



TIMBER!

Your Growing Investment

Forestry Commission
ARCHIVE

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FORESTRY COMMISSION

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Timber!

Your Growing Investment

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Contents

PAGE	3	Foreword by Leslie A.W.Jenkins <i>Chairman of the Forestry Commission</i>
	4	How the Forestry Commission Grew
	6	Modern Methods Succeed Traditions
	8	The Land
10		Seed
12		Nurseries
14		Planting
16		Harvesting and Marketing Timber
18		Round Timber and Sawn
20		Paper and Man-Made Board
32		Road Construction
34		Fire Protection
36		Estate Management
38		Research
41		Training and Efficiency

PAGE	42	Forest Parks
	44	Nature Trails, Adventure Centres and School Plots
	46	Wild Life
	48	Private Estate Woodlands
	50	Landscape Planning
	52	Statistics
		Graphs:
	22	How Softwood Output Will Rise
	23	Forest Land Held by the Nation, 1900–1970
	24	All Forest Land, 1900–1970
	28	Annual Planting, 1900–1970
	30	Forest Land Held by Private Owners, 1900–1970
		Maps:
	25	Commission Forests in Scotland
	26	Commission Forests in England and Wales

Foreword

Since I have the good fortune to be Chairman of the Forestry Commission in the year in which it is celebrating its 50th anniversary, it is my privilege to introduce this short account of the Commission's achievements in the last fifty years.

That these achievements have been impressive is self-evident, and I will not dwell on them except to say that—such is the long time-scale of forestry—they still represent only the foundations of a majestic enterprise which cannot be fully productive in this generation.

Succeeding generations will reap the full reward of flourishing forests, with the multiple benefits they can bestow on the countryside, on industry and on the community at large. But we in our generation can be grateful that successive Governments have had the foresight and imagination to finance a national enterprise which cannot provide a quick or dramatic return but which in the years to come must enrich the country for all time in so many ways.

None of this would have been possible without the dedicated enthusiasm and skill of the staff of the Commission, at all levels throughout the length and breadth of Great Britain. They now have a tradition of service half a century old; but their readiness to accept change and to originate and apply new ideas is well reflected in the revolution, based on sound and imaginative research, which has taken place in recent

years in many of the Commission's techniques, with outstanding effects on productivity.

A special word of thanks is also due to all sectors of the diverse economy in which the Commission works; to the wood-using industries, old and new, for their wholehearted co-operation; to the countryside community, whether as landowners or tenants or neighbours, for its goodwill and understanding; and to the general public, whose growing appreciation has been a real source of encouragement. The Commission is also indebted to the various Committees associated with it, for the time they have so freely given to its concerns; and to the societies and voluntary organisations which have worked to keep interest in the art and practice of forestry alive.

Not least, a tribute must be paid to the private woodland owners who, side by side with the Commission, have added so much to the increasing impetus of the forestry industry in these last fifty years.

I hope that many of you who read this story of vigorous growth will take the opportunity of seeing and learning more about your national forest heritage in the many Commission forests throughout the country which the public are welcome to visit.

Leslie A.W. Jenkins

How the Forestry Commission Grew

Before the Industrial Revolution, Britain met most of her needs of timber from her home woods, nearly all under private ownership. There seemed no need for any national authority to plant forests or to encourage landowners to do likewise. As industry prospered with the coming of coal mines, iron furnaces, railways and modern manufacturers, from 1750 onwards, and population rose fourfold, there was a tremendous increase in demands for timber and all kinds of paper products made from wood pulp. But the very prosperity of our industries made it easy for us to import all we needed. Ships that took coal and manufactured goods to North America, Scandinavia and Russia returned laden with the timber that these countries, then less developed industrially, were glad to fell at low cost in their virgin forests. Britain, during that prosperous period, had little economic need to grow her own supplies of wood.

The First World War, from 1914 to 1918, ended Britain's long-established sense of security. A major German submarine campaign was deliberately aimed at stopping timber imports, particularly pit props for the coal mines. Had it succeeded, coal production would have ceased, and vital war industries would have ground to a halt. Timber rationing, and drastic overcutting of our limited home woods, saw us through that emergency, but the lesson of dependence on overseas timber supplies had gone home. In 1917 the war-time Prime Minister, David Lloyd George, appointed a Forestry Sub-

Committee in his Ministry of Reconstruction, to frame the country's first national forest policy. After this committee, chaired by Sir Francis Acland, had reported, the Forestry Act of 1919 set up the Commission with adequate powers and ambitious aims, but without a tree or an acre of land to its name.

Under the chairmanship of Simon Fraser, Sixteenth Lord Lovat, and the technical skill and drive of Roy Lister Robinson, an Australian who later became Lord Robinson of Kielder Forest and Adelaide, the Commission set about its work of creating forests for Britain's future needs. Nurseries were established and land bought, and in the autumn of 1919 the first trees were planted at Eggesford Forest in mid-Devon. In 1924 the Commission took into its care the New Forest and the Forest of Dean, two Royal Forests of great historic and scenic interest, held by the Crown since the days of William the Conqueror. This brought in 75,000 acres of woodland, which proved a useful nucleus for gaining management experience and training staff. Otherwise the Commission has acquired little standing timber. Its policy has been to afforest bare land or replant felled woodland, leaving the management of existing tree crops to private owners.

Between 1919 and 1939, when the second world war broke out, the Commission had planted 600,000 acres of new woods, at an average rate of 30,000 acres a year. Its main attention, and half its staff, were then diverted to timber production—

fig 1 Flashback to 1945. During the Second World War many immature conifer plantations were cleared to make pit props for the coal mines. Girls of the Women's Timber Corps tackled the felling.





fig 2 A landmark in the Commission's progress. Her Majesty the Queen unveils a plaque to mark the planting of the Millionth Acre at Eggesford Forest in Devon, where the Commission's first planting was begun in 1919. 8th May, 1956.

mainly from private woodlands as the Commission had few mature woodlands of its own. Heavy fellings to meet war needs reduced our timber reserves to their lowest ebb. Meanwhile, planting continued on a modest scale until 1947, while plans were laid for a big post-war expansion.

The blue-print for this was the *Report on Post War Forest Policy*, published as a Government White Paper in 1943. It advocated the formation, by the year 2000, of 5 million acres of economically productive and well-managed woodlands, part being owned by the Commission and part by private landowners, and substantial progress has been made towards this end. In 1956 the Commission passed its first major milestone when Her Majesty The Queen unveiled, at Eggesford, a plaque recording the millionth acre planted.

By 1970, twenty-three years after the post-war programme began in 1947, there will be 1,800,000 acres of plantations under Commission ownership, and 1,200,000 in management schemes on the private estates. Commission planting proposals aim to add a further 500,000 acres by 1978, while private planting, after allowing for woods felled and replanted, is expected to bring into efficient growth another 200,000 acres over the same period. This will give Britain 3,700,000 acres of well-managed woods by 1978.

Even so, we shall only be able to meet a fraction of Britain's timber needs. How large this proportion may be is hard to forecast, for no one can judge exactly the size of the timber and paper markets thirty years hence. All the evidence is that, despite every likely substitution of alternative materials, the forest products market will expand in the future as it has done in the past. In broad terms, we should be able to double the share of the home-grown trees, in the home market, from the present 10% to 20%. This will mean a great saving of foreign exchange, for timber, after food and oil, is our most costly import, costing us more than £500 million yearly.

Over its fifty years of active life, the Commission has grown steadily, like its trees. Setbacks due to war or economic difficulties have quickly been overcome. Money has been wisely applied each year in what is truly a growing investment. By 1970 a total of £250 million of public funds will have gone into the forestry enterprise, and for this the nation will have secured 1,800,000 acres of thriving plantations, together with fixed assets, such as roads and buildings, conservatively valued at £300 million in all. As the young plantations mature they will yield marketable thinnings and mature timber, providing the nation with a permanently productive asset, as well as a great scenic and recreational amenity.

Modern Methods Succeed Traditions

The first fifty years of the Commission's vigorous life has been remarkable for the development of modern, scientific methods for growing and harvesting timber quickly and cheaply. Research scientists, Work Study teams, and the field staff of forest officers, foresters and engineers have all played their parts in developing new efficient ways of planting and felling trees, and transporting the resulting timber. To gain a measure of the drastic changes, let us look back over fifty years to see how things stood when this forestry revolution began.

In 1919, there were only two commonly used sources of power in the woods—the muscles of a man and those of a horse. All the tools were hand tools, or devices like pulley-blocks to make a special use of a horse's effort when loading timber. Machines were virtually unknown, and the only sounds to be heard in the forest, even at the busiest times, were the ring of the axe and the soft hiss of the hand cross-cut saw, followed by the crash of branches as a tall tree fell, and the horseman's cries as he urged a team of sturdy Shires or Clydesdales to drag a great log through the undergrowth. The whirr of the power saw and the purr of the tractor were both unknown. Much of the woodland produce was worked up on the spot by craftsmen. In the South of England hundreds of hurdle-makers were busy weaving hazel hurdles, entirely by hand, making a handy form of fence then widely used on farms, though seldom seen today. Rough branchwood was turned into charcoal in traditional earth kilns, shaped like beehives, that needed watching night and day.

The technical revolution has been greatest in the forest nurseries, which now have an output of 100 million trees a year. When the Commission first expanded its planting programmes, hundreds of men, women and girls were engaged to carry out tedious repetitive tasks. Every spit of soil had to be turned by the spade, while every seed was sown, and every seedling transplanted, entirely by hand. Even more troublesome was the weeding for every tiny seedling weed that threatened the small trees had to be removed with hand tools or a girl's nimble fingers.

Today, a single tractor, equipped with tools specially designed or adapted by the Commission's experts, deals with nearly all this work. In turn it ploughs, harrows, forms seed-beds, rolls them smooth, sows the seed, and spreads a covering of grit. When the seedlings are large enough, it draws the transplanting machine which 'lines-them-out' by the thousand, often planting 100,000 little trees a day. Finally, a year or two later, it pulls a tree-lifter that raises them, with roots intact, ready for use in the forest. The weeds? They have been vanquished by modern chemical sprays that attack the weed plants but—at the dosage applied—leave the young trees unharmed. There again a solitary tractor carries an automatic sprayer, safeguarding millions of tiny trees in the space of a few hours. When big enough, the young trees travel to the forest by lorry or on a tractor's trailer, normally protected nowadays by polythene bags that maintain their water content and check losses from drought. Forest planting, oddly enough, has *not* been mechanised. This is because, in Britain,



fig 3 The traditional felling methods. Axe and cross-cut saw used to bring down a huge silver fir in Cumberland, about 1940.

most forests are established on land that is too steep, rough, rocky or soft for planting machines to operate. But the advance preparation of the ground, by deep ploughing, is a job that calls for powerful crawler tractors and giant ploughs designed by the Commission's mechanical engineers. Machines and chemical sprays now play a growing part at the next stage of tending—the weeding of the undergrowth.

The power saw has taken over all the tasks in the harvesting of timber that were once laboriously tackled with axe and hand-saw. It is used for the tricky job of felling trees, large or small, and later for cross-cutting the logs to length and trimming away the side branches.

Transport from the stump—the point where the tree falls—was once done entirely by horses, working alone or in well-schooled teams. Today the engine power of a farm tractor operates an overhead winch, drawing the logs to the road. Other tractors are designed to operate within the plantations, going right up to the stump to pick up loads of logs. Heavy timber is handled by still larger crawler tractors, again equipped with powerful winches.

The loading of timber on to lorries was once a back-breaking job for squads of men, taking much time at high cost. Hydraulic cranes and grabs, using the power of the lorry's engine, have changed all this, and huge weights are nowadays loaded easily in a few minutes.

Timber handling at the sawmill or factory has likewise been revolutionised. In 1919 nearly every log was sawn into planks by crude though sturdy circular saws, powered by steam engines. Today, band saws that cut more swiftly and accurately, with less waste, are the rule, electricity has succeeded steam, and the logs and planks are speedily shifted by automatic devices, instead of being shoved around by hand.

Even more important to the forester has been the development of entirely new industries to turn his trees into 'man-made wood', or various kinds of paper products. Wood chip-board, hardboard, insulation board, and carton board are modern materials essential for building and packaging, that were unknown fifty years ago. Huge paper mills now consume vast volumes of home-grown wood annually, for it has been found equal in quality, and competitive in cost, with anything grown overseas. All these new industries make good use of small logs—an important point to the forester since it enables him to market small trees as well as large ones, and so thin out his young crops at a profit.

The Forestry Commission has followed up every change in methods and markets that would put home-grown timber to better use, at lower cost. Its new ideas have been shared equally with private timber growers, nurserymen and timber merchants, so that the whole timber-raising industry has benefited by higher efficiency in every sphere.

fig 4 How timber was handled in 1919. A horse team loading logs in the New Forest.



The Land

Woodlands of one kind or another occupy just over 4 million acres, or 8% of Britain's land surface. The Forestry Commission will hold, by 1970, 1,800,000 acres under trees, with a further 200,000 acres awaiting planting. Private landowners hold around 1,500,000 acres of well-managed tree crops and a further 700,000 acres of woods used mainly for sport, shelter or amenity. This includes hillside scrub in the north and west, often of considerable value as winter shelter for sheep.

In most countries overseas the national forest authority has always possessed great areas of natural forests, but in Britain only 75,000 acres of old-established Crown woodlands were available to the Forestry Commission after it was set up in 1919. These were mainly in two ancient Royal Forests—the New Forest in Hampshire and the Forest of Dean in Gloucestershire. The rest of the Commission's estate has been built up through a slow but steady progress of acquiring land, by purchase, feu or long lease, from willing sellers or lessors. In the hill country it is often impossible to obtain the lower slopes suitable for tree growing without accepting the upper hill ground, and even the summits, too. This explains why the Commission's total land-holding includes 800,000 acres of 'unplantable land' with a score of peaks over 3,000 feet high.

This mountain land, which is of very low value, is managed to best advantage as rough grazing for sheep, or even for deer. The Commission's total estate covers 2,800,000 acres, and is the largest single holding of land in Britain.

Some of the Commission's new forests, about 400,000 acres in all, have been established on former woodlands whose owners were unwilling to undertake replanting themselves. As a result, forests can be found in every county of Great Britain, bar London itself. But the greater part of the new forest ground has been taken over from marginal grazing use in the uplands of Scotland, Wales and the North of England. Foresters can make productive use of relatively poor land, and prevailing prices around £10 per acre (in 1968) contrast sharply with values of £100 to £200 per acre for good agricultural properties.

Under the national policy of promoting home food production, the Commission consults the appropriate Agricultural Department in each country, before it acquires land for timber growing. The Minister concerned only approves afforestation where he is satisfied that it is the best form of land use for that particular area. Where a wise division of ground has been made, sheep and cattle stocks have actually been increased, despite the diversion of substantial areas to forestry. The aim

fig 5 Kielder Forest in Northumberland, showing good land in the North Tyne valley reserved for agriculture, with sprucewoods on the higher ground.





fig 6 Helicopter spraying phosphate fertiliser to improve low-quality land in Minard Forest, Argyll.

is to increase timber output without serious loss of food production.

Foresters accept the challenge presented by large expanses of the poorest land in Britain. They realise that the ground they get will have drawbacks, such as low fertility, bad drainage, steep slopes, and poor access. The climate may be harsh, with high rainfall and little shelter from winter gales. Over the years they have developed methods and machines that enable them to tackle, successfully, moorland wastes of peat and heather that formerly defeated tree planter and grazier alike.

The key to the taming of poor hill ground is the tractor-drawn plough, gradually developed over the past thirty-five years as tougher metals and more powerful tractors became available. One kind of plough is designed to slice through soft peat, leaving open furrows that serve as drains every five feet or so. It throws up long ribbons of overturned turf to give rooting points, usually for spruce trees. Another kind, bearing a ploughshare of tempered steel, rips into the rock-hard compacted soils of the heather moors to break the 'pan' and turn up a broken band of stony soil suited to the establishment of larches or pines.

