw blades.

In framesawing swage set blades with their increased production rate and reduced kerf are looked on as an important advance.

In mills which produce 10,000 standards and up, kiln seasoning is regarded as essential. The use of bark from mills with their own peeling machines as a source of at any rate part of the heat required in kilning is a common practice which incidentally overcomes the problem of bark disposal.

Packaging of sawn timber is regarded by the exporting mills as a service that in the near future will have to be given in order to compete with other countries but it is in its infancy and is looked on as a costly extra.

Little attention appears to be given yet to standard logging lengths. From the point of view of the seller the incentive will be to log always to his own greatest financial advantage while from the point of view of the sawmiller there seems little point in not cutting in as long lengths as possible until there is much closer integration with the end-users i.e. the manufacturing industries, engineers and architects.

In the years 1960-64, 1,000 sawmills closed in Southern Sweden; yet production of sawn timber increased over this period. Two large Swedish mills would saw the whole of the softwood sawlogs converted by all mills each year in Great Britain.

Part VII Appendix I
SWEDISH FOREST ORGANISATIONS

TABLE 11.

<i>Swedish Name, Abbreviation and Organisation</i>	<i>English Name, Abbreviation and Organisation</i>	<i>Remarks</i>
KUNGL. DOMÄNSTYRELSEN DOMANVERKET DISTRIKT	Royal Board of Crown Lands and Forestry The Swedish Forest Service Region (= Conservancy)	Alternatively The National Board of Crown Forests and Lands II Regions in 2 Divisions:— (1) NORRLAND plus DALARNA/GÄVLE i.e. DALÄLVEN river system and North (2) South of the DALÄLVEN valleys
REVIR	District	8 to 12 Districts per Region
KRONOPARK	Forest ranger district (Beat)	Average of about 4 beats per District, each beat comprised of several forests
SKOGSSTYRELSEN	Forest	
SKOGSVÄRDSSTYRELSE	National Board of Private Forestry (Private Forestry Board)	In addition to the overall direction of forest policy and the County Boards it carries out special duties such as silvicultural investigations, the regulation of timber measuring and statistics
	Provincial Boards of Private Forestry (County Boards)	25 on a county basis, watched over by a Federa- tion (FORBUND)
BEVÄKNING	Forest ranger district	Activities include:— Supervision of 1903 Forestry Act Forest education Forest road planning Forest management—individually and collectively Establishment, including nurseries Stand treatment Management of communal and some publicly owned forests The territorial charge of a "Länsskogsvaktare" or County Forest Ranger It will cover a number of parishes
SVERIGES LANTBRUKSFÖRBUND (SL)	Federation of Swedish Farmers' Associations	The Central body directing the national price negotiations with industry
SVERIGES SKOGSÄGAREFÖRENINGARS RIKSFÖRBUND (SSR)	National Federation of Swedish Forest Owners Associations	23 provincial associations organised geographi- cally i.e. a combination of province, county and river system
SKOGSÄGAREFORENINGAR (SKOGSÄGARNA)	The Forest Owners Association 132,000 members owning 17 million acres of productive forest	Tending to combine under industrial collaboration e.g. SSSF (4 southern Associations) and N.C.B. (9 northern Associations)
SKOGSBRUKSOMRÅDE = (S.K.O.)	Organisation varies between Associations but is usually into Regions and districts looked after by District Officers and inspectors Within the Associations have been formed 252 "forestry areas" comprised of 16,000 members owning 2.5 million acres of forest	Their objective is co-operative harvesting and marketing together with the associated forest operations

(Continues overleaf)

TABLE 11 (cont.)

