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No. 33 : 1964

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EDITING COMMITTEE

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Articles

We should like to thank the Ordnance Survey for permission to reproduce the articles "The Deserted Villages and Crofts of Scotland" and "Welsh Platform Houses"; the Forest Research Branch of the Canadian Department of Forestry for G. S. Chester and E. J. Hopkins' article "An Unusual Potential Cause of Forest Fires" renamed by us as "Can the Sun's Rays Start Forest Fires?"; to the editor of *Span* and to the Welsh Plant Breeding Station for J. P. Cooper's article "Climatic Variations in Forage Grasses" now appearing under the title of "Why some Trees Grow Faster in Aberystwyth"; to the editor of *Allgemeine Forstzeitschrift* for Oehler's "Practical Hints on Excursions", H. Machler's "Prevention of Accidents in Timber Production, Timber Haulage and other Forestry Work" and K. Rehrl's "Prevention of Accidents with Machinery"; to the editor of *American Forests* for A. S. Harris's article on "Sitka Spruce in Alaska"; to the Department of Agriculture, University College of Wales for R. S. Edwards and Sheila M. Claxton's article on "The Distribution of Wind-borne Salt of Marine Origin in some Western Areas of Wales"; to the Commonwealth Scientific and Research Organisation, Melbourne, Australia for J. J. Mack's "A Note on Wooden Ladders"; to the Forestry Department of Northern Ireland for J. Hendry's "Basic Course on Fire Protection, Northerwood House"; to the editor of *Education* and to W. M. Brown, Headmaster of Kielder County Primary School, Northumberland for the article on the school; and to the editor of *Norsk Skogbruk* for K. Nedkvitne's article on exotic conifers in Vestland, Norway. We are also grateful to the Hertfordshire Local History Council's magazine *Hertfordshire Past and Present*, and the editors of *Sylva*, *Arbor*, *The Exmoor Review* and *The Scotsman* for articles by our staff which previously appeared in those publications.

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EDITORIAL

The Commissioners

The constitution of the Commission at the end of 1964 was as follows:

The Earl Waldegrave, D.L., J.P., *Chairman*
Major D. C. Bowser, O.B.E., J.P.
Mr. E. Gwynfryn Davies, J.P.
Capt. J. Maxwell Macdonald
Mr. G. E. H. Palmer
Mr. F. Sellers
Major Sir William Strang Steel, Bt.
Mr. T. Taylor
Col. J. F. Williams-Wynne, D.S.O., J.P.
Mr. H. A. Turner, *Secretary*

Lt.-Col. Sir Richard Cotterell, Bt., C.B.E., J.P., a Commissioner since 1945, retired on 31st July, 1964, and his service is reviewed under *Retirements*.

Honours

In the 1964 Birthday Honours List two of our colleagues were honoured. Mr. George Batters, Conservator for North-east England, was awarded the O.B.E. Mr. Batters has devoted 37 years to public service and under his supervision large-scale afforestation programmes have been realized in North-east England. He has always considered relations with affiliated bodies, particularly private woodland owners, to be of great importance.

Mr. John Blane, Mechanical Engineer for Director, Scotland, has received the M.B.E. for the considerable advances he is responsible for in the field of forest engineering, particularly ploughing and drainage.

We would also like to congratulate Mr. E. Bryan Latham, M.M., until 1963 one of our Commissioners, on his award of the O.B.E.

In the 1965 New Year Honours List, Lt.-Col. Sir Richard Cotterell, Bt., J.P. received the C.B.E.

Mr. Charles Macdonald of Skye Forest, North Scotland Conservancy, was awarded the M.B.E. Head Forester Macdonald joined the Commission in 1926 and has done much to promote community life on Skye.

Obituaries

We regret to announce the deaths of two of our District Officers and two Head Foresters.

District Officer Iain McNeill of West Scotland was tragically killed in a car accident in February, 1964.

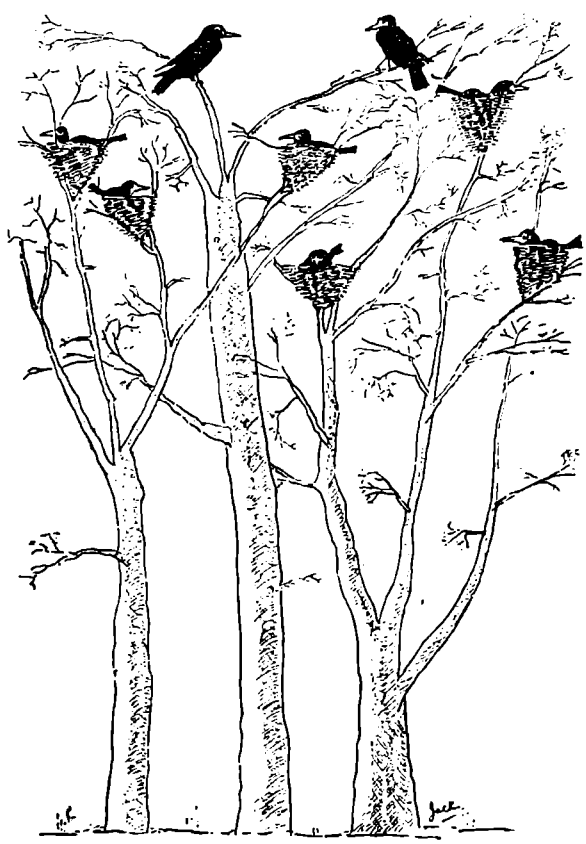
District Officer Ronald Golding, South Scotland Conservancy, died early in 1964. Mr. Golding had been ill for a short time beforehand and was only 37 when he died.

Head Forester J. Mackenzie of Inverliever Forest, Argyll, West Scotland, died in February, 1964. Mr. Mackenzie had been with the Commission for 43 years.

Robert Crozier, Head Forester at Loch Ard, West Scotland, also died suddenly early in the year. Mr. Crozier entered the Benmore Forester Training School in 1930.

Appointments

Miss Sylvia Crowe, past president of the Institute of Landscape Architects and present vice-president of an international architectural organisation, was appointed as Landscape Consultant to the Commission. Miss Crowe has done much landscape work concerning the planning of Harlow New Town, and also two nuclear power stations at Trawsfynydd and Wylfa, in North Wales.



"Bred any good rooks lately?"

Promotions

We are pleased to report that several of our District Officers, Grade I, have been promoted to Divisional Officer rank. They are Mr. J. L. Davidson, Director (Scotland), Mr. W. A. J. Johnson, South Scotland, Mr. R. J. Piper who moved from North-east England to South Wales and Mr. L. C. Troup, who has left South-west England for Work Study, Edinburgh.

Mr. R. G. Brown, who left us some time ago for the Pay Research Unit, has now been promoted to the Administrative Class of the Civil Service, in the Ministry of Land and Natural Resources.

Transfers

Divisional Officer E. M. Conder has moved from the office of Director (England) to York, North-east (England).

Nine of our District Officers, Grade I, were transferred during the year. They were Mr. T. W. G. Coulson from Lichfield, North-west England, to Work Study; Mr. J. V. St. L. Crosland from Kendal, North-west England, to Director (England); Mr. G. A. Dey from Cairnbaan, West Scotland to Cardiff, South Wales; Mr. S. Forrester from Strathcarron, West Scotland to Cairnbaan; Mr. E. H. M. Harris from Cardiff, South Wales to Gwydyr, (Education); Mr. J. N. Kennedy from Ipswich, East England, to Director (Scotland); Mr. J. E. Leslie from the New Forest to Durham, North-east England; Mr. I. F. MacIver from Malvern, South-west England to Barnstaple, South-west England and Mr. A. A. Rowan from Rothbury, North-east England to South Laggan, Inverness-shire, on Work Study duties.

Retirements

Lt.-Col. Sir Richard Cotterell, Bt., C.B.E., J.P., retired in July, 1964. Sir Richard had been one of our Commissioners for 19 years, and during this period he spent much time improving relations between the Commission and private owners. He served with the Royal Horse Guards from 1927–32 and, during the last war, with the Shropshire Yeomanry. He commanded the 76th Medium regiment, Royal Artillery, in the Middle East and Italy from 1943–45. From 1945–57 he was the Lord Lieutenant of Herefordshire, and up to the time of his retirement he had been a Justice of the Peace for 26 years. Sir Richard owns 750 acres of woodland which include fine plantations of ash and chestnut coppice. He is always profoundly interested in field activities and the life of the countryside.

Mr. Frank Oliver, Conservator for East Scotland for 17 years, retired during the year. He had been with the Commission since 1926. After the great gale of January 1953 Mr. Oliver organised the clearance of 50 million cubic feet of timber. This quickly became known as "Operation Windblow". Mr. Oliver has always shown a keen interest in silviculture and his working life has been dedicated to good and economic forestry.

Mr. J. P. Mackie-Whyte, O.B.E., B.Sc., retired in May 1964 after 38 years with the Commission. Mr. Mackie-Whyte was Chief Land Agent and his services throughout the years have been valued highly, particularly in the formative years of state forestry. His knowledge of ownership and land-use in Scotland has been considered unsurpassed, and he is active in the affairs of the National Trust for Scotland.

Head Forester I. Adams of Mortimer Forest, North-west England, retired in September after 49 years' service. Mr. Adams is responsible for the many fine stands of Douglas fir in Mortimer Forest.

We also announce the retirement, due to ill-health, of Mr. C. P. Carr, Head Forester at Crychan Forest, South Wales, who has devoted 38 years to the public service. During his seven years as Head Forester he dealt with a steadily increasing production programme.

Controlling Forest Pests and Diseases

Chemical, biological and silvicultural control methods were discussed at a symposium at Oxford, in July, 1964, on internationally-dangerous forest diseases and insects.

Speaking to the 140 delegates from some 40 countries attending the FAO (Food and Agriculture Organisation) and IUFRO (International Union of Forest Research Organisations) symposium, Dr. J. M. Franz (Germany) said that increased attention was being paid to biological methods. These included releasing parasites to attack the pest, using micro-organisms which caused disease in the pest, releasing male pests which had been sterilised by radiation and employing chemical "sex attractants" to lure and catch other pests.

Growing awareness of the hazards of pesticide residues which persist after use was mentioned in a paper by Dr. W. V. Benedict (U.S.A.). He pointed out that, as a result, there would probably be much greater control of pesticide use in the future as well as increased research into more effective non-persistent pesticides. Dr. Benedict said, however, that pesticides are still being used, as they have been in the past, to safely and effectively control forest pests and diseases.

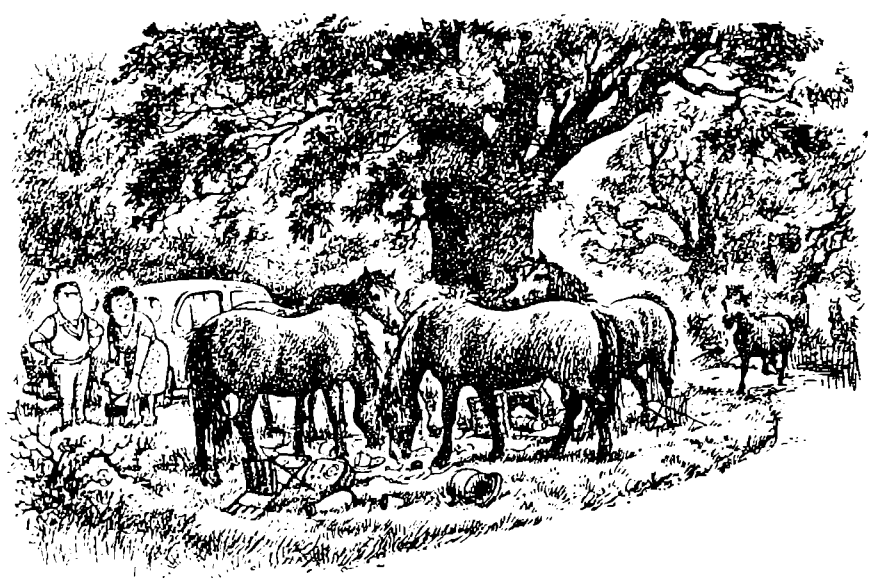
The symposium, under the chairmanship of Dr. J. R. Hansbrough (U.S.A.) covered three main subject fields: forest diseases (chaired by Dr. Hansbrough); forest insects (under vice-Chairman, Dr. B. M. McGugan, Canada); and quarantine measures (under vice-Chairman, Mr. A. P. Thomson, New Zealand).

The symposium reviewed, region by region, those forest pests and diseases causing greatest economic loss. Some indication of the magnitude of these losses was conveyed in a joint paper by Dr. A. G. Davidson (Canada) and Dr. T. S. Buchanan (U.S.A.). This mentions an annual loss from diseases alone in the United States and Alaska of 4·9 billion cubic feet, equivalent to almost half the total timber cut in that country each year.

The symposium discussed quarantine regulations, based upon the principle that countries must recognise the need for controlling both imports and exports. It was stated that some countries in particular, due to their extensive areas of even-aged artificial plantations of single species, should recognise the need for destroying potentially harmful pests and diseases in both exports of timber and imports of manufactured wood products.

An international tree disease register was proposed by Dr. G. H. Hepting (U.S.A.). This project, known as "INTREDIS" would make available world research literature on forest diseases through a punched card system. It was stated that this system would be equally applicable for forest insects. It would provide an easy reference to specific pests and diseases and would allow advance appraisal and prediction of potential hazards.

The symposium was held with the close co-operation of the Forestry Commission and the Commonwealth Forestry Institute of Oxford University.



'We're not really supposed to feed them'

"There *must* be an easier way than this of producing wood"

The Deserted Villages and Crofts of Scotland

A Note from the Ordnance Survey

While similar conditions to those in England operated to bring about desertions in the Lowland areas of Scotland, and some work has been done on the matter, the largest region affected lies in the Highlands and Islands. This is a more recent affair. Today the virtual collapse of rural life in many of the remoter places presents grave social problems. Under present conditions the flight of younger people southwards to the towns and industrial areas is difficult to stem, much more to reverse, but the process of depopulating the Highlands began more than two hundred years ago with the end of the old way of life following the collapse of the second Jacobite rebellion in 1746.

There is no space here to rehearse the various factors which have led to the emptying of the Highlands. Apart from the actual hardships of life in the region and the lure of emigration overseas there has been the deliberate action of Scottish landlords to displace people following the old traditional way of life and to substitute a more profitable way of exploiting the land. The most notorious example of this was the depopulation of the greater part of Sutherland by Patrick Sellar in 1819–21, acting as agent for the Duke of Sutherland. This was a belated version of the urge to adopt sheep-farming in agriculturally difficult land which had been the cause of so much trouble in England in the 15th century. This particular depopulation was carried on with great determination and brutality, yet before the middle of the century it had been matched in many other places. Already before this time many had left the Western Islands for Canada, and as late as the 1880s the 'Crofters' Wars' accompanied evictions in Skye and elsewhere, leading to a disastrous decline in population.

The importance of this for the field worker is that the ruins of the old crofts still survive in many places along with the other features associated with them, like their corn-drying kilns and the stone dykes which show the former limits of the cultivated land painfully wrested from the moor. While the most obvious ruins are those of the latest dwellings on the various sites, an examination of places like Rosail, Truderscaig and Grunmore in Sutherland, now quite deserted, will show the long continuance of life as shown by the presence of earth-houses and brochs. In these cases it is plain to see that there had been settled life for at least two thousand years.

There is need today for the identification, study and recording of these places. The present visible remains may not be more than one, or at the most,

two centuries old, but they represent an extinct way of life and are as much archaeology as Nineveh or Tyre.

The current 6-inch resurvey programme of the Ordnance Survey which is producing a more accurate contoured map of these highland regions is trying to depict as many of these remains of the old life pattern as possible, but the work of making a complete study of them is more than the present resources of the Archaeology Division will permit. A good many of them are already on the old 6-inch map series, but their detail is often incomplete. Some of the sites lie far from modern routes because the pattern of tracks joining them was completely disrupted when they were abandoned, and a new pattern of roads was introduced.

It is common for these old settlements to proclaim themselves by rough grass vegetation contrasting with the normal heather, bracken, and dwarf willow cover of the open moorland. These grassy areas are often surrounded by an old stone boundary dyke. Evidence of ancient cultivation is the occurrence of numerous small cairns of stones which are often masked by peat and vegetation. These have been gathered to clear the ground and their recognition is sometimes complicated by the presence of superficially similar low mounds which prove on examination to be the remains of old peat stacks which have been cut, piled, but never removed. But these features almost certainly belong to the earlier Iron Age phase of these settlements whose more recent agriculture prior to the depopulation was by rig and furrow, clear traces of which may often be recognised.

In these more remote places the agents of destruction which cause so much damage and loss in the South are seldom active, so that most of the sites are in no immediate danger. After the elements their chief enemy is the Forestry Commission. The tearing up of the surface by heavy machinery as a preliminary to tree planting does much damage, and when the plantations have grown they make the task of finding such settlements as still survive within them almost impossible.

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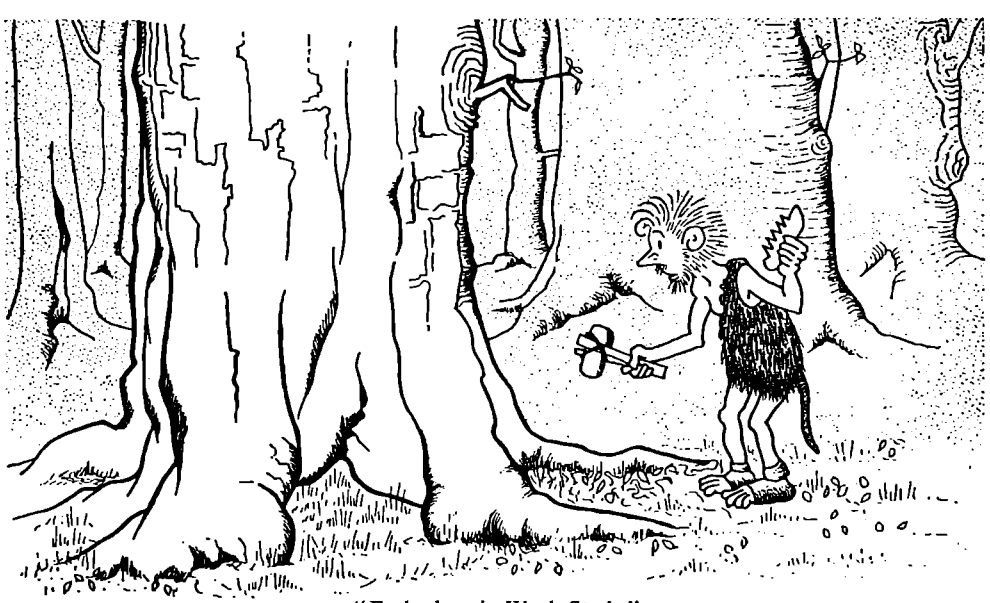

"Early days in Work Study"

Welsh Platform Houses

Note from Ordnance Survey

A type of site known as the platform house has now been recognised in most parts of Wales. At present the largest number seem to be in the north of the country. Their full range in date is not yet certainly established but the present evidence shows that they were in full occupation during the Middle Ages.

These house sites are usually found near the better agricultural ground and not so high in the hills as some other early settlements. The prime feature is a levelled rectangular area cut into the slope of the ground and some of the excavated material has been arranged as a curved protective embankment or hood round the top of the scarp cut into the hillside at the upper end. This platform carries traces of buildings and enclosures. The buildings usually have a long rectangular form but the plan of some may vary from this. There is a fairly large associated enclosure or compound surrounded by an earth bank and not far away there are often signs of old cultivations. These sites can occur singly or in groups and they have often suffered damage by being converted into sheepfolds of more recent date. A limited number have a size and complexity which suggest that they were the homes of local leaders.

They are not uncommon in South Wales, but here some are set high in lonely, steep and inhospitable places so that it is not always easy to imagine what sort of life the people lived who dwelt in them. Much more work will have to be done to get a better knowledge of these sites all over Wales. Some appear to belong to the period before A.D. 1400 and they have been interpreted as the homes of the free Welsh tribesmen.

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Can the Sun's Rays Start Forest Fires?

by G. S. CHESTER and E. J. HOPKINS, (*Forest Research Branch, Canadian Department of Forestry*)

Stories of forest fires caused by focusing the sun's rays on a suitable fuel by pieces of broken glass or water in bottles are usually discredited as highly improbable or merely imaginative. Occasionally, though, one finds first-hand an ignition source that adds credence to the stories.

In April 1963, as part of a silvicultural project, small greenhouses (6·5 × 6·5 × 5 feet, sloping to 4 feet at rear) were erected in an aspen stand located in Essa Township near the town of Barrie. The greenhouses, of light frame construction, were covered with polyethylene sheeting.

On June 17, Department of Forestry personnel detected the smell of something burning and, on investigating, found a strip of charred and smouldering duff approximately 12 inches long in one of the greenhouses. Close examination revealed that rain water had collected on the roof of the shelter and the resultant pool was acting as a burning lens. The pool was dumped and the smouldering material extinguished.

At the time of discovery the pool was approximately 2½ inches deep and contained an estimated 1½–2 gallons of water. No information is available on how long it had been there. The shelter was in full sunlight from about 7.30 a.m. on the morning of June 17. The smouldering duff was discovered

at 2.35 p.m. and according to calculation had been smouldering for approximately 50 minutes.

Conditions inside the greenhouse at the time of the incident were as follows:

Drought. The duff layer was extremely dry, having received no moisture since the greenhouses were erected in April.

Air temperature. The maximum air temperature on the day of the incident was 102° F. inside the shelter and 86° F. outside. Inside and outside minimum temperatures the night before were 38° F. and 36° F. respectively.

Relative humidity. The relative humidity inside the shelter was approximately 25 per cent; outside it was 23 per cent. The higher relative humidity inside the shelter was probably due to transpiration and restricted air movements which prevented this moisture from being readily carried away.

Wind. Ventilation of the greenhouses was by means of small vents located just under the roof. Air movements inside were thus minimal.

Duff. The floor of the shelter was covered with partly decomposed aspen leaves, bracken fern fronds, and other herbaceous material. The surface of the duff had been lightly disturbed by raking, and the light litter removed before the greenhouses were erected.

Herbaceous plants. Scattered bracken ferns up to 23 inches high were the dominant vegetation in the shelter. Also found were aspen suckers, wintergreen, and bindweed. Density of the plant cover was never sufficient to provide heavy shading of the duff.

"WELL, DARN – SOME IGNORAMUS PUT OUT OUR FIRE WHILE WE WENT FISHING"

"LOOK, HENRY— HERE'S ONE SPOT THEY DIDN'T MUSS UP."

Exportation of Christmas Trees

A batch of 50 young Norway spruce from Newtyle Forest, Morayshire, was flown 2,000 miles to Gibraltar shortly before Christmas. The trees were a gift by the Forestry Commission to Servicemen and their wives in hospital wards in Gibraltar. Men from R.A.F. Kinloss undertook to fly the trees direct to Gibraltar.

Another cargo of Christmas trees found its way into foreign parts. A shipment of trees, some 30 feet tall, were delivered to the West Indies. Not one tree arrived in a withered condition as the cargo had been stored in the ship's refrigeration plant!

Quotable Quote

"On far too many estates the pheasant rules the roost."—*Brian Holtam.*

Contributions are welcome—

The Editorial Committee will be glad to receive notes, articles, photos, or drawings from any member of the Commission's staff, dealing with any topic related—directly or indirectly—to the Commission's work.

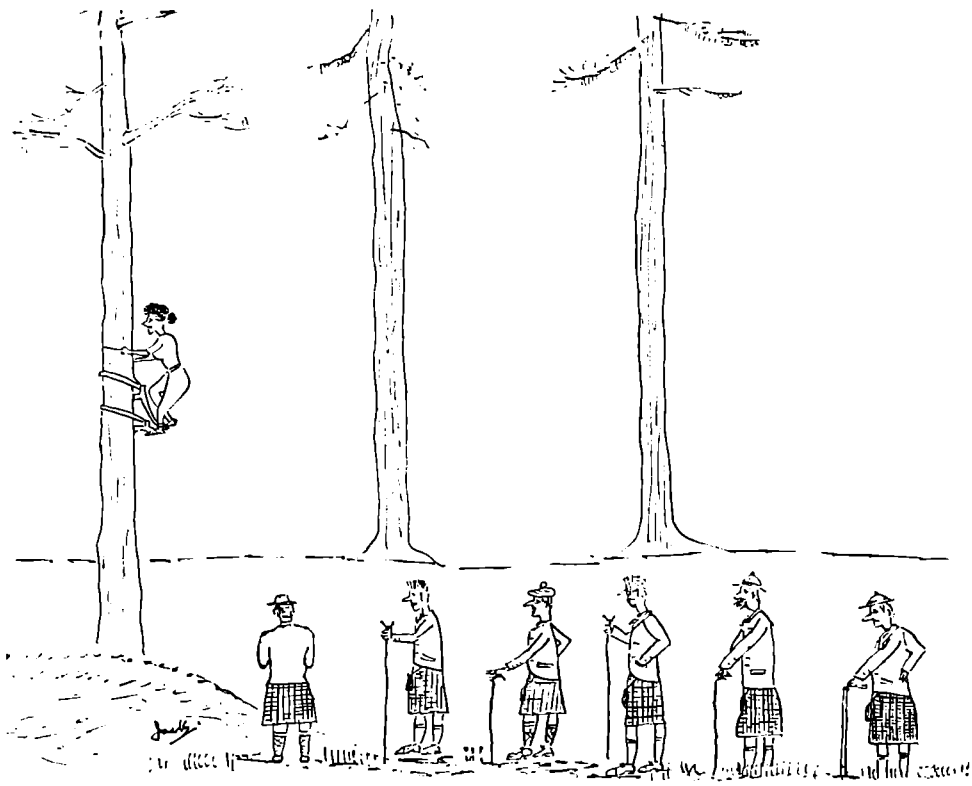
These should be sent to the Editor at the Commission's headquarters, 25 Savile Row, London, W.1., either direct or—if the subject is one that relates to work in your own Conservancy or specialised branch—through the usual official channels.

But No More Puzzles!

Though one or two puzzle features appear in this issue, the Editorial Committee has decided that these must be the last. Since the *Journal* only appears at annual intervals, it is not a suitable medium for "question and answer" games. Nor can we accept, for reasons of economy of space, features that need a lot of wordage for a very little fresh forest lore.

Otherwise the only test is this—will my contribution interest or entertain my colleagues?

"The Forest Worker's Christmas."



" . . . and on this occasion we have invited our only lady member, Miss McTavish, to demonstrate the tree bicycle to the Society."

THE ROYAL FOREST OF DEAN 1806–1964

by R. J. JENNINGS, *Head Forester, Forest of Dean*

The sunlight glints through darker shades of green
As spruce and fir replaces oak and yew,
A camp fire glows where charcoal once was burned
Electric wires and pylons frame the view.
Where ferryman at Biblins plied his oars
A spider web of metal spans the Wye,
And gaily coloured caravans and tents
Now line the bank where silvery salmon lie.
The Pennant blue not quarried now by hand
Is shattered by explosive in Nagshead.
Where Roman legions forded Blackpool brook
A bulldozed road winds through the sandstone red.
But ancient rights resist the centuries,
Custom and privilege are with us still,
The freeminer wins coal on Staple Edge
And Commoners graze sheep on Fetter Hill

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RUMANIA

An account of a visit paid to Rumania by LORD WALDEGRAVE, SIR HENRY BERESFORD-PEIRSE and MR. E. G. RICHARDS from 22nd September to 30th September 1964. *Report by Mr. Richards*

Rumania is one of Europe's main producers of wood; with an annual cut in 1961 of over 500 million hoppus feet she ranked fifth after Sweden, Finland, France and Western Germany. All her wood industries are State owned and, with the exception of the paper industry and factories making pulp for paper-making, all come under the Ministry of Forest Economy—the State Forest Service. Approximately 15 million acres or one quarter of her total land surface is covered with forests, all of which belong to the State.

The country falls into two broad regions, the flat lands of the Danube delta and steppe-like plains of the south east giving way gradually to the Carpathian Mountains which with other ranges cover the greater part of the country. The itinerary was so arranged as to show forest industries; something of the forestry conditions in the mountainous regions; and, at the other extreme, the conditions in the Danube delta itself from Tulcea eastwards to the Black Sea.

The Forests of the Pitesti, Brasov, Ploesti Region (Mountainous region)

At Piatra Arsa near Sinaia in the Prahova Valley, some 2,100 acres of natural forest are managed and maintained as a woodland reserve. From the valley bottom the land rises steeply to over 7,000 feet. Pure beech woods give way to mixed stands of beech and silver fir (50-50 mixture) at elevations of about 2,700 feet. Then Norway spruce begins to take over and finally towards 5,000 feet—the tree limit—the forest changes to a mixture of spruce and larch (*Larix sibirica*).

As elsewhere in Rumania one of the things that first strikes the British forester's eye is the remarkable absence of any sign of deformation of trees by wind, even on exposed sites at elevations of 4,000–5,000 feet. Windbreak and windblow are, however, very much of a problem.

Since 1956 the area has been managed by the Forest Experimental and Research Station at Sinaia. The object of management is to study national development of forests in the mountainous regions. It was explained that although the principal object of management of Rumanian forests is to produce the maximum out-turn of utilizable wood, there are considerable tracts where the protective role is of paramount importance and the exploitation of timber in such woodlands must be carried out in such a way as to preserve an uneven-aged cover of trees over the whole land surface.

The work at Sinaia is undertaken in great detail, covering fundamental studies of soil and vegetation, mycology, entomology, ecology, and studies of growth of the stand. For example when the surveys of tree growth are carried out (every 5th year) over part of the area every single tree is measured. Over that part of the area where these detailed tree by tree mensurational studies are carried out, fellings are undertaken according to the "méthode du contrôle".

Our Rumanian guides were at pains to point out that there was no intention of introducing such intensive systems of management in other protective forests but here and at one or two other research stations it was hoped to evolve from these studies, simplified methods of management which could be applied extensively to protection forests. We understood that something like 125,000 acres of forest had been set aside for such studies in Rumania and that the "méthode du contrôle" was being applied to something like half this area.

In the beech woods of Sinaia the Rumanians are collaborating with F.A.O. in a study of the phenology of European beech.

In the Timis Valley region a method of natural regeneration commonly used in mainly coniferous woodlands in Rumania was seen. In 1958 about half the standing crop of spruce and silver fir was removed and the ground screefed in patches to assist in the establishment of an understory of seedlings. In 1963 the remainder of the old crop was felled and the few gaps in the abundant natural regeneration was planted up. The sporadic natural regeneration which had appeared as single trees or small groups before 1958 was removed in the 1958 cut. Experience has shown that those individual trees and small groups which had become established under the old crop before the "regeneration cut" is made, grow into coarsely branched trees when the old crop is clear felled; they take up a disproportionate amount of space and reduce the value of the new rotation. Their removal is an essential part of the system of regeneration. Lop and top is either piled in windrows and left to rot, or is scattered through the area. But at present when there is a demand for material down to $1\frac{1}{2}$ inches over bark (for fibreboard manufacture for example) and when even brushwood over $1\frac{1}{2}$ inches diameter is utilised, the disposal of lop and top does not present too much of a problem.

Planting is used where conditions for natural regeneration are judged to be difficult e.g. in some mixed stands of Norway spruce, silver fir and beech; or where it is desired to change the species or to manipulate the species mixture.

In both naturally regenerated and planted crops, thinning is carried out with considerable care as removal of too little too late, or too much too soon was considered to accentuate the already fairly high risk of windblow.

The Danube Delta

The Danube Delta fans out from Tulcea eastwards to the Black Sea; between the three main channels lie hundreds of square miles of low lying land and swamp, intersected by many narrow natural winding waterways and an occasional man-made canal. The swamp areas are the home of the famous Danube reeds; where the land rises a foot or more above the summer level of the water, willows abound.

During the autumn and, especially, in the spring the river floods to a height of several feet. The traditional method of managing the willow is to cut it several feet above ground level, just above the normal high-flood mark, and so encourage a coppice-like or, more precisely, pollard-like growth of shoots, which are then harvested.

The cultivation of pollarded willows is however rapidly giving way to poplar cultivation. After grubbing out the willow, selected strains of poplar are being planted in strips several hundred yards along each side of the waterways. Spacings have been as close as 2×4 metres with thinning taking place in the 4th to 5th year and continuing on a 4- or 5-year cycle. Close spacing plus thinning will give an early yield of pulpwood and fibre and chip board material over a period when new mills will be coming into production in the region; but costs will be high. Rotations of about 25 years are envisaged and the final crops are destined to be used as pulpwood rather than veneers or sawn lumber.

The transport of plants to the planting areas and of the produce to the factories is largely done by boat.

The use of wider spacings, 6×6 metres, with cultivation of maize between the rows, is being tried on an increasing scale, especially on the higher ground less liable to flooding.

In the last 6 or 7 years, interest has been aroused in the possibility of cultivating willow in the same way as poplar, and a breeding programme has been started to obtain strains particularly suited to the delta. Seventeen varieties of white willow (*Salix alba*) have been selected for commercial planting; one was said to be able to "resist" flooding for as long as 340 consecutive days.

At present poplar, pulpwood is exported to Italy, or up the Danube to Austria as a means of earning foreign currency, but the situation may well change when the new pulpmills in the delta area come into operation.

A pulp and board industry has been established to use reeds—the only "crop" which can be grown on the wetter swamp areas. The reeds are harvested by amphibious machines which work on the principle of the agricultural reaper, cutting and bundling the reeds into "sheaves".

Roadside and Shelterbelt Planting

The planting of roadside trees, especially of poplar, either in single rows or in narrow belts, is an activity which one cannot fail to notice everywhere in the South-eastern part of Rumania. On the great grain-growing plains that lie between the Black Sea and the main mountain massif, the planting of shelterbelts is now starting on a fairly big scale. Although many of the shelterbelts comprise mixtures of drought-resisting shrubs and species of maple (*Acer*), *Thuja*, cypresses, wherever possible poplars are planted because of their timber value.

Poplar and Willow

Over the whole country new poplar plantings made since 1948 are estimated to be equivalent to 125,000 acres of plantations. The future programme is to plant 12 million poplars per annum (including re-planting) equivalent to about 10,000 acres per annum. It is hoped in future to plant about 2,500 acres a year of selected strains of willow, but this figure includes areas destined for "osier" willows for the basket industry.

Plants of poplar and willow are produced at Cornetu Research Station near Bucharest and its 16 sub-stations scattered throughout the country. The Cornetu Research Station is one of the stations of the Forest Research Institute.

Nurseries

The policy is to create large central nurseries where by mechanisation it is possible to lower costs. At Beizadele near Ploesti, a "Central Tree Nursery" of 170 acres of flat alluvial and brown forest soils produces 10 million one-year-old seedlings and rooted cuttings per annum. The productive area, 130 acres, is divided into 3 sections, each of which is two years under trees and one year under green crop.

The annual precipitation is about 20 inches; irrigation is used, water being pumped from a nearby river and distributed through permanent underground pipes to rotating sprays.

Only one-year old hardwoods are raised, including poplar, lime, ash and *Acer* species. The average cost per 1,000 one-year plants or cuttings is 45 lei compared to 63 lei for small nurseries. One-year rooted poplar cuttings cost 105 lei per 1,000 as compared with 140 lei in small nurseries.

The basic equipment comprises a Russian and a David Brown tractor with tool-bar attachments. The supervisory staff consists of a professional forest officer (silviculturist), an engineer and one clerk. The thirty permanent workers (male and female) are supplemented by casual labour at peak periods of activity.

Higher Education

Higher education, at university level, in all branches of forestry and forest industries is given at the Polytechnic Institute at Brasov. The institute covers every aspect of forestry and the forest products industries, except the paper industry and the manufacture of pulp for paper-making which come under the *chemical* industry. Altogether there are some 5,000 students at the Polytechnic of whom about 2,500 live in hostels and 3,000 use the central dining room. The remainder live in digs in the town.

A degree course lasts five years (10 semesters) and entry, at about 19 years of age, is by competitive examination. The current out-turn of graduates with degrees in silviculture is 180 per annum; in the wood-working industry it is 160 per annum.

After the first general year, students have to choose which specialised stream they wish to follow. For example, the faculty of silviculture offers degrees in "forest culture" and "exploitation of forests" and wood-working offers degrees in "semi-finished products" such as plywood, chipboard and fibreboard, and in "finished products" such as furniture.

Graduates are guaranteed employment in the sector in which they have specialised. The Polytechnic has been given the right to award doctorate of science degrees, intra- or extra-mural.

The Polytechnic is extremely well equipped both on the biological and technical sides; there is a system for ensuring that teaching staff keep up to date. For example, those teaching basic sciences, periodically have to satisfy the Rumanian Academy of Science that they have understood and appreciated the significance of new discoveries.

The Wood-Working Industries

The Ministry of Forest Economy has under it the so-called "wood-working industry" which includes the sawmilling, joinery, box and packing crate, plywood, chipboard, fibreboard and furniture industries, the manufacture of pre-fabricated houses made of wood and wood products, and part of the small boat-building industry.

After the second world war Rumania "did not have a timber industry, only a large number of old-fashioned relatively small plants scattered throughout the country". Recently a whole series of new wood-working combines have been built. These vary in purpose and type.

At Pipera, near Bucharest, one integrated factory employing 2,300 workers, technicians and administrative personnel, carries out the following processes:—

A furniture factory produces 15,000 sets of furniture and 80,000 chairs per annum whilst another factory produces window frames and doors. A third production line coats hardboard with melanine impregnated papers (10,000 tons p.a.) and a fourth produces lacquered hardboard for kitchens and bathrooms. Much of the production is destined for the large new building programme in Bucharest, but from 1964 increasing quantities of furniture, melanine faced boards, doors and window frames have been exported.

Wood is purchased in sawn form from sawmills belonging to the Ministry and seasoned in kilns, and again the hardboard is not produced locally but purchased. Perhaps the main item of interest is the manufacture of window

frames which are made from random lengths of small-dimension low-quality sawn softwoods. The worst defects are cut out and the (now much shorter) acceptable pieces are planed and glued together in a semi-automatic machine which produces endless lengths of laminated wood of the required dimensions for the heavy continental-type window frames and door jambs.

Consideration is being given to converting the wood waste into yeasts for animal feeding, using a French process.

At Pitesti a larger and newer integrated factory occupies more than 100 acres. In contrast to Pipera this new factory converts from the round.

A hardwood sawmill with a capacity of about 2 million cubic feet per annum is at present being run-in; the machinery is mainly of British manufacture. The softwood sawmill will have a capacity of over $1\frac{1}{2}$ million cubic feet per annum when in full production. The plywood factory will produce $\frac{1}{2}$ million cubic feet of (mainly beech) plywood per annum and a fibreboard mill will produce some 35,000 tons of board per annum.

Part of the sawn timber, the plywood and fibreboard will be used in the furniture, parquet flooring and joinery factories. (Joinery will be mainly doors and window frames).The remainder will be sent to other factories or exported.

Waste is expected to amount to 20% of the true volume under bark of roundwood delivered to the factory and will be used to raise steam in the central boiler house. This remarkably low figure is likely to be achieved because much of what would be waste in unintegrated mills can be used in the fibreboard plant.

A box-making factory is being built and the whole complex is expected to employ 3,000 men when in full production.

The Rumanians are under no delusions about the magnitude of the task of building such integrated factories from scratch, running in the machinery and training personnel. The average age of the managerial staff is 25 years.

Recreation and Game Management

At Comarova, on the Black Sea coast just north of the Bulgarian border, some 2,000 acres of woodland has been managed for shooting, particularly for pheasant. Now some 12 miles of motor road have been built through the area. The road is flanked on either side by a belt of ornamental trees and evergreen shrubs. A low-lying marshy area will be made into a large artificial lake and stocked with fish, and holiday villas will be built on the side of the lake. The whole will then form a "recreation" forest where people may enjoy a shooting, fishing, boating, bathing holiday.

Organisation of the Ministry of Forest Economy

The head of the Ministry of Forest Economy is a deputy minister, who is a member of the Government. He has in his Ministry sections responsible for forest management, silviculture, exploitation and transport of wood, minor forest products, change of land use, hunting and fishing, purchase and sales, capital formation including roads, and of course the very important wood industry section.

The Field Organisation

So far as the field organisation is concerned the country is divided into regions each with a "Regional Direction of Forest Economy" under a Director. Each region is further split into Districts and Forests. The regional Director and his staff are responsible for management of the forests and the exploitation and transport of wood to consuming centres, and for any small sawmills not forming part of an integrated factory.

The Directors of the integrated wood-using complexes do not come under the Regional Directors but are responsible direct to the section dealing with wood products in the Ministry.

For road construction and buildings generally, there are several permanent "enterprises" located throughout the country and directly responsible to the directorate of capital formation of the Ministry. Each enterprise has a number of mobile gangs which are moved around the area they serve as the need arises. They draw whatever mechanical equipment they may require from a pool held centrally at the headquarters of their "enterprise". Additional temporary labour may be recruited locally or hired from the forest where a mobile gang is working.