Fertility is restored to poorer hill soils by giving each small tree a few ounces of a phosphate fertiliser, for trials have shown that lack of phosphorus is the commonest source of poor growth. Later on, this essential element will be returned

to the soil in the tree's natural leaf-fall, to be re-used again by the tree's roots.

Fencing is another essential step before the planting of young trees can begin. In most districts farm livestock are kept out by stock-fencing, and where rabbits are common wire netting must be used too. In the Scottish Highlands deer fences, six feet high, are built to exclude these agile, graceful beasts that can prove very destructive to young trees when winter snowfalls deprive them of other food.

After the first survey of a possible addition to the national forest estate, farming interests are consulted and eventually boundaries and prices are agreed. When the remaining sheep stocks have been removed, the great ploughs go in, drains and access roads are constructed, and fences are set up. Then, a few years after the land was first considered, the trees arrive from the forest nursery and afforestation begins.

Each stretch of ground is allotted to a particular forest, under the care of its resident Forester, who is responsible for all work therein. There are around 400 forests in Britain. They vary considerably in individual size but average 4,000 acres – or over 5 square miles – of tree crops apiece. Land is being acquired at appropriate rates, currently about 50,000 acres a year, and nearly all of this lies in districts, such as the upland counties of Scotland, Wales, and Northern England where any alternative form of land use has become unprofitable.



fig 7 A giant plough, pulled by a crawler tractor, turns up ribbons of turf for planting spruces on poor hill pastures in the West Highlands.

Seed

The Forestry Commission plants over 100 million trees each year, and nearly every one is raised from a small seed. The only important exceptions are poplars and willows which are increased by cuttings. The choice of seed, that is of the parentage of the future timber crop, is a major factor in forest management. When possible the seed is collected in Britain from selected *seed stands*, which are entered in a special 'Register of Seed Sources' as desirable parents for future plantations. Otherwise an overseas source, or *provenance*, is carefully selected—in Japan for Japanese larch, in Corsica for Corsican pine, in British Columbia for Lodgepole pine, Sitka spruce or Douglas fir, and in Central Europe for the Norway spruce.

Conifers bear their seeds in woody cones, which ripen each autumn, winter or spring, high up amid their branches. Seed trees are climbed by highly-skilled workers using ladders or a *tree-bicycle*. They are equipped with safety lines and move through the crowns of the trees with great agility.

The cones are sent to *seed extraction plants*, where they are dried in a kiln by a stream of hot air. This causes their scales to open, so that they are ready to release the seeds. Next the cones are tumbled over within a large wire-mesh drum. This shakes the seeds out of the cones, and they fall through the holes of the mesh and run down into sacks fixed below. Each seed carries a little wing, useful in nature to help its dispersal by wind. These wings are removed by a de-winging machine, all dust is winnowed away, and then the seed is ready for storage.

Most conifer seeds can be kept for several years provided they are stored under correct and constant conditions of temperature and moisture. At Alice Holt Research Station a refrigerated seed store has been built to hold bulk supplies for several years ahead. It serves both the Commission's nurseries and those that grow trees for private estates. The seeds are first sealed in polythene bags and then placed in square tins, which are stacked in a cool chamber, maintained at a steady temperature just above freezing. When seed is needed for sowing each spring it is drawn from this cold store, but first it must be tested.

Seed testing is carried out by taking a small sample of seed from each lot. Small seeds are sown on a moistened sheet of filter paper, or larger seeds in sand, and placed in an incubator which maintains a suitable temperature for them to sprout. After a few weeks, a count of successful seeds is made, indicating the germination capacity. Every nurseryman needs to know the quality of his seed and its characteristics in order

to plan his sowing programme correctly. Besides handling all its own seed, the Commission imports, stores and tests a large proportion of the seed used by commercial nurserymen.

Because seed crops vary greatly from year to year, forecasts are made of future needs, and a reserve is held in the cold store to meet annual sowing needs. The seeds of broadleaved trees present a particular problem, because good crops, or *masts*, only occur once every four years or longer. These seeds vary a great deal in size and character—from large nuts such as acorns and chestnuts, to the hard stones found in the juicy wild cherry, or the tiny wind-borne seeds of birch. Special techniques, to suit each sort, have to be followed to forecast crops, collect the seed from the best parents, and store it for as long as possible. Acorns and beech nuts are occasionally imported from Europe to make up shortages.

Foresters now aim to breed improved cultivated varieties of timber trees. The Commission's Genetics section is busy selecting the best possible foundation stocks of 'Plus' trees. Once a potentially good parent is found, it is increased by grafting its shoots on to stocks of ordinary seedling origin. When these grafts bear flowers, controlled crossings are made between male and female flowers of two selected origins. After the resulting seed has ripened, young trees are raised from it and watched to see if they have inherited their ancestor's good shape and vigour of growth. Those parent trees that pass this test are multiplied, by further grafting, so that 'seed orchards' can be established as large-scale sources of pedigree seed for future forests. Seed orchards are already producing seed of the fast-growing Hybrid larch, obtained by planting alternate rows of European larches and Japanese larches—all selected as desirable parent trees. This arrangement ensures cross-pollination, and a high proportion of vigorous 'first-cross' hybrid seedlings.

All this painstaking work calls for accurate records. The Commission co-operates with the Tree Seed Association to issue certificates of origin, for both seed and the resulting seedlings and transplants. Trees take 60 to 100 years to mature, so it makes good sense to start off with the very best race available, and to have a guarantee of its identity.

Now for a few figures. One pound of acorns contains about 130 separate seeds, and yields maybe 80 plants for the forest. But one pound of seed of the Sitka spruce, nowadays our most widely-planted conifer, holds around 170,000 seeds, and from this a skilled nurseryman can raise as many as 100,000 trees fit for forest planting—enough to plant up 60 acres of land!

fig 8 Collecting cones from a seed stand of European larch. The trees have been selected as good parents and thinned out to encourage flowering and seeding. The collector has climbed the tree on a 'tree bicycle' and is now secured by safety lines.



Nurseries

All the trees needed for planting in the national forests—nearly 100 million a year—are raised in the Commission's own nurseries. These cover 1,500 acres—over 2 square miles—but this is only half the area needed to grow the same number fifteen years ago. Intensive research has made it possible to raise sturdy transplants in half the time, and at half the cost, once thought essential. Only half as much seed is now needed to obtain a given number of satisfactory plants; this means the forester can select seed of a higher standard than ever before.

Nursery management has become a full-time job for highly skilled foresters. The land selected must be freely draining and suitable for work at all seasons. It need not be highly fertile as nurserymen can easily restore to it, year by year, the nutrients removed by each crop of young trees. Nurseries are therefore established on light, sandy soil in districts of low rainfall.

Let us follow a batch of trees through successive stages, from seed to transplant, ready for forest planting. Nearly every job is now mechanised and the nursery is planned round a farm tractor, equipped with a range of detachable tools for each successive task. Beds are made at a standard width so that the tractor's wheels will straddle them.

First, land for seedbeds is cultivated by tractor-drawn

ploughs to give it a fine tilth and free it from weeds. Mineral fertilisers are added, and a common addition is 'spent hops' from a brewery; this is a weed-free organic fertiliser that helps to give a good rooting medium for tiny tree seedlings, and also holds moisture in the soil. Early in spring the prepared land is built-up into seedbeds, 3½ feet wide, by tractor-drawn ridging ploughs, and these beds are firmed down by heavy rollers.

Tree seed is then sown on the surface of each bed, at a carefully calculated density that varies with the kind of tree. This may be done by hand or with a drilling machine. Sown seed is at once covered with coarse light-coloured, lime-free sand, which promotes a higher yield of seedlings than does a cover of ordinary soil. A few days later, before the seedlings appear, the seedbeds are sprayed with a selective weedkiller applied under pressure through a spray boom from a tank carried on the tractor. This weedkiller wipes out nearly every sprouting weed seedling but—if applied at the right time and rate—leaves the *tree* seedlings unharmed.

Seedling trees germinate in 1½ to 4 weeks, according to kind of tree and weather. They are allowed to grow in seedbeds for one or two seasons, and in that time they reach heights between 3 inches and 1 foot. Some hand weeding is usually needed, and if necessary fertiliser top dressings are applied. One acre of seedbeds may hold 1½ million seedlings. To allow for losses during later stages, some 300 million seedlings must be raised by the Commission each year.

Few seedlings are sturdy enough, or well enough rooted, to start growth safely on the kinds of land the Commission afforests. So nearly all the seedlings are transplanted after their first or second growing season. They are given more space to grow as they spend a further year, or two years, in transplant beds or 'lines'. Transplanting makes them develop stouter stems, shorter shoots, and better root systems, features which help them to make a good, sure start when planted out. Machines are used to speed the huge yearly task of transplanting, which is, in practice, crowded into a few weeks of early spring. But only the nimble fingers of forest workers—usually women or girls—can put the tiny trees into the machine or transplanting board at just the right point to ensure success. Each worker, with the aid of tractor-drawn machinery, transplants on average 7,000 young trees in one day. Transplanted trees are set in straight lines, at a precise spacing and depth in the soil. Alternatively, seedlings can be 'undercut' or root-pruned, to promote bushy root growth, without the work of lifting and transplanting.

Transplants, like seedlings, are threatened by weed growth. Nowadays they are protected by a remarkable weedkiller called 'Simazine' which, if applied after the transplanting to soil free of weeds, kills weed seedlings that emerge thereafter, but leaves the young trees unharmed. Other weeds are uprooted by tractor-drawn tools designed to work between rows of trees or else, in the last resort, by hand. After one or two seasons growth, the transplants, now between 9 inches and 2 feet high, are lifted from the ground for transport to the forest. Again machinery is used where it will speed and cheapen the job.

Once out of the ground, the young trees are counted, graded, and packed for transport to the forest. They are usually bundled and placed in large polythene bags that conserve their vital moisture, and they must always be kept in a cool place, out of direct sunlight. At some nurseries refrigerated stores are used to provide a reserve of trees throughout the busy planting season.

fig 9 Two-year-old seedlings of Sitka spruce in a Highland nursery; the tractor-drawn machine is a root pruner.





It takes from two to four years to raise a forest tree, and seed collection must be organised a whole year before that. Plans must therefore be made three to five years ahead to ensure that enough young trees are ready for each year's planting programme. The planners must know what kind of land is likely to be available, for this governs the kind of tree to be used, and also the best age and size to plant. Every year there is a full stocktaking to match supplies with future needs. Trees needed for planting on private estates are grown by commercial nurserymen, but here too information and resources are pooled so that no precious trees are wasted, and no acre of land left unplanted, if suitable trees can be found for it.

How many trees are growing, at any one time, in the Commission's nurseries? The answer is about 250 million, with another 250 million in trade nurseries that supply private estates. That makes 500 million trees, or ten for every man, woman and child in Great Britain!

fig 10 Seedling Corsican pine, one year after sowing in the seedbed.

fig 11 What the nurseries produce: planting Sitka spruce transplants on ploughed moorland in South Wales.



Planting

Planting is the key job that sets the pattern for future forests in terms of size, situation, and kind of tree, for scores of years ahead. Annual planting programmes give a sound guide to each country's forestry progress. The Commission's programme began with a modest 1,600 acres in 1920, rose to a peak of 70,500 acres in the post-war expansion of 1954 and is now maintained at a steady 56,000 acres per annum, due to rise to 60,000 by 1976. Future programmes are fixed, on a five-yearly basis, by the Forestry Ministers, at reviews held every five years. About 12% of the annual programme represents re-stocking of former Commission woodlands, and the remaining 88% the extension of forests on to fresh ground—usually moor or mountainside but including some cleared woodland or scrub acquired from private ownership.

The planter's first decision is the choice of tree to use. The kind selected must be well suited to soil and climate at each new plantation, it must produce timber at a fast rate, and that timber must be in keen demand for forest industries, such as sawmilling and paper-making, both now and in the future. The Commission's trial plantations include over one hundred sorts of timber tree, all hardy in Britain, but in practice only twenty kinds are grown on any considerable scale.

The most widely-planted tree is Sitka spruce, native only to a narrow coastal strip along the Pacific shores of Alaska, British Columbia, and the Western United States. It finds an ideal match of climate along our western seaboard, from Scotland through northern England and Wales, Devon and Cornwall. Provided the land is ploughed, drained and fertilised it thrives over most of the poor hillsides that are available in the west for new afforestation. It has a high rate of timber production, and its firm, white, easily-worked timber is the first choice of paper-makers and in keen demand from sawmillers. Its close ally, Norway spruce, native to the Alps and eastern Europe as well as Scandinavia, is used over a wider range of conditions, mainly farther east in regions of lower rainfall. It yields the 'whitewood' of commerce and makes excellent paper. Spruces account for 46% of the Commission's current afforestation.

Three kinds of pine make up 35% of present-day planting. The native Scots pine, which yields the timber merchant's 'redwood', is a hardy and adaptable tree for poor soils and difficult local climates. Corsican pine yields similar timber at a faster rate, but only thrives in districts with low rainfall and hot sunny summers. It is preferred in eastern and southern England and along narrow coastal strips of Wales and eastern Scotland. Lodgepole pine, from British Columbia and the Western state of Washington, U.S.A., is by contrast well equipped to grow in the rainy and cloudy west. There it is used on a growing scale for really 'marginal' land where it would be risky to try to grow anything else.

Larches of three kinds—European larch from the Alps and Czechoslovakia, Japanese larch and the hybrid between them, are used on a smaller scale, about 5% of planting each year. They grow vigorously on bracken-clad hillslopes and yield a strong timber with durable heartwood, favoured for fencing and estate maintenance and also for the planking of Scottish fishing boats.

Two other conifers are planted on a smaller scale on carefully chosen ground. Douglas fir, from British Columbia, yields large volumes of strong structural timber on low valley slopes where it finds fertile soil and shelter from wind. Western hemlock, from the same region, stands a great deal

of shade and proves useful for replanting broadleaved woodlands where complete clearance of ground is inadvisable. It grows fast, and its creamy-white wood is well suited to joinery and paper-making.

Little of the land acquired by the Commission has soil fertile enough to grow economic crops of broadleaved trees. Beech is preferred to conifers as the main crop on the chalk hills of the south-east, including the Chiltern Hills and the Downs of Wiltshire, Hampshire, Sussex and Kent, though it is often established with conifer 'nurses' to secure good early growth. Oak is planted on the most fertile land available in the Midlands and southern England, and over smaller, carefully selected, areas elsewhere. Ash and sycamore are also planted locally, but most land that can grow broadleaved trees to the large sizes demanded by the hardwood timber trade remains in private ownership. Since 96% of the industrial demand for timber is for softwoods, that is, the wood of conifers, the Commission directs its main efforts towards those trees.

The outlines of the new plantations are nowadays planned to fit into the surrounding landscape. Rectangular patterns of roads, crop boundaries, fire-breaks and planting lines, which gave rise to criticism in early years, have been abandoned. Expert advice is sought from a consultant landscape architect wherever a new forest will become a major scenic feature. View-points are often left unplanted, and belts of broadleaved trees are retained where their rounded outlines will soften the impact on the eye of more regular young conifers.

Planting is done mainly during the winter resting season, from October to the end of April. During these seven months the Commission plants, annually, 100 million young trees, adding some 50,000 acres of new forests to its estate, and re-stocking around 6,000 acres of former woodland. The young trees, raised to the height, degree of stoutness and amount of root development judged best for each type of ground, are very small when planted out—only nine inches to two feet high. They are transported in polythene bags to keep them moist, and spaced, according to species, at from 5 to 8 feet apart. The number needed for one acre ranges from 1,750 trees down to only 700. Rapid planting, by simple methods gives the best results. A forest worker seldom plants less than 500 trees a day; on easy, ploughed, peat land his quota may go up to 1,200. All planting is done by hand, as the land is too rough, steep or soft for machines. On poor ground phosphatic fertiliser, say two ounces of ground mineral phosphate per tree, is applied at, or before, planting time.