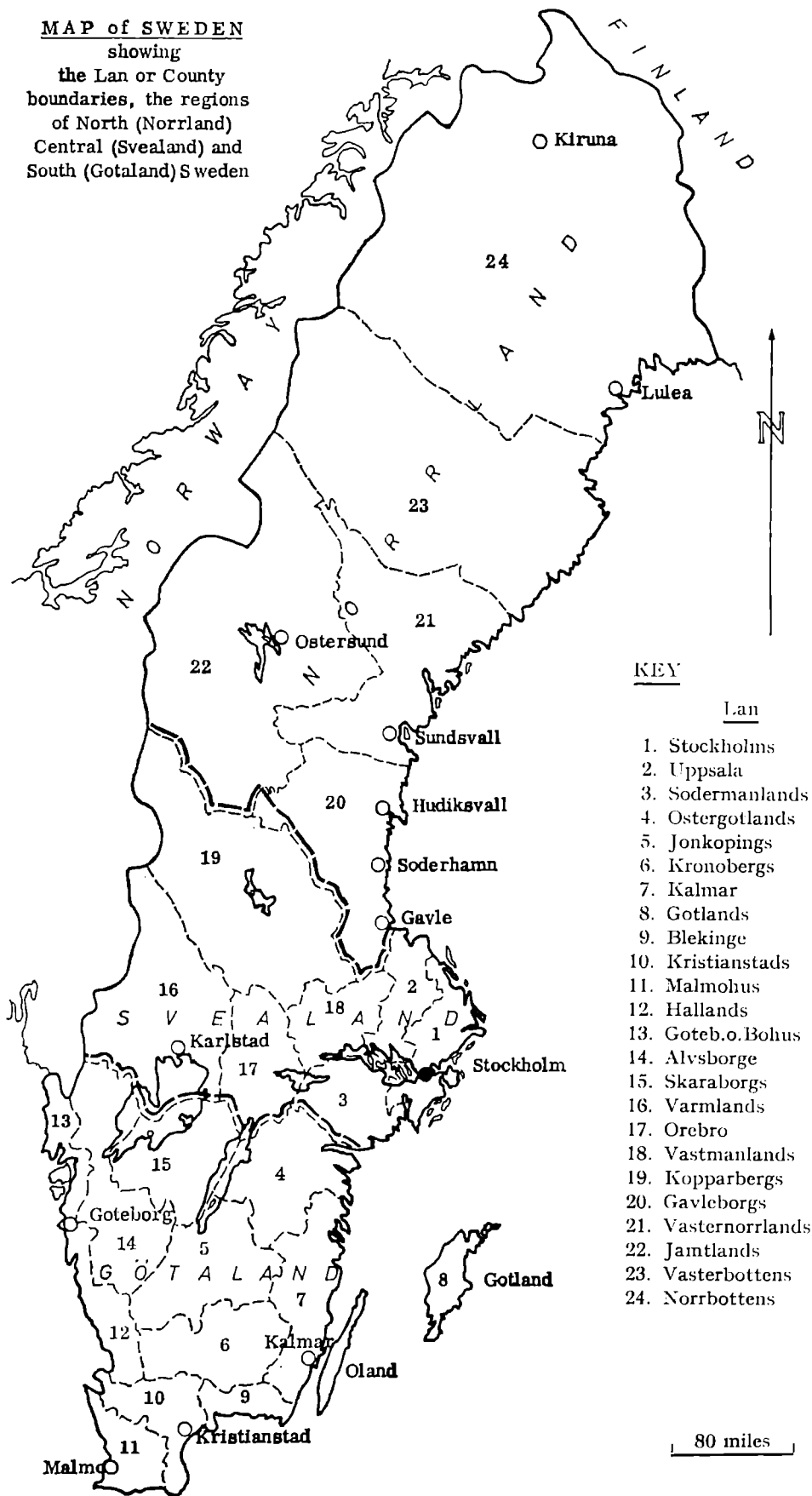
<i>Swedish Name, Abbreviation and Organisation</i>	<i>English Name, Abbreviation and Organisation</i>	<i>Remarks</i>
<i>AB STATENS SKOGSINDUSTRIER</i> (ASSI)	State Forest Industries Ltd. comprised of:— <i>Sawmills:</i> — 8 In North 4 producing 65,000 stands In Mid Sweden 4 producing 55,000 stands <i>Wallboard factories:</i> — 2 In North 1 producing 50,000 tons In Mid Sweden 1 producing 90,000 tons <i>Sulphate Kraft pulpmill</i> 1 in north producing 130,000 tons <i>Kraftpaper mills</i> 1 in North producing 70,000 tons <i>Kraft Liner board mill</i> 1 in North producing 110,000 tons Other concerns:— Joinery factory, mineral wool, steel shot works	Since 1957 under Ministry of Commerce By comparison Swedish Cellulose Co., Ltd., owns <i>Sawmills:</i> — 6 producing 82,000 stands <i>Wallboard factories</i> 1 producing 47,000 tons <i>Sulphate Kraft pulpmill</i> 6 producing 690,000 tons <i>Kraftpaper and Liner board mills</i> 4 producing 352,000 tons Other concerns:— Prefabricated house factories, joinery, parquet flooring, windows, plastic flooring tiles, hydro- electric works, engineering works
<i>SVENSKA SKOGSVÅRDFÖRENINGEN</i>	Swedish Forestry Association	General promotion of forestry. Non-commercial
<i>NORRLANDS SKOGSVÅRDFÖRBUND</i>	Society of Forestry in Norrland	General promotion of forestry. Non-commercial
<i>SKOGSÄLLSKAPET</i>	The Forestry Society	General promotion of forestry. Non-commercial. Management of communal forests
<i>SVERIGES SKOGSÄGAREFÖRBUND</i>	Federation of Swedish Forest Owners	Large estates and companies are members. Con- cerned with forestry politics and prices. The com- panies are members of regional purchasing organisations
<i>FÖRENINGEN SKOGSBRUKETS</i> <i>ARBETSGIVARE</i>	The Society of Forestry Employers	Employers associations, partially geographically separate
<i>SVENSKA LANTARBETSGIVARE</i> <i>FÖRENINGEN</i> (SLA)	The Swedish Society of Agricultural Employers	
<i>SVENSKA SKOGSARBETSAREFÖRBUNDET</i>	Swedish Forest Workers' and Log Drivers' Union	Policy. Labour relations. Technical advice. Pro- ductivity. Safety
<i>SÅGVERKSFÖRBUNDET</i> a section of <i>SVENSKA ARBETSGIVAREFÖRENINGEN</i> (S.A.F.)	Swedish Sawmill Employers' Federation The Swedish Employers' Association	

(Continues opposite)

TABLE 11 (cont.)

<i>Swedish Name, Abbreviation and Organisation</i>	<i>English Name, Abbreviation and Organisation</i>	<i>Remarks</i>
FORSKNINGSSTIFTELSEN (SDA) (SKOGSARBETEN)	The Logging Research Foundation	<p>Formed by the union of three Work Study organisations:—</p> <p>SDA = Work Study Department of the Forest Employers Association and State Forest Service</p> <p>VSA = Society of Forest Work Studies in VÄRMLAND</p> <p>MSA = Association of Forest Work Studies in Central and Southern Sweden</p>

MAP of SWEDEN
 showing
 the Lan or County
 boundaries, the regions
 of North (Norrland)
 Central (Svealand) and
 South (Gotaland) Sweden



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