SWEDEN

DIARY OF A WEEK'S VISIT

9th to 14th August (inclusive) 1964

by

B. W. HOLTAM

Divisional Officer, H.Q.

Introduction

Lord Waldegrave accompanied by Lady Waldegrave, Sir Henry Beresford-Peirse and Mr. B. W. Holtam visited Sweden from 9th to 14th August, 1964. Mr. W. Plym Forshell, Chief of Section of the National Board of Private Forestry organised the tour and he, with Mr. Eric H. Höjer, Director General of the Board of Crown Lands and Forests (the state forest service) accompanied us throughout the visit. Mr. Folke Johannson, Director General of the National Board of Private Forestry, accompanied the party on Wednesday and Thursday, 12th and 13th. The warmth of the kindness and hospitality that was bestowed on us by these two heads of the Swedish forest service, their assistants and officers, and by farmers and mill managers and their wives was generous and memorable. Each stage of the visit had been arranged with impeccable care and a great deal of work had been done by a larger number of forest officers, mill managers and farmers who all explained various interesting aspects of their work in excellent English. This diary is written to record those forestry matters which we saw and discussed and which are likely to be of interest to us in Britain and only the slightest mention is made of the generous entertainment that we were given and which provided so much opportunity for free and helpful discussion.

Object of the Visit

The main object of the visit was to study the organisation of private forestry in Sweden, the arrangements for the sale of produce from private estates and the relationship of forest industries with private forestry and with state forestry.

General information

We were provided with excellent printed accounts of state forestry, private forestry, farm forestry, Swedish Forest Law and other matters, and no attempt is made to summarise this general information in this diary. An appendix to the diary summarises some factual information on prices and costs which might be of value to the Commission in its marketing.

Sunday, 9th August

We flew from London Airport and were met at 12.30 p.m. at Airlanda Airport, 25 miles north of Stockholm, by Mr. I. Mackenzie (Commercial Counsellor to the British Ambassador) who drove us to Stockholm.

During a reception by the British Ambassador, Sir Moore Crosthwaite, and a dinner at the Solliden Hotel given by the Swedish Ministry of Agriculture, some background information was gleaned.

The law of gavel-kind prevails in Sweden. Although land is not necessarily sub-divided for management on inheritance, the interest in that land is shared equally by all the children of the deceased. Consequently it is often impossible for the County Forestry Boards to consult all the interested parties to discuss future management of woodland. The government is considering a proposal to make one of the equal successors to title legally responsible for the management of the inherited land, while leaving the interest in the property to be shared equally by all successors.

State-owned forest industries such as pulp and saw mills originated in the 1930's—to alleviate unemployment. It was accepted then that a state which owned forests should also own industries. There was no criticism from private enterprise of these developments. Now however there is considerable criticism on the grounds that state-owned industries are held, by private enterprise, to be supplied with cheap ("subsidised") wood. In considering this criticism a suggestion has been made that 40% of the state industries' requirements should be bought at auction and that the remaining 60% should be bought, whether from state or from private sources, at the weighted mean of the auction prices.

Professor Sundberg thought the main development for extraction was the four-wheel drive tractor with single drum winch along racks at 100 feet intervals.

Monday a.m. 10th August

Visit to Royal College of Forestry and to the Forest Research Institute of Sweden, in Stockholm:

Professor U. Sundberg who is in charge of the Department of Work Technology at the Forest Research Institute explained that the Research Institute (which is 100 years old) is now merged with and steered jointly with the Royal College of Forestry (which is 150 years old) by a board appointed by the Government and composed of representatives of the various forest authorities and interests including the Director of the State Forest Service, Director of the National Board of Private Forestry, Dean of the Royal School of Forestry, Chief of the Forest Research Institute, Chiefs of the Royal College of Forestry and representatives from the Universities. This makes for close liaison and exchange of information, ideas and results of research and of practice. This very representative board maintains standards of entry to the Royal College of Forestry in liaison with the College of Agriculture both colleges being under the Minister of Agriculture. The Universities come under the Minister of Education—and this makes for some difficulties in maintaining standards as between the Royal College of Forestry and the Universities, although there seems little doubt that the College maintains standards at least as high as those of the Universities.

The training of forest officers at the Royal College of Foresters tends to come closer to that given at the Universities. The present trend at the Royal College of Forestry is to give the students a sound academic training in the sciences; students at the Royal College will, in future, be able to substitute "university" subjects for certain of the college subjects. Much more emphasis is being given to economics, statistics and surveying. Some broad principles of administration and management are taught but it is held that the students can only learn their

job of forest management after they leave the College. The Universities are conducting an enquiry into the best type of education for forest officers, recognising that business training is needed, as is other specialist training, after the biologically based forester training. More specialists will be required in future. Many foresters already have degrees in business economics, statistics and surveying. The state and private forestry boards arrange refresher courses, the College does not, although it takes part in the courses. The Royal College of Forestry at Stockholm is the only one in Sweden; it has three permanent training centres located in different parts of the country. 180 students are admitted over a 5-year period (36 a year). There is great competition for these 36 places. Average age on admission is 25. Most of them have done two years practical work; they have done their military service and many of them have also spent one or two years at some university. The course of study at the College lasts 3½ years.

The research programme is decided by the board which also makes appointments at lower level both to the Royal College of Forestry and to the Institute of Research, but the Government finances both and appoints professors to both.

Once every five years the board holds a 2-day meeting (which is also attended by additional representatives of farmers, companies and the state forest service) to review past work and to discuss and arrange a programme of research for the next five years. The programme is approved by the Joint Board of Directors of the Royal College of Forestry and of the Research Institute.

Although the Research Institute is financed by the state is also does some sponsored research and receives donations from various sources.

Department of Work Technology

Work study began at the Research Institute during the first world war but the results were not statistically analysed until 1930 when work study was resumed on a systematic basis in a joint effort between the state and the bigger companies. The main task was to collect data for establishing piece-work rates for logging, subsequently three work study organisations were set up by the big companies, helped by the state, and these tended more to study rationalisation of work; these have now merged into one—the National Logging Research Foundation (visited in the afternoon).

At the Forest Research Institute the work is more basic and long term.

Before 1959 the Institute had a Department of Forest Technology which did wood and work technology. These are now dealt with by separate departments. Work technology—development of tools, equipment and work study comes under Professor Sundberg, who maintains very close liaison between the Institute, the Companies, the farmers and the State forest service.

Silvicultural work is included in the studies with the object of improving efficiency.

A doctor employed part-time deals with the physiology of work.

More than 80% of work in Swedish forests is piece work. Piece work rates are calculated in close collaboration with the National Board of Private Forestry. No "standard times" are published. The Research Institute studies and advises on the variable factors in work and expresses the results in ratios, saying that such a way or such an environment requires 10% more time, or less time, as the case might be for a particular job. It is then left to the trade unions and to the employers to negotiate the bases for pay. A survey of average production under existing conditions is the main basis for the negotiations. Whereas in factories standard times for machines are used, these are of little value in forestry where the man's physical ability is relatively more important.

When new tasks occur for which there is no basis for comparison, the work is done first on a time basis, then on a time and piece-work basis, then with an

incentive scheme and finally on a full piece-work basis. Many wage agreements are based on work study.

At the Royal College of Forestry more than 20% of the students' time is given to studies of operational efficiency in all fields of forest work.

Professors and their assistants at the Royal College and at the Research Institutes must have practical experience with a forest service or a company. It is not easy to interchange people between research and the field because of housing problems; moves are difficult to arrange.

Department of Surveys

Popularly called the National Forest Survey because this department's main task is to survey the extent and status of the national forest resources.

A new national line survey was begun in 1953. One-tenth of the line length is surveyed each year. 9 kilometre squares are used in N. Sweden, 5 kilometre squares in the south. 4 to 7 sample plots are chosen around each side of each square. The survey includes a percentage forest boundary check and a stump enumeration on which permissible cut is assessed. An estimate of growing stock and permissible cut is made for each year. Distances from road or floatways are also estimated for the purpose of calculating costs. 1,000 squares (or survey tracts) are surveyed annually.

The survey material is compiled and machine processed by means of punched cards.

Department of Genetics

The main item of interest in a very brief visit to the Department of Genetics was to see a nearly completed phyto-drome which is being built at a cost of about £300,000 to £350,000. Equipped with very accurate temperature, light and humidity controls, each room in this building will involve daily running costs of £6 to £10. It is one of 5 such buildings in the world and perhaps reflects the importance which the Swedes attach to research in forest genetics. The equipment is all Swedish. The main interest to the Foresty Commission is perhaps to know of this, to use the results of Swedish research, and, possibly, to arrange for any necessary work to be done in Sweden?

Other Departments of the Research Institute

The Departments of Yield Research, Regeneration, Botany and Soils, Zoology, were not visited owing to lack of time.

Monday p.m. 10th August

Visit to The Logging Research Foundation in Stockholm

Mr. H. G. Lindberg, the managing director of the Foundation, had previously been vice-chairman of the woodlands division of Nova Scotia Pulp Ltd., in Canada. He explained that the three privately financed organisations (one for northern, one for western and one for central and southern Sweden) which had pursued studies of logging work study and rationalisation studies had amalgamated in January 1964, to form one new organisation, the Logging Research Foundation centred on Stockholm.

The main aims of the foundation are to further logging by developing equipment, machines and working techniques through research and experiments and to provide a basis for the establishment of sound payment systems in logging operations. The large private companies have their own sections for such work. The Logging Research Foundation will deal with questions where co-operative effort can be used to most effect. Members of the Foundation make their own

arrangements for local communication and practical application of research findings.

The foundation has three divisions, a technical division, a division of economics and a special division for the dissemination of information.

It has a £160,000 budget for the first year. It is financed by fees based on acreage of productive forest. The Government contributes about 30% of the total fees, which it pays as a forest owner. Farmers are not members, although their instructors are already being taught by the Foundation.

The Foundation collects, screens and develops new ideas which appear to have good applications in Swedish logging. It maintains close liaison with the Ministry of Agriculture machinery-testing station and with the Government organisation for testing machines for safety in agriculture and forestry. A newly appointed professor will deal with the physiological aspects of machine operating.

It was interesting to hear that hand power saws which have passed the Government tests for safety in Sweden have no guards.

The Foundation attaches great importance to the collection of information for decision making and the economics division includes in its work the examination of administrative economies which can accompany improved mechanisation.

Other points of interest were that saws of 8 kilogrammes (16 lbs.) total weight have been developed and these can be used for branching. Users will be obliged to wear ear plugs.

The general logging practice is to man-handle logs to tushing tracks. They are cut to 3 metre lengths in S. Sweden and to 2 metre or random lengths in N. Sweden—where the trees are smaller. The Swedes have not been able to resolve the problem of what is the optimum length. 8 feet was the optimum in Canada when Mr. Lindberg was there.

One-third of the extraction is by tractor, two-thirds by horse. "One man skidding" is the aim of this year's programme of research. In N. Sweden, recently-felled logs are too heavy for floating so they have to be peeled to facilitate seasoning. A tractor fitted with hydraulic grab picks up the logs, passes them through an attached Cambio and then stacks the peeled logs *on the same side* of the road as that on which they were stacked unpeeled. The tendency is to have a Hiab or other type of loader mounted separately on a tractor but, for small farm lots some self-contained lorries fitted with loaders are essential when half a load has to be picked up from one farm and half a load from another.

The Sund debrancher electrically operated by a diesel-powered generator, with 8 rotating spirally-bladed cylinders, weighs about 4 tons. With a Cambio behind it is a heavy set of equipment and its future is uncertain. Two developments are possible. One would be to design a Sund type of machine for use in the woods; another would be to design a machine suitable for use at landings or temporary depots. These possibilities will be examined together with the possibility of chipping in the forest stands. Floating and mechanical sorting of individual owners' logs are also problems to be studied.

The logging problems to be examined are becoming more and more closely integrated with the problems of the mills and with problems of silviculture and of measurement for payment etc.

Logging contractors went out of business in Sweden 40 to 50 years ago. Such contractors used to undertake all operations but they treated their workmen badly and they were squeezed out. It is possible that logging contractors might be encouraged once more. What is certain is that provision must be made by one means or another for farmers to have forest machines to do the work in their forests. There is no free market in land and it is therefore difficult to amalgamate holdings into economic units. Since 1947 the local agricultural committees have been able to buy land on a voluntary basis and this could help.

The companies can only buy land if it will help rational development. Since therefore most individual farm forest holdings are non-expanding enterprises the smaller farmers cannot economise by decreasing the numbers of employees nor can they increase their turnover. They have to find ways of improving the efficiency of work by employing machines and to find more gainful work themselves in the time which they will save thereby.

We proceeded from Stockholm by car to Skinnskatteberg where we spent the next two nights.

Tuesday a.m. 11th August at Skinnskatteberg

Mr. Fritz Malmström, Managing Director of the ASSI (State Forest Industries) sawmill and integrated hardboard mill explained the past history of the region and how a declining iron industry based on wood fuel had left devastated forests 60 years ago. The railway came in 1900, too late to revive it. A private sawmill had started and had done well until the first world war when it went bankrupt when prices for sawn timber dropped by one third in one month. The bankers took over the mill and the forest and sold both in 1944 to the Swedish State Forest Department. Water transport and horses had been used previously but roads were improved, lorries were used, and better exploitation of the forests within 50 miles of Skinnskatteberg was made possible.

Sawmill

Logs, bundled as whole lorry loads, are tipped into the log pond on arrival. They are barked by Cambio barkers and sorted by dimensions, and returned to water in a continuous sorting line, mechanically operated, between the barking shed and the sawmill. They are returned in bundles of one size to the log pond from which they are finally lifted, by a 10-ton capacity grab, to the sawmill.

The sawmill has four production lines each consisting of a head frame saw followed by a converting frame saw followed by a double edger. The sawn wood then passes to the sorting sheds where it is graded according to Swedish grading rules and stacked for kiln drying. It is kiln dried to 25% moisture content in 4 to 6 days and left in the kiln for 3 or 4 days. Then it is branded and bracked in specifications for despatch. The better grades and larger sizes are stored in well equipped storage sheds. Other grades are stored in the open but are given temporary roofs. There was little evidence of blue stain or of other degrade.

The sawn timber is only touched by hand on two occasions. The sawdust is conveyed to the central boiler with the bark.

This sawmill, working a 45-hour week, one shift only, and employing 200 men and women, converts 950,000 logs a year to produce 22,000 standards of sawn softwood and 1·75 million cubic feet of chips from slabs, equivalent to 56% of the total annual Great Britain home-sawn softwood production in 1960–62! The logs are of 5 inches minimum top diameter under bark and 11 feet minimum length. The aim is to have logs of 8 inches top diameter and 14 feet mean length. 5-inch diameter logs involve labour costs 2½ times greater than logs of 8 inches diameter. 28% of the production is of unsorted grade, 50% is fifths and 22% sixths. Not more than 20% of the unsorted is clear timber. 50% of the production is spruce and 50% pine. The throughput of logs is equivalent to 5·25 million hoppus feet over bark with a mean volume of 5½ H.ft. over bark (such a log of 14 ft. length might be 7½ inches mid quarter girth over bark=9½ inches in diameter over bark at mid point and, say, 8½ inches top diameter over bark).

Pine sawlogs attract prices generally 8% above those for spruce of the same size. Pine is also favoured for some of the chemical pulping processes used in Sweden.

Fibreboard (Hardboard) Mill

A hardboard mill employing 200 men and women on 3 shifts (about 66 per shift) alongside the sawmill works seven days a week. Workers are paid double time for Sundays and increases for the second and third shifts.

The mill produces 86,000 tons of board a year; this is one-fifth of Sweden's production of hardboard. 60% of the raw material is softwood and hardwood thinnings (the proportions are immaterial). The remaining 40% of raw wood requirements is bought as chips produced from unbarked slabs from neighbouring sawmills. The total wood requirement is of the order of 2·5 to 3·0 million hoppus feet a year. The *barked* slabs produced in the adjoining state sawmill are chipped at the fibreboard mill but are NOT used there. They are of too high a quality for economic production of fibreboard and are sold to two cellulose factories—one of which is 38 miles away and the other 94 miles away. The thinnings roundwood is not barked and the proportion of bark in the fibreboard is not regulated. The quality of the board appeared to be excellent.

The mill is equipped with 3 Asplundh disc type defibrators.

Mr. Malström was firmly convinced that neither the sawmill nor the fibreboard mill could possibly show a profit alone.

Tuesday p.m. 11th August

Forester Training School and Forest District of Malingsbo

Mr. C. E. Janlöv, the District Forest Officer i/c the state forests of Malingsbo, with his assistant officer Mr. Olsön are responsible for running summer field courses for forest officers. He explained that the forest of 68,000 acres consisted of successive purchases by the state since 1889 of forest farms and small iron factories. The last such factory closed in 1912. The farmers continued as tenants of the state farms and worked in the forests in winter especially. Increasing mechanisation has resulted in a surplus of hauliers and horses and the policy is to abolish the forestry farms but it is difficult to do this without causing unemployment and everything possible is being done to provide alternative employment, for example at the ASSI sawmill at Ludvika. Village houses are being constructed for those forest workers who will be employed full time in the forest in future and the aim is to have fewer, but fully (year round) occupied and better trained workers.

The district is divided into 7 foresters' charges. The district officer has one assistant officer and the district employs 230 workers of whom 50 are now tenants of state owned farms, 100 are tenants of village dwelling houses, owned by the forest service.

Every 10 years a new management plan for the whole district is prepared by the central office in Stockholm—taking account of volume production mainly, and aiming for sociological reasons at normality for the district. 1·2% of the area is clear felled and is restocked annually. Traditionally the stands have been thinned 5 or 7 times in a 100- to 120-year rotation. Management is now considering only 1 or 2 thinnings in the same rotation. Soil types are being examined to assess their ability to stand up to heavy machines. The 10-year plan includes roads and terminals for tracked transport. Control is by area. It is left to the District Officer to select areas for thinning and for felling.

Felling plans are made for 2-year periods or, sometimes, for 10-year periods. Annual plans begin with marking for felling.

The work is unequal in the seven foresters' charges, but forest workers travel in their own cars 10 to 12 miles and are paid for travelling time.

Mean annual increment is about 45 hoppus feet o.b. per acre; this is about the mean for Sweden.

In the forest we saw tractor tushing tracks which had been cleared at 25-to 30-yard intervals. Road lines and tushing tracks are cleared of trees and then the thinnings are marked. In this way 660 hoppus feet per acre or 35% of the standing volume of pine was removed in one operation.

The machines being used for extraction were of particular interest. A Boxer 350 two-wheel drive tractor fitted with a third pair of intermediate wheels and half tracks was equipped with a particularly efficient hydraulic hoist and grab of the Hiab type and towing an Ösa—126 "timber wagon" trailer equipped with four independently-sprung double wheels and adjustable telescopic struts loaded 10 hoppus feet at a time and extracted a maximum of 500 stacked cubic feet (say 250 hoppus feet) of unpeeled pulpwood at a time (about 8 tons) to roadside where it unloaded. This machine was operated by a one man contractor who had purchased the equipment new and undertaken a contract with the state forest service under which he was guaranteed a minimum of 200 days work a year in the district. The wheels of the trailer were particularly good at traversing uneven ground. It was emphasised that, with this type of extraction, it was most important to align the extraction tracks straight up and down the slopes.

We were shown an "S.F.I." scarifier made by Gustafson and Hijorth (sold by agents Ab Skogsbrucksmaskiner, of Stockholm.) Heavy wheel mounted tines were rotated at slow speed by chain drive from the two land wheels. The two sets of tines were at 1·8 metres (5 feet) centres—the planting distance for pine. The scarifier was towed by a four-wheel drive "tree farmer" tractor. (See Appendix para. 10 for costs.)

Next we saw the experimental Cambio peeling equipment consisting of the smaller Cambio peeler, trailer mounted, driven by the power take-off of a Foco Timberman tractor fitted with a hydraulic grab and specially made cradle.

It peeled 200 cubic metres (5,500 hoppus feet) of pulpwood in an 8-hour day with 2 men on the machine and two helping. The grab picks up nearly 40 hoppus feet of 3 metre lengths at a time as a maximum, and 30 hoppus feet as an average. It could peel 1½ million hoppus feet a year on one shift for a 300-day year.

Unfortunately the set of equipment is too heavy, weighing 17 tons, and the system is to be abandoned because the roads in the forest will not stand it. A lorry-mounted Cambio will be tried in its place.

The night was spent at Skinnskatteberg.

Wednesday a.m. 12th August

Travelled southwards from Skinnskatteberg to the forestry school of Vallmotorp. (En route learned from Mr. Hojer that without deliberate cutting out of spruce to favour pine most of Sweden would be spruce forest. The succession is birch, pine, spruce; elk (or moose—*Alces alces*) eat the pine but not the spruce and this has a definite effect in favouring spruce).

At the Forestry School of Vallmotorp Mr. Erik Falk (Chief of Section, National Board of Private Forestry) and Mr. Erik Sillerström, County Forest Officer for Sodërmanland, explained that the importance of the County Forestry Boards' work of supervising the application of the Forestry Act 1903 has diminished and instead, increasing importance has been given to the Boards' educational work in all fields of forestry. The 24 County Forestry Boards run 32 vocational forestry training schools in Sweden—all under the Minister of Agriculture.

9 years' elementary school education is necessary for admission (at 15 years of age) to the Vallmotorp training school where forest workers, owners and foremen are trained. Foresters are trained at the State Forest Training School at Skinnskatteberg—which recruits entrants from the best of the students at the

County Forestry Training Schools and elsewhere (Matriculation can qualify for admission to the Forester (Forest Master) training school.)

1,000 students a year are trained at the schools run by the County Boards of Private Forestry.

The Board of Crown Lands and Forests has its own training schools and some of the larger companies have their own too. The companies' school costs are 10% state aided. The National Board of Agriculture provides some forestry training at its agricultural schools.

The State Forestry Schools and Forester Training Schools are administered by the National Board of Private Forestry in Stockholm, and the County Boards of Private Forestry have no say in these.

The basic training given to forest workers at age 15–16 and to forest owners is also compulsory for those who wish to become foresters. The owners are usually owners of small areas; they need to work themselves and so need to acquire the forest workers' skills.

After one year's basic training the workers can go to a job in forestry or to the second year of the course which deals with forest management and machine management. Alternatively they might be recruited to courses for foremen or the best might be recruited to the forester training school.

In addition at Vallmotorp and similar schools short training courses are given to adult workers. The Swedes are convinced however that forest workers must be admitted to the training schools at 15 (the same age at which they are recruited to other schools or to other jobs) if forestry is to get good workers.

For admission to the Forester Training Schools students have to pass a competitive examination in Swedish, chemistry, biology and a psychological test to assess their suitability for a job in forestry. 70% of the students are so selected; the remaining 30% are given a more advanced psychological test and certain additional tests of a technical nature to select some bright students.

Forester training in the first year is as follows:

1. General subjects including biology	185 hours
2. Accident prevention, safety and physical training	70 ,,
3. Equipment and machinery	130 ,,
4. Forest growth	155 ,,
5. Felling and hauling	230 ,,
6. Forest mensuration	95 ,,
7. Protection of nature	15 ,,
	880 ,,
	22 school weeks
	20 weeks in the forest on practical work.

At Forester Training Schools such as Skinnskatteberg the basic forester training course takes 15 months or 16 months.

Great attention is paid to the need for good instructors. Few forest officers are employed in training forest workers—but suitable instructors for this work are given a course of 18 months training. They are selected from foresters with good knowledge of forestry and psychology and are subsequently employed as assistant teachers They are given refresher courses every 3 years. A special additional 12-week course is given to machinery instructors. 20% of the teachers in forestry schools have gone through this form of training.

The County of Sodermanland has an unusually large number of bigger private forestry estates. For the owners of such estates special courses are

arranged with greater emphasis on economics. Many of their sons go to state Forester Training Schools. Such owners often visit the agricultural schools in the County also.

5 or 6 courses are held each year for groups of, say, 10 foresters in villages. Instructors also visit workers in the forest and teach them on the job about tools and machines.

All courses are free except for board and lodging which are charged for at 8 Kroner a day (11/-); students attending courses are paid 175 to 200 Kroner a month by the state (about £12 to £14). Some of this is recouped in the value of practical work done by the students in training.

We visited selected practical training sites and saw safety instruction in logging, lifting logs with tongs, and felling and cross-cutting with mechanical saws. For the young workers very short periods of practical training are given. Mechanical saw operators are obliged to wear glass wool (down) ear plugs. They are equipped with metal gauze goggles for use when pruning etc., and the younger workers wear gloves.

Wednesday p.m. 12th August

After lunch at Vallmotorp School we travelled south through Katrineholm, Norrköping and Linköping to Sya nursery near Mjolby passing into richer flat agricultural country.

Mr. C. O. Bosson, the Forest Officer of the County Forestry Board of Private Forestry and his assistant, Mr. Ingmar Danielson, explained the nursery work. In this region of fertile soils planting is essential and natural regeneration accounts for only a small percentage of all restocking. A few years ago the nursery distributed 7 million plantable trees—now it distributes 16 million (50% Scots pine, 50% Norway spruce). Production is still too small. 850 kilogrammes of seed were sown this year. The last good Norway spruce seed crop was 10 years ago; it usually crops well every 7 years.

The nursery extends to 130 acres of light sandy soil free of stones easy to cultivate mechanically. Wind erosion is a serious problem and there is little shelter to windward. Green cropping on fallow is routine. Each crop is cut twice and ploughed in. Irrigation is usual. One 50 h.p. and one 35 h.p. motor pump water through 2 miles of pipe to deliver 2,000 litres per minute. Artificial manure is applied regularly as combined NPK. *Hylobius abietis* is dealt with by routine spraying.

Norway spruce seed is collected from good stands in the county and is imported from frost hardy strains in Poland and Russia. The nursery is equipped with cold storage rooms for seed and plants and with seed extraction plant capable of dealing with 3,000 litres of cones per 24 hours. The nursery employs 10 men and 75 women full time and 199 more (mainly women) in April and May. Most work of lining out is done in summer in 5 rows to a bed, set in place by hand in slots cut by the 5 discs of a disc harrow towed by tractor. Seed is sown broadcast. Planting stock is 2+1, 2+2 or 3+2.

One machine of particular interest was a transplant line weeding machine or mechanical hoe with 6 stirrup-shaped blades each enclosed in hinged flaps at front and sides (to protect plants from damage) rotated at ground level so that the flat of the stirrup cut weeds and scuffled the soil. The blades were rotated individually by 6 flexible drives which were turned by pulley attachments from the tractor; 3-point linkage with hydraulic lift. The weeding was efficient and damage to plants negligible. It is probably suitable only for stone-free soil.

There are few commercial nurseries in Sweden, and production of seedlings is usually difficult. Sweden has some 3,300 acres of nursery owned partly by the

County Forestry Boards, partly by the State Forest Service and partly by companies. 70 acres is usually regarded as the minimum economical size for a nursery. Seed collection is done by the County Boards and by the State. The Swedish Tree Breeding Association will require some 5,000 acres of forest for progeny testing of volume production per acre.

The night was spent at Jönkoping, where we were entertained to dinner by Mr. and Mrs. Åke Hallander. A memorable occasion.

Thursday a.m. 13th August

In a forest excursion under the guidance of Mr. Hallander we saw bizarre examples of naturally occurring Virgate spruce including *Picea abies* var. *virgata tabuliforme*—the only specimen in the world, standing about 3 feet high. The varieties of this oddity are many—varying from examples with no branches to others which came near to normal Norway spruce and others only 2 feet high at 50 years old. The stand is protected by law. The stand is on Skåeryd farm, Hyämseryd, whose owner, Mr. Bertil Nicklasson, accompanied us on this part of the visit.

A plus tree of Norway spruce in a stand 84 years old—on former pasture (last hay crop taken 1880) had a b.g.q.g. o.b. of 14½ inches.

Ips typographus was present in this stand as a secondary pest following lightning damage and *Armillaria mellea* and *Fomes annosus.*

The farm comprises 35 acres of fields and 91 acres of productive forest, which has been owned by Mr. Nicklasson since 1946 when he took it over from his father.

Since 1947—up to 1964 Mr. Nicklasson has sold 116,000 hoppus feet of timber worth £13,000 averaging about £750 a year. The growing stock is about 1,600 hoppus feet per acre a year. The owner is making a comparatively good living from farm and forest. He knows and understands his forestry, and the spruce stands are regarded as good seed sources.

We proceed to Växjo for lunch as guests of the Forest Owners' Association of Southern Sweden (S.S.S.F.), at the home of Mr. Gösta Edström, Managing Director of the S.S.S.F.

Thursday p.m. 13th August 1964
Forest Owners' Association of South Sweden

Mr. Sundberg (brother of Prof. Sundberg) Assistant Managing Director of the Forest Owners' Association of South Sweden, explained that 85% of the farmers of south Sweden are members of this Association. Farmers own 50% of the country's forests producing 60% of the country's growth. In this region 4/5ths of the woodland area is privately owned. Average ownership is 100 acres of forest; there are 42,000 owners. The Association was formed to overcome the problems of small ownership—to purchase machines etc. Its functions are trading, conversion (to some extent), to cultivate greater interest in the commercial aspects of forestry and to look after the farmers' even flow of work throughout the year, in combined farm and forest.

120 forestry districts are each led by a forester; there are 100 to 150 owners per district in possession of 10,000 to 15,000 acres.

Co-ordination allows of intensive management and it makes it possible to sell varieties of produce while making maximum use of local knowledge. The Association's own experts help the farmers to profit from new developments.

The Association handles for its members 20,000,000 cubic feet of sawlogs and 3,000,000 cubic feet of pulpwood annually plus other varieties of produce; £14,000,000 worth is being handled this year. Collection of small parcels into

saleable lots is an important part of the work which enables the farmer to get a fair price.

The Association is financed by the farmers who contribute a percentage of their net profits. A farmer is repaid his investment when he leaves forestry or when he leaves the Association.

Industrial Development

Industry showed little interest in new developments so the farmers decided to invest in new industries. One result is that wood prices in south Sweden are among the highest in the country. First they invested in sawmills, then in pulp-mills, and in boardmills. They own two of the largest pulpmills in Sweden; one in the N.E. of the region produces 180,000 tons of sulphate pulp and a new mill at Morrum produces 140,000 tons a year; another mill produced 40,000 tons a year of paper board and another two mills 50,000 tons of chipboard; they own the biggest paper sack mill in Sweden and they make 2,300 pre-fabricated timber houses yearly, and aim to produce 5,000. In several sawmills, (mostly small), they produce 32,000 standards of sawn softwood yearly. They employ 5,000 workmen and have a turnover of £35,000,000.

The Association aims to keep private forests efficient—and in private ownership, believing that it is more logical for the owners of the private forests to own the wood processing industries than vice versa. Members are free to sell their sawlogs to anyone. It is a problem to arrange for a steady income for owners of small areas but with 100 acres of forest plus 25 acres of farm an owner should be able to live comfortably, with a yield of 55 to 65 hoppus feet per acre per annum and felling say 5,600 hoppus feet a year. Help is given in logging where necessary. A farmer who fells once every 3 or 4 years puts the proceeds in the bank and draws annually on this and shows on his income tax returns what he draws annually. This is accepted.

The capital for the various wood industries owned by the Association has been raised by the members advancing 4% of the cost and contributing 100 Kroner per hectare through the banks, the banks accepting the farms and woodlands as security. Membership of the Association costs 0·25 Kroner per acre of productive woodland. Members pay 85 Kroner (£6) a day for the services of an Association forester. Machines and tools are charged for at cost. Forest plans are prepared for 50 Kroner per plan plus 3 Kroner per acre. (A plan for a 100 acre forest would cost say £25).

Possible arguments about location of industries have been forestalled by agreeing at the outset that a uniform at-roadside price will be paid to all members for produce supplied to their own mills.

At Almebara we stopped to inspect a 5-roomed wooden house which had, in addition, a kitchen and cellar, well contructed at a price of £4,500 including site and site works and occupied by one of the Associations' foresters. We learned that most Swedish foresters own their own houses. The house had been prefabricated at the Association's factory.

We proceeded to Almeboda forestry district where 35,000 acres of swamp are owned by 400 of the Association's members. The key employee of the Association in a district is the forester who has to build up enthusiasm and to make plans for the farmers. He also supervises a labour "bank"—and where a farmer has insufficient work on his own holding the forester arranges supplementary employment for him on a neighbouring farm. He supervises marking, cutting, labour, machines, production and procurement of timber, planting, thinning and other silvicultural work, road planning and construction and he is responsible for engendering "team spirit" by leading excursions. Between times he does his office work!

Selection felling led to badly stocked forests. Clear felling of small areas is now general practice. We were shown such areas which, having been felled, produced 3,500 hoppus feet per acre at 80 years; the remaining stands averaged 90 hoppus feet per acre current annual increment. 80 years is regarded as too long a rotation for such good sites. This was a farm of 192 acres of forest plus 10 acres of farmland. The owner was living comfortably in an attractive wooden house which had been built in 1816 and was still thoroughly sound. The farm has been in his family since 1600. He agreed that farmers could and should cut more than they do—as soon as industrial capacity can be increased to provide markets with good prices. More sawmills and more pulpmills are planned.

More than 40 produce assortments are prepared at this and similar farms. The general aim is to standardise specifications and so simplify production and stockholding.

We proceeded southwards to Ronneby Brunn on the south-east coast of Sweden, where we spent Thursday night, and dined as the guests of the S.S.S.F.

Friday a.m. 14th August, 1964

Visited Mörrum bleached sulphate mill, owned by S.S.S.F. and which began production in September 1962. It produces 140,000 tons of pulp a year and has a wood intake of 1 million stacked cubic metres—equivalent to say 35,000,000 stacked cubic feet or 17,000,000 hoppus feet ($1\frac{1}{2} \times$ Fort William proposed intake). The mill accepts unpeeled hardwood and softwood roundwood and peeled sawmill slabwood—all cut to 2 metre lengths. 1 ton of air dry pulp requires the equivalent of 7·5 stacked cubic metres of unpeeled roundwood pulpwood. The pulpwood is not very straight nor always free of fluting etc. and at a conversion factor of 0·6 this would be equivalent to saying that 1 ton of air dry pulp would require 124 hoppus feet o.b. of unpeeled pulpwood.

8 Cambio peelers peeled (not very thoroughly) all roundwood. (6 small Cambios and 2 large ones). The mill pulps hardwoods for 5 weeks then softwoods for 5 weeks.

3 large round towers store bark, hardwood chips and softwood chips respectively. The bark is used as fuel.

20 men normally operate the mill at each shift of 8 hours, but recently the mill has operated 4 shifts so 80 men are employed.

5 digesters give the wood a five-hour cook. Effluent is discharged through 3 miles of pipe to the sea.

The mill is not integrated with a paper mill because the pulps which are produced are suitable for blending with other pulps to make a variety of fine writing papers.

The yield is reckoned to be 50%.

"90%" of the smell is eliminated in a specially constructed oxidation tower which also serves for better recovery of chemicals. This particular equipment for oxidising noxious gases has been developed by the British Columbia Research Council.

One particularly interesting feature is that for the first time in Sweden open air storage of chips is practised. So far no deterioration in quality is observed.

The sawmill waste is chipped separately from the roundwood and the chips are of lower grade (more irregular and with much more dust than chips from roundwood). These are pulped in occasional separate runs to produce a lower grade pulp.

We lunched at Bäckaskog Castle—one time monastery. Lord and Lady Waldegrave left for Malmö and London after lunch.

Friday p.m. 14th August

Mr. Tham, State District Forest Officer, took us to see something of his 17,000 acres of forests of beech and oak, pine and spruce. The forests are 50% hardwood, 50% softwood in this region of south Sweden. Dr. Anderson, whom we had met at the Genetics Division of the Institute of Forest Research in Stockholm, joined us to talk about the tree seed orchards which we visited.

Mr. Forshell explained that it was decided 15 years ago that better co-ordination of the tree breeding organisations was needed. There were two societies one in the north and one in the south whose seed orchards were not scientifically sound. Dr. Anderson was employed to organise the work on a scientific basis. The National Board of Private Forestry now has soundly based seed orchards. 20 tons of conifer seed are required yearly. Demand will be for 30 tons soon. 3 tons a year are imported.

Dr. Anderson explained at the first (pine) seed orchard that 600 tree seed orchards have been planted already for the various County Boards of Private Forestry. The areas are 650 acres of pine and 500 acres of spruce. 10 seed orchard zones are recognised for spuce, 15 for pine. Trees are selected for vigour, form, sawmill quality, and branching characteristics. Pruning and fertilising are practised. Top shoots are pruned every 2 years. N.P.K. fertiliser is used to stimulate production of cones; strangulation is not satisfactory. Root pruning is good but application of fertiliser is better. The seed orchards with open spaced trees and heavy growth of grass are expensive to maintain. Mice and voles do extensive damage; 3 years hence ploughing will be done to prune roots and control grass in one operation. 20 to 30 clones are considered necessary; 40–60 would be better.

Mr. Tham in showing us a stand of beech 80–100 years old of 14 in.–16 in. b.h. diameter o.b. explained that beech in these favourable conditions could grow much faster. A Timber Jack which was purchased for £7,000 extracted 2,700 hoppus feet a day—equipped with a double drum winch—extracting trees averaging 30 to 50 hoppus feet, and practising whole tree logging, and employing 3 men, one on felling, one helping and one on the tractor; Mr. Tham is sure 2 men only need be employed. Branches were removed except those which would make pulpwood. He thought it would be a particularly good system for extracting mother trees through natural regeneration.

We stopped at a second (spruce) seed orchard which contained spruce—all from trees which had been selected and observed through one generation. In this dry soil and climate of south Sweden spruce flowers freely and is easy to fertilise.

On the other side of the road was a third orchard with 50% Swedish spruce and 50% Central European spruce and some Hybrid larch (*leptolepis* × *decidua*).

The next stop was at a good 5-year-old stand of Japanese larch 6 ft. to 9 ft. high. The soils have a high calcium content and spruce alongside was 90% *Fomes* infested.

Mr. Hojer and Mr. Tham, pointed out an area of 200 acres of good land which the Swedish State Forest Service has purchased with the aim of exchanging this with a farmer who owns adjoining poorer land of scenic beauty. The object is to preserve a stretch of open hill grazing for its scenic beauty; the Swedish forester might have to turn sheep farmer to keep it so!

We next saw a small but impressive stand of Sitka spruce on ridge moraine, 45 years old carrying 5,000 hoppus feet per acre, 500 trees per acre in an area which has only 20 inches of rain—subject to long periods enshrouded in sea fogs. Breast height diameter over bark was 11 inches mean and mean top height 85 feet. When last thinned 4 years ago no butt rot was visible. Similar small stands of 1 acre or so were seen throughout the beech woods whose leaf mould and shelter might have contributed to the good growth of the Sitka spruce.

No draft horses remain in this very fertile area of the south where agriculture is prosperous and tractors more common than further north.

Two-thirds of the planting in this region is done in the Spring and one-third in the autumn. The aim is to plant as much in the autumn as in spring. Good beech seed occurs only every 10 years and planting is the rule. The planting is 22% beech, 22% spruce, 21% oak, 10% larch, 10% alder (*A. glutinosa*) and others (Douglas fir, sycamore etc.) 15%. One further seed orchard was visited—10 acres of oak (*Quercus robur*) and of beech—which Dr. Anderson believes is the first beech tree seed orchard in Europe—established 1958–60. Vole damage was severe last year and new grafts have been transplanted.

Malmö gets its water from underground collection at Sojobo—poor sandy soil growing very poor pine and spruce—but Malmö town council says that such forest cover gives a better water yield than they would otherwise get.

Mr. Tham, who is an enthusiastic amateur entomologist, collects moths. In some recent years he has collected in Sweden numbers of moths which have flown from N. Africa. They would be more easily airborne than the more chitinous coated bark beetles but he believes that, nevertheless, bark beetles could readily be borne from the continent of Europe to Great Britain and that there would be a chance of breeding pairs meeting there and of surviving winter conditions in Britain. Something to consider when discussing quarantine measures!

Further items of interest which Mr. Tham gave were that all workers are paid by cheque; pay details are collated by Holerith punched cards; all bills are paid by cheque also—all from central office—and the foresters neither pay nor receive cash for any sales of produce or anything else. It might be worth the Forestry Commission sending someone to Sweden to study these matters. (Mr. E. H. Bradford, a Chief Executive Officer at Headquarters, and Mr. J. N. R. Jeffers, Statistician, visited Sweden for this purpose soon after these diary notes were written.)

Dalby National Park

Our last visit in Sweden was to Dalby National Park, an ecological reserve of some 60 acres of mixed hardwoods with a very rich hardwood flora on deep fertile clay soil.

Illustrations of the tour appear on our centre pages.

Appendix

1. Swedish fellers can earn as much as £25 a week.
2. Forest land carrying, say, 80 to 90 cubic metres per hectare (say 900 to 1,000 hoppus feet per acre) costs about £50 per acre in mid and south Sweden.
3. Bleached sulphate pulp costs 850 Swedish Kroner per air dry ton of 1,000 kilos F.O.B. This is almost equivalent to £60. 10s. per long ton.
4. Bleached sulphite pulp costs 750–800 Swedish Kroner per air dry ton of 1,000 kilos F.O.B. This is equivalent to £53. 8s. to £55. 10s. per long ton.
5. Boxer 350 Trailer—half tracked, two-wheel drive—equipped with Hiab type of hydraulic loader and grab (the latter particularly well articulated and positive in its pick up) and Osä trailer of 250 hoppus feet capacity was earning £13. 10s. a day for its owner/operator and costing him an estimated £8. 10s. a day in depreciation, maintenance and running costs.