On open, recently ploughed moorlands little after-care is needed, for grass and heather return only slowly. But where former woodland is replanted, vigorous weeds, including bracken, willow herb, foxglove, bramble, and tall grasses, rapidly re-invade the new plantation. For the first few years all this competing growth has to be cut back from the young trees each summer, using a reap hook or sickle, to save the trees from being smothered. Alternative methods, including machines and selective chemical weedkillers, are now used on an experimental scale, with the object of lowering costs. Woody regrowth from old coppice stools and tree stumps is quickly and effectively checked by applying chemical brushkillers. In the South of England, scattered taller trees are often left standing for several years because the 'dappled shade' that they cast aids the establishment of young timber trees, but keeps competing weeds in check.



fig 12 Replanting felled woodlands in Hambleton Forest, on the Cleveland Hills of North Yorkshire.

Harvesting and Marketing Timber

Trees are grown to be used. They are planted in remote places, often in spots where steep slopes or soft ground make access difficult. When first felled they are both bulky and heavy, needing special tackle to handle and move them. In round terms, the value of a tree doubles between the point when it is ready for felling and the stage when it has been cut down, hauled out, and delivered to a sawmill or factory only a few miles from the forest. Timber therefore costs as much to harvest as it does to grow, and efficient harvesting is essential to the economic success of the whole undertaking.

About half of the wood that grows in a plantation is taken out as *thinnings*. These are relatively small trees which are removed in stages to give their companions more room to grow. The removal of a fraction of the crop, every few years, is harder to organize than a clean sweep or 'clear fell' of the crop, and costs must be closely watched. Eventually, when the main crop of trees has reached its most profitable age and size, and is considered *mature*, it is brought down in a *clear felling*. This yields the second half of the timber volume and rather more than half of the total value and profit. But very few tree crops are mature below the age of 50 years, and for many years to come the Commission's main harvest will consist of thinnings.

How is the yield of timber judged and controlled? Ever since the Commission was set up in 1919, a team of forest measurement experts has made careful assessments of rates of growth in *sample plots* of trees, well spread throughout the country. The results of many thousands of measurements and calculations have since been published in *Forest Management Tables*. Armed with these, foresters can estimate just how many trees they can safely cut down for sale, from any plantation of any kind, according to its age, height, tree size and general vigour of growth, whilst ensuring that the remaining crop develops profitably. Selecting the individual trees to be removed is a skilled task, needing training and experience.

The total yield of timber from all the Commission's forests in Britain can likewise be estimated for many years ahead. It is now increasing at a most encouraging rate. The forecast for 1969 is 40 million hoppus feet of softwood timber, equivalent to a weight—when the wood is freshly felled—of 1.3 million tons, or a volume of some 50 million true cubic feet. At prices prevailing in 1968 this will be worth around £3 million even before the trees are felled, and twice that amount when the logs have reached the sawmill or the pulp-mill factory. By 1979 the volume and weight will have doubled, and by 1989 they will be three times as much as they are today. Values are expected to rise more rapidly because, quite apart from changes in overall price levels, big logs fetch higher prices per unit of volume than do small ones.

Who cuts the timber? At many forests timber merchants readily compete to buy standing trees at prices fixed by auc-

tion or tender. The subsequent felling, preparation, and hauling out of the logs is then left to them, subject to supervision by the Commission under the terms of the sale contract. Elsewhere, the Commission's own staff do the work throughout, and this enables the Commission to try out new methods and markets.

The first step is to fell the tree. The power-driven chain saw has now superseded the axe, wedge, and hand cross-cut saw that had served since pre-historic times. Though it is fast and efficient, this chainsaw brings its own problems of noise and vibration, and its users have to be taught safety rules and encouraged to wear ear protectors. Power saws are used for trimming off the branches of felled trees, and for cross-cutting the logs to length, as well as for felling.

Haulage to the roadside follows, and here the faithful horse is rapidly being replaced by the power-driven winch. Horses did the job at low cost and could go anywhere, but they are hard to find today and so are horsemen. Tractors can be easily converted to operate winches pulling overhead cables, and once a two-man team has mastered the techniques, they can handle large numbers of logs each day, quickly and economically. The tractor winch stays at the roadside, draws the logs to itself and stacks them.

Timber haulage machines that can go right through the woods, over rough ground, are being tried out by the Commission's Work Study branch. But many British plantations grow on slopes so steep that few ground machines can negotiate them. Here skyline cables are needed and promising new designs are being tried.

Once the logs have been drawn to the roadside they are loaded on to lorries or timber waggons for transport. The smaller logs were once laboriously lifted by hand to the lorry bed while a variety of cranes and sheer-legs, some powered by horse teams, were used to raise the bigger timber. Today the typical timber lorry is equipped with its own hydraulic hoist, powered by its own road haulage engine. The lifting tackle may be a grapple that picks up a whole bundle of small logs at one time, or else a grab or crane designed to cope with bigger timber, one log at a time. Loading has become a quick and simple business with a consequent saving in costs.

In all this harvesting work, the needs of the purchaser must be kept in mind. Will he accept small logs in long lengths, or does his machinery demand, say, the typical two-metre (6 ft 6 ins) billet that is customary for paper pulping machines designed overseas. For saw logs, what are his minimum girths and maximum lengths? These needs, and other factors such as rate of delivery, must be studied by the Commission's harvesting staff before a machine is ordered or a tree is felled. This ensures a steady stream of timber from the woods to the busy factories and sawmills, as each plantation falls due for its thinning or felling.



fig 13 Hauling spruce logs from a Highland forest, using a double drum winch powered by an agricultural tractor.

Round Timber and Sawn

Round logs, suitable for use as they are or stout enough to be cut into planks, boards, and all the other varied products of the sawmill, are the most valuable product of our forests. Despite the keenest competition from steel, concrete and plastics, wood holds its own as a key material in industry, building and communications. At present most of our supplies come from abroad, but an ever-increasing share is being provided by our own woodlands, thus reducing our dependence on imports.

There are three main groups of timbers. One, the tropical hardwoods, which are a substantial raw material of the furniture and joinery trades, cannot be grown in our cool climate and must be imported from Africa, Central and South America or the Far East. The second, the temperate hardwoods, also used for furniture and joinery, may come from Europe, North America, or even Japan, but in practice rather more than half of the volume used annually is drawn from our home woods. These include oak, elm, beech and sycamore, and as they are preferred as large logs cut from trees over 100 years old, the main suppliers are the owners of private estates. A well-established home-grown hardwood trade, with sawmills and seasoning yards well dispersed throughout the

country, handles this business capably. Well-grown mature broadleaved trees command good prices.

But the hardwood side of the timber industry is small compared with the enormous trade in softwoods or coniferous timbers. These versatile materials are used in every kind of constructional work, from fencing, pitprops and telegraph poles to building, engineering, and packing cases for heavy machinery. Our imports, which currently cost us around £200 million per year, come mainly from four great forested countries—Russia, Finland, Canada and Sweden. The two staple imported softwoods are the red deal or Baltic redwood drawn from Scots pine, and the white deal or Baltic whitewood from the spruces. Other kinds used in lesser amounts are Western red cedar, a naturally durable and attractive timber, Western hemlock which resembles spruce, and Oregon 'pine', a structural wood of exceptional strength, available in large sizes, which starts life as a Douglas fir tree; all these are native to the West Coast of Canada and the United States of America.

Nearly all these softwoods can be matched, on equal terms for specific uses, by logs from our own forests. These are taking an increasing share of the market as more and more plantations approach the right age, with trees of adequate size.

fig 14 Home-grown fencing stakes stacked to season in Thetford Chase Forest, East Anglia; these will all be creosoted before they are sold to farmers.





fig 15 A modern sawmill near Banchory in Aberdeenshire, which cuts home-grown pine logs into building timbers.

The first industry to take substantial quantities of home-grown logs was coal-mining. Despite the growing use of steel supports, millions of pitprops are still required annually. In Scotland, the home woods now meet all mining timber needs, while in England and Wales the home-grown share is steadily growing.

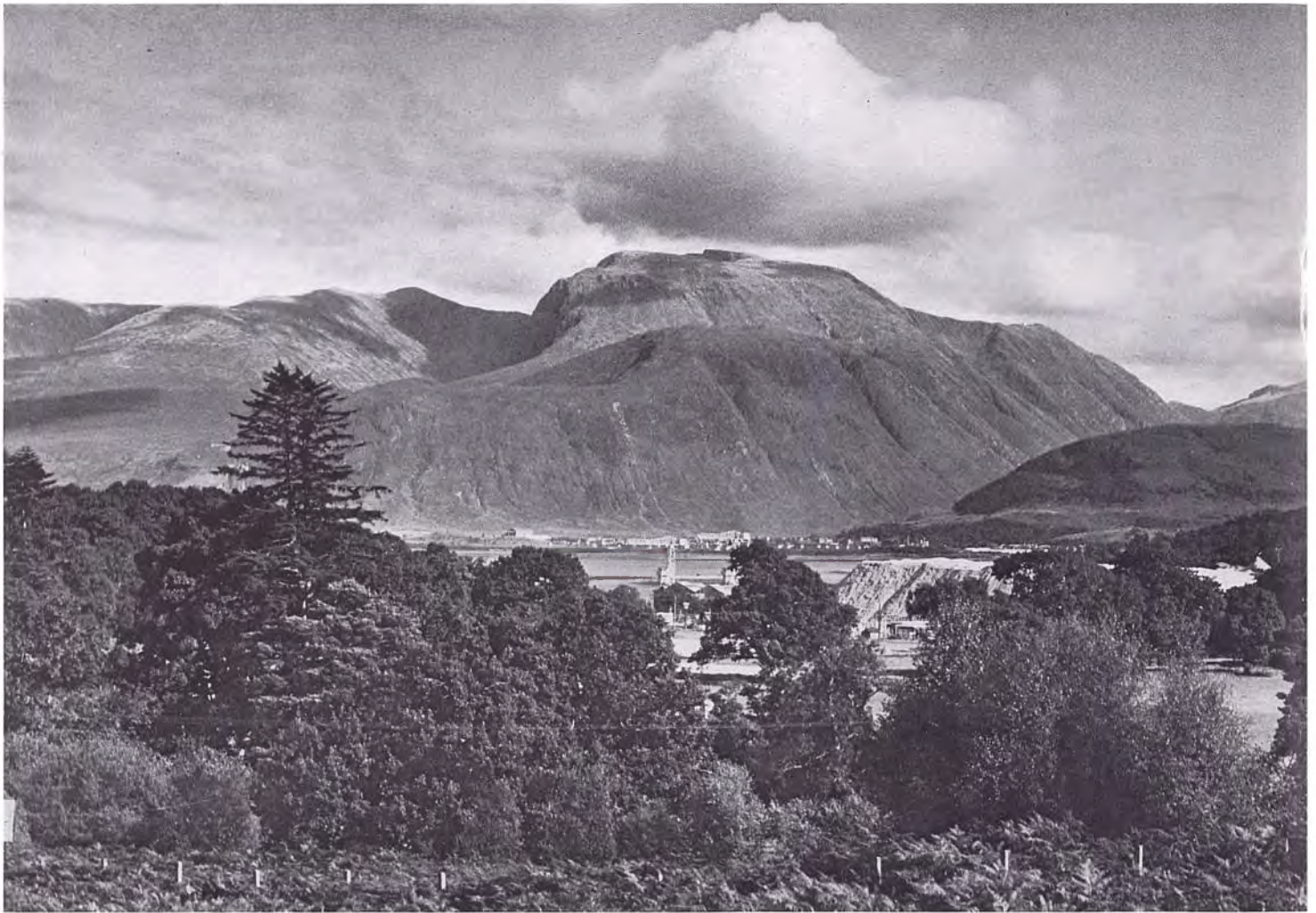
Home-grown timber also claims a large share of the fencing market, being used, in one form or another, for every type of farm or garden fence. Supports may be round, cleft, or sawn. Because they are used in constant contact with damp ground they last far longer if they are treated, before use, with preservatives; creosoted home-grown Scots pine, for example has a service life of forty years or more. The other members of a fence may take many forms, including round or cleft rails, sawn bars or boards, or interwoven boarding. Home-grown timbers of every kind make sturdy and attractive barriers, with or without paint or preservative treatment. Selected home-grown trees are also used, in the round, for telegraph and transmission poles, flag poles, and ships' masts.

Sawmilling is a highly technical industry, with mills and machines geared to a supply of logs of different kinds and dimensions, and to markets for particular classes of end-products. Packaging timbers are one of its major products, and these range from the thin boards used in cheap, non-

returnable fish boxes to the stout planking used to construct strong and elaborate packing cases for the overseas shipment of expensive machinery.

As a growing supply of large logs becomes available from the home woods, an increasing proportion is proving suitable for sawing and seasoning to the specifications demanded by the building trades. Scots pine and Douglas fir do the work of imported redwoods, while Sitka spruce and Norway spruce take the place of whitewoods drawn from overseas. Thanks to the saving in transport, all these home timbers are marketed at competitive prices. The market is a large one and its demands will continue for so long as men build.

Yet it has not been easy to gain a firm place for the home-grown softwoods in the home market. Users have had to be persuaded that they are the equal, grade for grade, of the well-established imported materials that have hitherto gone unchallenged. An extensive programme of research and testing has been carried out by the Forest Products Research Laboratory at Princes Risborough, which also tests timber imported from all over the world, to evaluate every sort of home-grown wood for every likely end-use. Searching comparisons made at this research station have proved that wood from our own forests, properly handled, can hold its own in our big industrial markets.



Paper and Man-Made Board

Go shopping in your High Street and it will not be long before you are buying something made from wood, whether you realise it or not. Your newspaper is printed on newsprint, made from a 'mechanical' wood pulp, which is simply coniferous timber ground down to its basic fibres. The wrapping paper that surrounds your purchases, and the stationery you buy for correspondence, are all wood re-constituted by the chemical and technical magic of the paper-makers. So, remarkably, are cellophane wrappings and every thread of a rayon fabric. Buy a packet of sweets or cigarettes, or a packet of peas from a frozen-food cabinet, and you will find they are packaged in carton board, another major type of re-shaped wood fibres.

Builders, furniture makers, and do-it-yourself handymen make tremendous use of various kinds of man-made board. This is made by breaking down logs to particles or fibres, and then re-building them into sheets of any reasonable desired size by re-fixing each little piece with plastic resin or glue. Board makers can use waste wood or small logs that are relatively cheap, and the users get a material which, though lacking some of the qualities of sawn timber, has other features that may make it more convenient to use. Each kind of man-made board can be tailored to suit its particular job. Examples are wood chip-boards or particle boards, made up

of visible chips, which are used in shopfitting and furniture; thick soft-boards or insulation boards used by builders to deaden noise and lessen heat loss; and much thinner and denser hardboards and paperboards used as light panels or as a backing to decorative, hard-wearing plastics such as 'Formica'.

Plywoods are another form of man-made board. They consist of thin sheets or 'veneers' peeled from large logs and then stuck together, using plastic glues, to make a light yet strong and stable panel. Because the grain of each sheet runs at right angles to that of its neighbours, plywoods are very hard to split. The same principle of combining the strength of many pieces of wood, each individually small and weak, into a larger piece having great strength and stability, is found in *laminated wood* of all kinds, from small members used in furniture-making to large beams designed by engineers as a satisfactory, lighter, cheaper and fire-resistant alternative to steel girders for large buildings.

The bulk of these man-made materials is made from imported timber. Some comes into Britain as logs and is processed here, while some reaches our ports in the semi-processed or finished form. All these industries have flourishing factories in Britain, but we should not risk becoming entirely dependent on overseas sources for such vital every-

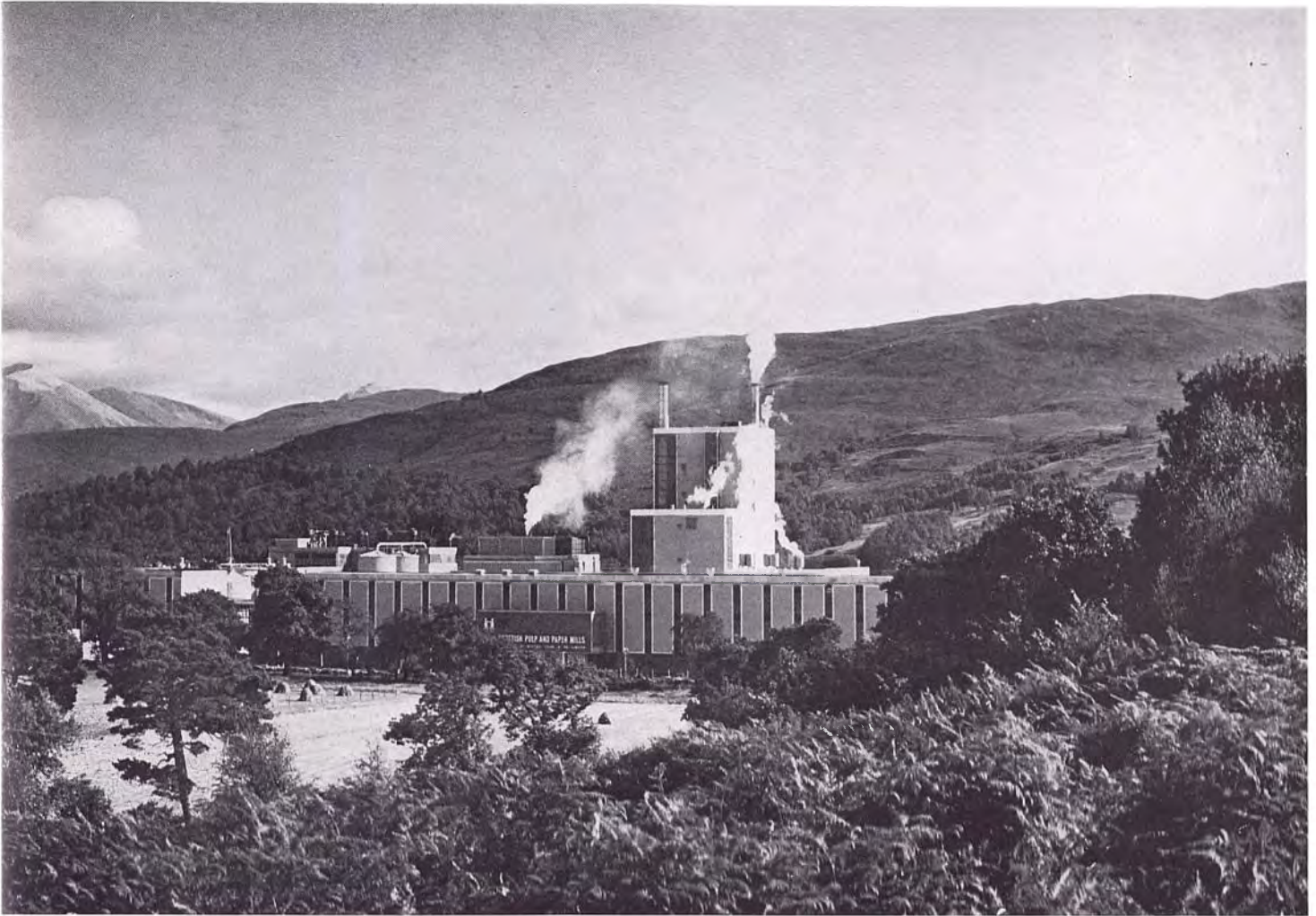


fig 16 Below Ben Nevis, at 4,406 feet Britain's highest mountain, stands the great Fort William pulp and paper mill.

day needs as the paper on which our news is printed, or the packaging that protects our food.

Twenty years ago, when the first plantations that the Commission had established were nearing the production stage, enquiries were made about the suitability of conifer thinnings for these paper and man-made board industries. This led at first to a trickle, now to a flood, of small poles and logs to factories specially built to handle this new raw material. Long-term contracts cover supplies, at reasonable prices, far into the future. This is essential because the processing factories demand heavy capital investment and assured supplies of wood to match assured future markets.

The largest of these new industrial undertakings is the pulp and paper mill opened in 1966 by the Wiggins Teape group, at Fort William in West Scotland. This cost £20 million, employs 700 people, and has an annual requirement of 200,000 tons of home-grown conifer wood, equivalent to 700 tons for every working day. Supplies are drawn from forests and private estate woodlands throughout the Highlands. Logs, cut to the best sizes for low-cost handling, travel in long lengths from remote glens on specially designed lorries, equipped with hoists, or make a short-cut journey by the West Highland Railway. This new mill, equipped to make high-grade papers from a blending of home-grown and imported timbers,

has brought a new economic future to the West Highlands by ensuring a modern technological industry on the spot.

Another major paper mill using home-grown logs is the Bowaters establishment at Ellesmere Port, on the Mersey Estuary, which draws spruce logs from most of Wales and all the North of England, to produce a high-grade newsprint. The same firm also uses home-grown logs at its mills near Sittingbourne in Kent. At Sudbrook, near Chepstow in Monmouthshire, a mill owned by Ashton Containers, Ltd. produces large quantities of carton board from small home-grown hardwood logs—a plentiful and cheap raw material for which timber-growers need a steady outlet. Another factory, the St. Annes Board Mill, operates at Bristol. At Workington, on the Cumberland coast, Thames Board Ltd. opened, as recently as 1967, a big modern plant for making carton board from home-grown softwoods. Their products are intended mainly for packaging food.

Factories making other kinds of man-made board are widely spread, and draw wood supplies from a large number of forests and private estates. They operate in Ayrshire and Dumfries-shire in Scotland, Northumberland and Durham in the North-East, Flintshire, Monmouth, Gloucestershire and Bristol in the West, and also around London, in Kent, and in East Anglia.

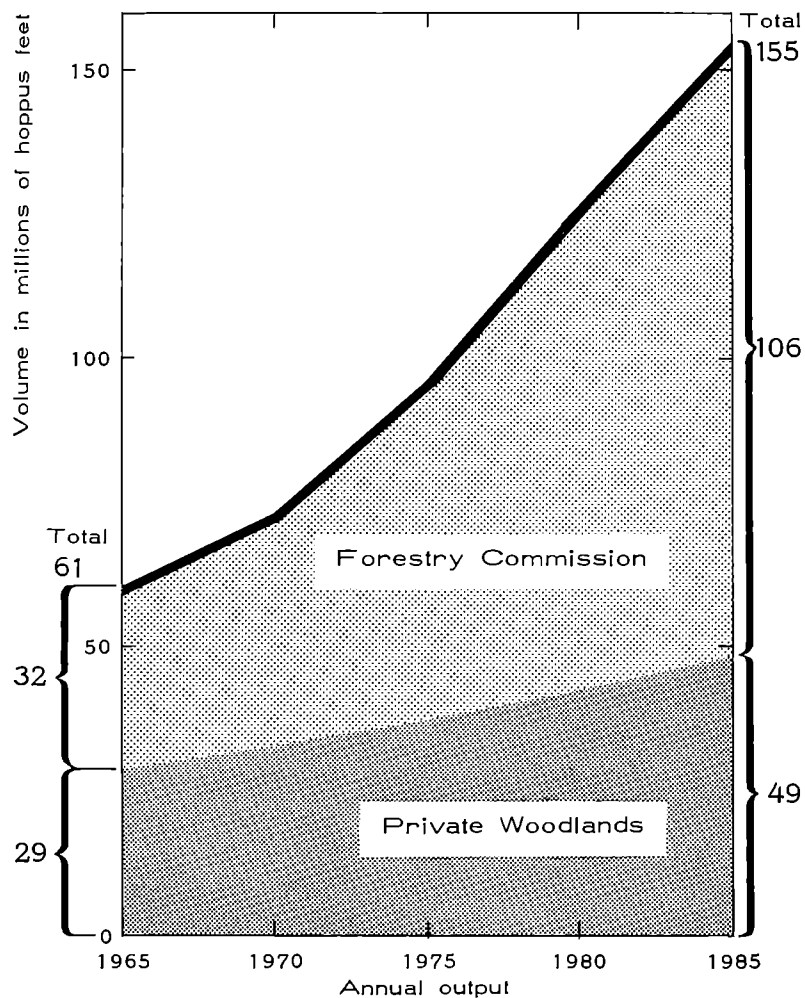


fig 17 **How softwood output will rise.** Output of softwood from privately-owned woodlands will increase by 70% over the twenty years 1965–1985, from 29 to 48 million hoppus feet per annum. Over the same period, the Forestry Commission output will go up by 230%, from 32 to 106 million. A combined increase from 61 to 155 million hoppus feet, or 154% on the 1965 figure.

The output of hardwood, nearly all of it from private estates, is expected to remain stationary at about 50 million hoppus feet per annum, and is therefore not illustrated.



fig 18 Snowdonia Forest Park, North Wales. Looking towards Moel Siabod over young plantations, with upland fields reserved for farming. Sitka spruce, in the foreground, has become Britain's most widely planted, and highest yielding, timber tree.

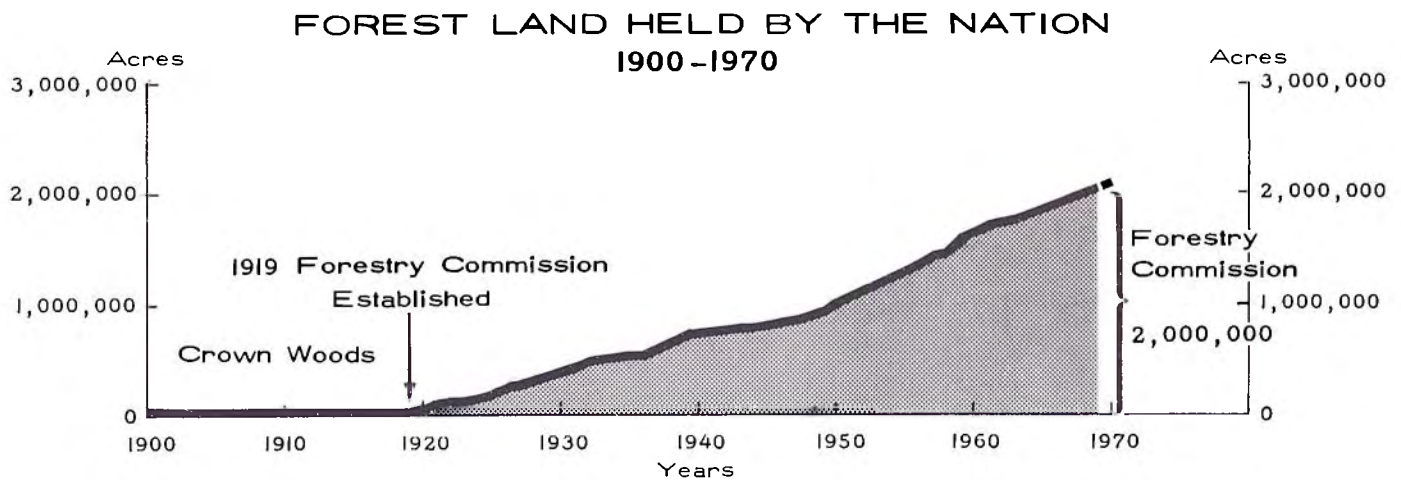


fig 19 Until 1919, the only woodland in national ownership was the 75,000 acres in Royal Forests, etc, held by the Office of Woods, Forests and Land Revenues of the Crown.

Steady expansion by the Forestry Commission has raised this to 2 million acres, of which 1,800,000 will be under tree crops by 1970, with 200,000 awaiting planting.



fig 20 Glen Affric in Inverness-shire, North Scotland, holds fascinating natural woods of birch and Caledonian pine. The reinforced concrete bridge, built by Commission engineers, across the River Affric, gives access to 6,000 acres of remote, yet potentially productive, hill ground. The snow-tipped peaks are Sgurr na Lapaich, 3,401 feet, and far Mam Sodhail, 3,877 feet.