6. At Malingsbo 3-metre lengths of unpeeled sulphate pine pulpwood stacked ready for loading at roadside attracted a price of 35 Kroner per stacked cubic metre. A conversion factor of 0·7 was used to calculate solid volume. On this basis and with 14·3 Kroner to the £ and 27·73 hoppus feet per cubic metre solid the equivalent price would be:

$$\left\{\frac{35\times240}{0{\cdot}7\times27{\cdot}73\times14{\cdot}3\text{ pence per h. ft. u.b.}}\right\}$$ 2/6·3d. per h. ft. u.b.

7. Spruce pulpwood on the same basis peeled for magnesite or sulphate in south Sweden (Ronneby) attracted an at-roadside price of 49 to 50 Sw.K. per cubic metre. Unpeeled the price was 42 Kroner. These prices are equivalent to 3/6·5d. per hoppus feet u.b. and 3/0·4d. per hoppus feet o.b.
8. Peeled pine sulphate pulpwood on the same basis as 6 above attracted 3/0·4d. to 3/1·3d.
9. Peeling costs (at Malingsbo where some hand peeling was being done to give full employment) 6 Kroner per stacked peeled cubic metre by hand; 4 Kroner per stacked peeled cubic metre by machine; equivalent to 5·5d. and 3·45d. per hoppus foot u.b.
10. Screefing costs—using the Gustafsen and Hijorth SFI Scarifier—screefing two planting lines at a time cost 200 Kroner per hectare or £5. 16s. per acre. The Scarifier cost 11,500 Kroner or £800.
11. In the Jönköping forests unpeeled spruce pulpwood in 3-metre lengths attracts 35 Kroner per stacked cubic metre at roadside. With a 0·7 conversion factor (stacked to solid) this would be equivalent to 2/6·3d. per hoppus foot o.b. (as for pine at Malingsbo—see para. 6 above). Pine only attracts 26 Kroner per stacked cubic metre, equivalent on the same basis, to 1/10½d. per hoppus ft. o.b. at roadside.
12. In the same forests spruce sawlogs of 8 inches u.b. top diameter, 10 ft. minimum length (average 13 feet to 14 feet) cost 2·5 Kroner per cubic foot (they are priced in Kroner *per cubic foot*!), equivalent to 3/6d. per cubic foot u.b. or 4/5½d. per hoppus foot u.b. or, say, 3/6d. per hoppus foot o.b. at roadside.

    Pine sawlogs on the same basis attracted 35 Kroner per cubic foot, equivalent to 4/2½d. per cubic foot u.b., or 5/4¼d. per hoppus foot u.b. or, say, 4/4d. per hoppus foot o.b.
13. In South Sweden—near Malmö—pine cut to metre lengths for conversion to box boards for fish boxes, 3 inches dia. to any maximum diameter attracted prices of 32 Kroner per stacked cubic metre unpeeled and 35 Kroner peeled. These are equivalent to 2/3½d. per hoppus foot o.b. and 2/6½d. per hoppus foot o.b. respectively.

IN NORWEGIAN FORESTS

By

H. L. EDLIN

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During two brief holidays in Norway I saw a little of the great forests that contribute so much wealth to that country's economy and such glory to its scenery. Over half the country is mountain, too high and bleak to support tree growth, and the main productive forests are concentrated in the eastern valleys that run down to the Oslo Fjord. They form, in one sense, a continuous woodland, broken only by small farms and hill ranges, Between Oslo and Bergen the

railway lines run through 200 miles of almost unbroken spruce woods, mixed to a greater or lesser degree with Scots pine and birch. At first it looks monotonous, but closer acquaintance reveals differences of plant and tree, landscapes of vale or crag, and waterways of lake, river or torrent, that give to its each vale its particular character and charm.

The Eastern Valleys around Oslo

This part of Norway enjoys warm dry summers with long hours of sunshine, and the Norwegians, who make the most of this, are nearly all sun-tanned. The winter, one is assured, is so cold that snow replaces rain for several months, forming deep drifts everywhere, though the total precipitation, if measured as rain rather than as snow, is only 25 to 40 inches.

However, the summer climate here is favourable to agriculture, and although one is in the same latitude (60° North) as the Shetland Islands, all the usual grain and root crops are grown, and there are thriving apple orchards. The mainstay of the farm is the dairy herd, which is stall-fed in winter. Much of the summer's long working day is spent on gathering hay and other fodder, for storage in the "log-cabin" type of barn-cum-cowshed which is a feature of every farm. In fact it is the same kind of cattle husbandry as you will find much further south in the Swiss Alps, or nearer home in the Yorkshire Dales and the Peak District. But owing to the past geological history of Norway, there are few farms on which all the land can be tilled or grazed. Everywhere the glaciers have left their mark—in bare rock faces scarred by ice-borne stones, in tarns and peat-bogs, and in morainic scree and hard compacted soil. Such ground is left to the trees.

Returning travellers have sometimes given a picture of the Scandinavian farmer wisely making a decision of how much land to devote to farming and how much to forestry. The truth is that nature made the decision for him about 15,000 years ago. He farms every square inch that is worth while and takes a timber crop off the rest. The more southern regions have been closely settled for around 1,500 years, and the limits of profitable cultivation are well known.

It follows that the land left under forest is desperately poor—in fact by British standards most of it is "unplantable". But nature has done the planting and the farmer-forester is happy to harvest an annual increment of around fifty hoppus feet per acre, which has cost him nothing to grow. Norway spruce is the main species, with admixtures of Scots pine, birch, Norway maple, a little oak and ash, common alder, grey alder (*Alnus incana*), rowan, and lesser shrubs such as juniper and the red-berried elder, *Sambucus racemosa*. Natural regeneration is relied on, in the main, and it is shockingly slow. The spruce seed-fall, though it only occurs abundantly at intervals of some years, is ample on the whole, and plenty of seedlings can be found on bare soil or gravel—and there is no shortage of that! The seedlings spend the next ten to twenty years struggling up to small Christmas tree size through a combination of adverse circumstances —keen mutual competition for a meagre supply of nutrients, partial shade from surrounding trees which is the more serious where the sun never rises high in the sky, even during the long summer days, and a short frost-free growing season. Eventually the survivors suppress their less fortunate comrades and profiting perhaps from some thinning or selection felling of older neighbours, start to grow into sizeable trees at a reasonable rate.

It is not surprising that the more progressive Norwegian foresters now doubt the value of leaving everything to nature. There is a swing away from the Selection system, which is described as "the green delusion", towards plantations run on regular rotations. Forest nurseries, and the annual planting programme, are alike being expanded, with a marked concentration on spruce. Over Norway as a whole, about 90% of new planting is done with Norway spruce, 5% Sitka

spruce, with a balance of some 5% including pines, larches, and a few broad-leaves. This action, in a country where the woods are essential to the economy, may surprise those foresters in Britain who would like to see the widespread application of multi-species selection systems in place of our prevailing even-aged conifer woods. We have already got what the Norwegians want!

Further, the Norwegians are expanding their forests by the planting up of moor and fell. Their fifty-year plan includes new afforestation over 1,250,000 acres. This implies an acreage rate of 25,000 acres a year, which is quite impressive though only a third of Britain's current rate (Commission and private planting combined).

The Nordmarka Forest at Oslo

Oslo, the capital city, is fortunate in having, within its boundaries, a great expanse of the vast Nordmarka Forest which clothes the hills just behind the city itself. A road and an efficient electric tramway wind up the long slope, passing pleasant suburbs wherein every wooden house has its own large garden, and also the world-famous Holmenkollen ski-jump. Just below the summit there is a restaurant called Frogner Seteren, with a magnificent view over the town and harbour far below. This restaurant is built in log-cabin style, and there is even a replica of the original seter or shieling, where the farmers from the lowland below kept their herds during the summer. Incidentally this word *seter* turns up on the maps of Scotland and England, anywhere from Caithness down to Derbyshire, in place-names that include "-ster", "setter", or "satter", such as Satterthwaite in Grizedale Forest; all these names mark places where Norsemen settled centuries ago. The cuisine of the restaurant is, however, quite modern, though the menu includes goat cheese and reindeer steak.

Access to the sprucewoods beyond the road-end and tramway terminus is not merely permitted; it is actively encouraged. This despite the fact that the woods form a gathering ground for the city's water supply. Visitors are not excluded even from the margins of lakes; they are simply told to have commonsense care for the purity of the water that they themselves may shortly be drinking. As in Britain, the forest roads are firmly closed to any traffic that is not essential for work in the woods; they therefore form quiet and pleasant ways for the rambler. Both roads and foot paths are clearly signposted; a simple colour code is used, and distances are given in kilometres—not in hours, as is usual in some countries. At several points in this Forest, there are log-cabin refreshment huts. Some are simple annexes to a forest worker's house, but two we visited had large dining halls and sold beer and cooked meals as well as soft drinks and snacks.

They are open all the year round, but it was clear that the greatest use is made —both of refreshment chalets and footpaths—during the winter ski-ing season. To a summer visitor, it is odd to see extremely rough tracks, covered with loose stones where jagged rock does not show through, signposted as ski-runs. But the winter snows lie so deep that all such roughness is buried below a smooth white surface. It is even stranger to see paths signposted across peat bogs that could never carry a man's weight, and which it would be suicidal to try to use in summer. The explanation is that in winter the bogs freeze solid, and so become quite safe to cross.

Bergen Mountain Woods

In contrast to Oslo's natural Nordmarka spruce forest, the woods on the mountain called Floifjellet, immediately behind the city and seaport of Bergen, are entirely man-made, though probably not one visitor in a hundred guesses that today, for they now look quite natural. Their pleasing irregularity is due to the varying growth rates of a wide range of introduced trees, all established

since 1900. Bergen enjoys—if that is the right word—a maritime climate very similar to the west coast of Scotland; although it is in the same latitude as the Shetland Islands (and also that of Oslo) it is kept warm and wet by the Gulf Stream. The ground flora of heather, juniper, birch and associated heath plants reflects this climatic similarity, and the rocks—schists and granites—are much like those of western Scotland; so is the coast-line, with fjords replacing our familiar lochs. So the growth of introduced trees provides interesting parallels to our own planting programme.

As with us, by far the most successful tree is the Sitka spruce, Norway spruce makes reasonable growth, but the North American white spruce, *Picea glauca*, makes no better showing than it does in Britain. None of the pines is impressive, though both Scots and Austrian species have been tried. The mountain pine, *Pinus mugo*, from the Alps, remains a stunted bush.

The woods are reached by a funicular railway, with an enormous restaurant at the top. This commands a wide view over Bergen city and the fjords and islands around it, one thousand feet below. Paths, clearly signposted, climb high into the hills behind, which are very steep and rugged, with much bare rock. There are no trees above 1,500 feet, but this may not be a natural treeline, as the tops are grazed by sturdy sheep, which carry bells. The main track to the summit of Runde Fjell (1,800 feet) passes above a precipice, and the walker is safeguarded by a fence fifteen feet high! This looks absurd until one remembers that in winter there may be ten feet of snow on the road, leaving only five feet of effective fence to protect a speeding ski-er. We often forget that our own six-feet deer fences in the Scottish Highlands become completely ineffective after a heavy snowfall.

As at Oslo, the mountain woods are communally owned and form a gathering ground for the city's water. Again there is no restriction of access to lake shores, only cautionary notices. We were lucky to see a party of crested tits gathering tiny insects, probably pupae, from pinewoods, also a red squirrel who was nearly as tame as our grey ones used to be in the days when they were tolerated as pets in our public parks.

The Fjord Country near Bergen

The country districts around Bergen include countless hillsides of rock and scree running steeply down to fjords. These are impossible grounds for farmer and forester alike—they could never yield a worth-while crop of anything. They are clad in scrub of birch, rowan, aspen, grey alder and common alder, and the best that can be said for it is that it looks pretty and helps to check avalanches. It may help, too, in regulating the flow of water to the many hydro-electric power stations. Power lines and pylons are often in evidence, and no attempt is made to hide them or to take them along inconspicuous routes. It would cost too much, and the vast scale of the mountains make such man-made objects look puny anyway. The scrub also provides summer grazing for herds of long-horned goats. These are milked to provide *geitost*, a curious, pinkish-brown goat cheese, with a rather sweet flavour, which is considered a special delicacy.

The roads through the fjord country wind above or below endless precipices. They are narrow but passing places are frequent. Large, well-maintained buses use them, even during the winter, carrying mail and parcels as well as passengers at reasonable fares. There is also a "transport pool" system of goods motor vans, giving a daily service to outlying settlements. The fjords are crossed by ferries, some of which take buses. The maintenance of communications to the most outlying inhabited places is accepted as a national responsibility; and one can buy a time-table covering every rural route in the country. It all looks very efficient by comparison with the haphazard public transport (or none at all) to many of our own forests and even forest villages.

An Old Stave Church

At Fantoft, a suburb of Bergen, we visited a remarkable old church; built entirely of native pine some 700 years ago. It was originally a parish church in the Sogne Fjord district some fifty miles to the north, but about eighty years ago, when the parishioners needed more room, it was sold to a landowner who found it still sound enough to stand removal and re-erection on his own estate. Built entirely of wood, it rests on a foundation of dry stones. Four mighty trunks, braced with cross-members, form a central key structure which cannot be seen from outside. Around them, smaller uprights carry the roof of pinewood shingles and the walls of pine staves. (See photo, centre pages)

I had often wondered how a fairly perishable timber could endure for so long in a climate which, though cold in winter, has a moist, mild summer well suited to the growth of wood-destroying fungi. The answer lies in the cunning design of steep roofs which shed the rain rapidly. No rainwater can reach the main beams or uprights, and the outer walls are protected by broad eaves which also provide a shelter for the worshippers when they come out of church. The shingles themselves are waterproofed with wood tar. Either it was appreciated at a very early age that damp meant decay, or else the need to keep folk dry had a fortuitously good effect on the timber.

The roof and steeple of the Fantoft stave church are decorated with wooden gargoyles in the shape of fantastic dragons—survivors of the fierce beasts of pagan Scandinavian mythology. This gives it the appearance of an oriental temple or Chinese pagoda. Both buildings have one point in common—the need to shed heavy rainfall from a wooden structure, hence the repetition of roofs at various levels.

The next village to Fantoft is called Stortveit, the great *tveit* or forest clearing. This is basically the same name as Storthwaite in Westmorland, and similar parallels with North Country place names are very frequent. *Rud*, another word for a clearing, is echoed by our "royds" in Yorkshire.

Local Uses of Timber

The traditional wooden buildings of West Norway are of the log-cabin type, and little regard was paid to economy of material. Good roofs with broad eaves doubtless helped to limit loss through decay, but it does seem that where wood is used in pieces of large cross-section, it lasts better than in smaller members.

Nowadays, when timber is as valuable in Norway as elsewhere, and is therefore used in smaller sizes, modern users take no chances. Every piece of wood we saw newly set up in any situation exposed to the weather had been treated with preservative, usually a copper salt showing its characteristic green stain.

Owing to the similarity of climate, West Norway yields spruce and pine timbers similar in character to those we grow in Wales and western Scotland—annual rings are relatively wide, with little summerwood. I was therefore interested to see how such material was used locally. It was instructive to note that it was applied to every appropriate use in box-making, house-building and joinery. Timber with narrower rings and a higher proportion of summerwood could have been brought in from eastern Norway, but apparently it was not thought worthwhile to do that. Local fast-grown stuff met local needs.

Farthest North for Beech?

The woods at Fantoft include a number of introduced trees, such as *Pinus cembra* from the Alps, and also a good deal of beech. The beech must have been planted along with the other exotics, for it is not native north of southern Sweden. On the forest floor my boy spotted a number of self-sown beech seedlings

which proved that the beech can in fact set fertile seed this far north. Corresponding latitudes in the British Isles would be Northumberland (for southern Sweden) and the Shetland Islands (for Bergen). The occasional occurrences of beech pollen in North of England peat mosses have been challenged as mistakes of identity, unlikely to be valid for the prehistoric period in view. However that may be, it is clear that beech can—in our present era—thrive much farther north than it grows naturally.

The Viking Ships

Whilst in Oslo we saw the two great Viking ships that were discovered some sixty years ago in burial mounds on the shores of the Oslo Fjord. Though built almost entirely of oak, their substance was in a soft and weak condition after a thousand years in the soil, and their reconstruction and preservation was a masterpiece of archaeological technology. The main impression that they give is of great size and seaworthiness, although they were open-decked. The Gokstad ship, 75 feet long, had sixty-four oarsmen, and it is by no means the largest recorded. Clearly a well-developed social organisation was needed to put a whole fleet of such war vessels to sea at one time. Fresh light is being shed on this by current research into fabrics recovered from the grave mounds, which carry pictures rather like a primitive Bayeux Tapestry. Such contemporary illustrations, along with ceremonial waggons and sledges that were unearthed beside the ships, suggest a highly developed civilisation, even in Viking times.

Incidentally, the ceremonial groups of marching warriors, women, and horsemen, shown on the fabrics, bear a strong resemblance to the Pictish carvings found on memorial stones in and around our forests in north-eastern Scotland.

Conclusion

Being on holiday we did not investigate any of the forest industries that are everywhere in evidence. But we could not fail to notice the activity in forest road construction. Evidently lorry transport is superseding the leisurely flow of loose logs down the rivers, which we saw at only one point. We also noted a forest supply store that stocked every gadget known to our Work Study section, and a lot more besides. The big paper mills, saw mills, and pulp mills which yield raw material for rayon and other cellulose products, are most impressive.

The manufacturing economy of Norway is rapidly being developed with the aid of plentiful, cheap, hydro-electric power and highly developed technical skills. But the fells and fjords are so vast that even modern industry is dwarfed by the magnificent landscape.

AN ASSESSMENT OF THE CULTIVATION VALUE OF EXOTIC CONIFERS IN VESTLAND AND THEIR PLACE IN THE FUTURE FORESTRY ARRANGEMENTS OF THE AREA

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from an article in 'Norsk Skogbruk", No. 13/14, *July,* 1964, *Vol.* 10, *pp.* 385–390,
translated by J. Smuts.

This paper is based on a thesis for the degree of licentiate and was originally published in New-Norwegian under the title "Ei vurdering av dyrkningsverdi til utanlandske bartrearter på Vestlandet og deira plass i landsdelen sitt skogbruk i framtida". Botanical names are those used in the original text.

The translation was put in hand because of the strong climatic similarity between West Norway and West Scotland—also Ireland and Wales. Except for *Pinus contorta*, which does better with us, Vestland experience resembles our own.

Introduction

By the term "Vestland" I denote here the area comprising the main parts of the following four districts: Rogaland, Hordaland, Sogn with Fjordane, and Møre with Romsdal (all near Bergen).

Within this area there are quite considerable differences in the climate, from the coastal parts towards the inner parts of this area, and as regards the selection of the species and provenances of trees it is now normal practice to arrange these four districts into an outer, central, and inner sub-area (Forestry Development Council, 1959).

The rainfall is 1000—1400 mm. (39½—55½ in.) in the outer sub-area, 1400 to over 2000 mm. (55½—79 in.) in the central sub-area, and 800—1400 mm. (31½—55½ in.) in the inner sub-area; in inner Sogn the rainfall is less than 800 mm. (31½ in.). Generally speaking, the rainfall increases with altitude above sea level.

The temperature can be expressed by the average temperature in July, and the average temperature in January. The July temperature, reduced to sea level is:

I. outer sub-area 13—14° C, central sub-area 14—15° C, and inner sub-area 15—16° C.

The January temperature, reduced to sea level is:

I. outer sub-area about + 2° C, central sub-area + 2—0° C, inner sub-area 0 to —4° C.

The length of the growth period, here defined as the time from the date on which the average temperature in Spring rises to over 7·5° C, to the date when the average temperature drops below the same level in Autumn, is: I. outer sub-area, from about 170 days in the south of Vestland to 150 days along the north part, in the central sub-area from about 170 days in the South to 140 days in the North, and in the inner sub-area from about 160 days in the South to about 140 days in the North.

We have known for a long time that in order to achieve success, when moving plants, we must have the same temperature and rainfall conditions in the new positions as in the original home of the plant. In recent times the "photo-periodicity" or length of the day has been considered in determination of the growth period of plants, and this must be kept in mind when shifting forest trees from one place to another.

If we now look at the areas where conifers grow, and then consider the climate we have here in Vestland, we can see that the temperature and rainfall conditions in the West parts of North America, on the North-East part of Asia (also in the mountains of Japan) and in the mountains of Central Europe correspond to those we have in Vestland. From these areas we have obtained conifers which have been tested and found to be useful as forest trees in Vestland.

Spruces

White spruce

In the later years of the 19th century and early in the present century plenty of white (or blue) spruce (*Picea glauca*) was planted on heathland in the outer sub-area of Vestland. White spruce grows well for the first years and is well-shaped, but after 20 or 30 years the growth in height stops, as the tree becomes ugly, with coarse branches. Also, the tree is heavily attacked by butt rot (*Polyporus annosus*).

The home of the white spruce is North America. It grows here in a belt right across the American continent, but it does not quite reach the West coast, where the climatic conditions are similar to those in the outer sub-area of the Vestland area. In accordance with what we have now learned about the moving of trees from one place to another, it was not to be expected that the white spruce would thrive in the coastal sub-area of Vestland. We now have to stop the planting of white spruce as a forest tree in Vestland.

Sitka spruce

On the west coast of North America the Sitka spruce (*Picea sitchensis*) has spread itself. This spruce grows from the Northern stretches of California and further North right up to Alaska, up to a northern latitude of about 61°. It is quite definitely a coastal tree, and found only over a belt about 80 km (50 miles) wide along the coast.

Hagem compared the climate of Vestland with that of the home of the Sitka spruce and showed that in British Columbia and in Alaska there are places where the climate, expressed as the July temperature, duration of the growth period, and quantity of rainfall correspond well to the appropriate conditions in Vestland (Hagem, 1931). On the West coast of America there is a belt, situated about 6° of latitude further South than Vestland, where we obtain corresponding temperature and rainfall conditions. The provenances which can be used in Vestland accordingly originated in an area of different lengths of the day than that obtaining in Vestland.

Sitka spruce has now been grown for over 40 years in Vestland forests, in accordance with the directives drawn up by Hagem. The experiences gathered in connection with Sitka spruce during these 40 years are satisfactory.

Sitka spruce is rather demanding as regards the soil, it grows most easily in deep, nourishing soil with fresh moisture. But it seems that the Sitka spruce grows better than common spruce on acid and less nourishing soil. On heathland, Sitka spruce grows fitfully, in the same way as common spruce, and it used to be ordinary practice, in earlier times, to plant the Sitka spruce protected by or mixed with pine trees. The fertilizing trials carried out in recent years show that a Sitka spruce plantation can be made to grow immediately after planting, even on heathland, if starting fertilizer is used.

The greatest advantage of the Sitka spruce is that this tree stands up well to the sea breezes. When Sitka and common spruce are planted right out on the coast in the sea spray, common spruce becomes brown and torn by the wind, and its growth soon stops, while the Sitka spruce stands there, fresh and vigorous, with long top shoots.

The Sitka spruce has so far remained practically free from disease in Vestland.

Butt rot attacks Sitka spruce in places just as much as common spruce. The Sitka spruce aphis (*Neomyzaphis abietina*) has been found in Sitka spruce plantations, and has spread quickly after mild winters, but the damage done by the aphis has been small.

The giant bark beetle (*Dendroctonus micans*), which has done much damage to Sitka spruce plantations further south in Europe, has not yet been seen in Vestland, as far as I know.

The Sitka spruce nurseries have suffered more frost damage than nurseries of common spruce. But this is mainly a question of the provenance. It should be easy to find provenances which are sturdy enough for the tree nurseries of Vestland, but this may lead to reduced production in Sitka spruce plantation

Sitka spruce sometimes develop heavy branches, but this also seems to be a question of the provenance employed.

In its home area, where the Sitka spruce becomes a very tall tree, it reaches heights of 80—90 or even 100 m. (265, 295, 330 ft.). We know very little about the maximum height which can be reached by the Sitka spruce in Vestland, the tallest trees are at present 20—25 m. high (65—80 ft.), and the Sitka spruce will certainly become high enough for efficient forestry. The quality of Sitka spruce timber is very much like that of common spruce, and these two types of tree can be employed for the same purpose.

On the basis of trial plots, up to 40 years old, the forestry research station of Vestland has drawn up temporary production tables for Sitka spruce in Vestland (Bauger, 1961). According to this paper, Sitka spruce has on good-quality soil a greater increment (volume growth) than common spruce on good-quality soil. Thus, on Grade I site, Sitka spruce has an annual increment of 1·39 m^3 per dekare (160 hoppus feet/acre), when the tree is 41 years old, while Grade I of the Norway spruce table for Vestland shows an increment of 1·26 m^3 per dekare (140 hoppus feet/acre) (average at the same age). No directly comparable experiments of the production of these two species of trees on the same site have been carried out, but there can be no doubt that in the outer coastal stretch Sitka spruce produces more than common (Norway) spruce or other species of trees tried out there.

Further inland, where it is protected against the sea breeze, the Sitka spruce is also growing well, and in many cases it probably grows better than common spruce.

Sitka spruce in the plantations of Vestland carries seed at an age of 35–40 years, and in 1954 we had the first good seed year for Sitka spruce. The seed was collected for sowing in the tree nurseries, and the seed had a very high germination percentage.

On several places right out at the coast we can see that the Sitka spruce reproduces itself to a considerable extent by new growth from its own seed.

The good results achieved so far with Sitka spruce in Vestland have increased interest in this species, and in recent years Sitka spruce amounted to about 15% of all forest trees planted in Vestland.

Glaucous Colorado spruce

This species (*Picea engelmanni*) came also from the West part of North America. It grows in the hills and mountains, the southern limit being about 31°, and the northern limit in British Columbia about 57° northern latitude. In the North it reaches an altitude of 1500 m. (5,000 ft.) above sea level and in the South it may go up to 3800 m. (12,500 ft.) above sea level.

The glaucous Colorado spruce may reach a height of 50 m. (165 ft.).

In Vestland, this spruce has been planted in groups and small plantations in many different places. The oldest of these plantations are now over 50 years old.

Several of these plantations are found in the mountain areas inland. I can give in this connection the following data: at Hedlo Tourist Hut in Eidfjord, about 950 m. (3,100 ft.) above sea level, there are 15-year-old trees up to 5 m. (16 ft.) high. In a small plantation on Fyrjo, in the Mountains of Voss, about 800 m. (2,600 ft.) altitude, there are about 55-year-old trees up to 10 m. (33 ft.) high. Above Lyster Sanatorium in Sogn, at about 700 m. (2,300 ft.) high there is a small plantation of glaucous Colorado spruce which has grown well and is taller than the surrounding trees.

These figures show that this spruce grows well, even at high altitudes above sea level in the inner sub-area of Vestland.

In the past, afforestation in the mountainous parts of Vestland was not regarded as important, as there was enough to do with forests on better soil. But the time may come for afforestation of the central sub-areas in order to improve the forestry production at high altitudes, where this spruce may turn out to be very useful in the hilly parts of central Vestland.

Several types of spruce have been tried out. I am thinking here mainly of the black spruce, *Picea mariana*, and the Serbian spruce, *Picea omorika*. A number of these species have been planted in Vestland forests in recent years, but it is difficult to say how they are going to develop.

Pine Species

We shall mention here two species of pine trees: *Pinus mugo* and *Pinus contorta*.

Mountain pine

Pinus mugo belongs to the mountains of Central and Southern Europe. The mountain pine can have one or several trunks. In the Vestland forests, the single-trunk variety *Pinus mugo arborea* has been planted, as well as the multi-trunk variety, *Pinus mugo frutescens*. The single-trunk variety, which here has often been called *Pinus montana gallica* or French mountain pine, can become up to 25m. (80 ft.) tall. The multi-trunk variety, which is called the bush pine, may become up to 10 or 12 m. (33–40 ft.) tall. Since about the turn of the century and up to the Second World War, it had been planted over large areas along the coast of Vestland. Most of it was planted on acid, lean heathland, but mountain pine has also been planted on better types of soil.

The mountain pine is grown to produce firewood on the treeless stretches along the coast, and it improves the soil so that later spruce can be planted. The single-trunk variety is also beneficial.

It has been seen that the mountain pine stands up to wind and grows well in the outer coastal stretches of Vestland. In plantations of bush pine on lean soil a mean growth of about 0·5 m.^{3} per dekare (56 hoppus feet per acre) per year has been measured.

Since the war, electric power and oil have largely replaced the wood previously used for cooking and heating in the coastal parts and there is now little demand for firewood. It is also an expensive matter to use the mountain pine as a soil-improving tree. The same aim can be achieved by using fertilizer in spruce plantations, and this is cheaper.

It has been found that the single-trunk mountain pine, which is the most valuable of the different varieties of mountain pine, is easily attacked by a fungus *Crumenula abietina*.

Since the war, there has been less talk about new plantations with mountain pine and we can assume that the planting of mountain pine in the forestry plantations of Vestland will cease.

Pinus contorta

In recent years, rather more of *Pinus contorta* (beach pine), an American pine has been planted. The Norwegian name of this species is *vrifura* (twisted pine).

Beach pine is found in two varieties: The coastal form, whose Latin name is *Pinus contorta* without variety notation, and the inland strain, *Pinus contorta latifolia*. The latter used to be called *Pinus murrayana*, and in Norway it is often called *murrayanafura*.

The coastal variety is a small tree, 9–10 m. (30–33 ft.) high, and it has usually a crooked trunk. It is found along the coast from California to Alaska, and it grows easily on very boggy or lean soil.

The inland form, *Pinus contorta latifolia*, has a fine trunk, reaching a height of 20–25 m. (65–80 ft.), sometimes growing up to 50 m. (165 ft.) tall. It reaches inland from the coast to Alberta and Colorado, up to 1,500 m. (5,000 ft.) above sea level in the North and up to 3500 m. (11,500 ft.) above sea level at the southern-most point.

Most of *Pinus contorta* planted so far in Vestland are of the murrayana variety, i.e., the inland variety. In the inner sub-areas, there are only young plantations on drained bog, but in the outer and central sub-areas there are several plantations 35 to 40 years old. It is found that the tree grows well during the first few years, and looks healthy, but when it becomes older it often suffers from fungus diseases. In Bjerkreim in Rogaland, there are two trial plots with murrayana pine, and the average growth at 32 years of age was 0·37 and 0·41 $m.^3$ per dekare (52 and 57 cu. ft. acre) per year, but the trees already show signs of disease (Robak, 1962).

In the outer and central sub-areas of the Vestland area, one would expect the coastal variety of *Pinus contorta* to keep better than the inland form. At present there are only very young plantations of the coastal variety. They promise well, but we have to take into account the possibility that the coastal variety will show a very poor type of trunk, and will remain smaller than the inland variety, and that its economical exploitation will be unsatisfactory. There probably are other types of trees which will utilise the poor type of soil in the coastal parts better than *Pinus contorta*, such as the coastal provenances of the common (Scots) pine.

Larch Species

There are two species of larch about which we have gathered some experience as forest trees in Vestland. They are the common or European larch (*Larix decidua*) and the Japanese larch (*Larix leptolepis*).

The European larch belongs to the mountainous areas of central Europe and reaches here an altitude of up to 2500 m. (8,200 ft.). The larch is found at several separate areas, and each area has its own typical local races.

The European larch has been planted in the Vestland area ever since 1789, when the larches were planted on Bremsnes on Averøy in Møre. Later some smaller plantations of large trees were established in the outer, central and inner sub-areas, in all districts of Vestland. The results of these larch plantations have been somewhat varying. Larch is easily damaged or attacked by diseases of various kinds. The worst damage it suffers is from larch canker (*Dasyscypha wilkommii*). Larch canker causes most damage in the outer and central sub-areas, but not so much in the inner sub-area and along the North coast of Vestland. It seems that larch canker causes the least amount of damage when the winter temperature is very low. Also, there seems to be a considerable difference between the susceptibility of the various races to the disease. However, we know too little about this to make up our minds about the importance of the European larch in Vestland forestry.

For the time being we cannot say for certain how much production we can reach with European larch in Vestland. There are only few measurements available. A test plot in Granvin in inner Hardanger looked very promising, the average growth at 44 years of age was 0·97 m^3 per dekare (108 hoppus feet/acre) per year. But the rate of growth was falling considerably, and some trees had been attacked by canker (10th Scandinavian Forestry Congress, 1962).

It seems that we shall have to take into account the possibility that *Larix decidua* will occupy in the future only a modest position among the forest trees of Vestland.

The Japanese larch has its home on Hondo Island in Japan. It grows there at an altitude between 500 and 2900 m. (1,650 and 9,500 ft.), where there is heavy rainfall and the air is humid. The soil must be rich in lime. The Japanese larch has been grown in Vestland for over 50 years, but by far the greatest part of the plantations is much younger.

The Japanese larch grows quite considerably when young. The shape of the trunk is somewhat uneven, and there is often a certain number of crooked trees. But if the larches are planted fairly close-spaced, the crooked trees can be taken out when thinning, and when the plantation is middle-aged it consists of trees of good shape. It is not very well known how much production one can expect from older trees, but it is estimated that the few older plantations in existence are quite promising. One plantation in Syfteland near Bergen had a growth of 1·47 m^3 per dekare (164 hoppus feet/acre) average, when 52 years old (Robak, 1962). This corresponds to site grade I for spruce.

Where the rainfall is heavy it seems that on somewhat poorer soil the production of Japanese larch is just as high as that of spruce.

Japanese larch has the great advantage that it is practically immune against canker and so far the Japanese larch trees in Vestland have suffered little from canker.

The timber of Japanese larch is stated to be not quite so good quality as the timber of European larch, but Japanese larch has hard heartwood. In the central parts of the Vestland area, a type of tree other than spruce is required which yields good timber with a high rate of production on poorer soil. It appears that Japanese larch will fulfil this requirement very well. Of the approximately two million larch trees planted every year in Vestland during the past 2 years about 80% were *Larix leptolepis*.

In recent years, hybrid larch (*Larix eurolepis*) has been planted in a few forest plantations in Vestland, and this hybrid may well turn out to be even more valuable as Japanese larch.

Silver Fir Species

Common (European) silver fir

In accordance with the directives issued by the Director of Forestry on the selection of species and provenances of trees, the common European silver fir (*Abies alba*) has a good position among the forest trees in Vestland. It is stated in the directives that *Abies alba* should be used because it is most immune against butt rot and because it has a very deep root system and is more resistant to gales than common spruce (Development Council for Forestry, 1959).

Abies alba has its home in central and southern Europe. It grows there in the mountains from the Pyrenees in the West to the Carpathian Mountains in the East, and reaches an altitude of 800–2000 m. (2,600–6,600 ft.). Within this area, however, there are considerable differences in the climate. In the Black Forest and in the Alps, temperature and rainfall levels can be found which are very much like those obtained in the central and inland sub-areas of Vestland.

Abies alba is the tree I dealt with in my thesis for the degree of licentiate (Nedkvitne 1963).

Abies alba has been grown in Vestland at least since about 1800, and there are forest plantations of *Abies alba* which are over 80 years old.

Abies alba grows slowly for the first few years but later its growth increases and it seems that *Abies alba* in Vestland grows longer than the common spruce. In some places, where the soil is deep and rich, we can in fact assume that the silver fir, at an age of 50–60 years, has the same large average growth as the common spruce. In lower-grade soil, the silver fir does not grow so well.

I found that *Abies alba* is very resistant to rot diseases, both butt rot and honey fungus.

On the other hand, my records of Vestland show that *Abies alba* does not offer much resistance against strong winds. I feel that one must keep in mind that *Abies alba* is as easily unprooted as common spruce.

It is also found that *Abies alba* very often has a sapwood core but on the other hand the sapwood is nearly as good as "fresh" heartwood.

The worst trouble with *Abies alba* is the damage caused by aphides. The silver fir aphis (*Dreyfusia nüsslini*) has spread widely in the past ten years, and many plantations in the outer and central sub-areas of Vestland have been entirely destroyed by it. Till now there has been no aphis damage to silver fir plantations in the inner sub-area, but I feel that once we start planting *Abies alba* to a larger extent in the inner sub-area, the silver fir aphis will spread to these parts.

Abies alba does not stand up to frost very well and there has been some frost damage to the plantations in Vestland.

There has also been frost damage in nurseries, and on the whole there has been difficulty in the cultivation of this tree. The yield of trees per lb. of seed of *Abies alba* has been very low.

On the whole I feel that we expected too much of *Abies alba* as a forest tree in Vestland. In most of the cases I think that the trouble we have had with this species outweighs the advantages. But used in smaller plantations in the inner sub-area, in places where the spruce is particularly subject to rot, *Abies alba* may perhaps be preferable.

Abies alba plantations easily reproduce themselves over the entire Vestland. This may be an advantage as well as a disadvantage in this particular type of tree.

Other Abies species

Two American Abies species have been tried out as forest trees in Vestland, the giant fir, *Abies grandis*, and the noble fir, *Abies nobilis* (or *procera*).

Abies grandis grows on the west coast between 38° northern latitude and the north coast of Vancouver Island at about 51° northern latitude. It is found both out on the coast and inland, reaching altitudes of up to 1200 m. (3,940 ft.).

In the central and inland sub-areas of Vestland, the giant fir has been tested in several smaller plantations. The plantations are still young, but the giant fir has grown here to a considerable extent. In a best plot at an age of 29 years, the average growth was 1·47 m.^{3} per dekare (164 hoppus feet per acre) per year. This is more than that found for any other species of tree, with the exception of a single plantation of Japanese larch (Robak, 1962).

Further south in Western Europe, the giant fir has also shown record yields. We know that in other countries the silver fir aphis causes little damage to the giant fir, and in the giant fir plantations of Vestland no aphis damage has yet been found.

However, we must assume that *Abies grandis* is not so resistant to butt rot as *Abies alba*, and it has been seen that *Abies grandis* is also not so windfirm in Vestland.

The timber of the giant fir is of a rather poor quality, it is light, soft, and not very strong. But in view of the high yields, and the fact that the giant fir has remained free of disease, it may maintain its position in Vestland forestry. I feel that the giant fir may become just as valuable from the forestry point of view in Vestland as *Abies alba*. In any case, *Abies grandis* should be tested out more in experimental plantations.

The noble fir originated in a comparatively small area of California, and further north, up to the boundary with British Columbia at a northern latitude of 48°. It grows also inland, at altitudes from 600 to 1500 metres (2,000–4,900 ft.).

Abies nobilis (or *procera*), however, has been tested very little in Vestland forests, although there are some smaller plantations in all sub-areas, these plantations are up to about 50 years old. The growth of these plantations is in most cases quite good. In particular in some plantations at higher altitudes in the inland sub-area, it appears that the noble fir grows quite well.

The noble fir is not so resistant to butt rot as *Abies alba*, but otherwise it is one of the stronger species. It also suffers very little damage by aphides, and the timber of the noble fir is said to be better than that of other species of Abies.

Also, the noble fir is a tree of pleasant appearance, and the twigs are very suitable for making wreaths and for decorative purposes.

On the whole I feel that it will be seen that the noble fir has many advantages, and it should be planted to a greater extent in Vestland.

Hemlock and Red cedar

From the west coast of North America we obtained *Tsuga heterophylla*, the Western hemlock.

Tsuga heterophylla has approximately the same north-south extent as Sitka spruce, but hemlock spreads inland a little further than the latter.

Tsuga heterophylla has been cultivated as a forest tree in Vestland for about 40 years, and there are many plantations which are about 30 years old. Apart from the most exposed parts of the outer sub-area, the growth of hemlock plantations has been quite good. The growth has been approximately as large as that of Sitka spruce plantations, and hemlock has as regards the soil about the same requirements as Sitka spruce. It appears that hemlock is more or less just as easily attacked by butt rot as Sitka or common spruce. Diseases other than butt rot have not yet been found on hemlock in Vestland.

The shape of the trunk is often not so good, it is sometimes rather bent and has often deep grooves. It appears that Western hemlock in Vestland does not stand up to strong winds.

The timber, which is white and hard, is suitable for planking work and for the production of cellulose.

The Western hemlock tolerates shade well and can be grown in protected positions, even more so than other species. But it does seem that this species has no great advantages compared with Sitka spruce or common spruce. This means that even if *Tsuga heterophylla* grows well in the outer and central sub-areas of Vestland, it has no special functions to fulfil in Vestland forestry.

Thuja plicata, the giant cedar, giant arbor vitae, or Western red cedar, has approximately the same spread as *Tsuga heterophylla*, but it does not go so far north. The northern limit of Western red cedar is at Sitka in Alaska, at a northern latitude of about 52°.

Thuja plicata has been tested in a few forestry plantations in the central and inland sub-areas of Vestland. The oldest plantations are about 40 years old.