ALL FOREST LAND 1900-1970

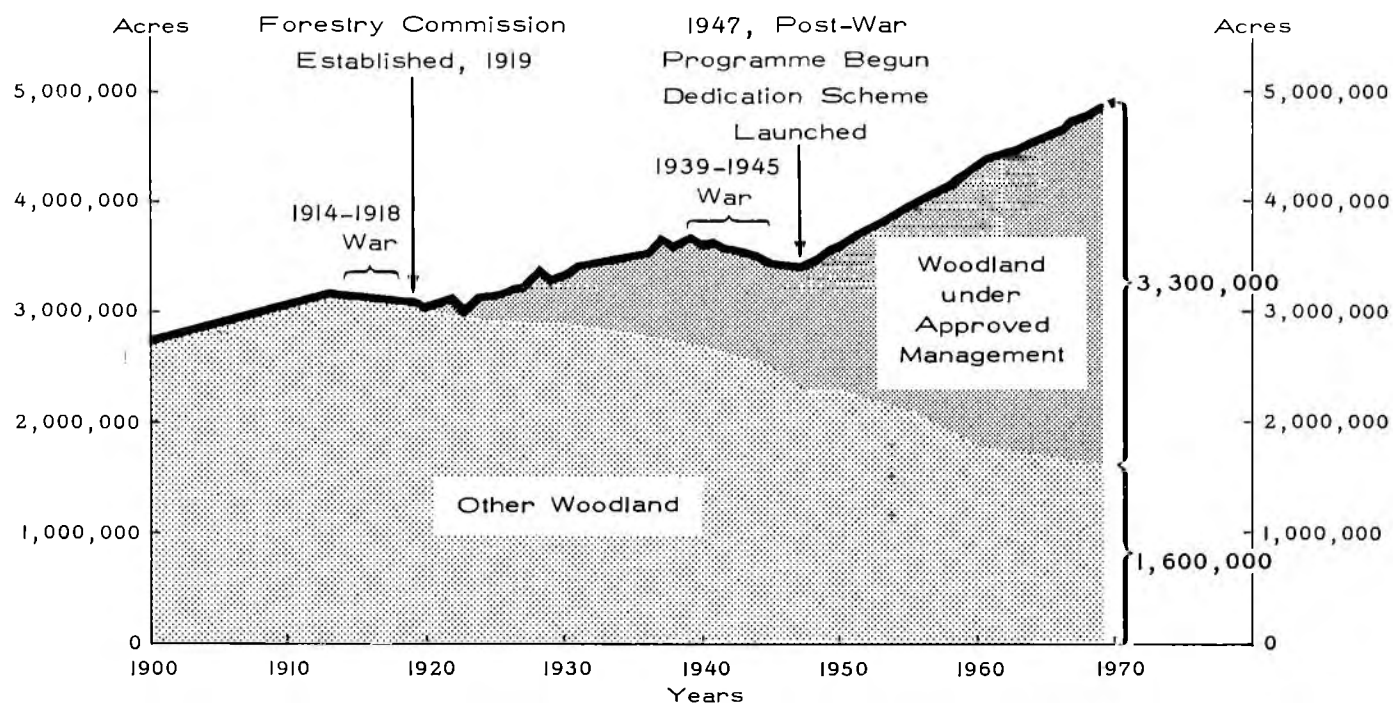


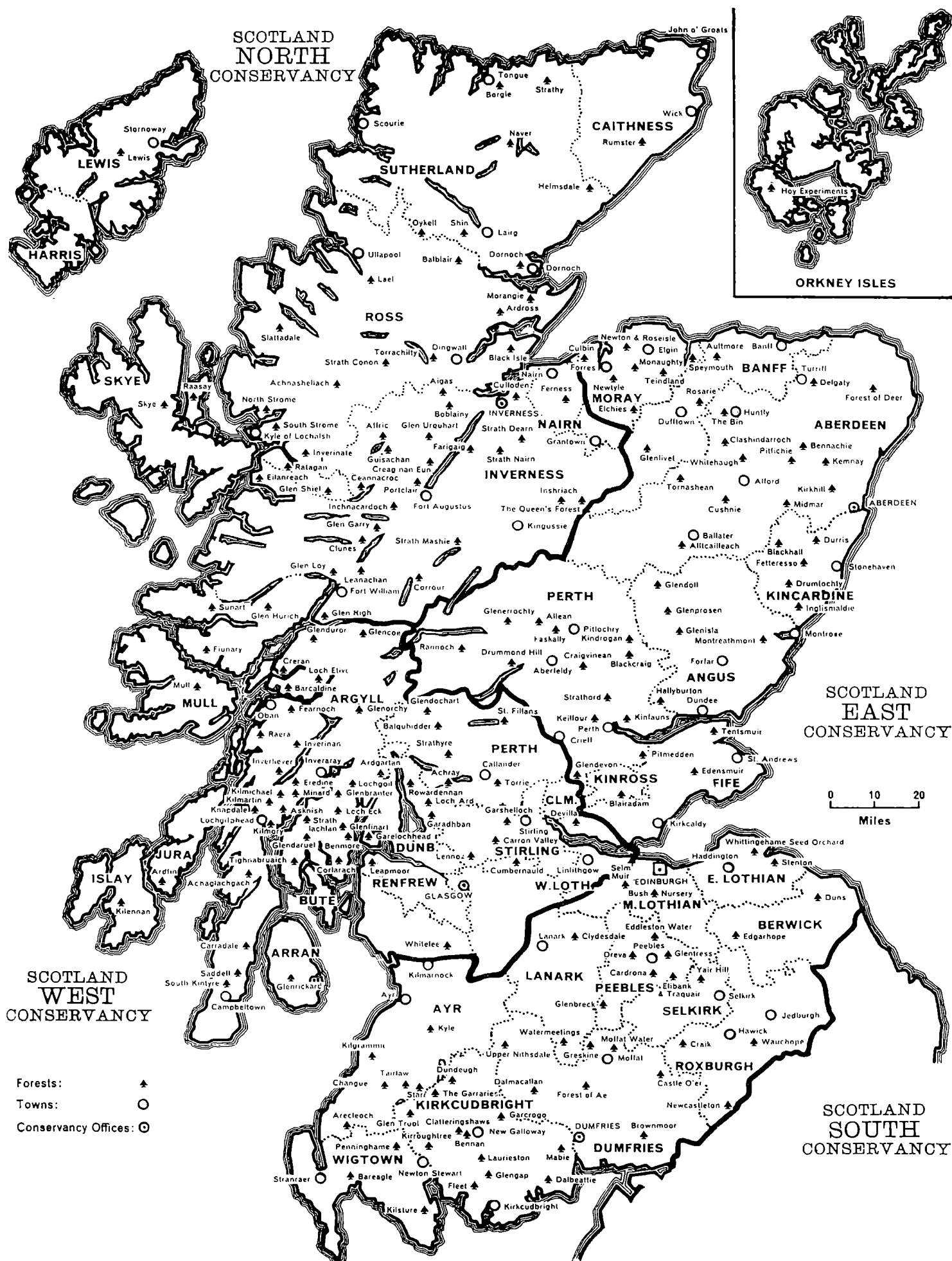
fig 21 The total area of forest land rose from 2,800,000 acres in 1900 to 4,900,000 in 1970, mainly through acquisitions by the Forestry Commission.

Woodland under approved management, through Working Plans,

Plans of Operations, etc., increased from 60,000 to 3,300,000 acres over the same period.

These figures include plantable land approved for acquisition by the Forestry Commission up to 1970; 200,000 acres of this are not yet planted up.

COMMISSION FORESTS IN SCOTLAND



COMMISSION FORESTS IN ENGLAND AND WALES

ENGLAND NORTH-WEST CONSERVANCY

ENGLAND NORTH-EAST CONSERVANCY

ENGLAND WEST CONSERVANCY

ENGLAND EAST CONSERVANCY

ENGLAND SOUTH CONSERVANCY

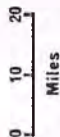
WALES NORTH CONSERVANCY

Legend:

- Forests: (Shaded area)
- Joint Scheme: (Dotted line)
- Towns: (Dot)
- Conservancy or Deputy Surveyors' Offices: (Circle with a dot)

Scale: 0 10 20 Miles

▲ Forests:
■ Joint Scheme
○ Towns:
○ Conservancy or
○ Deputy Surveyors' Offices:





ANNUAL PLANTING 1900-1970

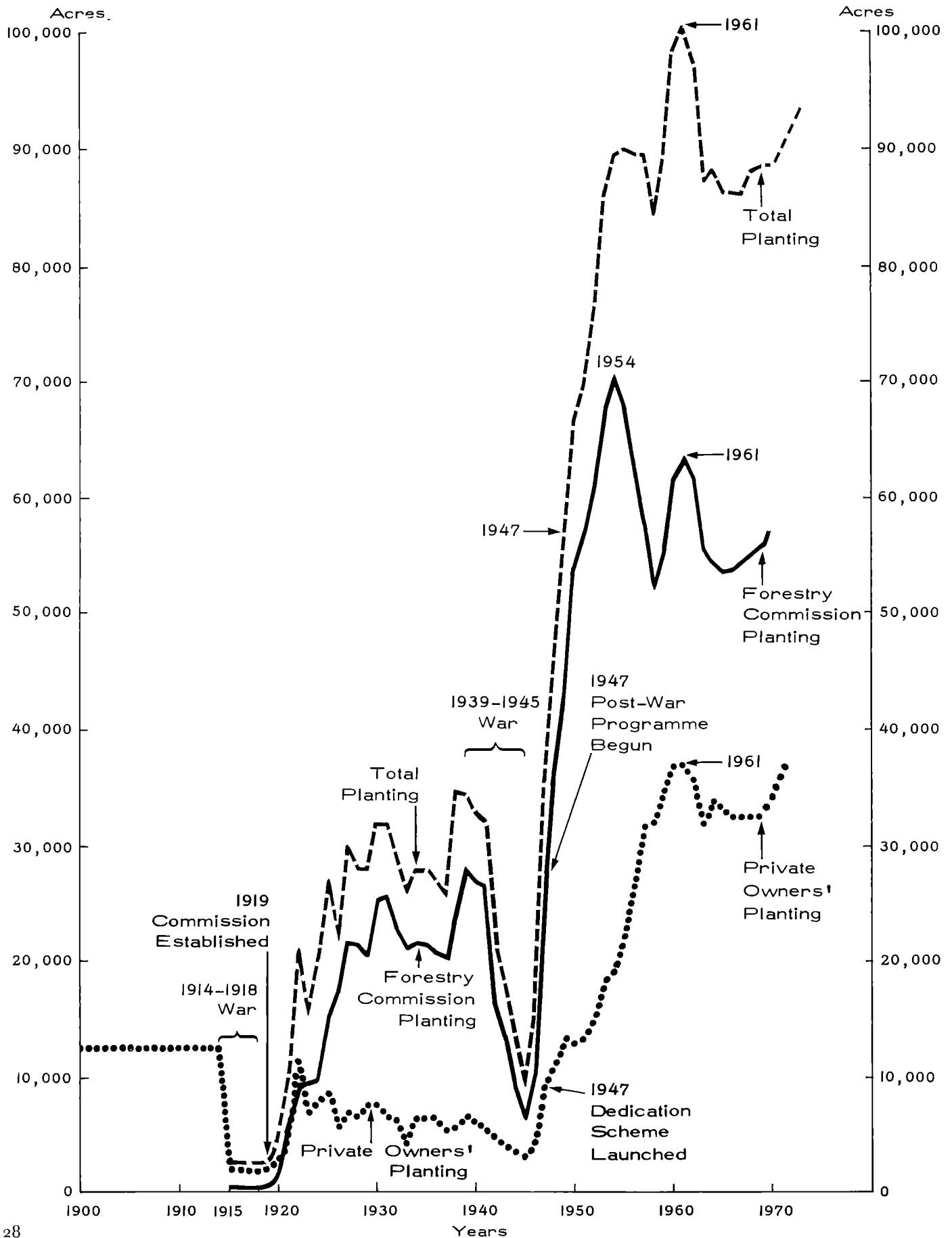




fig 23 Transplanting seedlings at Ledmore Forest Nursery in Perthshire. The tractor draws a lining-out plough, designed by a Commission forester. This places earth against the roots of trees, held in a trench by boards, and at the same time cuts the next trench. Girls re-fill each board in turn with more seedlings.

fig 22 (opposite) The top curve shows Total Planting, the combined result of work by Forestry Commission and Private Owners. Until 1914, the annual acreage, nearly all of it on the private estates, averaged 12,000 acres; it fell to 2,000 acres during the First World War, 1914–1918. A steady increase from 4,000 to 40,000 acres followed between 1920 and 1939. There was then a sharp drop to 10,000 acres during the war years, 1939–1945.

After the Second World War, there was a steep rise until 1961, with its record figure of 100,000 acres. The scale of total planting has since remained steady at around 88,000 acres each year.

The middle curve, for Forestry Commission Planting alone, shows a steady rise from 1,000 to 28,000 acres between 1920 and 1939 and a sharp drop to 6,000 acres during Second World War, 1939–1945. After that came a steep climb to a record 70,000 acres in 1954, followed by a steady average of 55,000 acres since.

The bottom curve, for Private Owners Planting, shows a steady annual rate, around 5,000 acres from 1920 to 1946, and then a rapid increase to 37,000 acres in 1961; current figures average 37,000 acres.

Since 1925, Forestry Commission Planting has always exceeded that done by private owners.

These figures include the restocking of cleared woodland, which is currently 6,000 acres annually in Commission forests, and about 20,000 acres on the private estates.

Allowing for this, the Commission adds around 49,000 acres to the total area under tree crops, while the private estates add 17,000. Total addition, therefore, averages 66,000 acres.



fig 24 The stump and butt of a 200-year-old native Scots pine tree, felled in Glen Affric Forest with a power saw. Alternating bands of yellow springwood and brown summerwood form annual rings, recording every year of two centuries growth. Note the thick, rugged bark.

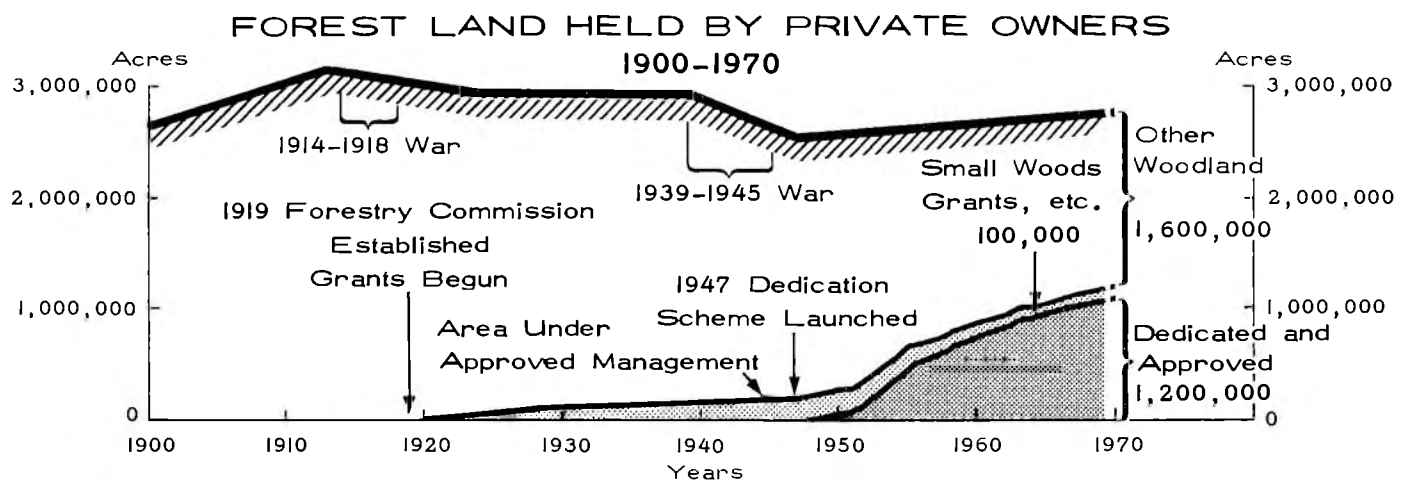


fig 25 The total of 2,800,000 acres has altered little since the start of this century. Slow though steady increases in normal times have been offset by war-time losses, and transfers to the Forestry Commission.

Since 1947 there has been a rapid increase in woodland under approved management, under the Dedication and Approved Woodlands Schemes, etc, from 200,000 to 1,300,000 acres.



fig 26 An operator wearing full protective clothing applies a modern herbicide to free forest trees from weeds.



fig 27 Dundough Forest in Kirkcudbrightshire, typical of afforestation work on marginal hill land; the reservoir feeds a hydro-electric power scheme.

Road Construction

Timber is a heavy and bulky crop. Strong roads and bridges are needed for its journey from the depths of the woods to the public highway. But since this harvest is drawn, from any one section of the forest, at intervals of several years, these roads and bridges must be reasonably inexpensive to construct and maintain. The main purposes they serve are the transport of timber, together with access by the forest staff for tree planting, the tending of plantations, and protection against fire.

The challenging problem confronting the civil engineer is to provide easily maintained forest roads, capable of carrying large vehicles, at low capital cost. He must think in terms of £5,000 a mile, contrasting with the £500,000 a mile available to the motorway engineer. Contractors are not attracted to such low-cost construction works spread over many isolated sites. The Commission therefore maintains its own staff of qualified professional and technical engineers who are responsible for the planning, construction and maintenance of forest highways and deal also with other problems of an engineering nature which stem from the ownership of a vast acreage of land. Intensive mechanisation of forest engineering operations has taken place over the last ten years, and the Commission's up-to-date mechanical plant and vehicle fleets are among the biggest in the country.

New forests are often formed in places where land is cheap and this usually means that access to it is poor. The countryside may be rocky and steep, with deep glens threaded by rapid torrents, or may consist of expanses of peaty moorland over a clay subsoil that provides poor foundations for perma-

nent roads. Rainfall is usually high and cloudbursts frequent. Often the engineer is asked to make the best possible road in the worst possible place!

A forest road is required to have a formation width of 17 feet, a carriageway of 10 feet, curves not sharper than 45 feet in radius, and gradients that do not exceed 1 in 10. This is an exacting specification for many kinds of terrain in which forests are grown.

Advance planning and survey work are essential. Every mile of road must serve a substantial area of plantations, destined to yield enough timber to justify its cost. The route chosen must avoid the most difficult hillsides, while bridges must be kept few and short. Once the best line for each road has been found and planned, the machines go in.

On the easier ground the road formation is prepared by angledozers, which quickly remove surface soil and shape the remaining subsoil into the outline required. On steeper, cross-sloping ground, angledozers or excavators are used to cut into the upper side of the hill and push the excavated spoil over to the lower side to form an embankment. Where spurs of hard rock are encountered, they are cleared by blasting with explosives.

When the road formation is ready, it is provided with base and surfacing courses of road stone. To save transport, different kinds of road metal are used in various districts; some is quarried from rock beds, and some dug by powerful shovels from old glacial moraines or river beds. Finally, heavy rollers compact the surface to fit it for lorry traffic.

fig 28 Heavy construction machinery excavating a road formation in a Highland forest.





fig 29 Why forest roads are built. A twelve-ton load of pulpwood begins its journey from South Strome Forest to the Fort William paper mill. Note the hoist above the driver's cab.

Few forest roads are open to private cars, and these are clearly signposted. The reasons for denying the private motorist access elsewhere are simple and compelling. These roads, which are not rights of way, are built for timber haulage, access for planting new forests and fire protection; delays caused by using single-lane roads for pleasure driving would be costly in terms of working time lost or plantations destroyed should fire break out. But nearly all forest roads are open to walkers, and ramblers enjoy their relative freedom from traffic.

At many points rivers must be crossed by bridges, to give access to extensive woodlands that will go on yielding, all the year round, substantial volumes and weights of timber. The old stone arch or fair-weather ford that sufficed for the farmer's sheep stocks cannot cope. Forest produce, bound for a distant market, is measured in tons per acre per year, rather than in pounds weight. Forest bridges are designed to Ministry of Transport standards and this can mean gross vehicle weights of 32 tons. They must be designed to last indefinitely, with minimum upkeep, for timber is a long-term crop; it may take 100 years to mature, and there is always the next crop to consider after that! Foundations must be well constructed, because many of the upland streams that are crossed do not have the firm, stabilised banks and courses found in the lowlands. They are subject to sudden spates and shifts of direction, so approaches and abutments must be exceptionally

sound. Modern forest bridges are graceful spans of concrete, usually pre-stressed to make economical use of materials.