On nourishing soil with plenty of fresh water, Western red cedar grows well. In Moberglia in Os, the plantations at present 30 years old have an average growth of 0·87 m^3 per dekare (96 hoppus feet/acre) per year (10th Scandinavian Forestry Congress, 1962). This corresponds to site grade I soil according to the spruce tables for Vestland.

Thuja plicata shows very good trunks in the Vestland plantations.

In a few places butt rot has been found on the *Thuja plicata*, but we can certainly assume that this cedar offers to butt rot greater resistance than common or Sitka spruce.

Cedar leaf blight (*Didymascella thujina*) has also been found in plantations i Vestland, but has not yet caused much damage.

Thuja plicata has reddish-brown heartwood which is very durable.

The wood is therefore valuable and since on good soil a high yield can be expected, we ought to use *Thuja plicata* as a timber tree in some places in Vestland. It is preferable to cultivate this cedar in the central sub-area.

Douglas fir

Pseudotsuga douglasii, Douglas fir, has a spread over a wide part of western North America. Along the coast it grows between 38° and 54° northern latitude and inland it grows even further north and south. At the coast it grows up to an altitude of 1500 m. (4,900 ft.).

Pseudotsuga douglasii is usually divided into three varieties, viz., the green Douglas (*viridis*), which is the coastal species, the blue Douglas (*glauca*), growing in the south-eastern parts of the area, and the Fraser River or grey Douglas (*caesia*), which is a variety intermediate between the other two. The three varieties are not distinct but pass into each other.

Green Douglas in the largest and most valuable of these, and it is the variety which is the most important one from the point of view of forestry in Vestland.

In America, green Douglas reaches 50–70 m. (165–230 ft.), under exceptional circumstances it may become 100 m. (330 ft.) tall. The timber is strong and hard, and very valuable. Douglas has been grown in Vestland for over 90 years, and there are several single trees 30–35 m. (100–115 ft.) high.

As far as I know, Douglas trees in the forestry plantations of Vestland are not older than about 40 years.

In the forestry plantations, Douglas fir grows well during the first few years, but often it is damaged by diseases before it grows old.

In Moberglia, two Washington varieties reached in the Autumn of 1958 an average growth of 0·59 and 0·73 m^3 per dekare (68 and 81 hoppus feet per acre) per year (10th Scandinavian Forestry Congress, 1962). This is a fine yield, but in both plots there has now been damage by needle cast (*Rhabdocline pseudotsugae*) and by smut mould (*Phaeocryptopus gäummanni*). These pests have caused much damage in Douglas plantations in several places of Vestland.

One would expect to be able to find a variety which is suitable for cultivation in the central and inland sub-areas of Vestland. But so far we have not yet been able to do so, and for the time being *Pseudotsuga douglasii* should be used only in the test plots.

According to this, few of the foreign conifers which have been tested in Vestland have so far shown enough promise to enable them to be used for timber production on a larger scale.

The general impression is, so far, that the selection of trees for forestry purposes in Vestland is confined to the following:

In the inland sub-area of the Vestland area, common spruce on the better soil, and common pine on poorer soil. The inland sub-areas have a valuable pine strain to which not enough attention has been paid in recent years.

In the central sub-area, spruce is the dominant species, but with some Japanese larch on the poorer soils and perhaps also a few plots with *Thuja plicata* and *Tsuga heterophylla.*

In the outer sub-area, Sitka spruce will dominate the picture as the most important forestry tree, but in sheltered places there is still room for common spruce. If the soil is so poor that Sitka spruce will not give satisfactory yields even after a starting fertilizer, the soil in question should not be used at all for forestry.

The other conifer species which have been grown in Vestland should be cultivated only for special purposes or under very special conditions.

It is an advantage in forestry work with the smallest number of species, not only from the point of view of cultivation, but also from the point of view of improvement.

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Photos of Japanese larch and Grand fir in West Norway appear in our centre pages.

TWO WEEKS IN ALSACE

A VISIT TO THE FORESTS OF THE VOSGES

By

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Preliminary

Early in the New Year of 1963 I made application for a Forestry Scholarship through the I.L.O. and having successfully negotiated the preliminaries entered upon the secondary stage when a preference as to country and type of course can be discussed. Being reasonably sure of myself as regards language and having an in-born love of France and all, or most things French, there was no doubt in my mind as to where I would wish to visit.

As a result of much help and encouragement from the right quarter the second stage blossomed into fruition in the shape of a charming letter of invitation from the Director General of French Forestry to visit Saverne in the Bas Rhin district during November 1963. There followed a detailed programme of excursions and visits of every possible facet of local forestry. With alacrity I declared this could not be bettered and accepted with all haste and gratitude.

Now in case it is thought that the foregoing is all too normal and just another story of Visits Abroad, allow me to introduce a note of disillusionment—the third stage—the Scholarship itself—never arrived. My candidature was not accepted.

It all might have ended here and this account never been written, but I still had the letter from the Paris office with details of my expected visit, the plans that had been made, the opportunity still there—perhaps never again available. This was too much. In haste I wrote again to ask if I could come under my own steam as it were. Typically the answer was yes and that I would be put in touch

with the Conservator at Strasbourg. Within a few days the now familiar *Eaux et Forêts* envelope arrived with details of an intensive two weeks' tour of the Vosges with practical experience in the conifer and hardwood areas there, together with a letter of introduction to local officials.

By anticipating several days of next year's leave, sufficient time was accumulated for the visit and a unanimous family decision indicated that my wife and youngest daughter aged four should accompany me. We know now this was a remarkably sound idea—for the experiences gained and friendships made far out-weighed the financial implications.

Living as we do, close to Southampton, there was no doubt in our minds that to begin this trip in a fitting manner we should cross the Channel by Big Ship. It may not be generally known but facilities exist for passengers to Havre or Cherbourg to travel on scheduled Trans-Atlantic liners at little more than normal Cross-Channel fare, with all food and full Cabin Class amenities. It so happened that the *United States* was sailing to Havre on Friday, 14th November, and fitted in exactly with our requirements.

The utter luxury of this remarkable ship—surely the status-symbol to end all others—has to be experienced to be believed. For sheer value for money there can be no better way of crossing the Channel. A sumptuous cabin, three superb meals—all for the price of the ticket. Sad that it lasted but eight hours and we found ourselves on the quay at Havre, in the dark and the last train to Paris gone.

We stayed that night in Havre and caught an early train to Paris via Rouen. The line follows the Seine valley for the most part, the river in view most of the way, with heavy barge traffic indicating the immense use made of the waterways. These large self-propelled vessels moving rapidly along the wide river with an assorted family wash flapping in the breeze are so typical of Continental rivers.

Arriving at the Gare St. Lazare we were whisked across to the Gare de l'Est by taxi, driven by a gay young Parisienne. Apparently there are several hundred lady taxi drivers in Paris. The afternoon was pleasantly passed in the train heading East, once again along river valleys—the Marne and the Moselle. It was dark by the time we reached Nancy and a further hour's travel saw us at Saverne.

Waiting to greet us was M. Toussaint, *Ingénieur des Eaux et Forêts*, in whose district at Saverne we were to stay. He had already organised us a room at the *Boeuf Noir* in Saverne and in little time we were all doing justice to the first of many sumptuous meals we were to enjoy.

The Forest

Next day was a Sunday and the morning was spent exploring Saverne, a busy, provincial town of interesting architectural variety. The deep roofs and serried ranks of dormer windows indicate the German influence on house building. Many of the houses date from the seventeenth century and are built in the local colourful red sandstone. Bathed in the bright winter sun the buildings presented a delightful picture reflected in the waters of the Marne-Rhin Canal which flows through the town. On all sides the hills of the forest rise from Saverne, a mosaic of subtle shades with the winter-stripped hardwoods contrasting the dark green conifers. This was what we had come to see and promptly after lunch M. Toussaint with his charming wife and family called for us on our first forest tour.

It was soon obvious that the forest is to a very great extent naturally regenerated and efficiently managed at all ages. *Abies alba* is dominant amongst the conifers whilst Scots pine at lower levels provides beautifully shaped stems and freely regenerating stands. There is, however, much damage by deer—roe

and fallow abound here—and several methods of repellant were observed. An intricate web of fine polythene strand had been spread as if by some giant spider amongst young natural Silver fir in one area. In yet another twists of polythene web had been applied to the leading shoot as well as shining aluminium foil dangling amongst the dark green foliage. It was understood that as yet it was too early to determine the results of such experiments. (See photo, centre pages).

I gathered that the whole deer question is just a little delicate. *La Chasse* is very near to every Frenchman's heart and a vital part of country life—especially here. The hunting is syndicated and hired out. Big money is involved . . . . . —at this point I deemed it diplomatic to apply the ubiquitous shrug and wave of the hands and changed the subject.

A remarkable feature of the forest is the spendidly engineered road system. Magnificent tarred roads wind up gentle slopes to more than 3,000 ft. and extraction of produce is virtually no problem. It would be no exaggeration to say that a bicycle could be ridden up most of the inclines—if you could find such a vehicle that is. Today the push-bike is largely a thing of the past in France; everyone without a car has a Velo—or motorised cycle. Quite ancient old ladies can be seen tottering out from their cottages, shakily mounting the snarling Velo and belting off down the road to the nearest village.

That evening we enjoyed the hospitality of the Toussaints at Saverne—a pleasant family party and informal discussion on our respective forests and methods.

At this point is should be explained perhaps, that M. Toussaint's position in the forestry organisation is comparable to that of a Senior District Officer. His district is known as an *Inspection*, of which there are seven in the Vosges Conservancy with the Conservator's headquarters at Strasbourg. There are, incidentally, 42 Conservators in France presided over by the Director General in Paris.

Subordinate to the *Ingénieur* at Saverne are six *Chefs du District*—equivalent to Head Foresters—each having some four or five Foresters or *Chefs du Triage* under his charge. I was somewhat confused to find also that several Foresters were referred to as Agents Techniques but gathered this was an upgrading after lengthy service.

It was becoming obvious that our *Hotel Boeuf Noir*, whilst being extremely comfortable and providing magnificent food, was going to prove too expensive for a fortnight's stay. This was discussed with M. Toussaint and it was agreed that we should move some 14 km. down the Route Nationale to Wasselonne—still within his Inspection and in which town resided one of his *Chefs du District*, M. Francois Brun.

Wasselonne proved to be a delightful little town of some 3,000 inhabitants—very old architecturally with a strong German influence. There is a fine cobbled market square, flanked at each end by a church—one Roman Catholic, the other Protestant. This division of religious faith is most marked in this part of France and is indicative of its chequered history—three times under German domination within the last 100 years.

We were welcomed to the *Hotel l'Etoile*, which is quite the focal point of the town being in the middle of the square—facing the *Mairie* and possessing the only cinema for miles!

The *Chef du District*, M. Brun, was soon introduced and in company with M. Toussaint we set out on a Forest Tour. At once the excellent stocking and careful management of the Forest was apparent. Large areas of first-class oak natural regeneration were seen, from which the mother trees had been removed some years previously. The crop was thick, very even and of good form. At a

higher level *Abies alba*, locally known as *sapin*, also regenerates very freely and seemed to be the most sought-after product. This is the superior species for timber quality and, as I learned later, realises excellent prices. Specimens of up to 140 ft. were frequently seen completely bough-free up to 80 or 90 ft. There are large stands of such stems and some frantic mental arithmetic indicated a prodigious volume per acre.

Enquiries into utilisation methods and sales produced the surprising fact that all sales are carried out through merchants or wholesalers who resell to the various markets. This even applies to the Mines and Telephone Authorities. The Forester at *no* time handles any money whatsoever and all sales are carried out by the Community through the Mayor of the district. This process is discussed in detail later when an Auction of Timber is described.

Firewood is much sought after in this predominantly rural area and is beautifully processed. Each piece of wood is cut to exactly one metre long. All pieces over about three inches are split and great attention is paid to stacking with mathematical precision. Each cubic metre—the unit of measurement—is known as a *stère*. As a rough guide I decided that four cubic metres would about equal one cord.

Thinning generally I considered to be on the cautious side, but bearing in mind the exposure on this side of the Rhine Valley, was probably justified. The thinning cycle is eight years and is carried out strictly as prescribed in the Working Plan I was later able to inspect.

Extraction of produce other than timber is by sledge, a lightweight construction of ash with metal strapping. On level ground this is pulled by a light tractor, or in hilly territory guided downhill by a worker in front. This appeared to be a highly dangerous operation. I was assured this was not so and accidents were very rare. Nevertheless the thought of at least ½ ton of cordwood careering down a slope of about 1 in 3 immediately behind the worker was a little shattering. I was very anxious to film this operation but due to fog one morning we arrived after the final load of cordwood had been 'sledged' down the steep slope. Nothing daunted, however, on seeing my ciné camera, the team gallantly carried about half a cord back up the hill, loaded it on to the sledge and performed the whole process for my benefit!

Surprising, too, was the fact that there is absolutely no brashing. It may well be that the drier, colder climate has the effect of causing the branches to die off at an earlier age. Access was reasonable even in younger regenerated crops. This continued to surprise me throughout my visit. Self pruning of oak is effected by the known process of planting beech in groups around selected stems.

All conifer except the very smallest poles are peeled immediately on felling, the piece-work price being inclusive of this process. Peeling spades of familiar design though of French manufacture were used and the work was cleanly and efficiently carried out.

The following day I was collected by M. Toussaint early and together with M. Brun drove up into the forest where I was introduced to three more Foresters. We had met to carry out a marking of 130-year-old oak. Marking is normally done in a team. We spread out through the wood to take about a 100-yard swathe at a time—so it can be imagined progress was rapid. The actual blazing of the tree is made by the blade of the forester's hatchet—a small instrument—very sharp, with a hammer head on the other side. This is used to emboss a special number within the blaze. For security a further blaze is made on a suitable buttress at the butt, and similarly stamped. There is thus no fear of any 'illegal' marking. At the time of marking, the diameter of the tree is determined by a caliper and called out to the *Chef du District* who books it down

into categories of a predetermined tariff. I was amazed to find out that this particular marking was for felling in 1965. How splendid to be so far in advance! It was evident my choice of stems for felling was of great interest but presumably satisfactory for after half an hour I was an accepted member of the team and we proceeded merrily with good humoured backchat on all sides. Two more interesting sidelights emerged—the thinning was closely supervised by M. Toussaint who sometimes would decide that a particular tree should be marked, and secondly I was interested to see that a *maître bucheron*, or chief forest worker, was at times invited to assist with the marking. (Photo, centre pages).

The normal tariff system is followed whereby a count of all stems in each diameter class multiplied by the tariff volume, totalled up, rapidly gives the total volume to be removed in the thinning.

In order to arrive at the agreed piecework rate a points system is employed. Points are given for the various factors affecting the felling, i.e., slope, form of trees, length of carry, density, vegetation and rock outcrops, etc. The sum of these points is the salary category applied to the job. Lists indicate the various rates for different types of produce. It is gathered that there are discussions over rates at times but generally the system is accepted by the Unions.

French foresters were appalled to learn that we actually pay our men, and horror of horrors, did it weekly too! The actual calculation of cash earned, less deductions, National Insurance, etc., is made by the Forester and passed to the *Maire* for payment. Cash is collected by the *Maîtres des Bucherons* (Gangers) who pay men in their gang. This is done monthly but 'subs.' can be arranged fortnightly.

In the afternoon after a colossal meal at one of the Foresters' houses, to which we all contributed in cash, we marked some enormous *Abies alba* and Norway spruce. The conifers were much over 100 ft. high on a very steep slope. No doubt it was the effect of the splendid lunch and wine—somehow progress was not quite so swift during the afternoon. Nevertheless a total-up of the day's work indicated we had marked over 60,000 cu. ft.—often scrambling up and down slopes of 1 in 4!

Torrential rain and gale-force winds cancelled the next day's programme of measuring in the forest. Instead I was invited to visit a local Veneer Factory at Romansviller in company with M. Brun. This modern, very streamlined factory, produces beautiful veneers for a world market from mostly West African woods. The manager kindly presented me with a representative collection of named veneer samples as a souvenir of my visit.

After lunch my family and I were collected by M. Toussaint and his wife to visit Strasbourg—some 15 miles away. It so happened that this was the day when the wife of the Conservator, Madame Meyer, gave her annual party for the wives of her husband's senior staff. We were privileged to be invited and were most graciously and hospitably received at their beautiful apartment.

Forestry School

At Saverne there exists one of the very few 'finishing schools' for forest workers in France. It was emphasised that this is an *école de perfectionment* for experienced men. It was to this school that I was invited for the next few days. The school itself is administratively attached to the Technical College which draws its students from a wide radius. The lectures I found especially interesting and informative, the subject this day being power saws. The lecturer was a local Forester—obviously carefully hand-picked for the job. For my ears especially, he spoke clear, slow French. The point might here be interposed that the normal language of this region is not French but Alsacien, an oral-only patois of German origin. It is a distinct effort for local people to bring themselves

back to French, consequently all are completely bi-lingual. Newspapers are printed in two editions, French and German.

Most of the power saws in use were German manufacture, a few Canadian—no British. Great emphasis is laid on safety at all times and I was impressed by the feather-weight plastic safety helmets worn by the cutters when using power saws. These hats were bright yellow in colour—easily seen in undergrowth and well designed—with a gutter round the back to prevent rain down the neck. Obviously sensible and practical especially in a forest where a bough falling from say 90 ft. would have the velocity and killing power of a bullet.

Out in the forest with the students I had an opportunity of using their splendid equipment including the most practical wet weather clothing ever seen. Apart from the normal waterproof trousers the upper part consisted of a loose broad-shouldered smock, armless and fastened with tapes at the sides. This enables free movement in comfort and I can testify as to its coolness and non-encumbrance, whilst protecting the front and back from the heaviest downpour.

Talking with the students I found them well pleased with their two weeks' courses; all felt it worthwhile foregoing their usual piecework pay to travel to Saverne, and considered they were learning many new useful techniques. It was fascinating to listen to the many dialects echoing through the woods: a cross section of rural France gathered together with the common purpose of improvement of forestry standards and methods.

Timber Auction

Reference has been made earlier to the fact that no cash sales are conducted by the Forester or indeed by anyone senior to him in the Service. At all times sales are supervised by the Head of the local Community, *M. le Maire*, who is responsible for all public affairs. Driving licences, family allowances, pensions, even marriage guidance, are all dispensed from the *Mairie*, the virtual nerve centre and heart of each village, town or city. Communities that have forests within their jurisdiction apply the name *Forêt Communale* to their woodlands. Sales of produce from such areas, are direct income to the community. The title *Forêt Dominiale* indicates a State Forest, revenue from this source returning to the National Exchequer via the *Mairie*.

It was to the nearby community of Westoffen the following Saturday morning I was taken in company with the *Chef du District*, M. Brun, and several of his foresters—by now old friends of mine. This was the day of an Auction Sale of Timber—produce from the Westoffen *Forêt Communale*. Produce had been previously carefully checked by us in the woods for accuracy of description.

The sale was held in a sunlit hall above a restaurant; a good crowd was already seated, a busy hum of Alsacien, and the air already thick with the powerful local tobacco—so truly the very perfume of France. The forest staff were in best uniforms today—a gendarme-type kepi, green tunic of military style with medals, and blue trousers with wide red stripe. Foresters in Government Service, incidentally, are regarded as part of the Armed Services and as such have power of arrest, can be called for police action or crowd control for such special occasions as a Presidential visit. A profitable sideline on their status is indicated by the virtually free issue weekly of 80 cigarettes or tobacco of comparable weight!

The morning of the Auction Sale followed the receipt of the shocking news of President Kennedy's assassination and I was struck by the great number of black ties and armbands amongst the throng. I was ushered to the raised top table and seated next to M. Schnetzel, the *Maire*, who incidentally is locally much loved and has held office for 27 years. The rest of the *Maire's* staff and the foresters took their places and the auction began.

It was entirely conducted in German, bids normally rising by 5 New Francs at a time. The auctioneer was very slick and the sale proceeded swiftly. A running commentary was whispered into my ear by M. Marshall, one of the foresters, with frequent potted histories of the clients and discourses upon their financial and sometimes marital conditions. From my raised viewpoint I was able to watch the variety of faces before me—mostly local and rural with weather-beaten skins of the outdoor worker. These men were bidding for firewood mainly, either for themselves or neighbours, sometimes a small parcel of timber for local conversion and home use. Here and there, however, was a face not of this type—these were the shrewd timber buyers, eyeing each other and fighting for the obvious good lot. As each lot was knocked down the buyer came to the table, gave his name, signed, and received a chit giving him authority to remove the timber from the forest. Extraction could take place any time after the day of the sale and payment in this instance had to be made by 30th January —fairly generous treatment, I considered.

It is probably fallacious to draw comparisons between prices, so much depends on the factors involved, but it will be seen that prices are very high indeed. Generally, each cubic metre (1 stere) of cordwood fetched 30 N.F. (45/- approx.), give or take a franc or two according to accessibility. This would indicate something in the region of £8 per cord! Beech, especially cleft wood, fetched 15–20% more than oak, whilst small unsplit oak was much cheaper. Timber prices, especially the peeled conifer logs, were excellent, and undreamed of if directly translated into sterling.

So the morning proceeded at a brisk pace, all the lots were sold, the crowd slowly thinning as the catalogue came to an end. I gathered we were not expected to depart at once, indeed some hint had been given of a small repast to come. Descending into the private room of the restaurant it was obvious that some ceremony was expected. A magnificent banqueting table was laid out with the Community plate and silver. It was apparent that this 'small repast' was to be one for which the benefit of some previous training would have been appropriate.

This delightful practice of inviting the foresters of the district together with the *Maire's* staff for a luncheon after a sale was apparently the custom at Westoffen. I began to appreciate the affection the community had for M. Schnetzel—small wonder he had been *Maire* for such a time! I was indeed grateful for the privilege of being considered as a guest at this function and for an insight into the workings of the Timber Auction system.

The last few days of our visit passed all too quickly. Once more a good day's team-marking of oak and young conifers—mainly *Abies alba*. The lack of brashing continued to surprise me but access was quite adequate. Several nurseries were visited, small in size, of the heathland type, which are used for a few years until such time as weeding costs become too high to be economic.

One afternoon the only sombre note of our whole trip was experienced. Returning from a forest tour with M. Brun we came upon the most remarkable memorial of the last war. Descending into a lovely valley from the forest, the road passes, in all its horrific authenticity, a complete concentration camp—Struthof—preserved exactly as it was during the dark and wretched days of the occupation. Here are the crematoria, the gas chambers and all the fiendish Nazi paraphernalia for mass extermination, surrounded by high barbed wire and machine gun towers. A single white stone tower has been erected amongst the hillside of white crosses above the camp, with a blood red concrete road to the flagstaff where flies always the Tricolour at halfmast.

This was a most moving and indeed bitter memorial to the hundreds who perished horribly here, subjected to the utter depths of degradation to which man can sink in his treatment of others.

It was with some effort that we returned to the delight of the now peaceful countryside in which we were able to pass the last few days of our visit.

There was much fond farewell at Saverne Station as we took leave of our French friends. We had much for which to be grateful—weather had been cold but mainly dry with some sun, accommodation and food really splendid, and we were grateful to everyone who had made the trip so fruitful and worthwhile. We are especially indebted to M. Meyer, Conservator at Strasbourg for organising the vist, M. Toussaint, *Ingénieur* at Saverne, for making local arrangements and transport, also M. Klein at the Forestry School, and to M. Brun, *Chef du District*, and all his foresters for welcoming and entertaining us so royally. It would be a great pleasure to be able to reciprocate some of this hospitality one day.

Such happy memories seem almost dreamlike now, but in more tangible form I am pleased to say I have a half-hour 8 mm. film to prove it!

A REPORT ON A VISIT TO THE QUEEN CHARLOTTE ISLANDS — MARCH, 1931

By

A. D. HOPKINSON

Retired Conservator

1. Introduction

The following report is based on:

(a) Observations made on the Islands during a short visit in August, 1930,

(b) Information supplied by the Forest Service of British Columbia.

I landed at Queen Charlotte City on the morning of the 19th August having sailed the previous evening from Prince Rupert and was accompanied by Mr. A. E. Collins of the Survey Branch of the Forest Service of British Columbia and Mr. Ian A. Clarke. The headquarters of the party remained here until the 23rd when it moved to Tlell accompanied by Mr. Benson—the Forest Ranger in Charge of the Queen Charlotte Islands. A further move was made to Port Clements on the 25th and the party sailed from here on the evening of the 27th for Prince Rupert.

The time spent on the islands was shorter than had been arranged but owing to the somewhat meagre and irregular steamship connections with the mainland, this could not be avoided.

It was a matter of good fortune that Mr. Collins was able to accompany me as his previous experience on the islands and his great knowledge of forest conditions in British Columbia generally were most useful.

Arrangements for lodging and for the various expeditions made were carried out ably by Mr. Benson who put at our disposal his motor launch which proved most useful.

The two main subjects for study appeared to me to be:

(a) The conditions under which Sitka spruce grows to its full development, i.e. its 'optimum' and

(b) The conditions under which the species develops less freely and finally disappears as a constituent forest species.

With these objects in view I consulted with Mr. Benson and arranged the programme of the tour.

Firstly a study was made of the conditions existing around Queen Charlotte City where magnificent Sitka may be seen. Secondly the party moved to Tlell on border of the 'muskeg' country of the North-east of Graham Island where

owing to swamps all tree growth including Sitka spruce becomes poor and in places is entirely absent. Thirdly an expedition was made to Kundis Island where changes in soil conditions and their effects on the occurrence of Sitka spruce and its growth were observed.

It is necessary to note here that means of communication other than by boat are still very limited on the Islands. There is one road capable of light motor transport from Queen Charlotte City to Port Clements and another track between Masset and Tow Hill and these constitute the only means of vehicular traffic.

Furthermore there is an almost complete absence of tracks, trails or paths through the forest. This state of affairs made investigations difficult to carry out owing to the time required to travel through the untouched primeval forest where conditions are such that walking from one point to another is a slow and arduous process—so much so that three or four miles per day with packs is considered good going for experienced lumbermen.

These conditions unfortunately precluded an excursion into the interior which I was anxious to make in order to observe the growth at various altitudes and the effects of exposure.

The weather conditions during the visit were ideal; it being warm and sunny with practically no rain.

2. Geography

The Queen Charlotte Islands lie almost entirely between latitudes 52° and 54° North. That is to say they are approximately in the same latitude as the country lying between London and North Yorkshire.

They form part of a submerged mountain range and consist of about 150 islands varying greatly in size but the main bulk of their area is made up of two islands, namely Graham Island in the North and Moresby Island in the South which are only separated by a narrow channel.

The islands which lie from 50 to 70 miles off the coast of Northern British Columbia extend about 185 miles from North to South and the greatest width is about 60 miles in the Northern part of Graham Island.

The total area of the islands is 3,950 square miles or 2,528,000 acres of which 1,890,400 acres go to form Graham Island.

3. History and Development

The Queen Charlotte Islands were first discovered by Europeans in 1774 when Juan Perez visited the group.

The first comprehensive survey was made by Dr. Dawson in 1878.

The Haida Indians who inhabit the islands are distinctly of Mongolian origin being a short thick set race now numbering a mere tithe of the population which existed prior to the arrival of Europeans. Small-pox and other diseases of civilisation have reduced them in numbers from 10,000 to between 700 and 800. Formerly they were a war-like nation and even within the last hundred years they made expeditions in large dug-out canoes down the coast of British Columbia ravaging and plundering the coast Indians by whom they were greatly feared.

It is probable that they mainly subsisted on fish, of which both the sea and rivers are plentifully stocked, as there is practically no evidence of cultivation and very little if any of the forest was cleared prior to the advent of settlers.

The present day Haida Indians are a happy and contented looking people engaged almost entirely in the fishing industry catching chiefly halibut, which is conveyed to the United States in cold storage, and salmon which are canned on the islands.

They are now well housed and such matters as education and sanitation are carefully looked after by the Dominion Government with the result that their numbers are now increasing.

Whereas formerly the islands were studded with Indian villages the present native population is confined almost entirely to two areas in the vicinity of Masset and Skidegate.

There were few settlers prior to 1910 but by 1916 there were nearly 2,000. Now there are not half that number. The reason for this is that of the Europeans entering the islands the majority are not colonists but persons employed in the lumber industry together with a few prospectors and trappers and persons engaged in the salmon canneries.

It would appear improbable that any rapid development of colonisation is likely to take place in the near future unless some economical method of removing or consuming root stumps is brought into action for as matters stand at present it costs more to clear and prepare land (about £35 per acre) than it is worth when cleared. Land settlement has also been retarded considerably by bogus schemes which have been organised in the past by unscrupulous persons.

Cattle and horses appear to thrive and fodder crops can be readily grown after clearing and draining. In fact climatic conditions owing to the mild winters render the country attractive for colonisation and the abundance of wild fruits and fish make for cheap living but the presence of dense forest with rapid regeneration on felled areas is likely to retard serious colonisation for a considerable period.

I only saw one or two small farms during my tour, with perhaps 30 or 40 acres of meadow land apiece, and this was in the neighbourhood of Sand Spit and Tlell where a few British settlers have established themselves and make a living by selling their produce to the lumber and cannery companies.

Their cattle run in a semi-wild state through the neighbouring forest and it is quite a common practice to shoot bullocks which are required for meat when they come down to the seashore or river bank as it would be almost impossible to round them up in any way.

It would appear that for many years to come the chief use of the land surface will be in the production of timber for which it is so well suited.

But for the super-abundance of timber on the mainland and the undeveloped condition of British Columbia generally it would seem strange that lumbering operations have not developed more rapidly than has been the case. Owing to the shape of the islands no part is far from the sea and there exist excellent natural harbours so that it cannot be maintained that transport is a difficulty, yet the history of lumbering has been a checkered one.

Prior to the Great War of 1914–1918, but little timber was exported but when the suitability of Sitka spruce for aeroplane construction became evident and a demand for this species arose two large sawmills were erected, one at Queen Charlotte City and the other at Port Clements. Both are now in ruins not having been operated for a number of years and with them to a certain extent have also decayed the townships in which they were placed.

Even as lumbering operations go in British Columbia the working of these mills was intensely wasteful. Huge piles of sawn timber lie around rotting away and in the surrounding forest many a fine tree was felled merely to be left to decay.

It is probable that the operators were caught by the post-war slump and found it paid neither to continue milling nor even to export anything except the very best of their stock.

All the valuable machinery is left almost just as the crew left it after their last shift except that now it is probably of little worth owing to rust and decay.

Another large milling plant was erected at Buckley Bay on the Masset

Inlet but this, although not abandoned as those mentioned, was not operating last year and as far as could be ascertained was not likely to operate for a considerable time.

Altogether the lumbering industry presented a very depressing picture in the Queen Charlotte Islands in 1930 and to a certain extent this depression was obvious in many parts of British Columbia although not so acute in the Douglas fir areas. A few small operations, it is true, were still going, such as shipping cedar (*Thuja plicata*) poles to California for electrical work and felling logs for towing to mainland saw and pulp mills, but generally speaking the timber industry in the islands is at present at a standstill.

Probably this state of affairs is advantageous from the point of view of conservation as when lumbering opens out again the Government may, and it is to be hoped will, be in a better position to insist on more economical utilisation and some regard for the maintenance of the forests.

Parenthetically it may be observed that this state of affairs discloses a serious defect in our system (or entire lack of system) of inter-Empire trade. Granted British Columbia is more distant than our European sources of supply of softwoods, but a number of the timber operators with whom I discussed the question were of the opinion that they could ship timber at competitive prices to Great Britain if only the trade was organised and the people of this country educated to appreciate the value of such timbers as Sitka spruce, red cedar, Douglas fir and hemlock.

4. Physiography

The islands may be fairly described as mountainous as there is very little flat land except the 'muskeg' area of the North-East of Graham Island which lies to the North of the Tlell—Port Clements road and the elevated plateau country between Masset Inlet and Naden Harbour.

The mountains rise gently from the east coast and more abruptly from the western sea-board and form a chain extending from North to South all through the group. The maximum height is about 4,000 feet and this is only reached in one or two spots such as Mount Needham in the South of Graham Island and in parts of Moresby Island.

A large part, the greater part in fact, of the islands have not yet been explored and mapped so it is somewhat early to dogmatise over exact altitudes.

Viewed from Skidegate Inlet the country is strongly reminiscent of the western coast of parts of Scotland. The coast is cut up by many sea lochs which are dotted with islands of varying size and the general outline of the distant mountain ridges is similar. But for the ever-present forest one might easily imagine that one was sailing, say up Loch Sunart as one enters the Skidegate Inlet. There is the same mist drifting across the hills and a similar atmospheric effect caused doubtless by humidity in both cases.

Many fast running crystal clear streams drain the mountain slopes but there are only a few rivers of any importance such as the Yakoun and the Tlell Rivers and these, as far as I was able to observe, were somewhat sluggish and muddy and subject to but small variation in volume.

The coast is generally rocky but an important exception to this is the stretch between Tlell and Rose Point where for fifty miles there lies a sandy beach piled with driftwood from all parts of the North-West coast of America. Many thousands of tons of logs of varying species and sawn timber appeared to have drifted up from the South to find a final resting place on this desolate uninhabited shore. In places there is distinct evidence that the sea has been receding for a considerable period in face of the piling up of sand but no dunes of any great height were observed and there was no evidence of blown sand perhaps because trees colonise it almost before it is surrendered by the sea.

There are a few lakes of importance such as Yakoun Lake, Ian Lake and Mayer Lake, only the last named of which I was able to visit.

5. Climate

Generally speaking the climate may be described as mild and humid. The rainfall is of moderately uniform distribution and extremes of temperature do not occur.

It seemed to me, without studying any figures, that the climatic conditions more closely resembled those of the south coast of Ireland than any other part of the British Isles. It certainly appeared to be warmer than the west coast of Scotland and the sea water on the east coast of Graham Island was much warmer than that off the coast of Scotland or North England.

Rainfall

The precipitation appears to vary from about 200 inches on the mountains of Moresby Island to about 50 inches at Masset.

For fifteen years the average has been 63 inches at Queen Charlotte City and for thirty-two years the average has been 54·5 inches at Masset. Both these places are at sea level and the former is distinctly sheltered by mountains from the west. The high figure of 200 inches may be correct but too great reliance should not be placed upon it as it is doubtful whether it is based on many observations.

I think from the figures mentioned and taking into consideration the configuration of the country that the average rainfall lies between 80–90 inches.

In the following table the monthly average rainfall is given for Queen Charlotte City and Masset and for the purposes of comparison are added the rainfalls as estimated by the Meteorological Office at 800 feet above sea level at the following places in the British Isles.

Month	Queen Char. City	Masset	Bellingham	Newcastleton	Glenbranter	Achnashellach	Betws-y-Coed	Carrick-on-Suir
January	7·05	5·52	2·8	4·6	9·6	9·9	5·3	4·5
February	6·32	4·40	2·5	4·2	7·9	8·4	5·0	3·9
March	5·72	3·90	2·9	4·3	7·4	7·9	4·8	3·3
April	4·05	4·62	2·1	3·0	5·4	5·5	3·7	3·1
May	3·23	3·79	2·4	3·0	4·6	4·8	3·6	2·8
June	1·42	2·31	2·3	2·9	4·6	4·3	3·4	3·3
July	1·41	2·90	3·2	4·0	5·8	5·7	4·0	3·9
August	2·60	2·82	3·5	4·7	7·7	7·0	5·5	4·7
September	3·51	3·84	2·4	3·6	7·5	7·4	4·4	3·4
October	8·55	6·60	3·9	4·8	8·2	8·5	6·6	4·8
November	9·02	7·09	3·4	5·1	9·8	9·8	6·6	4·6
December	9·86	6·68	3·6	5·8	11·5	10·8	7·1	5·7
Total	62·74	54·47	35·0	50·0	90·0	90·0	60·0	48·0

It will be seen from the above that approximately 19% only of the total rainfall at Queen Charlotte City falls during the five summer months (May to

September) and that 81 % falls during the seven winter months (October to April).

As compared with them the British figures show a much more even distribution of the rainfall although both at Glenbranter and Achnashellach the winter months have approximately double the precipitation of the summer months.

Temperature

With regard to temperature the climate is equable and maritime. But little frost occurs and no high figures are recorded on the thermometer in summer.

Average monthly figures show that the temperature does not vary greatly from that of the southern part of Vancouver Island being only a few degrees less in both summer and winter. This is probably to some extent accounted for by the 'Japanese Stream' which flows at a little distance west of the Queen Charlottes and which maintains such a high temperature in winter that coasting vessels often steam out into it to clear their decks and rigging of ice.

Temperatures have been recorded at Masset for 32 years and the following are the average mean monthly figures for this locality in degrees F. For comparative purposes I have obtained from the Meteorological Office the estimated mean monthly temperatures at 800 feet above sea level for Bellingham, Northumberland; Newcastleton, Roxburghshire; Glenbranter, Argyll; Achnashellach, Ross-shire; Betws-y-Coed, North Wales; Carrick-on-Suir, Southern Ireland, and these are also given.

Month	Masset	Bellingham	Newcastleton	Glenbranter	Achnashellach	Betws-y-Coed	Carrick-on-Suir
January	35	35	35	36	35	38	38
February	36	36	36	36	35	38	39
March	39	38	38	38	37	40	41
April	42	42	42	43	41	44	45
May	47	48	48	49	46	49	50
June	53	54	54	54	51	54	55
July	57	56	56	55	53	57	57
August	58	56	56	54	53	56	57
September	53	52	52	52	50	53	53
October	47	45	45	45	44	46	47
November	40	40	40	40	36	41	42
December	38	37	37	37	36	39	39
Year	45	45	45	45	43	46	47

It will be noticed that the comparison is between sea level at Masset and 800 feet for this country. I considered it advisable to make the comparison in this way as the observations made in the Queen Charlotte Islands were mostly at but little above sea level whereas a considerable area of the ground forming or to form plantations in this country lies around 800 feet above sea level.

It will be observed that Bellingham and Newcastleton approximate fairly closely to Masset except that they are not so warm in July, August and September.

Achnashellach is distinctly colder throughout the year and Betws-y-Coed and Carrick-on-Suir, although averaging higher for the year, are cooler in summer.

According to the Meteorological Office, Buxton in Derbyshire more closely resembles the temperature of Masset than any other part of England or Scotland.

Wind

There are no records available as to wind velocities in the Queen Charlotte Islands but from observations on the East coast it would appear that wind has neither a particularly blasting effect on tree growth nor do high velocities often occur. Trees growing on the water's edge are well clothed with needles but their height growth tailed off somewhat as might be expected.

With regard to storm wind damage I only saw a few trees which had been up-rooted while many die of old age and other causes and break off at the base.

There is evidence, however, that some fairly even-aged stands must have originated through a 'blow out' but these as far as my observations went were limited in extent to a few acres or less.

On the West coast no doubt wind plays a more important part in restricting growth. As far as I could ascertain by talking to Indians and others who had been on this coast tree growth is considerably poorer particularly on elevated land and that really good stands are restricted to sheltered valleys. It must, however, be stated that what is considered a good stand of Sitka spruce in these islands is one where the trees are over 200 feet in height.

6. Geology and Soil

Geological Formations

The geological structure of the Queen Charlottes is complicated and has not yet been fully determined. It would appear, however, that the older formations of igneous and metamorphic rocks have been covered to a large extent by such sedimentary formations as conglomerate sandstones and shales of the Miocene and Upper Cretaceous periods.

The north-eastern 'muskeg' area of Graham Island is formed of gravels and clays and the sea board on the east coast in this district is bounded with a shallow belt of sand dunes.

Soils

The soil around the Queen Charlotte City and Skidegate districts in so far as I was able to investigate consisted of about one foot of decomposed organic matter—wood and leaves super-imposed on a fine sand mixed with gravel. The general impression obtained was that the sub-soil was impervious and that unless the surface was sloping it led to the formation of swamps. Nowhere as far as I could observe did the roots of even the largest trees (Sitka spruce) appear to penetrate more than eighteen inches or two feet into the glacial soil and a large part of the root system lay in the organic layer. *Thuja plicata* appears to root deeper under these conditions than Sitka spruce or hemlock and few if any of the former species were observed up-rooted by wind.

It is impossible to speak generally of the soil conditions of the islands from my own observations and there appears to be but little information recorded on this subject.

It seems probable however that there are considerable areas where the rocks are covered with glacial clay over which has been deposited on the lower slopes a varying layer of fine almost clayey sand.

On Kundis Island under fine stands of Sitka spruce the sand was not present and the organic matter about twelve inches in depth was imposed directly upon

a sour clayey sub-soil. Although trees of the very large dimension seen around Queen Charlotte City were not observed here, they reached a height of 220 feet.

It would appear then that although Sitka may not reach its finest development under such soil conditions it can grow to a very large size and reach an age of 300 years without decaying.

It must be inferred then that Sitka can grow quite satisfactorily on a layer of tree-derived organic matter overlying a clay sub-soil.

It is interesting to speculate as to what was the condition of the soil when this species first invaded and colonised the land. It almost appears safe to infer that the first arrivals did not reach the fine development now attained, as the Sitka is so obviously a lover of organic soils and it is difficult to believe that the organic layer, except in swamps, could have been of any appreciable importance prior to the invasion of forest species.

It is curious to record in this connection however that Sitka spruce can adapt itself to practically pure sand as was observed on the coastal sand area just north of Tlell. Here Sitka and Lodgepole pine were growing in rather open stands after fire and perhaps fifty or sixty years old and the Sitka was colonising the sea shore rather than the pine, a dense growth of seedlings being present just above the high tide mark. There was no evidence that Sitka was going to develop into anything but comparatively poor stands under such sandy conditions.

In the swamp area north of the Tlell-Port Clements road there were areas of peat of from two to six feet in depth but here Sitka spruce was very largely replaced by *Thuja* of poor growth.

This is a more or less flat area perhaps 50 to 100 feet above sea level and although the flora is composed largely of species of *Ericaceae* I only saw one that resembled heather in appearance (*Phyllodoce glanduliflora*), and there was nothing comparable in any way to a *Molinia* area.

From my limited observations it appeared that peat had not formed anywhere except where water was trapped and could not run off. No peat formation was to be seen on ground that was sloping. It may be said then that there are no extensive peat areas in the Queen Charlotte Islands comparable to our high moor peats.

Peat occurs but only in swamps so wet that except during the summer they are practically flooded and impassable. On such areas Sitka grow sparsely and poorly if at all, only reaching as far as was observed a height of 60–70 feet. *Thuja plicata* practically replaces Sitka here and grows no larger, and parts support no tree growth at all. If such swamps were drained it would appear probable that Sitka spruce would gradually replace to a great extent the *Thuja* and colonise the treeless areas.

In only one case was a 'pan' observed and this was on a road cutting about a mile west of Tlell. It was quite local and there was no evidence of a wide distribution of this pan which in appearance and position was similar to that occurring in the North Yorkshire Moors.

7. Vegetation

(1) Other than trees

The luxuriant growth of vegetation in the Queen Charlottes is most striking. The forests are a jungle and to traverse them it is necessary in many places to cut one's way through an undergrowth composed of such plants as red huckleberry, tall bilberry, thimbleberry, salmonberry, salal and devils club growing eight or ten feet in height not to mention young Sitka and hemlock springing up densely all around. Moss covers the ground and fallen trees. Beautiful ferns abound. Lichen hangs from the trees. On every side there is evidence of abundant moisture and a mild climate.

Very noticeable is the number of species bearing edible berries such as the first five just mentioned and many others. Among shrubs there was a very luxuriant growth of elder (*Sambucus racemosa*) near Queen Charlotte City and it was remarkable to note a crab apple (*Pyrus diversifolia*) growing on the muskeg of the north east of Graham Island under such swampy conditions that not even cedar would grow. Another noteworthy plant growing in the muskeg country with leaves three and four feet long is the skunk cabbage (*Lysichiton kamtschatcense*).

The chief species noticed in the good Sitka spruce stands around Queen Charlotte City were:—

Polypodiaceae (Ferns).
Pteridium aquilinum (Bracken).
Other species (not identified).
Ericaceae.
Gaultheria shallon (salal).
Vaccinium ovalifolium (tall bilberry).
Vaccinium parvifolium (red huckleberry).
Liliaceae.
Streptopus roseus (sessile-leaved twisted stalk).
Cornaceae.
Cornus canadensis (bunch berry).
Caprifoliaceae.
Sambucus racemosa (Red-fruited elder).
Saxifrageaceae.
Tiarella unifoliata (Foam flower).
Rosaceae.
Rubus parviflorus (thimbleberry).
Rubus spectabilis (salmonberry).
Ribaceae.
Ribes lacustre (swamp gooseberry).

Prominent species in the muskeg regions:—

Ferns including patches of bracken.
Sphagnum.
Rosaceae.
Rubus chamaemorus (cloudberry).
Pyrus diversifolia (crab apple).
Spiraea densiflora (Mountain spiraea).
Ericaceae.
Ledum groenlandicum (Labrador tea).
Gaultheria shallon (salal).
Arctostaphylos uva-ursi (kinnikinick).
Phyllodoce glanduliflora (false heath).
Vaccinium uliginosum (bog bilberry).
Vaccinium caespitosum (dwarf bilberry).
Araceae.
Lysichiton kamtschatcense (skunk cabbage).

(2) **Trees**

There are three main species of conifers in the forests of the Queen Charlotte Islands, viz:— Sitka spruce (*Picea sitchensis*), Red cedar (*Thuja Plicata*), Western hemlock (*Tsuga heterophylla*).

These trees which generally occur in mixtures of varying proportions not only cover the largest area but comprise practically all the merchantable timber on the islands.

In addition four other coniferous species are found, viz:— Yellow cedar (*Chamaecyparis nootkatensis*), Lodgepole pine (*Pinus contorta*), Alpine hemlock (*Tsuga mertensiana*), Pacific yew (*Taxus brevifolia*).

All the above species are of comparatively little importance from a commercial point of view.

There is only one broad-leaved tree of any consequence and that is the red alder (*Alnus oregona*).

It is difficult to generalise with regard to the forests of these islands as to a very considerable extent they yet remain to be explored but there can be no doubt that they are of high commercial value and will at some future time be exploited thoroughly and it is to be hoped prudently. There can also be little doubt that they contain the finest stands of Sitka spruce which are to be found within the somewhat limited range of this species but it is probable that finer stands of the other two important species exist elsewhere in British Columbia.

With regard to the proportion in which the various species occur it may be said that, as far as is revealed by cruises already undertaken, the red cedar predominates in the lower and less well-drained country to the north of Graham Island but that elsewhere it is considerably out-numbered by Sitka and hemlock.

On the north side of Masset Inlet a cruise of over 30,000 acres gave the following result:—

Sitka 18% of Volume
Hemlock 27% of Volume
Cedar 55% of Volume

whereas for the remaining portion of the island the following figures would probably be more correct:—

Sitka 40% of Volume
Hemlock 50% of Volume
Cedar 10% of Volume

It is not easy to lay down any definite forest associations. Throughout the islands all the three main species occur in mixture but it would seem that on the mountain slopes the spruce-hemlock association predominates with an increasing proportion of the former species on the lower reaches and that on the muskeg country land of lower relief the cedar-hemlock association is found with cedar increasing as drainage becomes poorer.

There is little or no definite knowledge as to how altitude affects growth but good quality Sitka are found up to 1,500 feet.

On the eastern slopes of the mountains, as seen from the Queen Charlotte City district, forest growth appeared to reach practically to the summit of the highest ranges but it was impossible to determine either the species composing the forests at these altitudes (say 3,000–3,500 feet) or the quality of the stands.

By far the greater part of the forests may be regarded as uneven aged climax type. Forest fires have occurred but as far as I can ascertain their range was restricted to that area lying North of the Tlell-Port Clements road on Graham Island.

According to Indian tradition a great fire occurred about seven hundred years ago caused by volcanic ash from an Alaskan volcano. Without careful investigation this would be difficult to substantiate but there is definite evidence that a fire occurred in the muskeg area in the north-east of Graham Island about seventy years ago and it is here that *Pinus contorta* are to be found mixed with other species, chiefly red cedar, the dominant trees being about seventy years of age.

Owing to the high rainfall and the fact that rain occurs regularly every month of the year the fire hazard can only be very slight. In fact in the height of summer the prevalence of moisture everywhere is so striking that an extensive fire appears almost an impossibility.

I am inclined to the view that fire has never penetrated the greater part of the forests and that the area containing giant Sitka near Queen Charlotte City had never been subject to fire and consequently revealed the absolutely natural result of thousands of years of association of the three main species. It was not difficult however to find small areas of approximately even aged stands of Sitka and I attribute this to windfall of the previous generation.

The average forest contains about 17,000 to 20,000 board feet per acre or say perhaps 3,000 feet Q.G.

Sitka Spruce

This is the main commercial species of the Queen Charlotte Islands and one which attains truly noble proportions, eclipsing the other species both in height and girth.

It probably reaches a maximum height of nearly three hundred feet although the tallest specimens seen were about two hundred and thirty feet. Trees of two hundred and twenty feet are common. Large Sitka run about six to eight feet in diameter at breast height and I saw one—dead—which had a largest diameter of nearly thirteen feet, but it was elliptical.

These giant trees were estimated to be about five to six hundred years old and contained about 23,000 board feet of saw timber. (Say 4,000 hoppus feet!)

Stands in which such trees occurred run about 70,000 board feet of Sitka per acre in addition to other species.

(*Note:* It is not possible to convert the board feet measure employed in British Columbia into cubic feet as it has no fixed relation to true contents—the relationship depending on the diameter of the log. I went into this matter rather carefully when at the Experimental Station at Eleza Lake (Northern Interior B.C.) and found that in the case of a spruce about 100 feet in height and containing about 80 cubic feet that 5·8 board feet represented one cubic foot solid measure).

Thus it will be seen that even with such large trees the volume per acre is not remarkably great and could probably be equalled in this country in first class conditions in about eighty years or perhaps less.

Good stands of Sitka were examined on Kundis Island at an elevation of about 50 feet above sea level. The trees were about 300 years old and 220 feet in height with a breast height diameter around two feet six inches. These were only estimated to yield about 40,000 board feet per acre which included 40% of hemlock.

Sitka spruce regenerated everywhere naturally and in a very prolific manner except on the muskegs and presumably at high elevations around the mountain tops. The seedlings invade gardens, pastures and the sea-shore and roads would soon be obliterated were it not for the traffic. Preference is shown for decaying organic matter in the form of fallen trees and root stumps. Many cut over stumps are like flower pot stands with a mass of young Sitka and hemlock growing from the top. Most fallen logs have a complete covering of seedlings and young trees growing along the upper side and such trees can grow to quite a considerable size without any contact with the mineral soil. I noticed a striking example of this on the Slatechuck Creek which runs into Kagan Bay. Here not far from the outlet an old spruce had fallen across the stream which was perhaps a hundred feet wide and near the middle of it was growing a Sitka some fifteen feet in height amongst many smaller spruce and hemlock. This particular tree might have been twenty years of age as it was suppressed for want of light but otherwise appeared perfectly normal. So obvious is the preference Sitka shows for growing on decayed wood that several of the inhabitants suggested to me that I should take a few tons of decayed wood back with me to Britain to facilitate the raising of seedlings!

The examination of the root system of many seedlings and young trees revealed the same characteristic of long fibres spreading under the almost universal moss, similar to that which we associate with successful trees on peat areas in this country.

The root system of mature trees is undoubtedly by nature very flat, and wide spreading trees three hundred years old observed on Kundis Island did not appear to penetrate more than twelve to eighteen inches into the mineral soil, but the area which they cover is great as evinced by the very large area of surface soil lifted by the root system of blown trees.

Typically the stem of the Sitka spruce is, in mature trees, straight and clean but if given room it will grow just as persistent side branches as it develops in this country.

My enquiries concerning Sitka spruce aphis, either from official sources or from the local people, were practically fruitless.

Nowhere could I discover any traces of aphis on the foliage that was within reach of the ground. However on explaining to certain local lumbermen what I was in search of they informed me that several years ago a blight descended on certain trees especially those exposed to the south east and according to them it was in certain cases fatal. They advanced the theory that it came with a south-east wind from the mainland but I could obtain little or no evidence either to support or contradict such a proposition. The only point which was clearly exposed was that the said lumbermen had not the slightest idea of what an aphis was or looked like.

Hemlock

Almost everywhere this species accompanies the Sitka in varying proportions of mixture. Its 'optimum' conditions probably lie somewhat further south than the Queen Charlottes. Although not reaching such a great size as the Sitka it is a handsome tree with a good habit of growth, being tall, straight and clear of branches to a height of 70 to 80 feet. It is probably a greater shade-bearer than Sitka when young and it is rather difficult to understand why it has not ousted the latter species in certain areas, but Sitka appears to be able to hold its own at any rate until man intervenes to upset natural conditions.

This handsome conifer with its feathery drooping foliage adds greatly to the beauty of the forests and is now becoming recognised as a valuable commercial species.

Would it not be an interesting experiment to give it a trial in mixture with Sitka in some of our plantations? This would form in part at least a natural association of species. It would probably succeed best in a sheltered position where there was little or no peat and on a moderately well drained slope. Such a plantation in later life might well stand the ravages of storm winds better than one of pure Sitka.

Red Cedar (Thuja plicata)

This is another species which is probably a little out of its 'optimum' in the Queen Charlotte Islands but it forms a very important constituent species of the forests both as regards numbers and volume.

No large specimens were seen but this may well have been caused by the fact that all the large trees near the coast have been felled by the Indians for the purpose of making dug-out canoes. It is however capable of maintaining its place in the canopy with Sitka and hemlock.

Where natural drainage is poor and where muskeg conditions prevail the forest is liable to become almost pure red cedar but its development under these conditions is considerably restricted. It produces however a valuable commodity

in the form of telegraph and power line poles on poor sites and the extraction and export of these to San Francisco was, during my visit, the only active lumbering operation seen.

Lodgepole Pine

Little appears to have been recorded regarding the distribution of this species in the Queen Charlotte Islands. Perhaps the reason for this is that it is considered a tree of little or no economic importance and is comparatively scarce in the Islands.

It probably occurs scattered through most of the forest area but has not received the same chance of development here as compared with certain parts of the mainland, owing to the rarity of forest fires. There is reason to believe that it is most plentiful in the area lying north of Tlell—Port Clements road and local enquiries elicited the information that the best known stand was at the north end of Mayer Lake. I was unsuccessful in reaching this site although an attempt was made to get there.

A number of *Pinus contorta* were however seen in this district but nowhere in pure stands—always in mixture with hemlock and red cedar and sometimes Sitka spruce.

These mixed stands were on muskeg or semi-muskeg conditions, as a rule nearly flat and badly drained with a foot or more of organic matter over the mineral soil. They had doubtless originated through a fire and were about 60 years old. The Lodgepole pine were about 50 feet in height and 6–9 inches in diameter at breast height and were keeping up well with the other species which owing to the nature of the soil were developing poorly.

It would seem that although the Queen Charlotte Island type of *Pinus contorta* will grow under swampy conditions, it does not develop either so freely or so rapidly as in many parts of the mainland. It appears out of its 'optimum' and to have a considerable struggle for existence, whereas on the mainland after fires it often takes complete possession of the ground to the exclusion, for the time being at any rate, of all other species.

Yellow Cedar (Chamaecyparis nootkatensis)

This species forms a small component part of certain of the interior and west coast forest areas but no specimen was observed during my visit. I was informed on reliable authority that it reaches a very large size, specimens 7 to 8 feet in diameter being found.

Red Alder (Alnus oregona)

This is the only broad-leaved tree of any importance growing upon the Islands and it is found fairly generally scattered about.

The best trees that I found were between Queen Charlotte City and Skidegate close to the coast. Here on a small area that had been cleared of its original crop, was a mixture of hemlock and red alder about 40 years of age. The red alder had outgrown the hemlock and were 60–70 feet in height and 10–16 inches in diameter at breast height.

They are attractive-looking trees with their rapid growth, clean almost white bark, light branches and straight stems. The timber examined showed annual rings of about half an inch in width.

There appears to be a demand for the timber for furniture making in Japan but, owing to certain regulations regarding the necessity of milling before export this particular lot was being felled and split into firewood for local consumption.

It appears to regenerate freely under suitable conditions and the seedlings examined carried nitrogen forming nodules similar to the grey alder.

It is certainly a tree worthy of experimental cultivation in this country. Probably conditions under which poplar grow would suit it best—good deep soils at low elevations—and could its easily worked timber be introduced into the furniture trade it might prove quite profitable. It is certainly a much better timber tree than either the *A. glutinosa* or *A. incana.*

8. Summary of Important Points

The Sitka spruce probably reaches its finest development in the Queen Charlotte Islands which lie on approximately the same latitude as England.

Climatically the Queen Charlotte Islands are not very different from the western half of the British Isles. The chief difference lies in the somewhat greater rainfall which is more concentrated into the winter months than here.

There are no soil conditions comparable to our heather or *Molinia* peats in the Queen Charlotte Islands.

The Sitka spruce thrives best on well-drained slopes with a deep and fairly open soil. It will however grow to fine proportions on less well drained areas on very impervious sub-soil. It grows poorly on swampy ground where there is little natural drainage.

It germinates and grows well for a number of years on decayed organic matter (wood) without any contact with the mineral soil.

It would appear that if we are to grow it to maturity successfully in this country on peat areas they must be drained more deeply than is the practice at present. Any neglect of drainage during the life of trees is likely to lead to windfall and a slackening of the rate of growth. In every case the drains should be carried at any rate to the depth of the mineral soil.

While the planting of Sitka spruce under typical east coast conditions in the British Isles must, on account of climatic conditions, be somewhat of an experiment there would appear to be no obvious reason for the failure of this species to reach maturity in the western and middle districts.

9. Acknowledgments

To Mr. P. Z. Caverhill, Chief Forester of British Columbia and Mr. E. C. Manning, Assistant Chief Forester, my best thanks are due for the kindness and courtesy in arranging for my visit.

I wish to acknowledge gratefully the very valuable assistance I received from Dr. P. M. Barr, Chief of the Research Department, without whose help I should have been unable to compile this report.

Mr. A. E. Collins of the Survey Department of the Forest Service who accompanied me throughout my tour in the Queen Charlotte Islands I have to thank for much information and for his pleasant companionship.

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NOTES ON THE SITKA SPRUCE AND OTHER CONIFERS IN THE QUEEN CHARLOTTE ISLANDS

By

A. D. HOPKINSON

Retired Conservator

The Queen Charlotte Islands lie about 60 miles off the West coast of British Columbia between approximately the same latitudes as London and North Yorkshire. They comprise a chain of one hundred and fifty or more islands

large and small and may be described as mountainous although no elevation greater than about 4,000 feet above sea level is reached.

The climate is equable and maritime. The Japanese Stream which flows near the western shores is comparable in its effect to that of the Gulf Stream on the British Isles.

The rainfall varies considerably and the average for the islands may be put at 80–90 inches per annum although the data available is not extensive. Approximately 19% only of this falls during the fine summer months of May to September, the remainder falling during the rest of the year. Thus the winters are normally very wet and the summers considerably drier but still with an appreciable rainfall each month.

Moderate temperatures are recorded both in winter and summer. From the temperatures point of view the Queen Charlotte Islands fairly closely resemble North West England and South West Scotland.

The geology is complicated and somewhat obscure but it would appear that the older igneous and metamorphic rocks have been largely covered with sedimentary deposits such as conglomerates, shales and sandstones.

Glacial soils and subsoils are often found and these are noticeably impervious. On the lower slopes of the mountains they appear to be covered partially at any rate with a somewhat sandy soil often of considerable depth and it is on such sites that the finest growth of Sitka spruce is found.

On the slopes of the mountains the organic matter is composed almost entirely of decayed wood and tree foliage together with the decomposed remains of the remaining forest vegetation.

On the flat swampy country (*Muskeg*) which lies to the north of Graham Island there are considerable formations of peat up to six feet in depth. The cause of this peat is similar to the cause of our deep peats, namely lack of quick drainage due to an impervious subsoil, but they are derived from different species of plants although the latter include a number of the *Ericaceae* and some *Sphagnum*.

The typical muskeg, whether covered with a poor growth of *Thuja plicata* or free from tree growth, is not comparable to the typical high peat moors of Great Britain. It more nearly approaches a lowland swamp in character.

There are no *Calluna* or *Molinia* peats in the Queen Charlotte Islands but *Sphagnum* is found as a constituent though unimportant species in the typical Muskeg vegetation.

The vegetation of the Queen Charlotte Islands shows everywhere a luxuriant growth both of trees and other plants. On every hand there is abundant evidence of a moist climate such as is evinced by ferns and mosses which abound in the forests.

Taking first the plants other than trees, the prevalence of berry-bearing species such as huckleberry and salmonberry is very striking. We have species of *Vaccinium* and *Ribes* growing ten feet in height and rendering parts of the forest an almost impenetrable jungle. Salal is another very prevalent plant, perhaps the most common in the forest, and elderberry luxuriates in many parts. Bracken is also found quite abundantly even penetrating to some extent on to the muskeg country. The skunk cabbage—a remarkable plant with leaves three and four feet long—is a characteristic species of swampy conditions.

A number of plants are characteristic of both the best forest conditions and also the swamp (muskeg) country where tree growth is comparatively poor or even absent while certain others are typical of only one or the other as will be seen from the list on the next page.

There are three main tree species on the Islands namely. Sitka spruce (*Picea sitchensis*), Red cedar (*Thuja plicata*), Western hemlock (*Tsuga heterophylla*) and these together form perhaps nine-tenths of the forests.

Family	Species	Occurrence	
		Good forest land	Muskeg
Polypodiaceae	*Pteridium aquilinum* (Bracken)	Common	Local
	Other ferns	Common	Sparse
Ericaceae	*Gaultheria shallon* (Salal)	Common	Common
	Vaccinium ovalifolium (Tall Bilberry)	Common	Absent
	Vaccinium parvifolium (Red Huckleberry)	Common	Absent
	Ledum groenlandicum (Labrador Tea)	Rare	Common
	Arctostaphylos uva-ursi (Kinnikinick)	Absent	Common
	Phyllodoce glanduliflora (False Heath)	Absent	Common
	Vaccinium caespitosum (Dwarf Bilberry)	Absent	Common
Araceae	*Lysichiton kamtschatcense* (Skunk Cabbage)	Absent	Common
Liliaceae	*Streptopus roseus* (Sessile-leaved Twisted Stalk)	Common	Absent
Cornaceae	*Cornus canadensis* (Bunch Berry)	Common	Common
Caprifoliaceae	*Sambucus racemosa* (Red-fruited Elder)	Common	Absent
Saxifrageaceae	*Tiarella unifoliata* (Foam flower)	Common	Absent
Rosaceae	*Rubus parviflorus* (Thimbleberry)	Common	Absent
	Rubus spectabilis (Salmonberry)	Common	Absent
	Rubus chamaemorus (Cloudberry)	Absent	Common
	Pyrus diversifolia (Crab Apple)	Local	Absent
	Spiraea densiflora (Mountain Spiraea)	Absent	Common
Ribaceae	*Ribes lacustre* (Swamp Gooseberry)	Common	Local

The following species are indigenous but are from a commercial point of view of little importance:— Yellow cedar (*Chamaecyparis nootkatensis*), Lodgepole pine (*Pinus contorta*), Alpine hemlock (*Tsuga mertensiana*), Pacific yew (*Taxus brevifolia*).

The only broad-leaved tree is the red alder (*Alnus oregona*).

Typically, the forests of the Queen Charlotte Islands are composed of a mixture of the first three species—spruce and hemlock predominating on the best sites with cedar coming in strongly, even to the exclusion of spruce and sometimes hemlock where conditions become swampy.

Everywhere on the islands except the mountain tops and certain muskeg areas there is, or was before the interference of civilised man, dense forest. So dense in fact that it can fairly be described as a jungle which can only be traversed slowly and laboriously. The traveller is faced with masses of fallen timber in all stages of decay, dense natural regeneration and a luxuriant

vegetation of plants such as salal, thimbleberry, devil's club, etc. six to ten feet in height. Tree growth extends right to the high tide mark and on the sandy shore north of Tlell where the sea is receding Sitka spruce colonise the sand as soon as it is raised above the tide level.

Thus it is not remarkable that agriculture has made but little progress as practically every field has to be wrested from the forest at great labour and expense.

The exploration of the islands is far from complete and little is known as to the effect of altitude on the development of the principal forest species. It is, however, known that Sitka grow well to an elevation of 1,500 feet which considering the moderate height of the mountains is relatively high.

Again but little is known as to the effect of wind on the western sea board but from what scanty information is available it would seem probable that here good stands are confined to sheltered valleys and that the westerly winds have a considerable effect in stunting growth which is not seen on the east coast.

In this respect it must be remembered that a great deal of the sea coast, especially on the east of the Islands, is land-locked and not directly exposed to sea winds.

The majority of the forests may be classified as uneven-aged climax type. Fire plays but a comparatively unimportant part in the history of the forests. This is doubtless due to the wet climate but fires have occurred and may occur again especially on the muskeg country in the north and north east of Graham Island. Perhaps it is due to lack of fires that the Lodgepole pine has made such poor headway as compared with its development on parts of the mainland of British Columbia.

In spite of the density of the forest the average yield of timber per acre is low owing to reductions caused by poor stands in swampy areas and probably does not exceed three to four thousand cubic feet per acre although there are stands containing two and three times this quantity.

Sitka spruce although only forming from 20% to about 40% of the volume of the forests is the principal commercial species. It is capable of growing to a great size and specimens six feet in diameter at breast height are not uncommon. Such trees are generally from 200 to 250 feet in height but even larger dimensions are on record. These trees take approximately 600 years to reach maturity and many are still quite sound at this age.

Good stands may be seen a little over two hundred feet in height and with a breast height diameter of two feet six inches, and having an age of about 300 years. In such stands the Sitka reveals good silvicultural characteristics, being straight, clean and cylindrical.

Natural regeneration is nearly everywhere abundant and this species shows a marked preference for germinating on decaying wood. Furthermore it is capable of developing normally for at least the first thirty or forty years of its life without any contact with the mineral soil whatsoever. As to whether it could reach maturity without such a contact appears doubtful but it is evident that throughout life it is much more dependent for nourishment upon the organic soil than upon the inorganic.

It is typically a flat-rooted tree but the depths to which its roots penetrate depend upon the nature of the subsoil. On a sandy loam they will reach down a considerable depth but on impervious clay soils trees over two hundred feet in height do not send their roots more than eighteen inches into the mineral matter—the bulk of the great system being developed in the superficial organic layer. Natural seedlings show the same characteristic as young plants in this country of sending out long strings of roots just under the surface of the organic layer.

The Sitka spruce appears to be well capable of resisting sea winds and lthough the trees on the sea board are mostly comparatively small, they are not

by any means as stunted as might be expected. Also but little storm damage is seen although there is evidence that 'blow-outs' have occurred as they give rise to small areas of nearly even-aged stands.

The next most important species is the hemlock and this tree also grows to a great size and age in the Queen Charlotte Islands. Without reaching the gigantic proportions of the Sitka it maintains itself well in the canopy, and trees 200–230 feet in height are not rare. This species adds greatly to the beauty as well as the value of the forests and in many parts forms a fairly dense undergrowth to the almost entire exclusion of other trees. This is probably due to its greater tolerance of shade than either Sitka or *Thuja* and it is difficult to understand why, in the course of many thousand years, it has not become the dominant species to the almost entire exclusion of the other two.

Almost everywhere it grows in mixture with these two species but the proportions of the mixtures vary according to the locality. On the best sites and soils Sitka and hemlock predominate to a very considerable extent but as the soil conditions deteriorate *Thuja* takes an ever increasing part in the crop until on poorly-drained swampy land it is left practically pure.

Hemlock undoubtedly appears to be a more exacting species than Sitka and whereas the latter species probably reaches its maximum development on the Queen Charlotte Islands the former finds its 'optimum' somewhat further south. Again, on exposed parts of the coast Sitka is almost always the tree which takes the brunt of the wind, the hemlock coming in where shelter has been established. Also it would appear that this tree is less tolerant of clay subsoils than either Sitka or *Thuja*.

It is a species, however, of good silvicultural characteristics and the timber of which is becoming increasingly recognised as of considerable value. For these reasons and as there are many suitable sites in the British Isles for its growth, it will probably be planted less sparingly in the future.

As has been previously mentioned, the *Thuja plicata* forms a prominent constituent species of the Queen Charlotte Island forests. It is, however, also a little north of its 'optimum' and while growing to a great age and large dimensions, can be seen to greater advantage on Vancouver Island and elsewhere.

It is a tree which shows very great tolerance of water in the soil and reaches out further into the muskegs than any other species. True its growth is greatly reduced under such conditions, but it forms a crop which given time is capable of producing valuable produce in the form of telegraph poles and poles for piling work for which exceedingly durable timber renders it admirably adapted.

The Lodgepole pine is a comparatively rare species in the Queen Charlotte Islands but it is found fairly abundantly in parts of the northern half of Graham Island. Here it is found growing with *Thuja* and sometimes Sitka and hemlock on muskeg country with poor drainage. As a timber tree it is of little importance only reaching a height of perhaps eighty feet in a hundred years and never growing to such a size as is common on the mainland where its dense growth is the common aftermath of fire.

SITKA SPRUCE — ALASKA'S NEW STATE TREE

by

A. S. HARRIS

from 'American Forests'

On February 28th, 1962, Governor William A. Egan signed the law naming Sitka spruce as Alaska's state tree. Thus Alaska became the forty-fifth state in the nation to adopt an official state tree.

The choice of a single tree to represent the giant new state was difficult. Sprawled across 2,200 miles of longitude and 1,300 miles of latitude, Alaska contains two major forest zones, each with its distinctive tree species. In the interior the white spruce-birch-aspen forest reaches from above the Arctic Circle south to the Alaska range, while along the southern coast the dense hemlock-spruce-cedar forest follows the sea.

Why was Sitka spruce chosen? The Act is brief, merely recognizing Sitka spruce as Alaska's "most valuable" tree. But behind that simple statement lie many reasons, historical, commercial and aesthetic, best understood by those Alaskans who know the tree and the coastal forests where it grows.

Known also as silver spruce, tideland spruce, Alaska spruce, or coast spruce, Sitka spruce is at home in the dripping northwest coast rain forest where it is seldom found more than a few miles from tidewater. Its native range borders the North Pacific in a narrow band for 1,800 miles from Katchemak Bay near Kodiak Island in Alaska, curving east and south to Mendocino County in California. Hugging the shores of Shelikof Strait at the northwest tip of its range, the band widens to 100 miles or more in the island-strewn pan-handle of southeast Alaska, narrowing southward along the British Columbia coast until it is scarcely 30 miles wide where it passes through Washington and Oregon; and in northern California, the extreme southern limit of its range, the tree nestles in moist valleys facing the sea.

In Alaska, Sitka spruce grows in pure stands, in mixture with western hemlock and other species, or singly and in small groups on glacial flats and meadows. But most commonly it is found together with western hemlock in seemingly endless virgin stands where ancient spruce tower over their hemlock neighbours, giving the mountains a shaggy look from the water's edge to timberline. When trees grow in crowded stands, light-starved lower branches soon die and fall, producing the clear, smooth boles sought for high-quality lumber. Open-grown trees assume the conifer's classic cone shape with branches often reaching to the ground. Branches of young saplings slope jauntily upward in regular whorls and prickly blue-green needles jut out from every branch. As trees mature, branches become long and graceful, drooping with their load of slender branchlets, giving an impression of fringes and ruffles. Most years a scattering of small cylindrical cones two to four inches long hang from the topmost branches of many trees but every few years a bumper cone crop may literally cover many trees. Cones become noticeable by mid-summer, gradually turning from pale green to purple-green to light brown as they mature in the fall. During the first cold, dry days of late fall, cones open to scatter the tiny winged seeds on the wind. Empty cones remain to grace the trees throughout the winter and coming spring.

Sitka spruce is not only Alaska's largest tree but also largest of the world's spruces. Although somewhat larger specimens are found farther south, Alaskan trees average 3 feet in diameter and 150 feet in height, but many are from 6 to 10 feet in diameter and over 200 feet tall. The largest reported in Alaska was 14½ feet in diameter, somewhat smaller than the record 16-foot giant on Washington's Olympic Peninsula. In Alaska old-growth trees may average 400 to 500 years, while patriarchs of 750 years have been recorded.

Sitka spruce has long been closely identified with Alaska's history; and its scientific name, *Picea sitchensis*, Bong. (Carr.) offers a good introduction. Because a tree's scientific name is usually compounded to describe it or commemorate its discovery by science, digging into its origin often unearths an interesting story. So it is with Sitka spruce. Today the generic name, *Picea*, is shared in common with over 40 other spruces throughout the Northern Hemisphere. *Sitchensis*, the species name, commemorates its scientific discovery

on Sitka Island (now called Baranof Island) in south-east Alaska during the colourful period when our forty-ninth state was part of Imperial Russia.

On June 12, 1827, the Russian sloop of war, *Senyavin*, put into New Archangel (now Sitka), the capital of Russian America. The sloop, commanded by F. P. Litke, had sailed from Kronstadt nearly a year before on a scientific expedition around the world. Among the 62 men on board were several prominent scientists, including Dr. Mertens, the expedition's naturalist. For five weeks, while the *Senyavin's* crew repaired and refitted her for sea, the scientists spent every possible moment ashore observing the land and its people, and collecting plant and animal specimens. When the expedition returned to Russia two years later, Dr. Mertens turned over its large plant collection to the botanist, Heinrich Bongard, who found in it over 200 different plant species, including 35 never before described. One of these was Sitka spruce. Bongard first described the tree in a paper presented before the Imperial Russian Academy in 1832, and his name, ringingly abbreviated, is cited today in recognition. Bongard's first description placed Sitka spruce within the genus *Pinus*, where it remained until 1855 when the French botanist Carriere's revision placed it with the *Picea*.

So much for the name. But long before scientists classified it, Sitka spruce served Alaska's people. Over 200 years ago, Russian explorers found on the Northwest Coast a proud and intelligent people whose advanced culture depended on products of the sea and forest. The 'Kolosh', ancestors of the modern Tlingit Indians, used Sitka spruce in many ways. Graceful canoes were sometimes hewn from the straight, clear boles, and houses were built of logs or hand-split planks. Bentwood boxes were made, as the name implies, each from a plank grooved and bent to form the four sides; then the fourth corner and bottom were laced together with strong, supple spruce roots. Fitted with a lid and highly decorated with stylized animal figures, the boxes were used for everything from food storage to coffins. Hats, masks, and utensils were carved from the wood; baskets and distinctive high-crowned hats were woven from the vine-like spruce roots. Pitch was used for caulking canoes, and seeds served as a cure for toothache.

The early Russian settlers used spruce logs for forts and villages and lumber for buildings and boats. In 1790 a vessel of 100 tons was launched, the first ship constructed of native timber on the Russian-American coast. A half-century later, New Archangel became a shipbuilding centre with over 200 ships built from local timber between 1840 and 1860.

In 1805 Russian fur traders carried seedlings from New Archangel to plant near their settlement on Unalaska Island, far out along the Aleutian Island chain. This effort to 'spruce up' the remote and treeless island may have been the first attempt at afforestation in North America. How many trees were planted no one knows, but today six trees of the original plantation remain alive. Veterans of 160 seasons and the World War II bombing of nearby Dutch Harbour, their stunted and gnarled appearance speaks eloquently of the harsh Aleutians, 500 miles southwest of the tree's most westerly natural outpost.

Captain George Vancouver, the English navigator, used spruce in quite a different way. During his explorations along the Northwest Coast in the last years of the 18th century, he occasionally sent a party ashore to make spruce beer. Prized by Vancouver for preventing scurvy, it was a welcome treat for the sailors after months at sea. Spruce branches were first boiled in a cauldron for several hours; then more water, molasses, and yeast or wort were added, and the strained mixture put in casks to ferment. In a few days the beer was ready to drink and was issued to all hands. With variations, the recipe survives today, and a few Alaskans still brew up an occasional batch as 'salubrious and palatable' as any described by the early explorers.

After Alaska's purchase by the United States in 1867, mines, salteries, and villages sprang up along the coast, and sawmills cut spruce lumber to meet local demands. With the first salmon canneries in 1878–79, more spruce timber was needed; at first for lumber, and later for floating fish traps. These were made of buoyant logs up to six feet in diameter lashed together with cable to form a giant floating framework. Wire mesh was suspended from the logs and traps were moored several hundred feet offshore to catch migrating salmon. Canneries increased in numbers until 1929 when 160 canneries and 700 traps operated in Alaska. So efficient were the traps that as a conservation measure, Alaska's State Constitution now specifically forbids their use.

With World War I, high-quality spruce lumber suddenly came into demand for military airplanes. Because of its strength and light weight, Sitka spruce has been the most important wood for aircraft construction ever since and it has gone into many famous planes, including the wings of Colonel Lindbergh's 'Spirit of St Louis'. During World War II, a special spruce logging programme was set up in Alaska by the U.S. Forest Service to supply wood for thousands of training and combat aircraft.

Today Sitka spruce is a valuable commercial tree and the timber industry is vital to Alaska's economy. The amount of Sitka spruce timber growing in Alaska has been estimated at 27 billion board feet, most of this within the 21 million acres comprising the North Tongass, South Tongass, and Chugach National Forests. Two pulp mills, at Ketchikan and Sitka, convert spruce along with western hemlock to dissolving pulp for world markets; and about 30 sawmills in Coastal Alaska cut lumber for local use and export.

Since the wood has greater strength and toughness than any wood equally light in weight, it is sought for airplanes and gliders, ladders, boats, oars and paddles. Because it is easily milled and worked, it is used for doors, sash, woodenware and novelties. Being odourless and imparting no flavour, it is used in food containers and where food is processed. Its peculiar resonant qualities make it useful for piano sounding boards, stringed instruments and organ pipes. The wood's long fibres and pulping characteristics are ideal for newsprint, wrapping and high-quality papers, and dissolving pulp from which rayon, cellophane and plastics are made. Useful for plywood, it can be sliced paper-thin and has even been used as novelty letter-heads by some business firms.

Valuable as it is commercially, Sitka spruce's greatest appeal to many Alaskans is aesthetic. Alaska is a land of many moods and, along the southern coast Sitka spruce is a part of them, adding its beauty to Alaska's rugged landscape. By way of example, picture a giant spruce during a summer drizzle when fog swirls about the treetops, and across a quiet bay, forest, water and mist blend into mysterious greyness. Or imagine a crisp fall morning and a majestic spruce standing at the water's edge, head and shoulders above the neighbouring hemlock and reflected in the sea. Or in the half-light beneath a grove of ancient spruce, your gaze follows a smooth bole up 60 feet from the needle-carpeted forest floor to the first limb high in the vaulted canopy overhead.

There are many possible reasons for referring to Sitka as Alaska's 'most valuable' tree. Beautiful and useful, a prominent feature of the landscape, closely woven into Alaska's history, and vital to the economy, Sitka spruce is indeed a fitting choice for Alaska's state tree.

ROYAL SCOTTISH FORESTRY SOCIETY 67th ANNUAL EXCURSION TO NORTH SCOTLAND

18th May to 22nd May, 1964

by

J. E. W. LLOYD

Head Forester, South Wales

Introduction

I would like to express my appreciation to those responsible for my selection to attend the above mentioned excursion.

This was the first time for me to set foot on Scottish soil and on this occasion I covered something like five hundred miles of Highlands and about eight hundred miles in all during the week.

The problems of the Highlands, although much greater, are similar to those of the rural parts of Wales where the emphasis is on the depopulation of these areas. The old crofts dotted across the Highlands are fast becoming monuments of the past and one could well visualize the toughness and the hardship these old crofters had struggled through in order to exist.

Since visiting this large expanse of heather, hills and lochs I feel that I have travelled more than the famous George Borrow, author of the book *Wild Wales*, where the localities referred to in his book are not more than a dozen miles either way to what could be termed as civilization. It would be interesting to know what title he would have used on a similar story had he been based at one of the old Highland crofts.

It appears that the 67th Annual Excursion differed from the previous 66 in that more time was taken up in travelling and less in discussion.

The only thing that spoiled the week was the accommodation at Strathpeffer; one could term it as "Quality Class *minus* five". The least said about it the better and I advise others to give it a wide berth. The standard of the British Railways from Cardiff to Edinburgh tends to give one the impression that the same coaches are used for transporting livestock. Any remarks which might appear to be critical in this report should be interpreted as the writer's own personal opinion and accepted without any hard feelings.

Tour

Monday 18th May

After a fourteen-hour train journey from South Wales to Edinburgh, the writer joined the excursion which left Edinburgh by coach at 9.0 a.m. The journey followed a route via Stirling and Crieff passing through the Duke of Atholl's Estate along the Tay Valley and over Druim Uichdar Pass which is at one point 1,484 feet above sea level, then on through Spey Valley. Looking over to the right one could see part of the Old Caledonian Forest; then on to Inverness and finally Strathpeffer. An all-day coach journey of approximately 200 miles, a difficult job for an amateur like myself to find the appropriate adjectives to describe the wonderful and ever changing scenery.

In the evening the President of the Society opened the Meeting. A short talk was given by Conservator North Scotland in whose Conservancy the 67th Excursion took place. The North Scotland Conservancy appears to be the largest, at any rate territorially, in the United Kingdom and has its own particular problems. To mention a few:

1. Exposure.
2. Difficult terrain.
3. Costly road construction due to the nature of the country.

4. Difficulty, and usually a very long drawn out affair in acquiring sizeable parcels of land due to the old crofters' laws and customs.

Due to the presence of Red deer in large numbers about 50 out of 56 Forests must erect and maintain deer fences, these being extremely costly in comparison with a normal stock fence. The high cost of fencing, therefore, rules out small parcels of land except in the case of experiments and shelter belts. The population of the Red deer present in all Scotland is estimated around 150 to 160 thousand, the majority being in the North. The expansion of forestry in North Scotland is an attempt to arrest the drift of workers to the South and provide alternative work to the crofters who are fast becoming extinct.