The length of roads in the Commission's network now exceeds 10,000 miles, and current construction is over 500 miles a year. This is equal to one mile of road for every 180 acres of plantations, or nearly 4 miles of road to every square mile of forest. The aim is to carry a road within a few hundred yards of every tree to be harvested, that is, close enough for a modern winch to draw in the logs at low cost. Extensive studies have shown that, from that point on, transport along roads, on purpose-designed timber lorries, is cheaper than any alternative method. Lorries can run, without re-loading, almost from the tree stump to the sawmill or factory gate.

The fleet of road-construction, timber transport and other vehicles operated by the Commission is serviced and maintained at central repair depots equipped with modern plant and staffed by experienced mechanical engineers. The same teams also look after the crawler tractors, heavy ploughs and drainage machinery which the Commission uses to cultivate and drain its planting ground.

Research and experiments are always under way to find cheaper and better methods for road and bridge construction, maintenance of mechanical plant, and design and operation of ploughing and draining tools. Wherever engineering skill can aid or cheapen timber-growing and harvesting, it is promptly applied.



fig 30 Fire look-out tower in Quantocks Forest, Somerset.

Fire Protection

The greatest peril facing Britain's forests is fire. It can undo in a few minutes all the painstaking work of a score of years, leaving behind a blackened worthless ruin in place of a green hillside of living trees, promising future wealth and beauty. One tree can make a million matches—one match can burn a million trees!

Every forest is planned on the assumption that a fire may, sooner or later, break out. The trees are planted in distinct blocks, called compartments, seldom larger than 25 acres. Each compartment is isolated from its neighbours by a fire-break—a road, a clear ride 30 feet wide, a river, or a loch. All round the forest, and along every road or railway that crosses it, fire-proof strips are left. At Kielder Forest in the Borders, and in the New Forest, 'grazing strips', on which low grasses are encouraged to grow as feed for cattle or ponies, provide the best year-round fire-proof ground cover.

Quick access is all-important for fire-fighting. The network of new roads, built mainly for timber extraction, enable fire-fighting vehicles to speed quickly to within a few yards of

any outbreak. Maps of the road systems are held by the local County Fire Services, and by every Forester. The conspicuous signs labelled 'F.R.P.' for 'Fire Rendezvous Point', at forest entrances, mark mustering places for fire-fighting teams.

Fire look-out is the key precaution for prompt detection of any blaze, and its suppression before it can grow too large. The cheapest and most reliable way to keep a large expanse of woodland under constant watch is by using high towers. These slender structures, up to 90 feet high, have been built on hilltops at the larger forests. They are manned during fire-danger periods, particularly at weekends, when many people are moving around the woods. One man can keep 6,000 acres of forest, say 10 square miles, continuously in view from one well-sited tower.

After detection, the next vital step is quick, reliable communication between look-out tower, fire-fighting base, and fire-fighters actually in the forest. There are telephone links from towers to forest offices and County Fire Brigades, but

only radio can reach the men on the job. Every large forest region is equipped with a short-wave radio system, giving two-way communication over distances around ten miles. Each forest patrol van carries a set, and men on foot carry lighter 'walkie-talkie' outfits.

The Commission's fire-fighting vehicles are designed and operated in the knowledge that the larger, more powerful machines of the County Fire Services are also available, though at a greater distance. The Commission's role is *first assault* on the fire, aimed at reaching it promptly and keeping it small, if it cannot be knocked out completely. Only limited quantities of water can be carried on a lorry, or stored locally, so the fire pumps are designed to use small quantities slowly but effectively. In this first attack, water is regarded as an aid to the fire-fighting gang, who wield the beaters you see, stacked ready for action—beside every forest.

Land Rovers on forest patrols are equipped with fire pumps, which are powered by the ordinary road engine as soon as the vehicle stops; they carry a small emergency supply of water and can also draw on tanks or ponds. Lorries, maintained in

constant readiness at larger forests, carry tanks holding 500 gallons of water, powerful pumps, ample hose, and enough beaters, fire shovels and billhooks to equip a big gang. Fire-fighting crews, recruited from forest labour, have frequent fire-drills so that each man knows his task. Commission fire-fighting vehicles carry flashing lights and two-tone horns to secure priority over ordinary traffic.

These precautions would avail little without constant care and co-operation by the public. On a sunny day in late spring, with an east wind drying out dead grass or bracken, risk is terrific. A dropped match or discarded cigarette stub, including one thrown from a passing car, could start a serious blaze doing thousands of pounds of damage before fire-fighters, toiling for hours, could bring it under control. At every forest you see warning notices and occasionally indicators showing the daily degree of fire hazard. Some of the biggest fires have arisen through carelessness or mischance—a forgotten picnic fire or an overturned camping stove. If you see any fire out of control in or near a forest, report it at once to the police, the fire brigade or the local forest staff. Dial 999!

fig 31 Fire sweeps the pinewoods.



Estate Management

In the process of acquiring over 2 million acres of land for timber-growing, the Commission has become responsible for a further 850,000 acres of land which is either too poor and exposed to carry tree crops, or else too fertile for forestry. This situation arises mainly because landowners will seldom dispose of hill ground except in its existing farming units. Hence an acquisition of plantable slopes often brings with it both the neighbouring hill tops and the good land in the valley bottom. The Commission has always aimed to keep such ground in productive farming use, and it maintains close relations with the Department of Agriculture and Fisheries for Scotland, and the Ministry of Agriculture Fisheries and Food in England and Wales. Existing tenancies are respected whenever farms are taken over, and plans are worked out for the best possible subdivision, or integration, of the whole property as between farming and forestry. One of many sound arrangements—which naturally vary from one district to another—is the retention of the good ‘bottom’ land for farming or sheep wintering, while the highest land, above the planting limit, is used for the summer pasturage of the sheep stocks. Gaps are left in the long array of plantations so that the sheep can be driven down when needed, or may find their own way to a lower level when sudden blizzards strike the hills.

Many of the uplands, and also some of the forests in the Commission’s care, have a value for sport. This ranges from the stalking of Red deer in the Scottish Highlands, the shooting of Roe deer from ‘high seats’ within the forests, grouse shooting on the moors of the North and West as well as

pheasant shooting on low-ground. The first concern of the forest management must always be the protection of tree crops from possible damage, but it is still possible to maintain, at many forests, enough game for a worth-while shoot. Sporting rights are let whenever this is practicable. This provides a useful source of income for the Commission, as well as meeting a real demand for outdoor recreation. Where fishing rights on rivers or lochs belong to the Commission they too are let, usually to a local angling association. In all, there are 2,300 lettings of sporting and fishing rights.

The management of an estate of 2,850,000 acres involves the Commission in frequent dealings with its neighbours, and with the various public authorities that operate on its boundaries or, on occasion, over its land. The Land Agents are concerned with a large number of wayleaves or permission for access. For example, if the Post Office or an electricity supply board wishes to run wires through a forest, a water board wishes to lay pipes, or a farmer needs a new cart track into an outlying field, a Land Agent must agree the plans and conditions, and negotiate an agreement. A small number of residential properties, such as the old lodges of the Royal Forests and some isolated cottages in the hills, are also leased to suitable tenants at fair rents. There are, in all, about 5,000 of these varied leases and wayleaves that require constant supervision and occasional review.

Besides land management, the Commission’s Land Agents arrange housing for many of the Commission’s supervisory staff and forest workers. The Foresters—key men who have

fig 32 Integration with agriculture. Plantations on hilltops above valley farms at Brecon Forest, South Wales.





fig 33 Forest Workers' houses at Farigaig Forest above Loch Ness in the Great Glen of Inverness-shire.

charge of each forest and all work done there—are required to live on the spot, because of their responsibility for the safety of the woods—especially from fire—at all times of the day. Most Foresters occupy a house rent-free, under their conditions of service, and the Commission owns 1,100 such houses. The Land Agents choose the sites, prepare the plans, and see to the building of every new Forester's house, as well as its later maintenance. They cope with the exceptional problems that arise through building in remote places, away from the usual public services.

At one stage of the Commission's development, between 1925 and 1950, work at many forests was largely seasonal. Big labour forces were needed for winter and spring-time planting and nursery work, but not in the summer as there was then no timber harvest. A scheme of Forest Workers' Holdings was therefore set up whereby each tenant agreed to work half the year in the woods but was free, if he wished, to cultivate a rented smallholding at other times. Though conditions have

since changed both in forestry and farming, the Commission has kept in being over 700 Forest Workers' Holdings. They provide a valuable pool of local labour, and many holders earn a small but welcome additional income from their farming.

Forest villages have been built at a few of the remoter forests where there was no prospect of enough labour being available from existing settlements. The largest villages are in the Border Forests, such as Kielder in Northumberland, but there are also major ones at Glentworth and the Forest of Ae in South Scotland, and at Dalavich in Inverliever Forest beside Loch Awe. At each village, provision has been made for social services that every community needs. Depending on local circumstances, there is a school, a village hall, and a post office or general shop. At other smaller forests, groups of houses have been built, linked, where possible, to existing villages that already have their own shops, schools, churches, and inns. Altogether the Commission owns and maintains 2,500 Forest Workers' Houses, which are let at reasonable rents.

Research

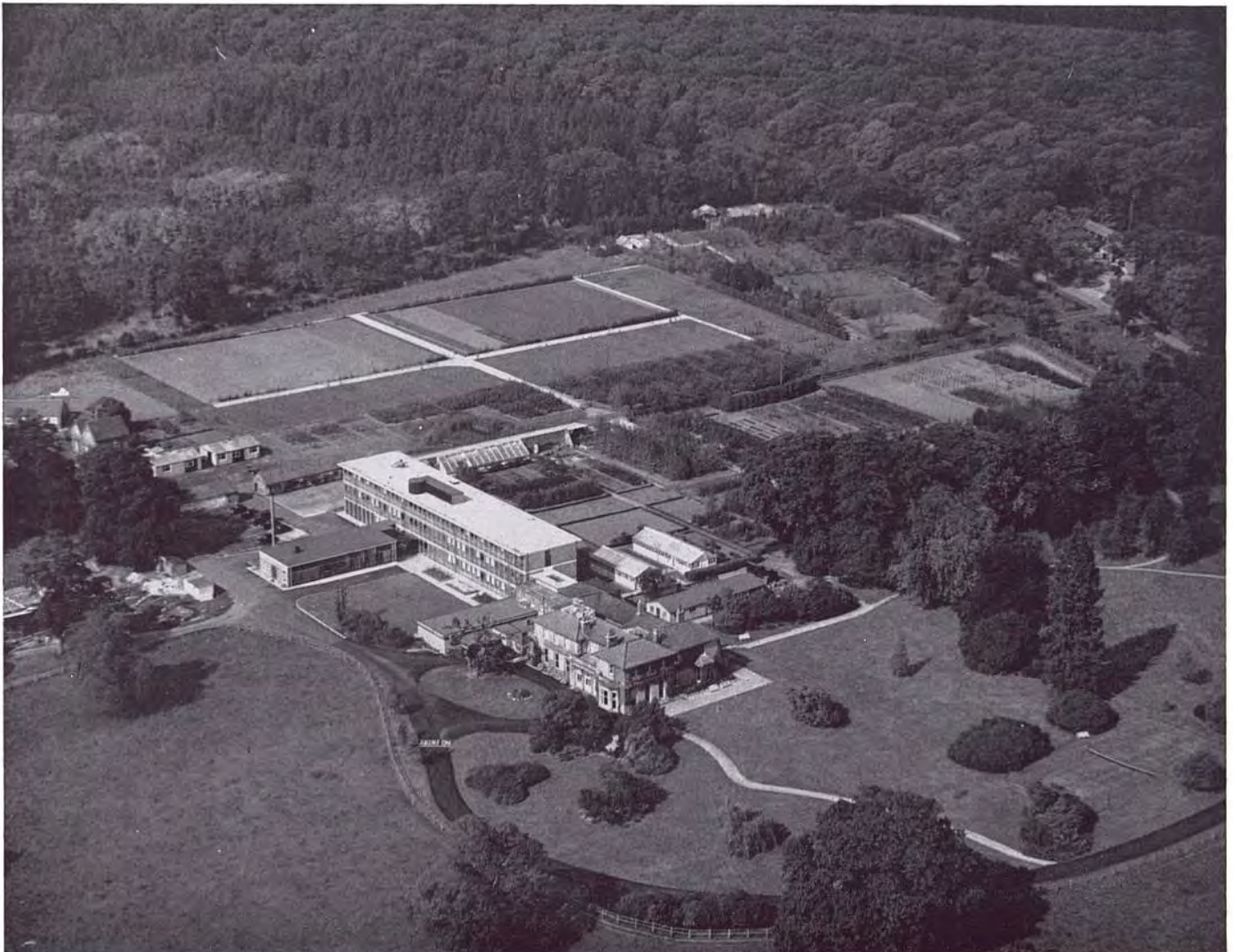
Much of the Commission's work involves pioneering. New kinds of trees, and new methods of raising them, have to be tried out on types of land where foresters have little or no previous experience. As the crops grow taller, new methods of management, new ways of harvesting timber, and methods for regenerating the forest as each crop is removed, must all be tried out. The need for an active research programme to produce early answers to the problems of how to form and maintain productive crops, how to protect them from pests and diseases, and how to manage them efficiently, was recognised from the outset.

As soon as the Commission was set up in 1919, it established an active Research Branch which has been extending its sphere of investigations ever since. In 1946, the Commission established its own Research Station at Alice Holt Forest near Farnham in Surrey and in 1968 it began to build and equip a second station in Scotland. This will be situated at the Edinburgh Centre of Rural Economy, on the Bush Estate in Midlothian, only seven miles south of the city centre, and near the site of the Fiftieth Anniversary Exhibition held in 1969. Forest research has two aspects. One is the gathering

in of new scientific knowledge indoors in the laboratory and the library, with a computer close at hand to handle the statistics, and photographic staff to make and keep pictorial records. The other side of the work consists of experimental work and trials in the field, covering every phase of the tree's life from seed and nursery seedling, through the plantation's progress from first establishment to maturity, to the great tree ripe for felling, and then to the felled log on the forest floor. Existing field trials and studies cover a wide range of soil, climate and tree species at each stage of growth. The Commission has set up, and maintains, no fewer than 366 major groups of experiments, scattered literally from Lands' End to John o' Groats and including the Welsh Mountains equally with the plains of East Anglia. These are tended, and measured at intervals, by a team of Research Foresters, each of whom is stationed at a centre convenient for his region, and who works in close touch with the men who manage those forests.

In the life cycle of the tree, research begins with the seed. Even before this has ripened on the tree, Research Foresters are looking at the flowers or flower buds to predict future crops of each kind, for seed crops vary from year to year. Later on,

fig 34 The Commission's Research Station in Alice Holt Forest, near Farnham in Surrey, seen from the air. Behind the old Lodge, which houses the library, stands the modern laboratory building, with extensive experimental grounds beyond.





each batch of ripe seed must be tested before and after storage, while enquiries are constantly in hand to seek better ways of collecting, handling and storing each kind.

Research into nursery practice has gone on continuously since the Commission sowed its first seed. It has paid handsome dividends, and has made it possible to raise better trees in half the time, and at half the cost—allowing for changes in money values—that obtained fifty years ago. Repeated trials, pursued over many seasons and at numerous nurseries, have shown the best soils and tools to use, and the right fertilisers, weedkillers, fungicides and insecticides to apply. Machines now make it possible for one man to transplant thousands of seedlings in one day, while polythene bags cut down the losses of plants through drought during transport from nursery to forest.