The future salvation of the timber industry in Scotland appears to be centred on the new pulp mill which is in the course of erection at Fort William; this mill is due to start partial production in the spring of 1965 and full production in the autumn of the same year. The full intake will then be about 12 million hoppus feet. The Forestry Commission have already guaranteed something in the region of 6 million which will come mainly from North Scotland. To date the private estates did not appear to have had their teeth into this project. In an address given by a representative of the pulp mill the lack of informative figures requested from private forestry is not satisfactory.

Tuesday 19th May

This was certainly the most interesting day of the whole excursion. Party left Strathpeffer at 7.0 a.m. and returned at 7.0 p.m. having covered something like 200 miles.

Having breakfasted en route the party was joined by a Forestry Commission representative who gave an interesting commentary when the party was passing through parts of Balblair, Shin and Oykell Forests. These Forestry Commission plantations are subjected to extreme exposure; the maximum elevation is around 750 ft. and certainly does not exceed 800 ft. The application of G.M.P. on all species is standard practice. At Shin, forestry and agriculture have toiled side by side in utilizing the land available. In this region the Department of Agriculture has reclaimed and re-seeded 360 acres for the benefit of the crofters and smallholders. In spite of the increase in forestry activities—planted area in the region of 6 thousand acres—the sheep population has only decreased from 2,500 to 1,900 over a period of six years. In the case of cattle, a herd of about 50 has been established where none existed before. Both Departments have carried out commendable work in this locality.

Reay Forest Estate (The Duchess of Westminster)

Reay Forest was bought by the Duke of Westminster from the Sutherland family in 1920, after being held on lease since 1866. The Earl of Sutherland first acquired the property from Lord Reay in 1829. Since then it has been increased by the purchase of some of the adjoining lands and the area now owned is approximately 98,000 acres.

In 1949, the 2nd Duke of Westminster started a large afforestation scheme and at the same time arranged for the erection of 17 new houses, a village hall and a school at Achfary. The afforestation of virgin deer forest in the north-west of Sutherland must be considered as an experiment of a pioneering nature bearing a certain amount of risk.

A programme involving the planting of blocks amounting to a total of 3,000 acres was started in 1950 and has now been completed, but a preliminary survey was first made and the advice of the Forestry Commission sought. This was not very encouraging—certain areas were scheduled as unsuitable and the Commission made it clear that no planting grant would be made on these

areas until such time as they were considered to be well established. It is understood that 86% grants have since been paid. There was also a certain amount of opposition at the start from the crofters and stalkers.

The cost of the scheme was high, as in the initial stages the labour was unskilled and had to be trained in forestry operations. Furthermore, much time was lost in travelling the long distances to and from the planting areas, many of which were very remote. It was also necessary to erect deer fences.

Choice of species is somewhat limited; for the most part lodgepole pine, Sitka spruce, Hybrid larch and Scots pine have been used. Under such exacting conditions the yield is not expected to compare with that from plantations established in a more favourable environment. Furthermore, owing to the occurrence from time to time of gales of hurricane force there is a danger that parts of the forest may be blown down before they have a chance to reach maturity. Failure to establish trees on the exposed knolls is very evident, but all species are doing comparatively well in the sheltered, wetter areas; even these would benefit further by cutting deep drains in the not too distant future. It is interesting to note that this part of the country benefits from the warm Gulf Stream air. The advanced growth, particularly in the local gardens, was very pronounced.

Plantations have suffered fairly extensive defoliation by sawfly. Biological control by virus is now being tried experimentally. The reproduction of the notes on this subject may be of interest.

1. The Pine Sawfly (*Neodiprion sertifer*)

Life History. The adult sawflies lay their eggs in slits cut into the current year's pine needles in July or August.

The insects over-winter in the egg stage and the larvae emerge in May and start to feed on the needles of last year's growth until June/July. Larvae pupate in cocoons in the upper soil layer beneath the trees and the adult insects emerge in July/August and fly to the current year's growth on the pines where they lay eggs.

Caterpillars are gregarious and live in colonies causing severe defoliation of pine and also sometimes spruce and Douglas fir but confine their attention to last year's growth leaving the current year's needles for egg laying.

2. Sawflies first appeared at Reay Forest in large numbers in 1957, mostly damaging the lodgepole pine and Scots pine. As growth is slow in this exposed part of Sutherland and the trees less vigorous, defoliation proved serious and if recurring for two or more seasons, proved fatal.

Normally sawfly attacks reach a peak in three years and then subside due to natural control by predators, parasites and disease, but at Reay where there had been no trees before, there were not enough birds or parasites to cope with the attack and the sawfly population continued to increase, showing no sign of collapse in the fourth year (1961). It was therefore decided to try biological control by spraying a virus and the Virus Research Unit of the Agricultural Research Council from Cambridge started a series of experiments in two hundred acre blocks which were heavily infested.

Spraying started in May 1961 on the colonies of larvae using a power mist blower and virus spray at the rate of 1 gallon per acre. After 17 days it was found that 50% of the colonies had virus-infected larvae and after 24 days the proportion had risen to 85% and good control was effected. Infected larvae from some of these colonies were introduced into untreated areas in the hope that they would produce virus-carrying adults which would breed with untreated insects and produce an epidemic the following year.

In 1962, a survey was made of the treated areas and it was found that infestation had decreased by 90% and by 1963 the disease was gradually spreading outwards from the treated areas which themselves had experienced relatively little defoliation.

It is hoped that having established the disease, the behaviour of the insect will revert to the normal three year cycle terminated by a virus epidemic.

3. Biological control by Virus Disease in Insects

(a) Insect viruses are specific, that is to say, the control of an insect infestation may be effected biologically by use of the particular virus to which it is susceptible without danger of harming any other insect or form of life.
(b) Virus diseases are highly infectious and have a long storage life.
(c) Method of infection is by simple ingestion through contaminated food materials.
(d) Latent forms of virus are often present in insects and can be stimulated by introduction of active strains which may then become hereditary.
(e) Fresh supplies of virus can be readily produced from the remains of infected insects at comparatively little cost.
(f) Once established, virus diseases may assume periodic epidemic proportions though there is some risk of eventual immunisation.
(g) Biological control by virus diseases may well replace the use of chemical sprays and so prevent many of the widespread and indiscriminate detrimental effects that chemicals have on other forms of life and eventually on the balance of nature.

Wednesday 20th May, Moray Estates Woodlands

Darnaway Forest was originally established as a hardwood plantation under Francis, 9th Earl of Moray in the middle of the eighteenth century. Previously it had been largely covered with old Caledonian forest, a small portion of which still exists in the south-west corner of the Estate.

The object of management is to maintain existing plantations and re-afforest unproductive areas within the limits of a restricted budget, to expand if possible to some 10,000 acres, and to convert some 200 acres of hardwoods to coniferous plantations.

First we visited the 8 acre nursery which last year produced half a million plants. All possible nursery operations are carried out by mechanical means and a demonstration was given of the Wright Rain Irrigation Unit. At the nursery, fire fighting equipment was also displayed; these were similar to Forestry Commission equipment except that a special fitted Land Rover was kept exclusively for fire fighting. I rather liked the Darnaway Fire Brigade set-up which was first formed in April 1959 to combat a past record of large scale fire losses in plantation. This is manned by a volunteer trained squad (estate workers) consisting of ten members. A Fire Control Centre is at Conicavel where there is a special phone and siren. Practice nights are held twice a month and members get an annual honorarium for attending these, in addition to the appropriate rates for attending fires. I am afraid that trade unions would protest loudly to the Forestry Commission if they adopted this scheme—uneven distribution of cash.

The estate is all out for mechanisation and a large variety, mainly secondhand, of their equipment range from auto scythe to road roller was viewed. One full time fitter is responsible for the maintenance of these machines and also for the construction of some of the home-made implements. One advice given to any potential purchaser is to steer clear of all secondhand track machines.

The forestry activities on this estate were obvious at the south west part where the following could be observed.

A windblow of recent years had been cleared and replanted with Scots pine. These appeared to be doing quite well. Close to these a fairly large area which had previously been cropped with Scots pine estimated to be somewhere around 100 years old and 6 ft. high had been cleared. A heavy plough had been used in order to break the pan which existed throughout the area, and was considered to be the main cause for the failure of the previous crop. The area has now been planted with lodgepole pine in the south west and Sitka spruce and Norway spruce in the north-east; all species are off to a good start. To the east one could see the area of the disastrous fire of 1959. To the west, part of Culbin Forest was visible.

In the afternoon a demonstration was given by the Forestry Commission Work Study Section. The theme of the demonstration was extraction of thinnings on moderate slopes or flat ground using wheeled tractors.

Two methods were shown:—

(a) Extraction by Ferguson tractor with a Thetford Timber Tongs, Alice Holt Draw Bar, etc.
(b) Extraction by County Super 4 Tractor with HIAB Elephant and trailer.

The tractors were shown in a simulated operation extracting pulp wood and saw logs. The Ferguson also demonstrated its flexibility by extracting pole-length material. The present experiment with mechanical extraction and loading is mainly concentrated to find the best method to deal with future programmes of transport/loading of pulp wood supply to Fort William.

Thursday 21st May, Novar Estate

This estate suffered badly from the disastrous windblow which occurred at the latter end of the last century. The estate is situated between the Ben Wyvis massif to the North and the Cromarty Firth to the south on ground which varies from deer forest to agricultural low ground. It consists of 15,000 acres hill ground, 5,500 acres of plantations and 2,000 acres arable land.

Planting in the ten years ending 1961 averaged 150 acres and in the last three years 470 acres. About fifty persons are employed directly, and indirectly, a further ten to fifteen are under permanent contract for work in the woods. Over 200 people, including families, live on Novar in estate houses.

The weather conditions conform to those of the favoured Moray Firth area, having a low rainfall and a high sunshine record. The mean annual rainfall varies from 26 inches near the sea to over 45 inches in the hills. The mean annual temperature recorded a few miles away at 60 feet over a period of 40 years was 46·6°F. Occasional severe spring and autumn frost and spring droughts constitute the greatest hazards.

Evanton Woods

Elevation 300 feet above sea level and the underlying geological formation is Lower Old Red Sandstone.

The wood appears to have been established partly by artificial and partly by natural means about 69 years. Originally it was a mixture of Scots pine and European larch, although some Douglas fir, spruce and beech were introduced at a later stage.

Permanent sample plots were established in September 1921 with the object of assessing the growth and yield of Scots pine under different grades of thinning. Practically all the subsidiary species were removed at that time, leaving a nearly pure crop of Scots pine.

One plot was thinned to a strict low grade, in which only dead, dying and suppressed trees were cut, while, for comparison, the other plot was treated to a heavy low thinning grade.

At that time the area was densely stocked with approximately 2,200 trees per acre with an average volume of 1 hoppus foot.

Top height was 42 feet which with an age of 27 years places the crop in Quality Class 1 of the Forestry Commission Yield Tables.

In the 42 years since the plots were established ten thinnings have been applied and these removed 4,200 hoppus feet per acre in the D grade and 3,000 hoppus feet per acre in the B grade.

Total volume production in the D grade has been 8,630 hoppus feet giving a mean annual increment of 125 hoppus feet compared with 9,500 in the B grade where the mean annual increment has been 138 hoppus feet.

From these data it appears that there has been a loss of increment due to D grade thinnings and this can partly be attributed to an exceptionally heavy thinning in 1941 when almost 40% of the standing volume was removed. The maincrop trees thereafter would have been insufficient in number to avail themselves of the site potential and the stand is only now being restored to normality.

The B grade is also on a somewhat better site which is reflected in its superior height growth.

The mean breast height quarter girth of the 100 largest trees per acre has been considerably influenced by thinning. In the D grade these trees have a mean breast height quarter girth of 11¼ inches and a volume of 30 hoppus feet overbark compared with a breast height quarter girth of 10¼ inches and a volume of 26 hoppus feet overbark in the B grade.

The data for the present maincrop per acre are as follows:—

Grade	No. of trees	Top height, ft.	Volume, h. ft.	Av. Volume, h. ft.
D	168	76	4,500	26·6
B	369	79	6,500	17·6

Current annual increment per acre is approximately 125 hoppus feet.

Over 20 acres were blown in the 1953 gales, five of which have been reclaimed as cropped, mainly by natural regeneration and a little manual distribution of these plants.

Thinning has been going on over the past few months, and a total volume of 59,508 hoppus feet equal to an average of 466 hoppus feet per acre is estimated to be removed.

Dalnahaun Wood

This is the "home" of the two "Plus" larches. The figures given in 1956 for No. 1033 were:— 49 years old, 103 ft. high by 5 ft. 4 in. breast height girth and at that time was the youngest known European Larch over 100 ft. tall.

Blackpark Wood

North of the Hydro-Electric line which bisects this block, are four Douglas fir trees selected by the Forestry Commission Genetics Branch. Their measurements to timber height only, are as follows:—

G.20=107 ft.=19¼ in. breast height quarter girth= 96·0 hoppus feet
G.21=114 ft.=17¾ in. breast height quarter girth= 89·3 hoppus feet
G.22=106 ft.×17 in. breast height quarter girth= 76·6 hoppus feet
G.23=114 ft.=19¾ in. breast height quarter girth=107·0 hoppus feet

Dalgheal Wood

Passing through Dalgheal Wood I saw the most magnificent specimen of the old Caledonian Scots pine. Human beings were most certainly dwarfed alongside these giants which are estimated to be around 150 years of age.

Friday 22nd May, Carr Bridge Sawmill (Messrs. Frank Sime Ltd.)

This modern mechanised sawmill for the conversion of native softwoods has a capacity of 1,000 cubic feet per day of timber, using a band headrig as the main breakdown unit.

The aim in the construction of the mill was to take advantage of the latest equipment in ensuring a production of softwoods that are sawn to dimensionally accurate standards, to obtain the highest possible recovery ratio with maximum efficiency and low labour costs in handling of logs and sawn timber. The equipment consists of:—

150 feet log haul with log kickers; log loading deck with log stop quadrants; lifting skids and loading arms; all pneumatically operated. Mechanised log carriage with four head blocks, pneumatic dogging, electric setworks; hydraulic feed gear etc., Band head rig—8 inch Saws; Radial arm band re-saw. Trim saws; Two-saw edger—18 inch diameter blades.

Conveyors, including roller conveyors behind headrig, cross transfer chains, idle roller infeed and outfeed, belt conveyors etc.

The labour force is four sawyers plus four labourers in mill. Additionally, the yard crew and sorting crew.

There is also a bandmill layout for hardwoods and rough conifers.

Inside the mill one had a feeling of 1964 automation. Everything controlled from one point, mainly by one man surrounded by the levers and press buttons. Outside the mill, the modern mechanisation collapsed completely—three to four workmen are employed carrying a plank or two each from the end of the production line to the various stacks twenty to forty yards distance. In wet weather these men wade through ankle deep puddles. An ancient mobile crane is used for moving timber. A firm, solid yard with mechanical bogies would be more in keeping with the interior of the mill.

Strathspey Estate (The Right Hon. The Countess of Seafield)

This was the last call and due to the lack of time, had to be curtailed. This Estate is situated in the heart of the Scots pine country. The woodlands now under management extend to some 38,000 acres—elevation between 600 and 1,250 ft. Average rainfall 30 to 32 inches. Winter conditions generally severe.

Large-scale clear felling was carried out during the two wars. The replanting of this area is being tackled at the rate of 700 acres per annum and will shortly be completed.

Party dispersed at 2.0 p.m.

Conclusion

1. At first, I was very surprised with the low maximum planting elevation, but after standing on an exposed site 300 ft. above sea level, soon became aware of the conditions even on a sunny May day.

2. The Highland forester lives in a perpetual fear of a wind blow which can destroy his forest overnight, and is powerless to do anything about it.

3. Having seen several specimens of the native pine, I am puzzled why the lodgepole pine is becoming more popular, particularly that the origin of much imported lodgepole pine seed is of a doubtful character—in fact the purchase of these seeds is akin to buying "A pig in a poke" with one major difference. The pig, or the lack of it, is discovered on arrival home, whereas it takes several years before the "pedigree" or the lack of it, of the seed becomes apparent.

4. It seems a pity that parcels of woodlands in the Sutherland area were clear felled during the war. These would have provided the necessary shelter to extend afforestation in this bare, windswept north-west part of the country.

5. Main link roads are narrow, some are single line traffic only. Transportation of material will be a slow affair for some years to come. 'County' road programmes and activities in the north-west are conspicuous by their absence.

6. This was a well organised excursion. The welcome, and the excellent teas and refreshments provided at all the Estates visited is not likely to be forgotten for a very long time.

THE ROYAL FORESTRY SOCIETY OF ENGLAND, WALES & NORTHERN IRELAND SUMMER MEETING AT EXMOUTH

4th May to 8th May 1964

by

D. A. COUSINS

Head Forester, Research

Members assembled at the Imperial Hotel, Exmouth on Monday evening 4th May for the Annual General Meeting.

Tuesday 5th May. Dartington Hall

The party arrived at Dartington Hall where we were met and welcomed by Mr. L. K. Elmhirst and introduced to Mr. R. M. Harley, who conducted us around the woodlands. The Dartington Hall Estate was purchased by Mr. and Mrs. Elmhirst in 1925. The estate comprised 183 acres of woodland on a very fertile site. Further additions to the estate were made in the period up to 1930. The woodland was composed mainly of oak coppice and scrub, the object of management being to convert this into coniferous high forest.

In 1931 the woods and other properties were conveyed into a perpetual trust and now belong to the Dartington Hall Trustees.

In 1947, a company, Dartington Woodlands Ltd., was formed to manage the woodlands. This company rents the land and buildings on a long lease from the trustees but it owns the trees and equipment.

Most of the woods carry a young crop, over half of the conifers being below twenty years old. Conifers also form 70% of the total plantations. Hardwoods, mostly oak, are in the older age class—40 plus. The main conifer used is Japanese larch, the next Douglas fir, both of which grow very well in the south west of England.

The company is self-supporting, including expenditure on research. Contract work on other estates, running of commercial forest nurseries and the growing of Christmas trees help greatly in providing income for an estate that has a large amount of young age crops.

The estate has been fortunate in having thirty years continuity of management by the late W. Hiley from 1930 until his death.

All work in the woods is carried out by their own staff and no sales are made of standing timber. The staff employed is in the ratio of 1·2 men per 100 acres.

Care has been taken in thinning, clearing and regeneration so as not to spoil the natural beauty of the area at Dartington. Most regeneration of the woods is preceded by small group fellings.

Chace Grove.

This small 11 acre wood was the first area to be visited. It was situated on a very fertile and base, rich soil—a natural ash site.

Ash had been planted there in 1914 and was of a very high quality. The crop had been awarded the Royal Show Silver Medal in 1930 and a Gold in 1932. It was also a registered seed source.

The thinnings had been sold as sports ash and the aim was to grow the ash to the optimum size for this trade—14 in. b.h.q.g. at 5 to 7 rings per inch.

There was much discussion on the crop, and it was suggested that the occasional cankered tree should be taken out right away. It is the intention to replant the area with ash again for the second rotation.

Nearby was a small plot of self-sown ash, dating from 1939, which had been cut back, pruned and thinned by Mr. Elmhirst personally. Final crop trees were selected early and given room for full crown development. The mother trees were probably from the crop mentioned previously.

North Wood.

The soil here was derived from Middle Devonian Shales, fertile but rather acid.

One stand of mixed conifers—European larch, Douglas fir, Sitka spruce, Norway spruce and silver fir—planted some sixty years ago was very under-thinned when acquired in 1932. Since then it has received frequent careful thinnings. The European larch was felled in 1960/1 and, in the groups formed, *Tsuga* was planted.

The next compartment IV d—planted 1941, consisted of various species planted with European larch, namely sweet chestnut, *Abies procera*, Lawson cypress and *Pinus strobus*. Many of the last two species had been killed by Honey fungus.

Compt. 10. This was a stand of uneven-aged mixed conifers planted 1897 to 1919. Again this crop was very dense when acquired in 1932. It was carefully thinned several times mainly in the larch and in 1943 a heavy thinning was made. This was underplanted in patches with Douglas fir and Japanese larch. In subsequent thinnings, further patches have been planted with *Tsuga* and *Thuja*. The older trees of Douglas fir and Norway spruce have responded to these thinnings and the plantation will now be managed on the Swiss system of single tree selection, controlled by basal area.

There was some discussion on the economics of this system. The main difficulties are the high weeding costs on the introduced plantings and natural regeneration. There was also the difficulty of an outlet for small amounts of produce obtained from the Selection System.

Compt. I l. This was a very fine plot of hemlock Quality Class I with a volume production of 8,620 cu. ft. at 28 years, exceeding that of Douglas fir and Sitka spruce at the same Quality Class. Unfortunately, like so many *Tsuga* plots, thinnings have revealed the trees to be infected with *Fomes annosus*.

Compt. I w. Lunch was taken in the now famous *Sequoia sempervirens* plantation. Although small, it was most impressive. It was thirty years old with a top height of 85 feet and had produced a volume of 11,728 cu. ft. with a M.A.I. of 390 cu. ft. Much interest was shown in the coppice shoots from the stumps of trees removed in thinnings. These shoots are easily rooted and several members decided to try it out for themselves.

Compt II k. This was a Japanese larch plot planted in 1938, thinned to 50 stems per acre in 1963, removing 1,750 hoppus feet per acre, and then underplanted with *Thuja* in 1963. The thinnings were converted and sold as pitprops. The response to the thinning by the crowns of the Japanese larch was interesting in that they had increased from 25% to 40%. It was proposed to grow the Japanese larch on for another 25 years until the girth was around 14 inches Q.G.

New Ground Plantation

The soil here was a heavy, yellow clay but less acid than in North Wood. The crop was of mature oak, planted 1815–34. It was the policy here to remove the poorer oaks gradually and regenerate the groups so formed with *Thuja*. This had begun in 1942 and was continuing. Thinning of the oak was done gradually to avoid having to drain.

There were questions on the difficulties of managing the uneven-aged crop of *Thuja* that would result from this plan.

A small stand of P. 37 *Thuja* was seen nearby which was being managed as a seed stand. Thinning here was designed to achieve long crowns on the chosen trees.

Dartington Hall Gardens

The Hall, built in the 14th century by the Duke of Exeter, is surrounded by very fine gardens, a unique feature of these is an old tournament ground. Overlooking this are four sweet chestnuts about 400 years old, heavily patched and treated with cement and bitumen.

The mild climate favours many tender plants and shrubs which are not seen growing outside in other parts of the country.

The tour concluded by taking tea in the White Hart dining room which is part of the new extension now being added to Dartington Hall.

Wednesday 6th May. Colaton Raleigh Sawmills

The first visit of the day was to the new sawmills owned and built by the Clinton Devon Estates.

We were welcomed to the mill by Mr. G. Fane Trefusis, and his agent Mr. N. D. G. James, who told us something about the mill and its operation.

The original estate mill was powered by water and situated at Yettington. Recently the estate decided to replace the mill with a new one because:—

1. The estate had a large programme of repairs and improvements requiring sawn timber.
2. They had a large area requiring thinning and prices of timber in the round were low.
3. Area of second quality oak needed felling.

The new site was chosen as a place that was central to the other scattered estates.

The mill was powered by electricity, the equipment all second-hand, and the buildings were constructed by the estate. The equipment consisted of two Stenner bandsaw rackbenches, one 48 in. and the other 42 in., cross-cut bench, planer, saw—sharpening machine and chisel-mortiser.

In the yard a three-ton Jones Crane was used to handle the logs.

The mill has a staff of eight men and works full time. The average weekly conversion is about 1,500 cu. ft.

A timber impregnation plant has been installed alongside the mill using the Celcure process. This was described to us by the Assistant Manager who was in charge of the plant.

Timber to be treated is loaded on to cradle trucks. Each truck-load is wheeled into a large cylinder, the door closed and clamped. Air is pumped from the cylinder and the timber remains in the vacuum for thirty minutes. This draws moisture from the timber and makes it receptive to the preserving liquid. The cylinder is then filled with the liquid. Pressure of 100 lbs. per square inch is applied to force the preservative into the timber.

Pressure is then reduced, the liquid pumped back and then a vacuum is re-applied for 60 minutes to draw off surplus liquid. Air is once again introduced

and the sequence completed. This process costs about one third of the price of creosote; it is clean, non-injurious and timber so treated will take paint. Naturally seasoned timber is preferable for treatment.

Bicton Gardens

Again we were welcomed by Mr. G. Fane Trefusis, the present owner and his agent, who gave us a brief history of the gardens. The gardens were reputed to be laid out by André Le Notre, who also planned the gardens of Versailles in the seventeenth century. The present owner's great grandfather, Lord Clinton, took a great interest in the estate and forestry in general. He was appointed Chairman of the Forestry Commission soon after it was set up.

A very recent addition to the gardens is the Woodland Railway constructed in 1962. This was inaugurated as an attraction to the gardens, which are open to the public, for it is only by revenue from visitors that it is possible to maintain the extensive grounds and their stock.

The line was surveyed, excavated and track laid by the estate staff; even the sleepers came from the estate saw-mill.

The gardens can be divided into four parts:—

1. Italian garden of formal layout with ornamental ponds and buildings. There are some very fine specimen trees here, notably four *Cedrus deodara*, probably among the first introduced into the country.

2. American garden, so called because it was originally intended to contain a collection of American trees but specimens from other countries have been added.

3. Pinetum, was laid out in 1820. It not only contains some extremely rare specimens but also some of the largest conifers in this country. In 1910 it was enlarged to include some of the conifers collected by E. M. Wilson mainly from the Far East.

4. Conservatories. There are five types of glass-houses: tropical, temperate, cacti, cool and palm-house. The tropical house was especially interesting with its collection of economic interest.

Specimens everywhere in the garden had been labelled, which for many of us was important, as often it was the first time that the plant or tree had been seen.

We concluded our visit by having our picnic lunch in the Temple from which the finest vista of the layout of the formal Italian gardens can be seen.

Wednesday 6th May, Afternoon. Exeter Forest

We were welcomed to the forest by Mr. C. A. Connell, Conservator for South West England, who introduced us to his District Officer, Mr. S. W. Rogers, and local staff.

He explained to us something of the history of the forest and its soil. Planting began in 1920 on the plateau with 871 acres and continued until 1940. In 1951, outliers were added until now the forest is 4,700 acres, mostly of conifers, the predominant being pines on the poorer gravel cap with Douglas fir on the more fertile slopes.

The tour was in two parts; first on the infertile gravel cap composed of compacted flint and chert overlying clay with impeded drainage. The soil here is very low in phosphate. The second part was off the cap, down the more fertile slopes of the Greensand on to the shales and clay of the Culm measures.

We first saw a typical piece of unplanted moorland on the cap, composed mainly of heather, dwarf gorse and *Molinia* grass. On either side were plantations of Scots pine, planted in 1923 and growing slowly. One of these was being used in a complex pole-stage manuring experiment, applying the elements

N, P, K, Ca and Mg in varying rates and combinations. Little yet has been obtained from this experiment.

Nearby we stopped at another experiment laid down in 1956 to obtain information on the best method of dealing with the worst and unacceptable pine crops on the gravel cap. The area had been cleared of vegetation by brushcutter or by spraying with 2,4,D. The ground had then been cultivated by three different ploughing methods:—

1. Single furrow tine plough
2. Ransome D.M.B. plough
3. R.L.R. plough.

Superimposed on these treatments were fertiliser forms and rates on two different planted species, Corsican pine and *Tsuga.* It was very noticeable that both species responded dramatically to the addition of phosphate and that the highest rate gave the best growth. Potassium gave no response either by itself or in combination with phosphate.

The next stop was at a large area that had been treated by the best methods shown to be successful in a local experiment. Here a mixture of Scots and Corsican pine had been planted, half on full ploughing using a tine plough, the remainder on single furrow ploughing, using the same implement. Both treatments had received 2 oz. of basic slag at planting. It was noticeable that the crop on the complete ploughing was superior in height growth to that on single furrow.

The last crop seen on the cap was planted in 1963. The area was heathland that had been completely ploughed and subsoiled, then rolled to give consolidation. Douglas fir had been planted and in spite of the severe winter of 1962/3, survival was good. Two ozs. of triple-superphosphate had been given to each tree.

We then left the plateau, by coach, for the western slopes on the Culm Measures. Here we saw crops in the pole-stage.

First was a good stand of Sitka spruce P. 22. Q.C. II, the standing volume was 4,600 cu. ft. per acre. As with many of the stands in the South west, the crop was awaiting market developments before being exploited. There was discussion on the intensity of thinning. It was explained that profitable markets for certain size classes were difficult in south-west England, owing to the long haul to centres. It was mentioned here that a very large sawmill was to be established by private enterprise at Winkleigh, on a disused aerodrome, where large quantities of all sizes of logs could be received and stacked on the old runways. This would mean that unlimited supplies of raw material could be taken.

Owing to heavy rain, the last part of the tour was curtailed and the final stop was at an area that was recently stocked with Q.C.I. Sitka spruce P.24. It had been severely windblown in the last few years due to insufficient drainage. The site was on heavy Culm clay and was to have an extensive drainage system before replanting.

Thursday 7th May. Morning: Eggesford Forest

Again Mr. Connell met the party at the forest and Mr. A. H. A. Scott, the District Officer, was introduced to us.

The party assembled at the monument commemorating the planting by the Forestry Commission of its millionth acre. The monument was of a bronze plaque set in a block of granite. Oak trees were planted by H.M. the Queen and H.R.H. the Duke of Edinburgh when Her Majesty came to unveil the plaque in May 1956. It was appropriate to site the memorial here for it was at Eggesford Forest in 1919 that the Commission's first trees were planted.

Eggesford Forest consists of 1,207 acres, situated around the watershed of the River Taw—mostly on steep valley slopes. The soil is mainly clays derived from the Culm Measures. Rainfall is around 35 inches p.a. and the mild climate makes good conditions for tree growth.

The main species grown is Douglas fir, its growth is uniform and most stands are Q.C. III.

The Working Plan for the forest has to bear in mind the amenity angle of the forest, situated, as it is, in a popular Devon valley. Any clear felling must be carried out in small groups.

We were shown a typical Douglas fir stand where the final crop trees had been chosen, at seven yard intervals, marked with paint and high pruned. This would give 100 s.p.a. of final crop trees.

There was the usual discussion on the type of thinning made. It was explained that thinning was varied to enable an even supply to be made to the trade.

The area, when taken over in 1919, was densely covered with ash seedlings and, as the previous crop of ash was supposed to have been of excellent quality, many of these were managed to form a mature stand but none fulfilled their promise. Ash areas were now being felled for pulp and Douglas fir will be planted in their place.

We saw further examples of the original ash in the Flash Down block, together with areas of mixed hardwoods, mostly ash, some of which had been clear cut and planted with Douglas fir in 1963.

The local forester had a Mist-blower on show which had been used to kill out the bramble by low-volume application of 2,4,5–T. Ammonium sulphamate had been used to prevent regrowth from the cut stumps of the previous hardwood crop. Discussion took place on the weeding of such areas and several members thought that by extermination of the bramble, grass would quickly become established making the weeding problem worse.

Thursday afternoon: Heanton Satchville

Once again we were the guests of Mr. Trefusis, who, with his agent Mr. N. D. G. James, introduced us to an outlier of the Clinton Devon Estates.

The particular block we visited had a problem, common in North Devon woodlands, namely the felling and replanting on very steep valley slopes. Access and extraction were the main difficulties to be overcome.

We began our tour at the Little Potheridge Farm where a unique means of transportation had been organised for the party in the form of a fleet of tractors, drawing trailers containing positioned straw bales for seats. The party moved off in convoy down narrow Devon lanes, looking as though our destination was the Harvest Dinner.

Our first stop was at an extremely steep valley side that had been clear felled of the oak and ash scrub for £45 acre. A 50% rabbit clearance grant was allowed thus reducing the cost to £22. Across the slope, a road had been bulldozed—the 570 yards having cost only £81 or £9 per acre. The area had been planted with Scots pine which had taken well. The cost of planting, including the trees, was £28, making the total cost of establishment at £50 per acre.

The party then continued on the trailers down the valley bottom to the River Torridge, passing plantations of various conifers planted from 1920 onwards, all of which were well labelled, giving data on the crop.

Returning back to the farm, we continued by coach to Heaton Satchville, the home of Mr. Trefusis, where tea was provided for the party in a marquee on the lawns. Rain, which had been threatening all day, began just as we were getting into the coaches for our return to Exmouth.

Friday 8th May: Killerton Gardens

The party were welcomed to the gardens by Sir Richard Acland, who told us something of the history of the gardens before we split up into parties to tour the grounds.

Killerton Gardens were given to the National Trust in 1944 by Sir Richard. They were laid out by Sir Thomas Acland after the Napoleonic Wars. The soil varies from a rich fertile loam derived from the Permian Red Sandstone to the more acid soil of the volcanic hill to the north of the house. This area is especially suitable for the rhododendrons and azaleas, of which there is a fine collection. The mild climate makes it possible for many of the more tender species to thrive. We were fortunate in that the season of our visit enabled us to see most of the rhododendrons and azaleas in flower.

A very fine specimen of *Cornus nuttallii* was in flower as also many magnolias, including the Chinese handkerchief tree. The vivid red flowers, against the dark green foliage of some *Embothrium coccineum*, made a startling show in a shady corner.

All the eucalyptus specimens seen had suffered damage and die-back from the severe winter of 1962–3, including the hardy *Eucalyptus coccifera.*

The mild climate had allowed a *Quercus suber* to grow to a considerable size.

In the Chapel grounds, most of the specimens were of mature trees. Of the most notable was a fine Turkey oak, *Quercus cerris*, and two grafted Lucombe oaks, *Quercus hispanica.* The latter commemorates a local nurseryman at Exeter about 1765. There was also an example of a broad-leaf evergreen oak, *Quercus acuta*, which looks more like a laurel than an oak at a distance.

It was not possible, in the time, to see all the gardens and parties joined Sir Richard at Killerton House at noon for sherry before departing for home.

The tour had been very interesting and most instructive. This was due to the work put in by our various hosts and by discussion at all times amongst members of the party.

PRACTICAL HINTS ON EXCURSIONS

by

PROVINCIAL FOREST OFFICER OEHLER, *Tübingen*

Translation of article in "Allgemeine Forstzeitschrift"
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by

S. H. SHARPLEY, *Executive Officer, Publications*

When, from 10th to 20th July, 1778, Duke Karl Eugen of Württemberg rode in the company of students at the College of Hohenheim to visit the great forests of Neuenbürg, Altensteig and Freudenstadt, it was not only a remarkable sporting achievement; it was one of the first large-scale forest excursions. Of course, it was probably concerned with less far-reaching considerations of afforestation than were the great drives which were being carried out at the time by Calwer Timber Company and the Pforzheimer Company, who opened up the large unused stocks of timber in the northern Black Forest by making floating possible on the Enz, the Nagold and the Murg.

The creation of transport routes resulted in forestry associations being set up during the last century, and this in turn opened the way for forest excursions.

In 1869, at Aschaffenburg, the Society of South German Foresters became the Society of German Foresters. This has now become the German Forestry Association. Even in the more limited field the need soon arose for the mutual

stimulus and development provided by communal forest visits and discussions on practical and scientific forestry questions. The numerous reports of visits and excursions are proof of this.

In Württemberg there were rallies of forestry officials within the Forest District, under the leadership of the Forest Officer. A visit by Forest Officer von Schiller (a son of the poet) at Neuenstadt was mentioned as early as 1849. Excursions were also carried out by the forestry societies of the "readers' circles", which lasted for many years. Larger societies were formed as a result of neighbouring Districts joining together for forest visits. But the Württemberg Forestry Association was not set up until 1876, at Crailsheim, after several attempts.

Fischbach said in 1854: "May there be more of these rallies. They give an opportunity for education, competition, and exchange of valuable experience which, if everyone went his own way in his own forest, could only be acquired by much unnecessary expense of time and money".

In 1855 Gwinner described the German forestry associations as "safeguards against the danger of foresters becoming isolated, whether through timidity and habit or high-and-mighty exclusiveness".

Nowadays, numerous excursions are organized, by educational institutes, by branches of the Administration, by forestry associations of all kinds, and also in the context of public works. They promote practical education and the exchange of experience. They help to maintain the bond between foresters both within the Province and outside it.

It may therefore be appropriate to offer a few hints on how excursions should be carried out in practice, for the benefit of leaders, or at any rate of those taking part. They are not meant as rigid instructions.

1. No 'excursion areas' should be laid down. There are current problems in every place and the forest manager who faces the problems must discuss them with colleagues everywhere.

2. Though the excursion has a definite theme, that does not prevent things of special interest being looked at outside the theme.

3. **Leader and Guide.** The Leader leads the excursion. He ensures that the chosen theme is illustrated from all possible angles; that the subject does not get out of hand; and that anyone who has a contribution to make has a chance to speak.

The Guide is the official in charge of the Forestry Office which is being visited. He arranges the itinerary and describes the locality. At the outset he must give general information on climate, geology, soil, standing trees, internal and external transport, markets, administration, size of District, working conditions, wildlife and so on. This information is important in deciding whether the conclusions arrived at can be applied to differing conditions elsewhere. Though local experience should not be applied indiscriminately to other places, it is just as wrong to generalize and say that though things may be all right in one place they cannot possibly have any value under other conditions.

4. The distribution of duplicated excursion guides containing general and local information saves time, and these are useful later as aids to memory.

5. To prevent the excursion from spreading out too much it is as well to limit it to 30 people. The fewer the better, but if there are too few the expense is not justified. If small groups of people carry on private conversations during talks it is a sign of disintegration, and the leader must take steps to prevent it. He should be supported in this by the members.

6. When our forefathers visited a District they drove in horse-drawn vehicles, but often they went on foot. This ensured that they at least got a general impression of the District. By the use of motor vehicles—buses and coaches—we are able to drive to selected places, picking out the plums. By doing this we risk

losing our bearings between these points, and getting an incomplete impression. We must be careful about this. Maps cannot always be handed round to each person, but a map of the District can be displayed. Frequent reference should be made to it, showing the route travelled.

7. Those taking part should not be too reserved. It gives offence when people with practical experience remain silent, leaving only higher-grade officers to dictate the course of the discussion. It is equally annoying when an obviously inexperienced member insists on giving his own views.

8. Visits to a District during the absence of the forest manager, very likely involving criticism of him, should be avoided.

9. Transport should, where possible, be by coach. This saves time and money, avoiding secondary journeys to and from the points of interest. The route should first be gone over to make sure that the forest roads are all adequate for the coach; that there are no stout jutting branches; and that no part of the route is closed for timber-sawing or extraction work. When using buses the route and meeting points must always be given, especially if the route goes along public roads or through towns with traffic lights, where the party can easily come adrift. Liaison towards the rear is the golden rule.

10. Local officials should always be present at excursions. For long forest trips it is a good plan to appoint a local man to show the way. He should always bring up the rear and collect stragglers, so that no one can get lost.

11. Do not miss places of special scenic or cultural interest if they are on the route.

12. The excursion should not be too long, exacting, or tiring.

13. At the finish it is the leader's job to summarize the most important results of the discussion, and to thank the guide and others concerned in the organization of the excursion.

14. An account of the proceedings should be written down by a Secretary for the benefit of those who could not attend, and for future generations. Excursion reports, especially the old ones, are a valuable source of forestry information.

15. The art of good organization lies in concealing itself.

THE EVOLUTION OF FOREST MANAGEMENT IN HERTFORDSHIRE

by

W. O. WITTERING

Higher Executive Officer, Research

Hertfordshire at one time was well-wooded. The Forest of Middlesex covered most of the area between the valleys of the Colne and Lee and a large part of the Chilterns Forest also lay within its boundaries. Traces of these forests remain to this day, but though Hertfordshire is no longer famous for its forests, it still retains a greater covering of trees than many English counties.

Domesday

The earliest record of an attempt to enumerate the woodlands of Hertfordshire came with the Norman Conquest and the great Domesday Survey. The county's woodlands were evaluated according to their ability to support pigs (i.e. to provide pannage); the species being largely oak and beech, the swine fed on the acorns and beech-mast. At the time of the Conqueror, our woods were recorded as being able to support 30,720 swine but it would be extremely risky to try to convert this figure to acres and we are left in doubt as to the exact

extent of the tree coverage. The largest holdings were those of the Abbot of St. Albans and the King. As well as those woodlands capable of supporting pigs, thirty-three estates are said to have been able to produce wood for fencing.

It is possible, however, to obtain a fair picture of the distribution of woods at that time. The villages in the southwest of the county are recorded as having a large number of swine and hence must have had large areas of woodland within their bounds. Generally, those of the northeast had very much smaller numbers of swine. This distribution reflects the surface geology, the heavy clays supporting the woodland as is the case today.

In the time of Edward the Confessor and William the Conqueror, Ramsey Abbey owned Therfield Manor and particulars of the estate, dated 1271, show that each tenant had to maintain a rood of fencing around the wood, to cut two faggots of sticks before Hockday (the second Monday after Easter) and three afterwards and also cut three faggots of underwood before Hockday and five afterwards.

Tudor Times

Four and a half centuries after Domesday the Dissolution of the Monasteries by Henry VIII (circa 1539) brought about considerable depredations to the woodlands which hitherto had been so well managed by the monks who had regarded them as part of the nation's heritage, to be nurtured with care and handed on in an improved condition. Under their new occupants, who did not own the land but were merely Crown tenants, the woods were very quickly exploited; all the good timber trees being removed with little or no thought for the future.

In an attempt to halt this depletion of the nation's timber resources, a Master of Woods was appointed in 1541 without whose authority sales of timber from Crown woodlands could not take place. Under this statute, the Crown appointed a Commission of six men to sell to the greatest advantage "all the underwood and wood of Connes Grove (18 acres) and Hyllys Grove (4 acres) parcel of the Manor of Hatfield lately belonging to the Bishop of Ely, but saving all manor (sic) of greate tymbretrees and saplying oykes lyke to be tymbre and certyn standes in every acre of the promisses according to the Custome of the Country." Open proclamation of the sale of the same to the highest bidder was to be made "in the Church of the Town next adjoynyng to the saide woode." At the same time, other Commissioners were charged with the sale, under like restriction, of 36 acres of wood of the manor of Abbots Walden, late parcel of the possessions of the Abbot of St. Albans.

Two years later, an Act of Parliament was passed applying to *all* woodland, whereby: "in every copse of underwood felled at 24 years growth, 12 standrells or store oaks (or in default, elm, ash, asp, or beech) to be left standing on each acre; when cut under 14 years, the ground to be enclosed or protected for four years; when cut from 14—24 years to be enclosed for six years." Cutting trees on waste or common land was to be punished by a fine of 6s. 8d. for each tree cut. Elizabeth strengthened this Act in 1570 by extending the period for enclosing copses against damage by cattle after felling.

After this date, various steps were taken during Elizabeth's reign to check the spoliation of the woods of Hertfordshire. In 1575, a special Commission was set up to inquire into the "wastes and spoils" of wood on lands belonging to Colney Chapel (now Colney Heath). In 1577 another was appointed to inquire into the spoiling of the woods in the manor of Hatfield then belonging to Her Majesty the Queen.

Seventeenth Century Forestry

Broadfield Estate near Buntingford was an example of good forest management in the 1600's. Reginald Hine in his "Relics of an Uncommon Attorney" describes how the estate came into the ownership of James Forester who inherited it from his grandfather Arthur Pulter in 1689. He devoted a great deal of his time to improving the estate woodlands and in some of the outlying undrainable areas, as at Great Wymondley, he tapped a new source of income by planting osiers (willows). The woodlands were the best income-earning part of the estate. In 1604 when England was building more ships, the estate (then in the hands of his great great grandfather, Edward Pulter) furnished the King with 663 timber trees, and out of the trees planted in their place, Forester was able, in his first year on the estate, to market 39 oaks and three ashes from Foxholes Wood alone. On 7th March 1690, he sold a parcel of ash timber to two wheelwrights at Barkway for 11d. per foot. He paid 6d. per tree for felling; bark peelers were paid 4d. per yard and the bark was sold to a Hitchin tanner at just over 1/- per yard. His workers produced faggots at the rate of ten a penny. To clear the ground for replanting, he blasted away unwanted stumps and roots with gunpowder.

At the sawpit which he constructed, he paid 1s. 4d. per 100 feet for "running" work and 2s. 6d. per 100 feet for "breaking" work. He kept a special hand to "look to ye woods" and his plantings must have been considerable for when in 1849, the estate fell into the hands of a timber merchant, the latter was able to recoup £7,000 of his purchase price of £22,000 from selling the finest of the trees. Forester planted a fine double avenue of limes leading up to his mansion; the 172 trees cost him 1s. 3d. each, the plan being based on that of Hamels Park near Puckeridge.

The fence around Cottered churchyard was made from trees felled in 1633 in Walkern Park and trees from Broadfield provided the frame for the Tables of Degrees of Marriage, the communion table and the altar rails.

Board of Agriculture Report, 1795

In 1795, the Board of Agriculture caused a report to be prepared dealing with the agriculture and forestry of Hertfordshire. The following extracts are of interest:

"Independent of the woodlands contiguous to the seats of gentlemen, nearly the whole county is interspersed with small woods and coppices, and these generally occupy the most barren and gravelly spots which are well adapted to the quick growth of underwood. The woods are well fenced in when cut and preserved from the bret [damage] of cattle and also drained if necessary. As the growth of hop-poles is not attended to, the woods are cut in succession about every ten years and the straight saplings of oak, ash, beech, sallow, birch, poplar, hornbeam or any other woods either from stub or seed are preserved until the succeeding fall and then a good succession of oak, ash, and beech seedlings are preserved. The rest are cut down and split for sheep flakes [hurdles].

"Great part of the underwood is hazel and a conversion of the straight hazel rods into hoops [used for sugar barrels] for the West India trade would be much more to the advantage of the growers than into charcoal or firewood, but this conversion is not much understood or followed in Hertfordshire. A good plant [plot] of thriving underwood may be averaged at 20/- per acre per annum."

The report, produced with such painstaking care by D. Walker, also noted that the county possessed a considerable quantity of timber fit for the Navy and "inferior shipping," and anticipated that a large supply would eventually be brought to London via the Grand Junction Canal. Peeled oak timber was being sold at that time near Berkhamstead on the canal at £3. 10. 0 per load which

Walker felt would have been worth at least £5. 10. 0 at any of the King's or merchants' yards.

Board of Agriculture Report, 1804

A more elaborate report on the county was prepared by the Board of Agriculture in 1804. The Secretary, Arthur Young, devoted a whole chapter to the consideration of the woods; he wrote:

"The woods in the county between Hockerill, Ware and Buntingford are generally rented at about 12/- per acre and are cut at twelve years growth when the produce is worth about £9 per acre. On a poorer soil the Marquis of Salisbury has 1,500 acres that do not yield above 7/- per acre.

"There are large tracts of woodland south of Hertford towards London, 2,000 acres almost altogether. When let to tenants, they are cut at nine to ten years growth that they may be cut twice in a 21-year lease, but they are mostly in the landlords' hands and are then cut at twelve years. At twelve years they produce from £4 to £12; they are chiefly applied to the making of faggots except the sallow and willow which make hurdles.

"Mr. Rook of Hertford has hollow-drained many acres and found it a very capital improvement. That gentleman estimated that *timber* if well-managed should at every cutting of the underwood produce as much as the sale of the *coppice;* he makes it a rule to mark every tree himself.

"At Beechwood, the best underwood in Sir John Sebright's copses is black sallow superior to all the rest; of this, hurdles are made; hazel and ash are the next in estimation. When black sallow abounds, an acre at twelve years growth is worth £15, paying better than the adjoining arable land without including the timber that is taken; this is particularly valuable. Wherever Sir John cuts down a timber tree in a copse, he plants a black sallow set, not a cutting as that will not grow. The sallow takes well and thickens the wood considerably with the most valuable of the copse tribe. I have rarely seen finer trees than at Beechwood. It has the name in strict propriety for the number of stately beeches is great, but the soil agrees with all sorts of trees, the cedars are immense, the oak very large, the ash straight and beautiful, the larch, spruce and scotch fir equally fine, but the birch uncommon. This wood is sold to the use of turners and since the war [against Napoleon] very much to barrel stores for dry goods. It was formerly 7d. a foot, now 1s. 2d. Sir John has sold oak at £6 a load without top or branch.

"About Kings Walden, the woods are let at 10/- per acre. Lord Grimston at Gorhambury lets his woods at 8s. 9d. per acre but his lordship has much timber in them. He sells his oak naked [peeled] at £5 to £6. 5. 0. the load, and a load gives fifteen yards of bark three yards broad and one yard high which sells at 3s. 6d. a cubic yard and costs 6d. in labour.

"At the Earl of Clarendon's at The Grove [north of Watford], ash, elm, beech, larch, silver fir and sweet chestnut thrive best. For a copse, the last excels and is far beyond the black sallow. Birch as underwood is good and on all soils from a rock to a bog. In cutting copses at twelve years growth, the beech are left for a second fall being always cut at twenty four years. These woods are let at 9/- per acre but full of timber which adds 5/- to the annual rent.

"On low ground, alders succeed which are brought by turners and pattern makers. Beech is burnt for charcoal. When I consider the immense number of crates and similar wooden packages for heavy goods required in London, I am surprised that the woods in Herts. should not pay more.

"Much of the timber in Moor Park is of great antiquity and no inconsiderable portion of it is in a state of decay. I know not any place where a large quantity of very old pollards mixed with many fine and stately trees and some woods of young and thriving timber unite better to form masses of a deep impenetrable

gloom and the ground being waved into bold inequalities of surface lofty enough to command all the surrounding fertile country. It forms upon the whole a place as beautiful as can be found without water for the reigning gloom of the woods is a happy circumstance so near London. The boundary fence rarely appearing, one might easily imagine it to be the centre of a vast forest.

"In the Duke of Bridgewater's park at Ashridge the timber is in great quantities and many of the beech and oak are of vast size.

"Mr. Sedgwick of Rickmansworth thinks it bad management ever to let woods to a tenant as they will never nurse up timber in the manner a proprietor will do."

Early Twentieth Century

Dr. E. J. Salisbury of Radlett visited most of the important woods of Hertfordshire many times in the early part of this century and found that by far the larger part were oak woods dominated either by Pedunculate oak (*Quercus robur*) or by Sessile oak (*Q. petraea*), the former on the heavy clays and clayey loams and the latter on the lighter loams or sandy soils. He noted that a considerable proportion of the oak was in mixture with hornbeam; in the south-east of the county the sessile oak/hornbeam woods predominated while in the west the woods were mostly oak with hazel. In the majority, he found the shrub layer to be extensive and periodically coppiced; he commented on the 1795 Board of Agriculture Report and said that in 1909 coppicing was carried out every fourteen to sixteen years, sometimes even twenty years. He added that the term "coppicing" loosely included the removal of the standards in succession and that the two processes often followed each other, the pure coppicing taking place in January to March and the felling of the standards in April and May, the standards usually being felled at between 80 and 100 years of age. [The standards were felled in late spring because at that time of the year the valuable tan bark is easily removed.]

Modern Woodland Enumeration

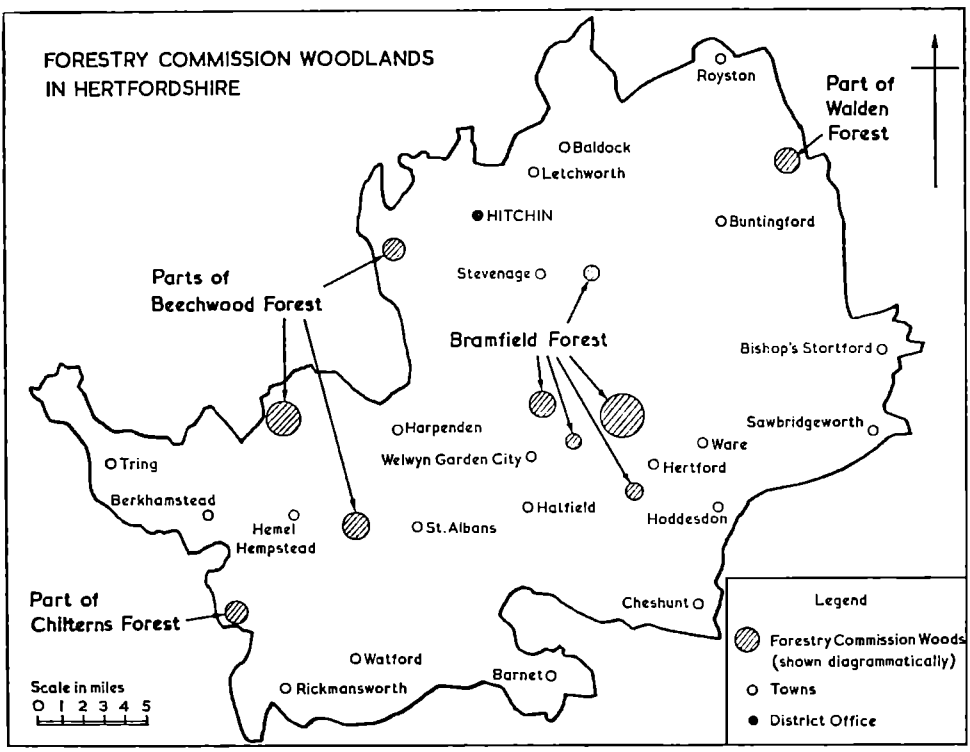
In the past, various censuses of woodland areas have been carried out as described in the Victoria County History. Though the woodlands were divided into "Plantations", "Coppice" and "Other", the definition of the categories seemed to differ between surveys, but the total areas are worth consideration.

The Board of Agriculture carried out a survey in 1913, woodland owners being required to complete and return a form giving the details for their own estates. The results of these and subsequent surveys are shown in the table below:

Table showing results of Woodland Surveys carried out in Hertfordshire 1891–1956

Year of Census	*Area of Woodland (acres)*	*Percentage of land area of county**
1891	23,151	5·7
1895	24,543	6·1
1905	26,568	6·6
1913	20,980	5·2
1926	25,912	6·4
1934	26,500	6·6
1949	26,401	6·6
1956	27,807	6·9
1956 (with woods of 1—5 acres)	30,461	7·5

NOTE: *The total land area of Hertfordshire according to Ordnance Survey is 402,740 acres.



After its constitution in 1919, the Forestry Commission decided that a complete inventory of British Woodlands was necessary and work started on a nation-wide census in 1921 but was not completed until 1926. Most of the work was carried out voluntarily by "county organisers" who recorded on six-inch maps the outline of woodlands over two acres in extent. The maps were then forwarded to the owners of the woods who marked in the type and class. This census had inherent defects such as variations in accuracy and fullness of the returns, and in the interpretation of the instructions. The report showed that there were 25,912 acres of woodland in the county made up of 9,123 acres of high forest, 12,086 acres of coppice, 420 acres of scrub, 1,824 acres felled or devastated and 2,459 acres classed as "uneconomic", a term which included shelterbelts and amenity woodlands.

A little later, a Land Utilisation Survey was carried out by the London School of Economics directed by Professor L. Dudley Stamp, who found that in 1934, 26,500 acres of the county comprised woodlands.

A further survey was carried out in 1937 by the National Home Grown Timber Council and was confined, strangely, to the woodlands of Hertfordshire. No report seems to have been made public and the Council was wound up in 1939.

With the war looming ahead, the Forestry Commission started another census in 1938 which had to be speeded up and hurriedly completed when war broke out the following year. The Ministry of Supply carried out a census of its own in 1942 to find out what timber was available to help fight the war. These two enumerations became out-of-date very quickly by the rapid and unabated fellings necessitated by the demands of the war machine.

The biggest woodland census undertaken since Domesday was instituted soon after the war when surveyors of the Forestry Commission visited every

wood of five acres or more in Great Britain. The data was revised and brought up to date in 1956. The figures relating to Hertfordshire are worth examining. The area of woodland of five acres and over in 1956 was 27,807 acres, a gain of 1,406 acres since 1949. In addition, the 1956 revision included woods of one to five acres in extent which were not detailed by counties in the earlier survey; 2,654 acres fell into this class giving a grand total area of 30,461 acres, 7·5% of the land area of the county.

High Forest (i.e. woods normally grown to maturity) accounted for 15,558 acres (56%); coppice 6,476 acres (23%); scrub (i.e. inferior growth unlikely to develop into a utilisable crop) 4,367 acres (16%); devastated (i.e. stands from which the best trees had been removed) 831 acres (3%); and felled areas 575 acres (2%).

In the High Forest areas, oak was the commonest species (40%), followed by beech (12%), ash (9%), European larch (7½%), birch (7%) and elm (5%). Broadleaved species accounted for 84% of this category and conifers 16%.

In the "coppice with standards" classification, the most common mixture was still as found by Dr. Salisbury at the turn of the century, oak with hornbeam. In fact, oak with various types of understorey accounted for 81% of this type of woodland. In the pure coppice (without standards) hornbeam was the most common species with 66% and was mainly confined to the southern half of the county. Little of it is now worked as coppice mainly because it can no longer be sold for charcoal burning.

Thorn accounted for 32% of the total scrub area followed by birch (22%), and hornbeam (18%). Much of the thorn and birch was attributed to the colonisation of derelict agricultural land. The hornbeam scrub would previously have been classified as coppice but had become overgrown and unmanageable.

Between 1947 and 1956, 1,165 acres (4% of the woodland area) were lost to forestry, 58% of this "lost" total going to the drive for post-war housing, and 31% to agriculture, the remaining 11% to a number of other causes.

The Advent of the Forestry Commission

The Forestry Commission was established under the Forestry Acts of 1919 to 1951 to promote the interests of forestry, the development of afforestation and the systematic management of woodlands, and to provide for the maintenance of reserves of growing timber in Great Britain.

The Commission's direct planting work, as distinguished from advice and grants to woodland owners, did not extend to Hertfordshire until January 1948 when 500 acres of the Woodhall Estate woodlands, near Bramfield, were acquired. The Commission's land in Hertfordshire is generally held on long leases with the standing timber, if any, reserved to the lessor, the land being replanted by the Commission when the owner has cleared the timber. Bramfield Forest, except for small parts known as the Navestock Woods in Essex, lies almost completely in Hertfordshire and, as well as the Woodhall Estate woods, includes the Balls and Beaumont woods to the south of Hertford, Box Wood between Stevenage and Walkern, and the Harmer Green woods above Welwyn tunnels, formerly part of Lockleys Estate. In the west and north-west of the county, another Commission forest known as Beechwood is situated. Its nucleus is the woodland so well looked after by Sir John Sebright in the eighteenth century and that of Lord Grimston at Gorhambury described in Arthur Young's report of 1804. To these have been added some isolated blocks from Putteridge Park around Lilley; one or two blocks lie in Bedfordshire. On the eastern marches of the county north-east of Anstey, Scales Park and East Wood form part of Walden Forest the remainder of which is in Essex. The fourth forest intrudes from Buckinghamshire with a few small blocks west of Sarratt and Chipperfield, the forest being known as Chilterns. In all, the Commission

now controls something over 2,500 acres of planted and plantable land in Hertfordshire.

Most of the land acquired for planting is known as derelict woodland, that type of former coppice-with-standards from which the bulk of the useful timber trees have been removed—mainly during the 1939/45 war. These are mainly of the oak/hazel and oak/hornbeam coppices lying on heavy clays. The Commission was faced with a difficult problem in deciding how best to deal with this type of land and has tried various methods. In the early acquisitions (early 1950's), the treatment was to clear the coppice completely and replant it with a mixture of Norway spruce and oak. At Bramfield in particular, clear felling was resorted to and a conifer species (either Douglas fir, Scots pine or European larch) was planted with a broadleaved species (oak or beech); the principle being that the conifer, being faster growing, would act as a nurse to help establish a final broadleaved crop. The disadvantage of this method was the initial high cost of clearing the coppice and the subsequent heavy weeding; the method suffered from too great a regrowth of the old coppice with the result that weeding and cleaning had to be carried out for eight years after planting to establish the crop at a cost of something over £100 per acre.

A different method had to be found and it was decided to thin the coppice sufficiently to permit underplanting it with shade-tolerant conifers which as before would act as a nurse to raise a final broadleaved crop. At Bramfield and Box Wood, a mixture of Norway spruce, Lawson cypress, Western red cedar, Western hemlock and Douglas fir with beech was tried. It was hoped that the conifers would gradually suppress and replace the existing coppice.

This method retained the existing cover, the amenity value of these woods in this increasingly residential area continued unimpaired, and the sporting was actually improved. As an extension of this method, the coppice was critically surveyed and any sycamore, ash, beech or oak poles of good quality were retained to form the final crop, the remainder being cut back. It was soon realised, however, that there were few areas where there were sufficient existing suitable pole trees for this scheme to be practicable, and what trees there were eventually had to be underplanted as described above. Beech was used as the broadleaved species where there was sufficient lime in the soil; oak being planted on the fertile clays.

Within the past three years, the coppice on the heavy clay and gravel on parts of Bramfield and in the Potterscrouch woods at Beechwood is being cleared and replanted with Corsican pine. A belt of thinned coppice is left around the conifer crop for amenity purposes and this belt is underplanted with beech. Here and there, amongst the pines, small plots of uncleared birch have been left and these have been underplanted with a North-west American silver fir, *Abies grandis*.

At Scales Park, there is less hornbeam coppice than elsewhere, the species on acquisition being mainly oak, ash and hazel. It has now been heavily thinned and replanted with Corsican pine with an outside amenity belt as at Potterscrouch. The coppice tends to suppress the weeds during the initial establishment but, because the pine needs light, the coppice has to be cleared after about three years. There are also "multi-species" plantings as at Bramfield.

Costs have been reduced in recent years in dealing with this type of woodland by using hormone weedkillers which are applied to the cut stumps, effectively preventing regrowth of the coppice.

When the Commission acquires a piece of land, the ground is firstly prepared for planting by clearing or cutting back the existing growth as described above, it is then fenced so as to contain the rabbit population which can then be systematically cleared by a warrener, then drained—a very necessary operation on heavy clay. Next, a squad of men come in to plant the small trees. The bulk of

the plants used in the Commission's woodlands in Hertfordshire are raised from seed in the Commission's nursery at Ampthill Forest in the neighbouring county of Bedfordshire. Roads are put in at an early stage so as to give access in case of fire and to permit the extraction of the resulting timber. Small parcels of the timber produced in the Commission's Hertfordshire woodlands are sold standing to timber merchants, but the Commission has with its own labour successfully thinned old trees acquired on the initial lease of Gorhambury from the Commissioners of Crown Lands. The produce, mainly larch, is converted and sold as rustic poles, fencing stakes and rails, stakes to support ornamental trees planted in new towns, and as raw material to make larch lap fencing. The methods in operation in the thinning areas and elsewhere are those recommended by the Forestry Commission's own Work Study staff and are some of the most modern available.

The Future

What of the future? Regrettably it seems that forestry on private estates and in the National forests has reached the maximum acreage it is likely to achieve. The demands for more and more land for the ever increasing London sprawl are with us to a greater extent than ever before. Let us therefore take care of the woods we have and, like the sixteenth century monks, see if we cannot hand on to our successors something worth cherishing.

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THE FORESTRY EXHIBITION

by

MISS L. M. STARLING

Clerical Officer, Publications

The first major, all-British forestry exhibition was held on June 17th and 18th, 1964, at Blackbushe Aerodrome, near Camberley in Surrey. The 250 acre showground lay in the heart of Bramshill Forest and the rides and racks of the forest itself were used to demonstrate some of the machinery. The exhibition was attended by 15,000 people whose forestry interests, though widely different, were all well catered for. Almost every firm and organisation with forestry interests supplied exhibits which served to inform the public on such subjects as the conservation of wild life in the nation's forests, amenity and public recreation without interference with the essential work of the forester, the integration of farming and forestry, and, of course, the national importance of

economic production of timber. There were 177 separate exhibits, so it is only possible to mention the highlights of the show in this short account.

The principle theme of many of the demonstrations was to show the public what took place between seed collection and sowing, and felling and extraction. Collection of seed from high trees has long been a problem to the forester, but the demonstration of the Tree Bicycle showed that this could now be efficiently and safely done. H.R.H. The Duke of Edinburgh, who visited the exhibition on the second day, was clearly impressed by this. An unexpected slip by our tree climber received much press publicity, but only served to confirm the security value of our latest, re-designed, safety harness.

Other modern seed collection methods included the use of tree nets and light alloy ladders, all of which emphasized the safety aspect. The Forestry Commission keeps a detailed list, available to private woodland owners through the Tree Seed Associations, of reliable seed sources in Britain.

Coachloads of people were periodically driven to a forest nursery, two miles away, to see how the seed was sown, how the young seedlings were tended and how the nursery was maintained. The value of proved chemicals in weed and pest control was stressed.

Some of the most impressive machinery demonstrated was used in the preparation of land before planting. The new Bogmaster Drainer, developed by the Machinery Research Unit at Alice Holt, was on show; so too were some powerful combinations of tractor and plough used to combat poor, stony soils on mountain slopes and moorland—notably a County Crawler tractor with the long Cuthbertson deep-drain plough which has a Cuthbertson-type mouldboard; a Fiat Crawler tractor and a hydraulically operated Parkgate trailed tine plough; the International BTD8 with winch and Parkgate twin-tine plough; and a mighty hydrostatic-transmission tractor.

Maintenance of forests was a subject of keen interest. The Chartered Land Agents' Society were at hand to explain how best to preserve timber for use as gate and fence posts. They had specimen posts which appeared strong and as good as new after nearly 40 years use. Roadmaking without any previous preparation was also demonstrated. One of the most impressive pieces of machinery used here was the 135 horse-power Fowler Challenger 33 bulldozer. The Commission is, at present, building 600 miles of forest roads a year.

There was much information on the use of chemicals to fight bacterial and fungal diseases in young plantations. Exhaustive experiments to find effective and safe chemicals are being carried out by our staff at Alice Holt, and results were readily available both by word of mouth and by the many comprehensive publications issued on this subject. Advice was also available on the protection of woodlands against wild life, including deer, that proved troublesome.

All up-to-date thinning and felling techniques were shown, and the whirr of the power saw was a familiar and distinguishable sound. The Machinery Research Unit showed their recently developed pendulum saw. Some of the largest and most powerful machinery of all was that concerned with the extraction of timber. Many of them are designed to cope with all sizes of timber and all types of land. Amongst some of the latest developments were the Isachsen Double-drum Winch, the Alice Holt Drawbar and the Thetford Tongs. Although the most complex of extraction machinery may not be accessible to the private woodland owner, the majority of them may well be operated to their benefit by contractors.

One machine which excited much interest was the Tree Mover. The machine used was owned by the Scottish Land Development Company who, in liaison with the National Coal Board, have carried out valuable amenity work. Housing estates and modern civic centres owe much of their beauty to tree planting developments.

Equipment for loading pulpwood onto roadside lorries was fully covered and included the Hiab Hoist and a National Coal Board product—the belt loader, which proved very attractive to the private owner.

Conversion techniques were also fully demonstrated. Bark peeling machines and modern saw benches were amongst products shown. Production figures and profits from various thinning, felling, extraction and conversion equipment were given. Emphasis was laid on marketing and utilization. Much of our small dimension timber is bought by the pulpwood and allied industries. When the great Fort William pulpmill in Inverness-shire opens shortly, it will be utilizing 1,000 tons of pulpwood a day. The G.P.O. had an exhibit to show that they purchase a great deal of good timber for use as telegraph poles; the National Coal Board also buys large quantities of quality softwood to be converted into pitprops. Some of the larger pulpwood organizations exhibited detailed models of their plants, and representatives were at hand to explain how they operated.

One of the most popular subjects of the whole exhibition was the mock forest fire which was very realistically staged to show modern fire-fighting vehicles and liaison with local Fire Brigades. The Machinery Research Unit demonstrated a Land Rover with tractor-sized wheels; it was fully equipped with water tanks, portable pumping units and hoses. This Land Rover can cope with the most treacherous of bogland.

There was much of interest besides the silvicultural aspect of forestry. Education was well dealt with, and the University forestry departments of Aberdeen, Bangor, Edinburgh and Oxford, were represented. An exhibit of much interest was that provided by the Chaulden Junior Mixed School, Hemel Hempstead, Herts—one of the many schools now operating a School Forest. The children themselves were explaining the type of work they did in their school forest, and they seemed well versed in the basic principles of forestry. It is satisfying to know that such children will grow up respecting the value of the nation's forests and realizing the dangers of public negligence.

Much attention was also paid to amenity and public recreation, and exhibits by the Ramblers' Association, the Camping Club and the National Parks Commission showed how these pursuits could be integrated with forestry. The Forestry Commission explained that their policy regarding wild life in the forest is one of management and not extermination. It has been said that by developing sporting rights, deer and other animals can prove a financial asset to the Commission. The Nature Conservancy and the National Trust also had exhibits to explain the value of rural beauty and conservation of our indigenous woodland creatures.

Thus, by the enthusiasm of all concerned, the 1964 Forestry Exhibition succeeded in filling a long-desired need—to show the public just where forestry fits in with the pace of modern Britain.

The exhibition was organised by Mr. J. Q. Williamson, Director of Forestry for Wales. His assistants included Mr. C. D. Begley and Mr. L. G. Cross, who are respectively District Officer and Head Forester in charge of Bramshill; also Col. R. G. Shaw, Mr. J. R. Aaron, Mr. A. L. Fagg and Mr. D. Healey from Headquarters, and Mr. P. F. Garthwaite from the office of Director, England.

Photos appear on our centre pages.

THE SCOTTISH GAME FAIR, 1964

by

R. T. F. LARSEN

District Officer, Directorate (Scotland)

The Fair took place on 24th and 25th July at Blair Drummond, near Stirling, Perthshire. The home of Sir John Muir, Bart., Blair Drummond with its sweeping parkland and clusters of fine old trees formed an ideal setting for the first event of this kind in Scotland. Here could be seen demonstrations of casting, gundog trials, shooting matches, archery competitions, together with stall upon stall devoted to the clothing and equipment without which the sportsman and woman is reckoned incomplete. Perhaps the most spectacular event, once the mediaeval requirements of space had been satisfied and it got going, was the demonstration of falcons and hawks flying to the lure.

As partners with others in the multiple use of land, we have a real interest in game, and it was fitting that we were able to join in an outfit, called by the military organizers of the Fair the 'Scientific Side'. This amalgam was housed in two one hundred foot long tents, and consisted of the Nature Conservancy (voles, stoats and weasels), the Wildfowl Trust (goose migration), Aberdeen University (grouse research), Department of Agriculture and Fisheries for Scotland (mink), Scottish Woodland Owners' Association (game and forestry), Timber Growers of Central Scotland (service information), Royal Scottish Forestry Society (information and publications), the Red Deer Commission (red deer management) and the Forestry Commission (wild life and especially roe deer). The general message was that wild life, and the enjoyment of it by man, was ultimately benefitted by informed management.

Our own stand occupied about fifty running feet: we introduced the public, via a series of photographs taken by David Stephen, the well-known Scottish naturalist and author, to our policy on wild life in general. Then the life history and relationship of the roe deer to forestry was illustrated, and a series of heads staged showing antler development in good, bad and indifferent beasts. This was followed by another series of heads showing the effects of malnutrition, of disease and of injury, and some trophy heads served to provide a contrast. The next board illustrated a typical (perhaps archetypal) plan of roe management at Mabie Forest, and we wound up with an exhibit of weapons used in deer hunting—this included a reindeer bone spearhead, a longbow, a crossbow, a musket and stages in the rifle culminating in our modern high-velocity weapons. We hope all sportsmen took the point about the ·303 coming next after the musket! The exhibit was completed with the series of cartoons on the grey squirrel. In addition, we used a very extensive area outside, on which were shown high seats, examples of damage to trees by a variety of pests, and a most ingenious sandpit illustrating the slots of all species and sexes of deer. For this last exhibit, the one on grey squirrels, and for a great deal of expert advice and assistance, we are indebted to our colleagues from south of the border.

The exhibit was an enormous success, and served two useful purposes. First, it enabled us to put over our ideas on wild life management to the people who matter—the laird, the farmer, the keeper and the sportsmen, who of course formed the bulk of the public there. Second, it provided us with the opportunity of meeting and exchanging information with our partners in the joint exhibition: such an informal background led to numerous discussions and much hair was let down and heat generated. As many of the participants were camping on the site, controversy raged well on into the nights and one evening we had an impromptu dinner in the (temporary) wreckage of the exhibit, when about a dozen people of five nationalities sat down (from time to time) and enjoyed Italian food laid on and cooked at short notice by that versatile international

chef, M. Long. Lack of light and rations, and the largest shaggy dog in the world, produced by Irish Gibson, finally brought the feast to an end, but it must be indelibly printed in the minds of all who took part.

Our part in the Game Fair has since been reported on favourably in the press, public and otherwise, and it is encouraging to know that we have made many friends in all quarters of sporting life and have enjoyed the sympathy of many in the principles we put forward.

(*Plate 17 shows the deer track exhibit*).

A VISIT TO THE SCOTTISH GAME FAIR, 1964

by

W. J. BLAIR

Forester, Research

For the first time, the Game Fair came to Scotland and found a perfect setting at Blair Drummond, a Perthshire Estate owned by Sir John Muir, Bart. The estate, which is situated to the south of Doune, on the River Teith, extends to approximately 3,000 acres of which some 300 acres had been set aside for the Game Fair. Pheasant, partridge and duck shoots are provided by the spacious woodlands and parklands while the river offers five miles of salmon fishing.

On arrival at Blair Drummond, I felt somewhat awed by the immensity of this vast, natural, sports arena, so I decided to seek temporary refuge in the familiar surrounds of the Forestry Commission Exhibit. It was obvious however, from the moment that I crossed the threshold that this exhibit was a far cry from the familiar. Gone were the lists of products (from napkin to coffin) and in their place were some nicely illustrated maps showing the distribution of the Roe deer in Scotland, periods of high roe deer damage and the normal life cycle. Gone too were the polished samples of a vast range of timbers, to be replaced by an impressive collection of handsomely mounted roebuck heads demonstrating the poor type of buck to be removed by selective control and the strong healthy type to be left to form the basis of a sound stock. Here was no display of axes and saws but one of rifles, knives and binoculars. Specimens of obsolete deer control weapons from a flint arrowhead to a 12 bore shotgun, were ranged alongside the modern ·270 rifles, at present in vogue. Built in trees were two of the favoured high seats, which if carefully sited and properly manned remove humanely, and with certainty, undesirable deer from areas of the forest where damage is being done. Scattered around were examples of trees damaged by deer, hare, sheep, voles and grey squirrels while close at hand was a very good demonstration of the slots and fewmets left by the four species of deer to be found in our forests (Red, Roe, Fallow and Sika). The whole exhibit was obviously laid out with the intention of conveying to the general public, that, while the Forestry Commission recognises its responsibility in the conservation of wild life, this will be done, not by complete protection, but by sensible control. No attempt was made to minimise the damage which deer inflict on our young plantations but great emphasis was laid on humane methods of killing by well-trained men. A small section of the stand was devoted to the grey squirrel and took the form of illustrations showing the habits and life cycle of this squirrel and a number of traps of approved design for use in its control. Completing the forestry exhibit was a scaled model of a small estate under the management of the Scottish Woodland Owners' Association which aimed at the maximum economic return while conserving the interests of sport and forestry.

On leaving the Forestry Section I turned my attention to two stands—one devoted to the life of the Red deer and the other to the stalking of this animal.

The exhibits informed me that there are twice as many hinds as stags in Scotland and that 17% of the deer stock could be culled without reducing the actual totals at the end of the year, as this percentage is lost due to the natural deaths of weakly and diseased animals. With those facts in mind it is strongly recommended that sportsmen and stalkers should concentrate on killing hinds and poor stags rather than young stags and stags of good quality. This selective killing would greatly improve stocks and safeguard the future of Red deer.

The Nature Conservancy Section provided much of interest to the country lover. One part of particular interest to the forester was the section dealing with voles and weasels. It detailed the life of a vole with special reference to damage to young trees and pointing out that this reached its height in February/April. The weasel and stoat were depicted as predators of the vole and this was given as one of the main reasons why neither of these creatures should be shot. Indeed the futility of killing a weasel is evinced by the fact that each pair of weasels reign over five to eight acres of forest and should those occupants be removed new tenants will immediately move in. Left undisturbed the numbers per acre will not increase apart from a short period after the birth of young.

A stand which aroused much favourable comment was that on the Research of Red grouse. Although only remotely connected with forestry (planting of heather areas), the problems of conservation and the need for sensible heather burning are of general interest. The decline of the Red grouse is obviously a very involved problem dependent on a variety of factors, some known, some unknown. Heading the list is a deterioration in land management. Early gamekeepers looked after 2,000–4,000 acres, now it is common for one man to work 10,000 acres. This leads directly to poor farming of heather on which the grouse relies. Heather burning should be on a 12-year rotation and should consist of a large number of small fires (4 to 5 acres—or the territory of a pair of grouse) rather than a limited number of large ones. The adverse effect of burning older heather on both parent material and subsequent regeneration was clearly demonstrated.

Good quality heather is necessary for food, food is necessary for healthy birds and healthy parent birds are more important to the survival of young than weather, although weather is often considered the most important factor by laymen.

Fishermen's Row provided the opportunity to talk to one of the staff of the Freshwater Fisheries Laboratory. On being asked if he thought that afforestation was having any influence on fishing in Scotland he replied that there were points for and against. Established forests provided breeding grounds for flies and insects and therefore plentiful feeding for fish and it was also thought that they standardised run-off so that there was less fluctuation in water levels and so less disturbance. On the other hand freshly ploughed ground causing rapid run-off meant a constant movement of gravel on the river beds. This fills up recognised 'lies' and hampers breeding. It is interesting to note than an experiment has been started in the north of Scotland to see what differences there are between a river (and stock) in a freshly drained valley compared with conditions in one running through land bearing the old type sheep drains.

While I thought that the stands and exhibits which I have described contained items of some interest to the forester, the complete Fair was a continuous stream of exciting spectacles and beneficial lore to everyone concerned with country life. I certainly found this to be a most rewarding and informative visit.

WHY SOME TREES GROW FASTER IN ABERYSTWYTH

by

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Editorial Note: Sometimes we can learn a lot that is helpful to forestry by looking at the methods of an allied science. This article, which originally appeared in the journal *Span* under the title 'Climatic Variations in Forage Grasses', makes three points of tremendous economic importance to our present operations. Diagram on page 94 merits close study.

(a) In our western coastal districts the growth of grass—and to a large degree that of trees—is seldom halted because conditions are too *dry*.

(b) Likewise, growth is seldom halted because conditions are too *cold*—remember, tree roots grow in winter as well as in summer.

(c) To gain full advantage from this favourable climate, we must use grasses and trees—of a suitable *provenance*.

H. L. EDLIN.

In recent years extensive studies have been made on how forage grasses vary in their responses to different climatic conditions. In this article the author shows that local varieties of forage grasses are closely adapted in their life cycles and seasonal duration of growth to local limiting factors. He describes how this is based on physiological differences in such features as flowering and dormancy requirements for temperature and daylength, and leaf and tiller development in different light and temperature conditions. These differences are genetically controlled and can be combined and selected by the usual methods of genetics and plant breeding.

Crop production depends essentially upon utilising the sun's energy to produce human foodstuffs and industrial raw materials. The primary climatic limitation to crop production in any region is therefore the seasonal distribution of solar radiation, but the effective use of this energy can be modified by two other important climatic factors, cold and drought. Every forage plant breeder aims to develop varieties which provide the most efficient conversion of solar energy in his own climatic environment, first into herbage of high nutritive value and then into animal products. So a knowledge of the pattern of climatic variation in his crop and in related wild species is of primary importance in planning programmes of plant introduction, selection and breeding.

The first step in a study of climatic adaption is to survey the pattern of variation in locally adapted varieties or populations, first in the field or experimental garden and then under more controlled conditions in the glasshouse or growth room.

In the forage grasses, the pattern of climatic variation has been studied most intensively from the Mediterranean region, along the Atlantic coast, to the more continental climates of North and Central Europe—an area which has provided many important forage species not only for Europe but also for Australia, New Zealand and parts of North America.

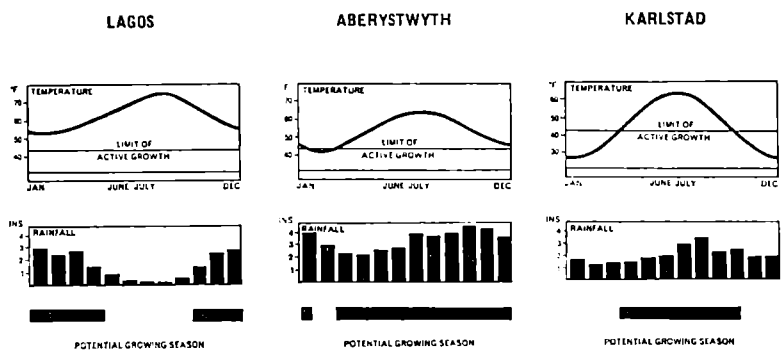
In a Mediterranean region the main climatic factor limiting forage production is summer drought; except at high altitudes winter temperatures are not low enough to prevent active growth. Mediterranean ecotypes of most forage grasses therefore have a winter growing season: growth begins with the autumn rains and proceeds actively through the winter; flowering occurs in early spring, and seeds are produced by the time the water supply is exhausted in early summer. Many species, such as *Lolium rigidum*, are winter annuals, and survive

the summer drought in the form of seeds, while such perennials as *Dactylis glomerata* and *Phalaris tuberosa* become summer dormant under the combined action of high temperature and drought. These Mediterranean populations have developed little frost hardiness and often die in the winter if transferred to a continental climate.

In North and Central Europe, on the other hand, winter cold is an important factor limiting production, although short days with low light intensity can also limit growth. Winter hardiness is essential in locally adapted varieties, and this often involves a degree of winter dormancy. Active growth begins in the spring, when the temperature becomes high enough, and continues until the autumn, with its low temperatures and short days. Reproductive development is late, with flowering early in the summer and seed development during the longest days of midsummer. When grown in a Mediterranean environment, this northern material may make some winter growth but fails to become summer-dormant at the beginning of the dry season and as a result often dies.