Once planted, the trees become the concern of Silviculturists—specialists in the growth of trees as a crop, who are aided by mensuration experts who measure rate of growth and timber production. At many forests you will see experimental plantations and Sample Plots, always carefully labelled and recorded, often with every tree numbered. Here the vital measurements are made, every year or so, to match each line of treatment against alternatives, on a strictly statistical basis. How deep to plough, what fertilisers to apply if any are needed, and what race of trees to select, are typical questions

ing to make headway because the soil lacks phosphorus, an element essential for tree growth.

that Silviculturists seek to solve. This means designing and testing new ploughs, seeking out fresh fertilisers as they become commercially available, and ranging the world for sources of still better trees.

The stability of tree crops is another active field of study, for it is no use establishing plantations if the wind subsequently blows them over. Wind speeds are measured in and around plantations and shelter-belts, and tests are made in wind tunnels. One interesting discovery here has been that a conifer's crown closes up when a gale blows, causing it to present a lesser area to the force of the blast.

Forests are often grown on land unsuited for farming, and consequently most of them occupy 'problem soils'. So a well-equipped Soils Section investigates the nutrient status and water-holding capacity of difficult sites, before they are planted up. It carries out laboratory analyses of both soils and tree leaves, and recommends, where appropriate, the best fertilisers and methods of drainage to apply. This brings more and more marginal land into productive forestry.

Trees, like other living organisms, are subject to diseases. Most of these are caused by fungi but some are due to bacteria or to peculiar conditions of soil or climate. The Forest Pathologist makes a searching study of each cause of loss, and this often involves 'culturing' a fungus, that is, growing it for a while in the laboratory to identify it more certainly and to

(continued on following page)



fig 36 A dramatic increase in growth and vigour is seen, five years after phosphate fertiliser was applied.

(continued from previous page)

discover which fungicides will check it. Then he prescribes remedial measures, such as spraying young trees in the nursery with a chemical, or planting another sort of tree on some very difficult site. Many diseases cause decay in timber, lessening its value even before it can be harvested. A major research success here has been the treatment of tree stumps, just after the thinning out of each crop, with a fungicide to kill the spores of *Fomes annosus*; otherwise this harmful fungus would spread through root systems, destroying many standing trees.

Forests are the homes of countless insects, from gaily coloured butterflies that attract collectors to minute aphids which, in incredible numbers, suck the sap from tree leaves and stems. Forest Entomologists keep a constant watch over the many pests that can increase very rapidly in numbers, and threaten the future of a timber crop. One example is the Pine Looper Moth, whose green caterpillars can devour every leaf on a tall Scots pine tree, so causing its death. If a plague of this creature gets out of hand, it can be controlled by spraying the whole forest with an insecticide from an aeroplane, at the stage in summer when the caterpillars are feeding on the leaves.

The Forest Geneticist, who selects and breeds new and better strains of timber trees, looks to the distant future for the completion of his fascinating task. He seeks out good 'parent trees', secures living shoots from their tall crowns, and grafts these shoots on to stocks of some commoner race. When the grafted shoots bear flowers, he cross-breeds them by controlled pollination, to obtain pedigree seedlings. After these have been growing for a while to judge their vigour, the best selections are grafted again to form 'seed orchards' that will yield pedigree seed for future forests.

Intensive efforts in forest research are being made in all countries with large forests. The Commission's research teams keep in constant touch with overseas experts so that knowledge is quickly shared and extended. But every new discovery has to be put into practice under the particular physical and economic surroundings of each country. For this reason the new research station, soon to be opened at Edinburgh, will give a powerful boost to Scotland's expanding forest enterprise. All the Commission's findings are freely shared with those who grow timber on private estates, by means of Stationery Office publications and an active advisory service.

fig 37 A back-acting digger deepens drains to improve root growth and stability in a crop of Sitka spruce at Carron Valley Forest, Stirlingshire.



Training and Efficiency

The Commission recruits its senior professional staff from universities and similar training centres that give degrees and certificates in forestry and allied professions. It arranges training for its own recruits for the Forester grade—the men who have local charge at each forest and are responsible both for the trees and all the work that is done there. These highly-trained and experienced men number 1,500.

What does a man learn to fit him to take charge, eventually, of a typical forest that holds 4,000 acres of plantation, employs 25 skilled forest workers, and has an annual budget of about £30,000? First, he must know every job his men will be called upon to do, through the whole range of forest operations. He will have to instruct them before each job starts, supervise its progress, and calculate the payments for it, probably on a piece-work basis. He will be responsible for the safety of the man on the job, which means he must know the safe way of handling every tool and piece of equipment, and he must also become skilled in first-aid.

This kind of practical know-how can only be acquired by doing the work oneself. So a great deal of the trainees' time is spent in the forests on actual tasks. They plant trees, weed them, mark them for thinning, fell them, and haul them to the roadside, using the latest methods and equipment. The rest of their training time is spent in well-equipped laboratories and lecture rooms, where qualified instructors make full use of the latest teaching aids. Study tours are made to selected forests in other parts of the country, and to research stations, so that future foresters gain a broad idea of the varied crops and conditions they may have to deal with, and get to know the latest scientific aids and information available. They are also shown how to teach, for one of their major concerns will be passing on new methods to forest workers.

A major task of the Commission's Education and Training Branch is the instruction of the forest workers themselves in the best modern labour-saving techniques. These techniques are first tried out by Work Study teams, armed with the familiar stop-watch, who give trial runs to each main job, using a variety of tools, machines, and methods.

As an example of a simple point that can emerge from such studies, let's look at tree-felling. Most trees can be felled in *any* direction, but if each tree is felled *towards* the road along which it will eventually be hauled out, instead of *away* from it, there is a small overall saving in time and cost of haulage. Multiply this by the 20 million trees the Commission fells annually, and really substantial cash savings result.

Over the past fifteen years there have been amazing changes in equipment used by forest workers. Traditional skills handed down from one experienced woodsman to another now have little application, and several thousand men are being re-trained in new techniques such as the use of tractor winches and power saws. This is being achieved by mobile tool instructors, who visit each forest in turn, after they have themselves mastered the fine points of each new method or machine; they must also become skilled in

'putting across' complex techniques in simple terms to practical operators.

The principle of training everyone for their job, and re-training them whenever that job changes, is applied right through the Commission's staff of some 12,500 people. New entrants, including lads and girls joining junior clerical grades, go to introductory courses to learn about the Commission's background and objectives, as well as details of their particular daily tasks. Professional, executive and technical officers of all callings and grades are likewise encouraged to keep abreast of developments in methods and equipment. At present, for example, a team is studying possible applications of computers and related techniques to forestry—not an easy task when operations are widely dispersed over a thousand scattered woods rather than being concentrated within a single factory.

Trees grow slowly, methods change rapidly and repeatedly. The Commission aims to apply the best available techniques at every stage from seed to sawmill. Its research and training staff spare no effort to discover them and ensure that they are widely known, both to its own staff and to foresters and timber men throughout Britain's woodlands.



fig 38 Learning how to measure timber in the woods. A tape is used to ascertain the length of an oak log; then its girth is determined at the mid-point, and calculations give its volume.

Forest Parks

From the outset the Commission has played an active part in encouraging outdoor recreation in its forests. The New Forest, which it took over in 1924, was already widely used and enjoyed by the public, and its facilities have been defined and broadened by two Acts of Parliament passed in 1947 and 1964. An exceptionally popular camping ground has been opened at Holmsley in the south of the Forest, while independent campers may still, under permit, pitch their tents on their own chosen sites on unenclosed land within this 66,000-acre expanse of wood and heath.

The Forest Park movement, which anticipated by ten years the National Parks in England and Wales, was the imaginative concept of Lord Robinson, later the Commission's chairman. In 1938 he established a Park with mature woodlands in the Forest of Dean, an ancient Royal Forest in the west of Gloucestershire, and added the neighbouring Tintern Forest in the Wye Valley. This proved an immediate success and today holds one large and well-equipped public camping ground—at Christchurch near the famous viewpoint of Symonds Yat, six attractive woodland camp sites for youth organisations, and five Adventure Centres with permanent accommodation for young people. Five forest trails have been laid out, and way-marked paths lead tourists across the Forest or along rewarding circular routes. Yet this Park—with 35,000 acres of rugged, wooded countryside, is so vast that you can still find solitude, and shy rare birds and beasts, deep in its midst. The Dean is easily reached from Gloucester, Hereford, Bristol or Newport.

Snowdonia in North Wales holds a magnificent mountainous Forest Park, established in 1937 and extending to 24,000 acres. This lies within the larger Snowdonia National Park

and comprises four large forests, Beddgelert on the west of Snowdon summit, and Gwydyr, Lledr and Machno in the Conway Valley to the east. At Beddgelert there are picnic halts and a well-sited camping ground, and forest trails have been opened through the woods. Gwydyr, also well-equipped with forest trails, footpaths and routes for pony trekkers, has a wider range of scenery. Rushing torrents course over cascades, including the famous Swallow Falls on the Llugwy, and a score of still lakes, embowered by spruce, pine and larch, mirror the high peaks of Snowdonia, snow-tipped over much of the year. Betws-y-Coed, Llanrwst and Capel Curig are convenient centres for touring Gwydyr Forest, which lies within easy reach—even for the day visitor—of Liverpool, Birmingham and Manchester.

In 1936 a group of forests on the Cowal Peninsula, thirty miles north-west of Glasgow, were formed into the Argyll Forest Park, which now embraces 65,000 acres. Here woods of spruce, pine, larch and Douglas fir rise from sheltered arms of the sea and long freshwater lochs, towards windy summits far above the tree line. The southern approach, across the Clyde by ferry from Gourock to Dunoon, leads to Benmore Gardens and Kilmun Arboretum, famous for sub-tropical rhododendrons, palms and Australian eucalyptus trees. The northern approach, beside Loch Long or Loch Lomond to Arrochar, brings hardy climbers to The Cobbler rock climbs and the wild wastes of Ben Ime, 3,318 feet high and snow-clad throughout the winter. There is a well-sited camping ground at Ardgartan, near the head of Loch Long, and recreations include mountaineering, boating and canoeing on sea or inland loch, and pony-trekking.

Glen More Forest Park, formed in 1948, lies in the heart of

fig 39 Pony trekkers beside Loch Ard in The Queen Elizabeth Forest Park, between Aberfoyle and The Trossachs.





fig 40 Camping ground beside Loch Long, near Arrochar in the Argyll Forest Park.

the Cairngorm Mountains of Inverness-shire and holds recreational areas of unique importance. Only a quarter of its 12,500 acres are under trees, comprising The Queen's Forest, famous for its ancient native Caledonian pines. In the heart of these pinewoods lies Loch Morlich, large enough for exciting canoeing and dinghy sailing, with picnic points and bathing beaches. A fine new road winds up to ski-ing slopes, the finest in Scotland. Here snow is available from December to May during most winters, and January to April in all. A chair lift takes skiers in winter, or adventurous ramblers in summer, almost to the tip of The Cairngorm, 4,084 feet above sea level; in winter several ski-tows operate also. Aviemore, now a winter sports centre, is the nearest town, while on the spot there is a camp site, a Youth Hostel, and a residential centre called Glen More Lodge, run by the Scottish Council for Physical Recreation.

In 1943 the Glen Trool Forest Park was created in the Scottish province of Galloway, a little-known region of outstanding scenic attractions. At its heart lies Loch Trool, scene of a victory by Robert the Bruce over English forces in 1307, while Loch Doon, Loch Ken and a score of lesser waters lie within or near the forests and open uplands. The summits include The Merrick, at 2,764 feet the highest peak of southern Scotland, and the Park embraces 140,000 acres of forest, moorland and fell in the counties of Ayrshire and Kirkcudbrightshire. Newton Stewart is the best town centre for explorations, while there is an attractive camp site in Glen Trool itself, fifteen miles north-west.

The region between Loch Lomond and The Trossachs, on the southern fringe of the Highlands, has attracted a stream of

tourists ever since Sir Walter Scott immortalised its scenery with his romantic poem *The Lady of the Lake* and his historical novel *Rob Roy*. Since 1930 it has been the scene of a great afforestation programme, and in 1953 its three forests, named Rowardennan, Loch Ard, and Achray, were declared, with Her Majesty's gracious consent, The Queen Elizabeth Forest Park. Developments to aid public access and enjoyment include two camping grounds—one at Rowardennan beside Loch Lomond and the other at Cobleland near Aberfoyle—the David Marshall Lodge forming a centre for rest and refreshment on the Duke's Road above Aberfoyle, and sign-posted picnic halts, forest trails, footpaths and pony-trekking routes. The Park, which covers 45,000 acres in the counties of Perth and Stirling, reaches to the summits of Ben Lomond (3,192 feet) and Ben Venue, and touches on the shore-lines of four famous lochs—Loch Lomond, Loch Ard, Loch Achray and Loch Venachar. Callander, Stirling, Glasgow and Edinburgh are all close enough for day visits.

The Border Forest Park, created in 1955, embraces 123,000 acres in seven forests along the historic Scottish Border. Northumberland holds three of these, namely Kielder, Wark and Redesdale in the dales of North Tyne and Rede. Cumberland adds Kershope Forest in Liddesdale, while Roxburghshire includes Newcastleton and Wauchope Forests on the Scottish side. This is a land of vast spruce forests, rising to high bare hills such as Peel Fell that give the Rambler wide views over two countries. There is an attractive camp site at Lewisburn, beside the North Tyne in Kielder Forest. No considerable town stands anywhere near, but the Border Park is easily reached by car from Newcastle, Hawick or Carlisle.



fig 41 Setting up a nest box on a School Forest Plot in South Wales.

Nature Trails, Adventure Centres and School Plots

As the Commission's forests have grown taller, there has been an increasing demand for more public access, and for information about their wild life of plants and animals. If people new to a forest wander into the woods unaided, they see and learn little, and often miss good viewpoints and features of interest only a few yards off their path. The practical answer to this need is the provision of well-planned Forest Trails, each with an appropriate printed guide showing people where to go and what to look for on their way.

A typical Forest Trail starts at an easily-found spot, such as a camp site or a forest office close to a public road, where cars may be safely parked. Here a simple printed guide may be bought for a few pence or a shilling. Arrows lead the visitor along an instructive route, chosen by foresters who know their ground intimately, and each change of direction or halting point is marked by a sign. The guide shows what you should see at this spot—perhaps a rare orchid or an exceptionally tall tree, a badger's earth, a track frequently followed by deer, or the nesting place of some unfamiliar bird. There will be at least one view-point commanding a wide landscape of forest and distant hills, and again the guide will say just which features merit your attention. Finally the arrows along the path will lead you back, after a ramble of a stated distance and estimated time, to your starting point.

One great advantage of these Forest Trails is their informality. You don't have to make any appointment or book in advance. Just drive up, at any reasonable daylight hour, buy your guide, and set out on an exciting exploration, going as fast or as slow as you please. At most forests, a picnic site will be found near the start of the Trail.

For more organised groups, the Commission provides, in co-operation with Youth Organisations, reserved camping grounds and Adventure Centres. Most of these are in or near Forest Parks, which have the widest range of suitable countryside. Organisations whose members and students make regular use of the Commission's forests for recreation and study include Youth Hostels, Councils for Physical Recreation, Field Study Centres, Scouts and Guides. The Commission is always ready to help any educational organisation to visit its woods—whether it be on day visits or for a fortnight's camp. But advance arrangements are essential, as there is a keen demand for available sites and knowledgeable staff.

The School Forest Plot scheme, providing a way of taking the classroom out-of-doors, has been welcomed by teachers in rural areas. Briefly, the Commission finds the school a carefully-chosen plot of land in the heart of a forest. Here the children carry out practical tasks such as fencing and tree-planting, and make biological studies of wild plants, insects, larger animals and birds that they find on the plot and in the surrounding woodlands. Several schools have built shelter huts as an exercise in practical carpentry. As the trees grow taller and the landscape of the plot develops, there are fascinating opportunities for observing and recording seasonal changes in the life of the wilds. The free pamphlet *Starting a*

School Forest shows what several enterprising schools have achieved, and further plots can be found for any school near a suitable forest.

Teachers in towns often wish to take the woods into the classroom, and effective ways of doing this are outlined in the free pamphlet *Forestry and the Town School*. This shows how children can carry out indoor studies based on occasional visits to forests or even to trees in their local park. Observations on different kinds of trees at each season of the year, measurements of their heights and rates of growth, and studies of local timber-using industries, all provide a practical basis for rewarding studies linking biology with the economic life of the community.

We have a tremendous new resource for enjoyable recreation and productive study in the wealth of woodland that the Commission has created—evenly spread across the map so that every county has at least one forest within easy reach for town dweller and countryman alike. Every encouragement is given to those who wish to make a wide use of these new opportunities to enjoy their heritage of wild nature and magnificent wooded landscape.

fig 42 Following a Forest Trail through Glen More Forest Park, Inverness-shire.



fig 44 Crested tit at its nest hole in Glen More Forest Park, Cairngorms.



Wild Life

As the owner of the largest single estate in Britain, the Forestry Commission realises its exceptional responsibility for the conservation of wild life. Woodlands provide an excellent habitat for a number of rare beasts and birds that need the sanctuary of tree cover to live, feed, and breed in seclusion and security. They also give peculiar conditions of shade and shelter that are essential for the well-being of many plants, ferns, mosses, insects and other small invertebrate creatures.

Because the plantations and their associated hills are so extensive, and have so many boundaries with the lands of neighbouring farms and estates, it is not possible to treat them simply as nature reserves. Deer, for example, can jump any fence under six feet high, and if they were allowed to breed unchecked they would soon do grave harm not only to trees but also to food crops on nearby farms. Control must, therefore, be linked with protection, and at every forest the Commission has a plan for keeping the numbers of animals within bounds, without exterminating any native kind. Sporting rights, often valuable, are leased where appropriate, but always within this framework of conservation.

Four kinds of deer are established in forests in various parts of Britain. The magnificent red deer, though most familiar in the Scottish Highlands, can also be found in the Thetford Chase woods of East Anglia, in the New Forest, the Lake District and on the Quantock Hills of Somerset. Fallow deer and Japanese Sika deer, which originally escaped from parks, have formed breeding herds roaming at large in many forests of England, Scotland and Wales. Even more remarkable has been the resurgence of the little roe deer; once very rare, it now finds congenial cover in most of the Commission's woods and on many private estates. The usual method of deer control is by selective shooting from high seats—that is, observation platforms set at tree-top level beside favourite feeding grounds, well-known to the stalkers.

Squirrels are typically tree-top dwellers and here a sharp line has to be drawn between the native red squirrel, which rarely does serious harm, and the introduced American grey squirrel, which can prove a serious pest of broadleaved trees, killing large specimens by ring-barking them. Research has shown that, although this squirrel is now too widespread to be exterminated, it can be controlled locally by skilful trapping and shooting. Rabbits, which can do serious harm to young trees, are also closely controlled, or else fenced out of young plantations.

Forests and their associated uplands are the refuge of our

fig 43 Scottish wild cat.



rarest predatory beasts—wild cat, polecat and pine marten. They also hold, in their remoter fastnesses, the eyries of golden eagles and even, on occasion, the nest of our scarcest breeding bird, the osprey, an amazing hawk that lives on fish caught by plunging into Highland lochs. In the Highlands, you may encounter four kinds of grouse in or near the pine-woods—the huge capercaillie, almost as large as a turkey, the handsome blackcock who spars with his fellows for mates each spring, the moorland red grouse, and the ptarmigan that lives only on the highest summits and turns white each winter to match the snows. More lowland or southerly forests often shelter pheasants, with partridges nesting on their fringes.

Forests hold many lakes and streams well-stocked with fish and, where fishing rights belong to the Commission, arrangements are made for their well-ordered use, either by the issue of permits or through a local angling association. One of Britain's rarest freshwater fish is found in waters bordering Commission forests; this is the powan or freshwater herring of Loch Eck and Loch Lomond. Pools that attract wildfowl have been carefully maintained wherever they occur in the woods.

Rare plants call for particular care to ensure suitable conditions for survival, and need protection from misguided collectors. The higher slopes of mountains like the Cairngorm in the Glen More Forest Park, and Ben Lomond near the Trossachs, are the home of scarce alpine, while the New Forest harbours one of Britain's greatest rarities, the native wild gladiolus.

In its work for the preservation of fascinating animals and plants, the Commission co-operates with the Nature Conservancy and kindred organisations, such as Naturalists Trusts. Forests inevitably change the character of large stretches of countryside, but if care is taken to preserve natural features that provide the right surroundings for plants, birds and beasts, there is no reason to fear serious loss. The trees, by providing greater shelter and a wider range of feeding grounds, may well increase the range of fauna and flora that attract the naturalist. Nature trails, forest museums, and displays at Forest Park camp sites all help to spread knowledge of these attractions amongst visitors, while the network of new forest roads, open to walkers, provides a fresh range of observation points, over both woodland and hill.



fig 46 Golden eagles at their eyrie.



fig 45 Red deer hind and calf.



fig 47 Ornamental trees in Paradise Wood on the Monymusk Estate in Aberdeenshire, planted by Sir Francis Grant in 1741. Silver fir, beech and sycamore.

Private Estate Woodlands

Before 1919, when the Commission was formed, nearly all the woodland in Britain was privately owned. Over half is still in private hands, giving woodland owners an important share of the forest industry.

During the First World War, much of the better timber had been cut, and from 1919 to 1939 replanting did little more than keep pace with continued felling. Then the Second World War, with heavy demands on already depleted timber stocks, used up many of the surviving stands of timber.

The Commission's financial and technical help to private owners gained momentum with the launching of the Dedication Scheme in 1947. Under this scheme owners, in return for financial assistance, covenant to use their woodlands for timber production and manage them to an approved Plan of Operations, which is periodically revised. Dedication, and the related Approved Woodlands scheme, have attracted nearly 4,000 estate owners and 1,200,000 acres are now being managed with the main object of growing timber for industry. Owners whose woods are too small or scattered to fit in, may receive a Small Woods planting grant. The planting grant under all three schemes is currently (1969) £23 3s 6d per acre; full details are given in the Commission's free pamphlet *Grants for Woodland Owners*. Besides giving financial aid, the Commission have helped in the formation of forestry co-operatives, and have made freely available to the private owner the results of their research, educational facilities and experience. Because trees take so long to mature, special arrangements apply for income tax and estate duty, and also for Selective Employment Tax and Capital Gains; all these measures help to promote long-term investment in forestry.

With this encouragement, the area planted on private estates, has risen steadily, as our graph shows. In 1968 it reached 37,000 acres a year, the highest figure ever recorded. Private estates now hold 2½ million acres under trees, and four-fifths of this is economically productive. The balance of half a million acres either occupies very poor land or consists of scrub and outworn coppice suitable only for conversion to a more rewarding crop.

Complementary to encouragement of planting there is control of felling. Originally a war-time measure, felling control by licence is continued under the Forestry Act 1967, to conserve our limited stocks of growing timber, on all except Dedicated estates, where control is through the Plan of Operations. This ensures the replacement of felled woodland, because replanting conditions are attached to licences whenever it is desirable and practicable for the land to be restocked.

While many private estate woodlands are held by individuals, others are owned by companies or groups of people interested in woodland investment. Technical supervision is usually the responsibility of a land agent or a forestry consultant, while day-to-day work is supervised by a forester or carried out by a forestry contractor. Both big timber and thinnings are sold to timber merchants or to paper mills and similar industries.

The interests of private owners are looked after by the Scottish Woodland Owners Association, and the Timber



fig 48 Wiston Park near Steyning in Sussex. Oakwoods and willows frame the lake and the mansion house. Chanctonbury Ring, the clump of beech on the hilltop, is a 'folly' typical of eighteenth century landscaping.

Growers Organisation (in England and Wales). Other organisations that promote forestry include the Royal Scottish Forestry Society, and the Royal Forestry Society of England, Wales and Northern Ireland; both issue technical journals, and organise excursions.

Privately-owned woodlands have always been associated with their owners' homes, and our finest ornamental trees stand in parks around mansion houses. You cannot imagine any great country house without sheltering oaks, beeches, elms or conifers. These magnificent landscapes, designed by scenic architects such as the famous eighteenth century planter 'Capability Brown', are without equal overseas. The views are there for all to share, and many splendid parklands are open for the public to visit and enjoy, being in the care of the National Trusts or local authorities.

Both private owners and the Commission recognise the importance of conserving amenity, and great care is taken to minimise the effects of felling by the retention of screens. Whenever the landscape is at risk the Commission, before issuing felling licences, consults both owners and local planning authorities. Where amenity is of paramount importance, local planning authorities may also control felling by means of Tree Preservation Orders.

Landowners have been active over 200 years in planting and tending trees for shelter. They have thrown a network of shelterbelts over many of the bleaker Scottish uplands, enabling profitable stock-raising, and even arable farming, to be carried on over larger areas, and at greater heights, than would be possible in a treeless landscape. Across the English

lowlands countless hedgerow trees, linked to small woodlands, provide another shelter pattern that leads to kinder conditions for crops and stock, by moderating wind speeds, giving shade from summer sun, and shelter from rain or snow. Estate owners have also put to good use for forestry the winding glens, cloughs and dingles that thread the hills of Scotland, Wales and Northern England. Under trees such rough steep land gives both a timber crop and shelter to neighbouring fields, while soil erosion and the silting of streams is checked.

Sport is another benefit that flows from well-managed woodlands. They are essential for pheasant rearing and provide cover also for woodcock, blackgame, capercailzie, and the elusive roe and fallow deer.

Because these indirect advantages of scenery, shelter, and sport are so widely appreciated, privately-owned woodlands often occupy rather better land than is available to the Forestry Commission. Hence they have high rates of timber production. Private woodlands form our main resource of hardwood timber, particularly high-value mature oak, ash, elm, beech and sycamore. There is also much good Scots pine and larch, especially in the Scottish Highlands, and many flourishing young spruce plantations.

Whenever a new market, such as a paper pulp mill, is set up, the Forestry Commission discuss with representatives of private owners how best that market can be shared. At every stage from seed to sawmill, the aim is friendly co-operation between both sides of the timber-raising enterprise, for each has much to learn from the experience and forward thinking of the other.



fig 49 Ratagan Forest above Loch Duich in the West Highlands, showing a straight ride and the planting of square blocks which are both alike avoided, for scenic reasons, today.

Landscape Planning

As the owner of the largest single estate in Britain, the Commission has become very much aware of its need to preserve and improve the quality of visual scenery. Forests, particularly those set on hillsides, are very conspicuous features in the landscape, and once created they endure indefinitely.

In the Commission's early days the preservation of the character of the landscape was not a primary objective. Rides and roads were often straight lines: boundaries also were often straight and did not naturally fall in with the character of the landscape.

In recent years, the Commissioners have taken the view that the visual planning of their forests merits the same care as their economic planning, and they now employ a leading landscape architect whose advice is obtained on every major afforestation project.

First, the landscape character of the area that is to be afforested is carefully studied, for the new woods must be fitted into an existing frame of mountains and valleys, and sit amid land that will remain in farming use. Next, the practical forester must discuss with the landscape expert what kinds of tree he can grow on the land available within its limits of exposure, soil fertility, and likely markets for timber. Broad-

leaved trees, for example, may offer a commercial return from only part of the available ground, but they can often be sited where their softening effect on the scenery is most effective from the main viewpoints.

Next, the shape of the plantations is considered, for the outlines between woodland and grassland will become and remain very prominent landscape features. The temptation on the drawing board is to carry trees to straight edges drawn along property boundaries, or a particular contour on a hillside. Squares, strips, or even triangular arrangements of one kind of tree, which contrasts sharply in colour and form with its neighbours, may give the best financial return from a particular hillside. Straight roads or rides that divide the plantations with monotonous regularity into bands or square blocks may appear cheap to make and promise economies in use. Small adjustments of this first crude plan, made by skilful hands with an eye to aesthetic values, will usually change a harsh appearance into an aspect that the onlooker accepts as pleasing, because it stands in sympathy with its surroundings.

Trees inevitably reach maturity and fall due for harvesting. The forest scene, therefore, can never be static, but must change with the years. If the scenic values that the trees have

gradually built up are not to be suddenly sacrificed, care must be devoted to the whole business of clear felling and replanting. Again a landscape consultant can give valuable help, by forecasting visual changes. Straight edges and square blocks can usually be avoided. The operation can often be blended in with the surrounding woodlands by leaving well-sited screens of older trees standing until the new crop has grown up. Planned renewal of woodlands is essential, not only for commercial reasons but also to ensure continued pleasure for future generations.

Beside the broad view, seen from afar, the landscape planner considers many smaller features that can add greatly to the enjoyment of all who visit or pass by the growing forests. The visitors' first need will probably be for a car park, and in woodland this can often be sited unobtrusively below living trees that give welcome shade and shelter. Picnic places call for careful siting, in sunlight yet sheltered from wind, within easy reach of parked cars, yet safe from moving traffic, and with accessible but not too prominent litter bins. The design of an acceptable camping ground is naturally more complex. There must be a happy combination of good approaches for cars and caravans in all weathers, and privacy for each individual camping place, with easy access to the communal facilities of washrooms, water supply, shop and shelter huts. Woodland surroundings are a great advantage, but professional skill is needed to fit tents and caravans into the forest scene.

People who come to halt, eat and sleep, also wish to look and to wander. As trees grow taller they tend to shut-off broad views and confine the eye to narrow fields of vision. By removing a relatively small number of trees at selected points, or possibly simply pruning away the lower boughs of tall specimens, it is possible to reveal lost vistas. Leading viewpoints are nowadays kept permanently clear of trees, and at several places direction indicators have been set up, so that tourists can identify distant peaks and hill ranges.

Paths tend to disappear as trees grow larger and their branches spread, denying easy access to viewpoints or stream-sides that people have travelled far to enjoy. Footpath improvements are therefore made where appropriate, to link up with car parks, forest roads, and nature trails. Well-designed signposts are provided to aid the visitor.

As opportunities arise, other arrangements for the public to appreciate the scenic attractions of forests are steadily being improved and extended. You cannot really see the country from a car, nor learn much about it from a casual halt. But a visit to the David Marshall Lodge near Aberfoyle, with its magnificent views over Loch Ard Forest to the Campsie Fells, or to the Deer Museum and Information Centre at Grizedale Forest in the Lake District, will open the way to a wider understanding of all that forests mean to our countryside. The careful planning that they now receive will ensure that they enhance landscape values, as well as proving a growing investment in our rural economy.

fig 50 Glengarry Forest near Fort Augustus, Inverness-shire, showing how well-planned woodlands look completely at home in the Highland landscape. Looking across Glen Garry towards Ben Tigh, 2,957 feet.



STATISTICS

The position at the close of the Forest Year, 1967	<i>Total for Great Britain</i>	<i>England</i>	<i>Scotland</i>	<i>Wales</i>
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NATIONAL FORESTS

LAND USE

Total Area, acres	2,802,818	751,352	1,672,094	379,372
Forest Land, total, acres	1,960,978	622,274	1,009,541	329,163
Under plantations, acres	1,646,180	563,970	787,134	295,076
To be planted, acres	314,798	58,304	222,407	34,087
Other land, acres	841,840	129,078	662,553	50,209

NUMBER OF FORESTS	410	142	195	73
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PLANTING

Total area planted in Forest Year 1967, acres	52,393	11,165	34,485	6,743
New planting, acres	46,588	7,483	33,166	5,939
Restocking, acres	5,805	3,682	1,319	804

TIMBER OUTPUT

Total output in Forest Year 1967, millions of hoppus feet	33.625	16.017	12.385	5.223
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EMPLOYMENT

Forest Workers	9,765	3,859	3,718	2,188
Salaried Staff	2,758	—	—	—

ROADS

Roads in use, miles	9,016	3,739	3,273	2,004
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PRIVATE ESTATE WOODLANDS

Schemes for Dedicated and Approved Woodlands	3,954	2,702	855	397
Acreage involved	1,114,243	608,299	440,983	64,961
Planted during Forest Year 1967, acres	36,597	14,172	19,518	2,907

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