Maritime varieties of forage crops from the coastal areas of western Europe, where neither summer drought nor winter cold are severely limiting, usually show intermediate behaviour; they have a long growing season, little winter dormancy and only moderate cold resistance.

Local conditions vary considerably, even within the same climatic region. In the Mediterranean environment, for instance, the length of the potential growing season will vary according to the extent and duration of the winter rain. Recent studies have shown that populations of *Phalaris tuberosa* from localities such as Morocco and Israel, which have late autumn rain and an early onset of summer drought, have a shorter life cycle than material from more northern areas of Italy and Greece with a much longer potential growing season.



Temperature and rainfall distributions in typical Mediterranean (Lagos), maritime (Aberystwyth) and continental (Karlstad) environments, and their influence on the length of the potential growing season–longest in Aberystwyth.

This pattern of climatic adaptation is not limited to the Mediterranean-European region. A similar range of ecotypic variation in native American species of *Achillea* and *Potentilla* has been revealed by Clausen and his co-workers at different altitudes in California, from the maritime coastal ranges, across the San Joachim Valley with an extreme Mediterranean climate, to the mountain and alpine areas of the Sierra Nevada. Similar patterns of variation have evidently been selected in the Californian and European regions in response to the same limiting climatic factors, winter cold and summer drought.

Most of the studies on climatic adaptation in the forage grasses have been restricted to Mediterranean and temperate regions and it is important, therefore, to extend this type of survey to other climatic areas which have not received so much attention, particularly in tropical and sub-tropical regions where the limiting climatic factors will be rather different.

Physiological basis

The next step in the understanding of such climatic variation involves the physiological analysis of such varietal differences under more controlled conditions in the glasshouse or growth room.

Such important physiological characteristics as the timing of germination and flowering, and the onset of summer or winter dormancy, which determine the length of the active growing season, usually prove to be controlled by specific climatic factors. Many Mediterranean forage varieties show seed dormancy at high temperatures, which effectively prevents germination after occasional summer showers. In *Phalaris tuberosa*, this high temperature dormancy is particularly marked where summer rainfall is erratic and unpredictable. Dormancy has not developed in regions where summer rainfall is either completely absent or usually adequate for germination. Similarly, many wild grasses from northern or continental climates, such as *Nardus stricta* or northern populations of *Dactylis glomerata*, require chilling before germination, a mechanism which delays germination and seedling establishment until the spring. Most agricultural varieties of forage grasses, however, in which the date of sowing is under human control, show little or no seed dormancy.

Over the Mediterranean-European climatic range, the timing of inflorescence development is usually controlled by photoperiod. In *Lolium*, for instance, the Mediterranean populations, which flower in early spring, can initiate heads in the comparatively short photoperiods of winter (9 to 10 hours), while the later flowering varieties from northern Europe require 13 or 14 hours, and a similar variation in daylength requirement from north to south has been traced in varieties of *Phleum pratense* selected in the U.S.A. In cultivated forage crops, the selective influence of management may be superimposed on the primary effect of climate, as in *Lolium perenne* in Britain where early-flowering hay varieties with a low photoperiod requirement, and later-flowering pasture varieties with a higher requirement, have been developed.

Apart from the date of flowering in the spring or summer, which is controlled mainly by photoperiod, many of the northern perennial populations exhibit other environmental responses which prevent development of flowers in late summer and early autumn, even though the daylength is adequate for flowering. These include winter requirements for cold or short-day exposure as in *Lolium* or *Phalaris*, or a juvenile stage as in *Dactylis* (i.e. the seedling must reach a certain age before it can respond to temperature or day length.) In the Mediterranean environment, where active growth cannot start until the autumn rains, such responses are only slightly developed, although in collections of *Phalaris tuberosa* the cold exposure required before flowering is closely related to the date at which the autumn rains begin.

The seasonal pattern of vegetative growth also varies considerably with climatic origin. Recent observations at Aberystwyth and elsewhere have shown that Mediterranean material of *Lolium perenne*, *Dactylis glomerata* and *Festuca arundinacea* produces much more active growth than northern material of these species under moderate winter conditions in Britain. Studies in controlled environments reveal that the Mediterranean material can produce appreciable leaf surface at moderately low temperatures (5°C) while the northern material becomes semi-dormant. Over the climatic range from the Mediterranean to Northern Europe, there is a high correlation between the degree of leaf expansion at low temperature and the winter temperature of the place of origin, but a strong inverse correlation with frost hardiness. Furthermore, although there is little difference in the rate of photosynthesis between the Mediterranean and northern material at low temperature (5°C), the northern material shows a greatly reduced respiration rate accompanied by a build-up of soluble carbohydrates which may be implicated in its increased cold resistance.

The superior winter growth of the Mediterranean material is thus based not on a greater initial rate of photosynthesis, but on the use of assimilates for the production of new leaf rather than for storage.

So far, however, our knowledge of the physiological basis of climatic adaptation is restricted almost entirely to temperate and Mediterranean material. The environmental relations of tropical and sub-tropical species are comparatively unknown. The optimum season for flowering may differ considerably from that in Mediterranean or temperate species and many tropical grasses may require short-day conditions for flowering. Similarly, their temperature requirements for both flowering and active growth are higher. In the southern grasses *Axonopus affinis*, *Paspalum dilatatum* and *Sorghum halepense*, for instance, night temperatures below 55°F tend to inhibit flowering, while *Paspalum dilatatum*, *Sorghum halepense* and *Cynodon dactylon* have an optimum temperature for growth of about 85–95°F compared with 65°F in temperate grasses.

It is already clear that the patterns of climatic variation are based on physiological responses to seasonal fluctuations in light intensity, temperature, and photoperiod, and that those responses have been selected in each climatic region which provide the optimum life cycle and seasonal growth pattern.

Implications for crop improvement

The plant breeder tries to provide a continued supply of herbage of high nutritive value for as long a period of the year as possible. Many climatic responses, such as the rates of photosynthesis and respiration under contrasting light and temperature regimes, developmental mechanisms for cold or drought resistance, and the distribution of assimilates between seed production and continued vegetative growth, play an important part in determining total and seasonal production in forage species. It is clear that wide genetic variation exists for these climatic responses between local populations of forage grasses even of the same species, presumably as a result of past climatic selection.

WINTER GROWTH AND COLD HARDINESS IN CLIMATIC RACES OF PERENNIAL RYEGRASS, *Loilum perenne*, FROM REGIONS WITH CONTRASTING TEMPERATURES

	Leaf growth in December relative to May (%)	*Survival at* —5°C (%)	*Mean temperature of winter month* (°F)
Algiers	28·0	0	49·3
New Zealand	14·8	20	42·4
Oregon	13·9	13	40·7
Irish	12·8	47	42·1
Devon	13·2	36	43·0
Melle	13·7	57	34·4
Pajbjerg	11·0	73	31·8
Lithuania	9·7	92	25·5

A survey of the pattern of climatic variation in his crop and in related wild species can thus indicate to the breeder the best sources of the desirable characters required in his breeding programme, bearing in mind that natural climatic selection has operated for survival and reproduction rather than for the production of a continued supply of vegetative herbage. For instance, recent surveys of seasonal patterns of growth have emphasised the value of Mediterranean ecotypes of tall fescue, cocksfoot and perennial ryegrass in providing increased winter production in Britain.

Such climatic variation can be utilised at several stages in the breeding programme, depending on the level of improvement already attained. The first stage in a forage breeding programme usually consists of a survey of and selection

from local indigenous populations, as in the use of material from old pastures in western Europe. In regions such as Australia and New Zealand, which have few useful indigenous forage plants, the direct introduction of plants from similar climates is equally important. The Mediterranean *Lolium rigidum* and *Phalaris tuberosa*, for instance, have proved invaluable for the winter rainfall areas of Australia, and the north temperate *Lolium perenne* and *Dactylis glomerata* for much of New Zealand.

These indigenous or homologous populations, however, while well adapted in many respects, may lack certain desirable characteristics, and the introduction of genetic material from somewhat different climatic origins may be valuable as is shown by the use of Mediterranean material as a source of winter growth in Western Europe and New Zealand. The combination of characters from different climatic origins may, however, present certain difficulties. The winter activity of the Mediterranean ecotypes, for instance, is strongly correlated with frost sensitivity. The possibility of breaking these undesirable correlations depends on how far the two characters are physiologically related or how far they have simply been selected together.

Most of these climatic responses show continuous variation and are controlled by many genes. Furthermore, many perennial forage grasses are cross-fertilising, and so each local population contains considerable genetic variation which can be released in each generation by segregation and recombination. The synthesis of new and desirable patterns of climatic response can thus be achieved either by selection *within* existing local varieties or through hybridisation *between* contrasting climatic races and selection in subsequent generations. Both these approaches are being actively pursued at Aberystwyth and elsewhere. Despite our present knowledge it is clear that we need much more information on the detailed patterns of climatic variation for individual forage species, particularly in tropical and sub-tropical areas. The integration of field, glasshouse and controlled environment studies is of prime importance, both in obtaining such information and in putting it to use in a breeding programme.

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TREE BREEDING FOR TIMBER QUALITY

by

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Introduction

During the past 10–15 years a great deal of interest and activity has arisen in the fields of tree breeding and forest genetics. This interest developed firstly in the Scandinavian countries of Europe and was subsequently followed in Australia and the south-eastern states of the U.S.A. The reasons behind the up-surge of interest are not difficult to find and may be primarily accounted for by the now world-wide extensive afforestation and re-afforestation programmes based on planting methods, as opposed to natural regeneration methods, for crop establishment. These programmes are needed either to replace extensive fellings or to create new forests to meet current and future pulp and saw timber requirements. Foresters have been quick to notice the remarkable variations in habit, form, rate of growth and branchiness, etc., in their even-aged plantations, between individual trees derived from a single seed-source and, more usually, the even greater variation between plantations when seed from different seed sources (provenances) has been planted side by side. In addition to the external morphological variations, which are those normally affecting the facility of handling, storage, and conversion losses, are the hidden internal anatomical variations which affect the strength and machining properties and/or the yields of fibre and cellulose. It is of interest to note that tree breeders have been largely instrumental in highlighting the importance of fibre dimensions and structure and their effects on timber quality.

Variation

Most of the important characters affecting timber quality, for example, bole straightness, bole circularity, size of branch, rate of growth, annual ring width, proportion of spring wood to summer wood, length of fibres, fibril angles, cellwall thickness, angle of grain, etc., are all influenced to a greater or lesser degree by both *environmental* and *genetic* factors. To complicate matters even further the position within the trees in which wood is laid down has a marked effect on its properties and the progressive increases in specific gravity and fibre lengths from the juvenile core to the later-formed outer sheaths of adult wood are now widely recognised.

The variation between trees for most and probably all the important wood characters is continuous. This can be demonstrated by making measurements of a particular character, e.g. stem straightness, for a given population of trees. By plotting the values of the character against the number of occurrences in graphical form one can see at a glance both the range of variation and the pattern of distribution. The resulting curve quite frequently has a broad-based, bell-shaped outline with a single peak near the centre. Such a curve indicates that the variation in the character is the expression of not one but many genes (factors of inheritance). Discontinuous variation, shown by two or more peaks or even two separate curves, indicates that the character is controlled by only a few or even a single gene and furthermore that some of the genes show dominance effects over some of the others.

Selection

It is a relatively straightforward and comparatively easy exercise to improve a single character by selection and breeding, particularly if the expression of the character is controlled by a major gene or a small group of genes which exert

strong influences, e.g. tallness or shortness in peas, to use a well known example from agriculture. In tree breeding for timber quality, however, a large number of characters normally require simultaneous improvement. Some of the many characters may be closely correlated with each other so that selection for one automatically results in selection for others. However, the reverse may be true or there may be no correlation at all. In the latter case if for a certain degree of genetic improvement it is necessary to select say, one tree in fifty for a character X, one tree in 2,500 will be needed for characters X and Y, or one tree in 125,000 for X, Y and Z to obtain the same degree of improvement in all three. Thus the greater the number of characters selected for improvement the greater is the sheer physical effort required to locate a suitable potential breeding population.

The above situation at once imposes certain limitations on the breeder and it is essential that he concentrates his attention on the most important characters which also show the widest degree of variation. By doing so he will derive the maximum return for his investment. Thus if the wood specific gravity for a Norway spruce population ranges from ·25 to ·35 and that for Sitka spruce from 0·20 to 0·45 a much greater genetic gain will be obtained by directing the available effort on the Sitka spruce rather than on the Norway spruce. Scots pine in Britain is primarily used as a saw-timber and is generally relatively slow growing, somewhat crooked and often coarsely branched. By concentrating selection on vigorous, straight, finely branched trees more rapid progress will be achieved in the overall improvement of these characters than if an attempt is made to include other features such as fibre length and density. In contrast, Sitka spruce which is used both for pulp and saw-timber is relatively straight, vigorous and fine-branched but its timber is frequently marred by spiral grain. Furthermore its timber shows a wide degree of variation in both fibre length and specific gravity. Thus selection to reduce the amount of spiral grain, to narrow the range of variation in fibre length and wood specific gravity—yet maintaining the present values—is probably the most important line of attack.

Trees which are selected for breeding work, because of their apparent superiority for several important characters, are termed '*Plus*' trees.

Propagation

Soon after selection, the plus trees are vegetatively propagated by rooting cuttings or by grafting so that should the parent tree be lost through felling or windthrow, vegetative material having an identical genotype to the parent will be available for future breeding work. The actual propagation technique varies for each species and according to the age and condition of the parent tree. Thus Lawson cypress, Western hemlock, Western red cedar and some spruces, for example, are propagated by rooting cuttings in special mist propagation frames equipped with electrically-operated soil-warming cables. Other species, e.g. the poplars, can easily be propagated from cuttings in nurseries without special equipment. On the other hand the pines, larches and Douglas fir must be propagated by grafting scions from the parent tree on to seedling rootstocks which may be raised either in heated glasshouses or out-of-doors in the open nursery.

The successful grafted plants are then established at wide spacings in *tree banks* to be used for the production of future supplies of material for propagation and also for making field observations on such things as the times of flowering and amounts of flowers produced by each clone.

Clonal Tests

It was mentioned earlier that each individual tree growing in the forest is affected by both the environment and its genotype, and that rooted cuttings are genetically similar to the parent tree. Thus by comparing the performance of

rooted cuttings in replicated plots on a single forest site where climate and soil conditions are similar (clonal trials), it is possible to estimate the effect of genetic factors affecting particular characters. Special statistical techniques have to be employed to test the validity of any observed differences when making comparisons between different clones. To date none of the conifer clonal trials in Britain are old enough to produce data on characters affecting wood quality but early work in Australia on *P. radiata* and in the U.S.A. on *P. taeda*, amongst others, has produced results which indicate that the economically important wood characters of fibre length and specific gravity are strongly inherited. During the next few years much more information will become available from a wide variety of clonal trials of various tree species throughout the world which is expected to substantiate these and other earlier findings.

Grafted plants, as opposed to rooted cuttings, cannot be used with confidence to make heritability estimates of certain wood characters since the rootstock on to which the scion (cutting) from the parent tree is grafted is of seedling origin. The rootstocks are therefore genetically diverse in some respect and in all probability interact with the scion in a physical sense, so affecting the normal wood structure within the grafted portion of the plant.

Grafted plants are very expensive to produce and even those trees which can be propagated by rooting cuttings could not be mass propagated in sufficient numbers for the large present day annual planting programmes. For this reason propagation by seed is the only practical avenue of approach in the majority of cases, poplars being an exception.

Progeny Testing

During cross-fertilization the nuclei of pollen grains and egg cells from different parent trees unite, each male and female part exerting its own genetic influence on the development of the resulting progenies. For any particular character this influence may be strong, weak or intermediate in effect, and it is only by a procedure known as *progeny testing* that the influences can be determined. A variety of breeding methods can be employed to produce seed of partly or wholly known parentage and each method has its own merits and disadvantages from the points of view of cost, practicability and information ultimately yielded.

In practice the breeder aims to pollinate artificially each of his chosen plus trees with pollen from a single plus tree or with a mixture of pollen from several plus trees. This is done by isolating the female flowers against windborne pollen by protecting the flowers with bags or plastic tubes before they are in a receptive condition. When the female flowers are receptive, pollen is artificially introduced into the bag, using a syringe, and the bags or tubes are removed when the flowers are no longer receptive. When the seed is mature, it is harvested and stored until the following spring when it is sown in experimental replicated plots on a relatively uniform ground in the nursery. Ultimately, the plants are established in replicated plots on widely scattered forest sites similar to those likely to be encountered in practice.

During the course of development the trees in each plot are periodically assessed for survival, height and diameter growth, stem straightness, number and size of branches in each whorl, angle of branching, etc., and, when sufficiently old, timber samples can be obtained for specific gravity and fibre length determinations. A statistical analysis of the collected data enables the breeder to determine those parents which produce the largest numbers of desirable features. Such experiments were begun in Britain on Scots pine, larch and Sitka spruce some 7 to 10 years ago and valuable information which will affect the future direction of our effort is already becoming available.

Providing that all goes well, a progeny test for the most widely used species in Britain may take upwards of twenty years to complete from the date of pollination, but as so often happens in nature, things are seldom quite straightforward. Periodic flowering of the parent trees or grafts, damage to the isolated flowers by strong winds, insect predators on the developing cones, and unseasonable droughts which may cause excessive deaths in the progeny tests, all prolong the test period. Furthermore some tree species, and particularly the spruces, do not reach sexual maturity until they are 25 to 35 years old and even then they may only flower heavily once every five to seven years. Thus a successful breeder must have a measure of good luck and be an opportunist.

Tree breeders are now attempting to devise early test procedures which will enable them to predict, within certain limits, the behaviour of similar progenies established on a forest site. By raising seedlings in one or more controlled environments, it is hoped to collect performance data which may be closely correlated with the data obtained from progenies growing in the forest. If such methods prove satisfactory then much effort at present expended on forest trials could be saved. The knowledge of juvenile/adult wood relationships is already proving to be of value in this work.

Seed Orchards

Some two hundred acres of seed orchards composed of grafts or rooted cuttings of untested plus trees, planted at wide spacing in the sunnier and warmer parts of the country, have already been established to produce new species hybrids or cultivated varieties. This is a necessary step if supplies of seed of above average genetic quality are to be made available in as short a time as possible. As the progeny testing programme proceeds, those parents which produce below-average progenies for selected characters will be removed and new and much larger orchards will be formed using only *elite* parents as a basis, i.e. those which have consistently produced progeny of outstanding merit. It is hoped to ultimately produce all our home seed supplies of many of the conifers of major importance by these methods.

General

The principal problem of any tree breeder is that of guessing what the timber using industries will require 50 to 70 years hence. Without doubt vigorous, healthy, straight trees with fine branches will always be in demand and these will become available in ever increasing numbers as a result of present breeding efforts. With some few exceptions British timber-using industries are at present satisfied with the quality of the sawn products from home-grown mature timber derived from well managed forests in which regular thinning and pruning has been practised. Accordingly the present-day tree breeder must ensure that by the selection of vigorous trees of superior form he is not unwittingly selecting trees with well above or below average specific gravity and fibre-lengths, or those with extreme spiral grain. Nevertheless during his investigations the breeder has ample opportunity to locate and preserve trees with exceptionally low or high values for density and fibre length. Such trees can be easily preserved in tree banks for future use should the need for them ever arise.

Tree breeding is a long-term business and as such cannot be expected to yield results which will directly affect the timber using industries in Britain in any appreciable way during the next 30–40 years. We can however immediately profit from information gathered during the early stages of plus tree selection work when above-average crops can be located and put to subsequent use as seed sources. With this in mind numerous superior stands of a wide variety of species have been selected throughout Britain and registered with either the Tree Seed Association of England and Wales or the Scottish Tree Seed

Association. Many of these stands are now being managed with the principal objectives of quality improvement and seed production. As an interim measure, therefore, before certified seed becomes commercially available from seed orchards, every effort should be made to secure seed, or plants derived from seed, from such sources, for establishing future plantations. When such coniferous seed stands are approaching maturity and are difficult to climb for cone collections, it will be profitable to arrange fellings when the cones are ripe.

UNDERCUTTING AS A NURSERY TECHNIQUE

By

J. T. FITZHERBERT and E. G. HOLLOWELL

Divisional Officer, and Forester, South Wales

Introduction

The recent paper: "Survival and Growth of Undercut Seedlings in the Forest", by J. Atterson, which appeared on page 147 of the Forestry Commission *Research Report* for 1963, threw some light on this subject as a possible nursery technique. Unfortunately the economics and techniques were not fully explained. The object of this paper is to show the advantages of undercutting and to record the experience of many years of continuous field practice.

We in South Wales have shown that this technique can lead to substantial economies both in reduction of nursery areas and in the cost of forest plants, at least as far as our own Conservancy is concerned.

However, before dealing with any techniques we must endeavour to remove a slight prejudice that exists, mainly on account of terminology:—

(a) In the past all plants raised from seed were referred to as "seedlings" until such time as they were transplanted.

(b) Because of high costs of making seedbeds (with the intention of future transplanting) sowing densities were kept high and a status symbol was created in "seedlings per square yard".

(c) When surplus seed beds were "stood over" the seedlings became drawn out and weak and in an effort to improve the rooting they were "undercut". When later used for planting as undercut seedlings they were a failure.

Thus the average forester has a mental picture of poor undercut plants and high planting losses.

We submit that foresters must train themselves to the new method of raising plants.

The majority in South Wales have been won over and now accept that there are only *two* kinds of plants:—

1. The "Forest Plant" which is suitable for planting by *any* forester and is accepted only on sample. Size can be used by the customer as an indication of what is required. Age in years helps to indicate sturdiness. Conformity with British Standards Institute requirements guarantees this.

2. The "Nursery Plant" is that which the nurseryman wishes to retain in a nursery for further treatment. It can be from one inch upwards in height and from one year onwards in age. In short it is *not* ready for the forest.

If we accept this simple classification the nurseryman has a chance of producing good vigorous plants cheaply.

It is no concern of the customer how the nurseryman raises his plants provided they are satisfactory, i.e. acceptable. Thus instead of the old dictum of 2+0, 1+1, 2+1 etc., we would use the phrases 2-year Nursery Plant, 2-year Forest Plant, 3-year Forest Plant, etc. In time the forester will be able to picture the quality of a 3-year Forest Plant just as he now pictures a 1+2 or 2+1. The final choice however is on sample.

Into this range will come the 1U1 and other undercuts, not as seedlings, but as proud two-year Forest Plants. The smaller ones will be retained as Nursery Plants to be transplanted in the normal way and appear the following year as 3-year old Forest Plants.

Evidence from the Forest

In case there are doubts as to their suitability in the forest, I give below details which should help to ease the mind:—

TABLE I

USE AND SURVIVAL OF UNDERCUT 2-YEAR D. F. PLANTS IN PEMBROKE DISTRICT OF SOUTH WALES CONSERVANCY

Forest	P. Yr.	Acres	Thous. Used	Survival % at P.64	Height at P.64 feet
Preseli	61	22	25	90	5 ft.
	62	3	4	100	2 ft.
	63	45	56	90	3 ft.
	64	38	45	95	1 ft.
TOTAL		108	130		
Llanddowror	61	88	109	80	8 ft.
	62	56	67	80	5 ft.
	63	70	86	75	3 ft.
	64	82	105	80	1 ft. 6 ins.
TOTAL		296	367		
Teifi	61	9	10	90	6 ft.
	62	19	24	85	5 ft.
	63	8	10	80	3 ft.
	64	8	9	95	1 ft. 6 in.
TOTAL		44	53		

TABLE II

USE AND SURVIVAL OF SEVERAL SPECIES AT SLEBECH FOREST

Slebech	P. Yr.	Acres	Thous. Used	Survival % at P.64	Height at P.64 feet
D.F.	59	12	15	91	4 ft. to 8 ft.
D.F.	63	13	16	87	1 ft. 6 ins.
J.L.	64	7	8	92	2 ft.
C.P.	63	3	4	70	1 ft.
**Pinus radiata*	61	3	4	78	6 ft.

*Initial take 92%; difference destroyed by severe weather conditions F.Y.62/63.

Naturally all our experiments were in the parent forest to Slebech Nursery.

We have tried far more species than shown above but these are "Bread and Butter" species, plus *Pinus radiata* which is difficult at the best of times.

The Nursery

Costs

How does this affect the cost of plants to the forests? If undercuts are accepted the difference in cost will be as shown on page 106. This is a replica of a costing record maintained in South Wales Nurseries which gives an almost day-to-day cost return.

The form covers every week in the year and details are recorded weekly from progress reports and other F.C. records.

The forms have been compressed to save space, and weeks during which no work was done have been omitted. The numbering of the weeks starts with the first week in the forest year. (In the examples the correlation of dates and week numbers have been ignored.)

Table A shows all costs from time of sowing until the end of all operations as a 1-year Nursery Plant. The stock is 1,000,000 plants and the cost works out at 11/5d. per 1,000.

Table B is a continuation of Table A as the plants are not being moved but will be undercut and treated as 1U1 plants. But as this is in another forest year a new sheet is required. In this example, work scheduled as for the second year started a fortnight early due to favourable conditions but it is work in connection with the second year's growth.

The change in numbers of stock is recorded when it is finally decided that the stocking is as desired. Most of the thinning has been done as conditions permit through the autumn and winter. The final stock adjustment is made with the final lift. However the cost is now £1 4s. 4d. per 1,000 while the stock dropped to 840M.

Table C. This table shows the costs related to the 1-year Nursery Plants from Table A being transplanted and finally lifted as 1+1. The first entry is lining out and cost of plants at the agreed inter-F.C. price.

The number of plants received was 1426M. and the final stocktaking 1258M. This gives an 88% survival and fit-for-the-forest plants.

This on any standard is a good result but for this quantity we feel it is very good. Nevertheless the ultimate cost of the 1+1 is now £5 2s. 5d. per 1,000 plants.

From the figures shown it will be seen that an *Undercut* 2-year forest plant (1U1) costs approximately 50% of a *Transplanted* 2-year old forest plant (1+1). For quality of plants see page 111.

This is in spite of such a high output in the transplant lines as 88% fit-for-the-forest. If the output had been only 7% the cost would have risen to £6 8s. 0d. per 1,000. Thus the forest can save approximately £4 per 1,000 plants by using undercuts, or approximately £6 per acre.

Over a 50-year rotation at 5% compound interest each pound saved represents approximately £11 10s. 0d. at the end of the rotation. Thus in round figures an acre, one can save nearly £70.

Putting it another way, this saving is equivalent to the sale or production of an additional 450–500 hoppus ft. of timber at 3/- a hoppus foot.

Techniques

We feel that a word or two on techniques might help to dispel further some of the illusions that may have been created in the past.

1. *Density of Seedlings* is very important. We have found that this varies slightly with species but very roughly somewhere between 180–220 per sq.

yard can be looked upon as acceptable. It must be borne in mind that these plants are going to stay on this site for at least two years. (See Plate 20, centre pages).

2. *Undercutting*. The present impression that it is only necessary to cut the tap root *once* to produce a good undercut plant must be forgotten. It is true that the first undercut will sever the tap root but we have found that it is essential to do two, three or even four more such operations to produce good bushy, fibrous roots. We believe that the operations subsequent to the first are not strictly undercuts but more like extensive cultivations. We use various adaptations of existing undercutters confining the first cut to work by the Reciprocating Undercutter.

We have also found that undercutting should not be done in the first year but from the spring of the second year onwards. Care must also be taken to select fairly damp conditions so that the soil can quickly re-settle and the plants not suffer from lack of moisture.

3. *Soil.* This is a most important item in this technique. It is often thought, as we did, that a good light sandy soil would be the ideal for undercutting. Nothing could be further from the truth. The young seedlings have not so many roots and in sand are not gripped firmly enough for the cutter to do its work. Instead the roots are dragged along resulting in L-shaped roots which later grow downwards and become like a letter 'S'. In a heavier soil, as in South Wales (Tair Onen and Slebech), the root is cut cleanly the first time and all subsequent work is, in reality, extensive cultivation. The soil is aerated and any tendency to pack or pan is broken up. It also helps to retain the moisture in the lower levels. This same operation has the reverse effect in sandy areas and often results in too much drying out. We have found that while our heavy soils help us in our undercutting they are very difficult to work—except in ideal conditions—for transplanting. Thus from our experience we would suggest that light sandy nurseries should stick to transplanting and the heavier ones consider undercutting.

4. *Side Cutting*. Early in our experiments we found that in spite of undercutting we often got plants with long heavy roots, which made the plant awkward for planting. These we finally traced to shallow side roots and we have now overcome this embarrassment by side cutting. This obviously cannot be done when seed is sown broadcast. The machine used is of our own design and the cutting is done by discs, each individually spring loaded. Knives tend to drag and if they hit an obstruction they disturb a large area before the machine can be stopped. Furthermore, discs ride over obstructions and as they are individually mounted, only one at a time is affected.

This side cutting has been so effective that we have extended it to our stand-over transplanted lines with considerable success.

5. *Seed Sowing*. As mentioned above, side cutting is not possible with broadcast sowing. This strengthens our case for drill sowing which has many points in its favour. Not least among them being the ease of all methods of weeding—by hand, by hoe and by chemical sprays, together with a considerable reduction in the cost of grit covering.

In order to get exactly what we wanted we made our own—The South Wales Drill Seed Sower. The main feature of this machine is that it is a combined seed sower and grit distributor.

Thus the seed is covered with grit within a second of being sown in its drill. This permits sowing in weather conditions not possible by many other machines. The distribution of seed is still not perfect, due mainly to the different shapes and sizes of tree seeds, but we are happy enough with the results to continue our efforts towards the ultimate.

TABLES "A" AND "B"

NURSERY COSTING RECORD

F.Y. 63–64

SPECIES Douglas Fir QTY. 40 lbs. IDENT 59/7975/2 (Thou.) AGE Seed AREA 5184 sq. yds.

Purity 97% Germination 82% Viable Seed per lb. 34,000 Unit Cost per lb. (thou.) £6 4s. 0d.

Origin: Tenino, Washington Received on Form (T.12) A125 No. 101261: SLEBECH NURSERY

ESTIMATE £ s. d. *40 lb. Seed at £6 4s. 0d.: £248 0s. 0d. S. WALES, Conservancy

LIFT AS 1U1.

1		2	3	4	5	6	7	8	9	10	11	12	13	14
Week ending and week number		Labour	P.V.&M.	Materials	Nursery Miscellaneous percentage	Based on percentage Age of F.Y. Financial Statement: Labour Overheads (5 %)	Supervision Overheads (25 %)	District and Conservancy Office Overheads (12 %)	Total Overheads	Total Cost this Week	Total Cost to Date	Estimated Stocking based on counts finalised at stocktaking (Thous.)	Accumulating cost per thou.	Income per thou. based on 1962 price list
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
28:4:63	1	34 1 0	9 3 0	3 16 3	8 18 3	24 9 10	10 14 10	5 2 11	40 7 7	96 6 1	96 6 1	1,000	1 11	2 18 0
5:5:63	2	6 1 8	10 0		19 3	4 0 3	1 10 9	16 10	6 7 10	13 18 9	110 4 10	1,000	2 2	
12:5:63	3	6 1 3			2 4 0	4 14 2	2 1 4	1 0 0	7 15 6	112 6 10	126 5 7	1,000	2 6	
19:5:63	4	8 13 6			5 5 7	7 19 0	3 9 9	1 13 6	13 2 3	41 0 1	153 6 11	1,000	3 0	
26:5:63	5	10 7 6	19 9	53 5 0	3 7 6	7 16 8	3 8 9	1 13 1	12 18 6	193 5 1	234 5 2	1,000	4 7	
2:6:63	6													
9:6:63	7													
16:6:63	8	18 15 3	12 2	18 10	6 18 9	14 13 0	6 8 6	3 1 8	24 3 2	92 8 3	285 13 4	1,000	5 8	
23:6:63	9	6 15 9		*248 0 0	2 19 0	5 11 2	2 8 8	1 3 5	9 3 3	460 3 1	552 11 4	1,000	11 1	
30:6:63	10	4 13 0		3 10 1	2 6 9	3 19 7	1 17 5	16 9	6 13 9	109 11 0	569 14 11	1,000	11 5	2 18 0
7:7:63	11													
14:7:63	12													
21:7:63	13													
28:7:63	14													

(above) TABLE A. From Seed Sowing to 1 year Nursery Plant (1+0)

4:8:63	15													
11:8:63	16													
18:8:63	17													
25:8:63	18													
1:9:63	19													
8:9:63	20													
15:9:63	21	54 15 0	1 0 0	2 12 6	42 10 0	55 7 8	24 6 3	11 13 6	91 7 5	652 8 0	761 19 10	1,000	15 3	
22:9:63	22													
29:9:63	23	6 8 6	6 3		1 5 2	4 7 7	1 18 5	18 5	7 4 5	124 16 2	777 4 2	1,000	15 6	
24:11:63	24	22 5 4				12 13 9	5 11 4	2 13 5	20 18 6	43 3 10	820 8 0	1,000	16 5	
29:3:64	25				11 7 0	6 9 4	2 16 9	1 7 3	10 13 4	22 0 4	842 8 4	1,000	16 10	
5:4:64	26			10 0						10 0	842 18 4	810	Balance destroyed	
26:4:64	27			1 0 0						1 0 0	843 18 4	810	in Thinning.	
10:5:64	28	9 10 0	3 6			5 8 3	2 7 6	1 2 10	8 18 7	18 12 1	862 10 5	810	1 1 3	
24:5:64	29	7 17 4		1 1 5	5 7 7	7 11 0	3 6 3	1 11 10	12 9 1	26 15 5	889 5 10	810	1 1 11	As 1U1
7:6:64	30	3 4 6	3 9	14 6	7 14 6	6 4 10	2 14 9	1 6 4	10 5 11	22 3 2	911 9 0	810	1 2 6	4 10 0
21:6:64	31	1 2 0		16 6	2 6 0	1 18 9	17 0	8 3	3 4 0	7 8 6	918 17 6	810	1 2 8	
28:6:64	32	11 0	1 5 9		5 3 6	3 19 10	1 15 1	17 0	6 11 11	13 12 2	932 9 8	810	1 3 1	
12:7:64	33	2 10 10	14 4	5 6	4 5 6	4 8 11	1 19 0	18 9	7 6 8	15 2 10	947 12 6	810	1 3 5	As 1+1
23:8:64	34	12 8 6	2 16 6	2 1 9	10 11 3	13 2 0	5 14 11	2 15 3	21 12 2	49 10 2	997 2 8	840	1 3 9	
27:9:64	35	5 17 3		8 1	7 16 9	7 16 2	3 8 6	1 12 11	12 17 7	26 19 8	1,024 2 4	840	1 4 4	7 4 0
: :	36													
: :	37													
: :	38													
: :	39													
: :	40													

Forest Survival 84%

(above) **TABLE B. From 1 year Nursery Plant to 2 year Forest Plant (1U1)**

TABLE "C"

NURSERY COSTING RECORD
F.Y. 64

SPECIES Douglas Fir QTY. (lb.) (ozs.) IDENT 59/7975/2 Thou. AGE 1+0 AREA 22176 Sq. Yds.

Purity % Germination % Viable Seed per lb. Unit Cost per (lb.)/thou. £2 18s. 0d.

Origin: SLEBECH Received on Form T.12/A125 No. 72295 72310 72298 72311 72308 72309

TAIR ONEN NURSERY
S. WALES Conservancy

ESTIMATE £ s. d.

LIFT AS 1+1

1		2	3	4	5	6	7	8	9	10	11	12	13	14
Week ending and week number		Labour	P.V.&M.	Materials	Nursery Miscellaneous percentage	Based on percentage Age of F.Y. Financial Statement: Labour Overheads (5 %)	Supervision Overheads (25 %)	District and Conservancy Office Overheads (12 %)	Total Overheads	Total Cost this Week	Total Cost to Date	Estimated Stocking based on counts finalised at stocktaking (Thous.)	Accumulating cost per thou.	Income per thou. based on 1962 price list
		£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.	£ s. d.		£ s. d.	£ s. d.
: :	20													
: :	21													
1:3:64	22	562 4 5	34 16 0	*4,153 0 0	}									Transferred as 1+0 at 2 18 0
: :	23	264 12 0	19 4 0		}181 17 9	330 14 4	184 16 3	87 10 10	603 1 5	5,818 15 7	5,818 15 7	1,426		
: :	24													
: :	25													
: :	26													
5:4:64	27	141 15 0	7 4 0		32 12 0		33 2 6	15 13 9	108 1 9	312 9 8	6,131 5 3			
: :	28													
19:4:64	29		1 10 0	21 6 11										
: :	30													

: :	31													
10:5:64	32	20 15 0		3 15 0	4 15 5	7 1 1	3 18 10	1 17 4	12 17 3	42 2 8	6,173 7 11			
: :	33													
: :	34													
31:5:64	35	3 2	4 0	10 4 0	9	1 1	7	3	1 11	10 13 10	6,184 1 9			
: :	36													
: :	37													
: :	38													
: :	39													
5:7:64	40	21 13 10	2 10 0	20 0 0										
12:7:64	41	5 9 8												
19:7:64	42	15 8 3	14 0	7 0 0										
26:7:64	43	12 3 6			12 11 10	18 12 4	10 8 0	4 18 6	33 18 10	131 9 11	6,315 11 8			
: :	44													
: :	45													
: :	46													Price as 1+1
23:8:64	47	43 13 0	14 0	5 0 0	11 3 5	16 10 3	9 4 6	4 7 4	30 2 1	95 11 2	6,411 2 10			
: :	48	4 18 8												
: :	49	15 7 5			3 10 9	6 8 7	3 11 0	1 14 0	11 14 5	30 12 7	6,441 15 5	1,258	5 2 5	7 4 0
: :	50													
: :	51													
: :	52													
TOTALS		1108 3 11	66 16 0	4220 5 11	246 11 11	438 13 2	245 2 6	116 2 0	779 17 8	6441 15 5				

* If plants had been transferred at cost (table A) this item would be £814, thus reducing the total cost of materials by £3,339. Total expenditure would then be £3,102 15s. 5d. and the cost per 1,000 49/4d, still double the cost of undercut plants.

Forest Survival 88 %

(above) TABLE C. From 1 year Nursery (1+0) to 2 yr. Forest Plant (1+1)

Advantages

Germination and Stocking. It may not be out of place to mention here a feature which should encourage more undercutting.

All nurserymen will agree that no matter how good the seed or the sowing, there will always be some seed that germinates late. Thus in the most perfect seed-bed one finds big, average and small plants. If the stock is due for transplanting many of the smallest are either thrown away at the start (which is the correct thing to do) or somehow get lost during Lining Out. This results in a loss of anything from 5%—50% of the viable seed; not because they all did not germinate but because many started growth late and were too small at Lining Out time. If undercutting is to be done this bed of seedlings is not going to be disturbed until the end of the second year. By that time you will have big, average and small plants, but in the plantable range of perhaps from 18 ins. plus to 6 ins. plus. When these are lifted for the forest, the smallest or 6 in. plus, can still be transplanted in the nursery to become an excellent 18 in. to 24 in. plus, next year for Beating Up.

But these were the small plants which are normally lost when lifting a bed of 1-year seedlings. Thus in practice the nursery has had a better percentage lift of Forest plants than it would have had of Nursery plants.

An example occurred in Tair Onen this year where we were able to 'rescue' 250 M. small plants for Lining Out from a section of 1,500 thousand Forest plants. This in hard cash means about £1,000 worth of plants which will fetch over £2,000 next year.

An additional advantage is that these plants are not being re-transplanted but are normal 2-year seedlings being lined out for the first time but with much better roots. In any case if you look back at the costs in Table B you will see that the cost is comparable to a 2-year seedling: (old nomenclature).

Nursery Space. Nowadays this is a very important and costly item. Thus we do not want to evolve a technique that necessitates increased nursery area. When one pictures a seed-bed with only 200 seedlings per sq. yard you are apt to jump to the conclusion that with undercutting vast new nurseries will be required. The reverse actually applies. If South Wales swung over completely to undercutting we would save 20 acres of Nursery.

At 200 per sq. yard, a plant requires about 6 sq. ins. We will call this occupying 12 sq. inches for the two years.

In transplanting at 9 × 2 inches the plant requires 18 sq. ins. for one year, plus the seed beds for one year. Add to this the losses in Lining Out, allowing a 60% or 70% survival, and the plant is occupying 24 sq. ins. or more.

For this argument we can safely assume that alleyways, headlands, etc. are about equal in both systems, although with machine Lining Out the dead ground is generally higher than in seed beds.

Conclusion and Summary

We hope this record of our experiences in the South Wales Conservancy, which have extended over 8 years with many species and in different nurseries, will help to break the prejudice that has been falsely created about undercuts.

Foresters must accept the march of progress and the newer techniques. Where possible acceptance should be by sample until confidence is developed in the new phraseology and in the nurserymen. The proposed introduction of a British Standard will help.

Undercutting like all other systems must be planned from the time of sowing so as to get proper densities.

Attempts to adopt the system by some short circuit method will only result in failure and condemnation of a perfectly good and proved technique.

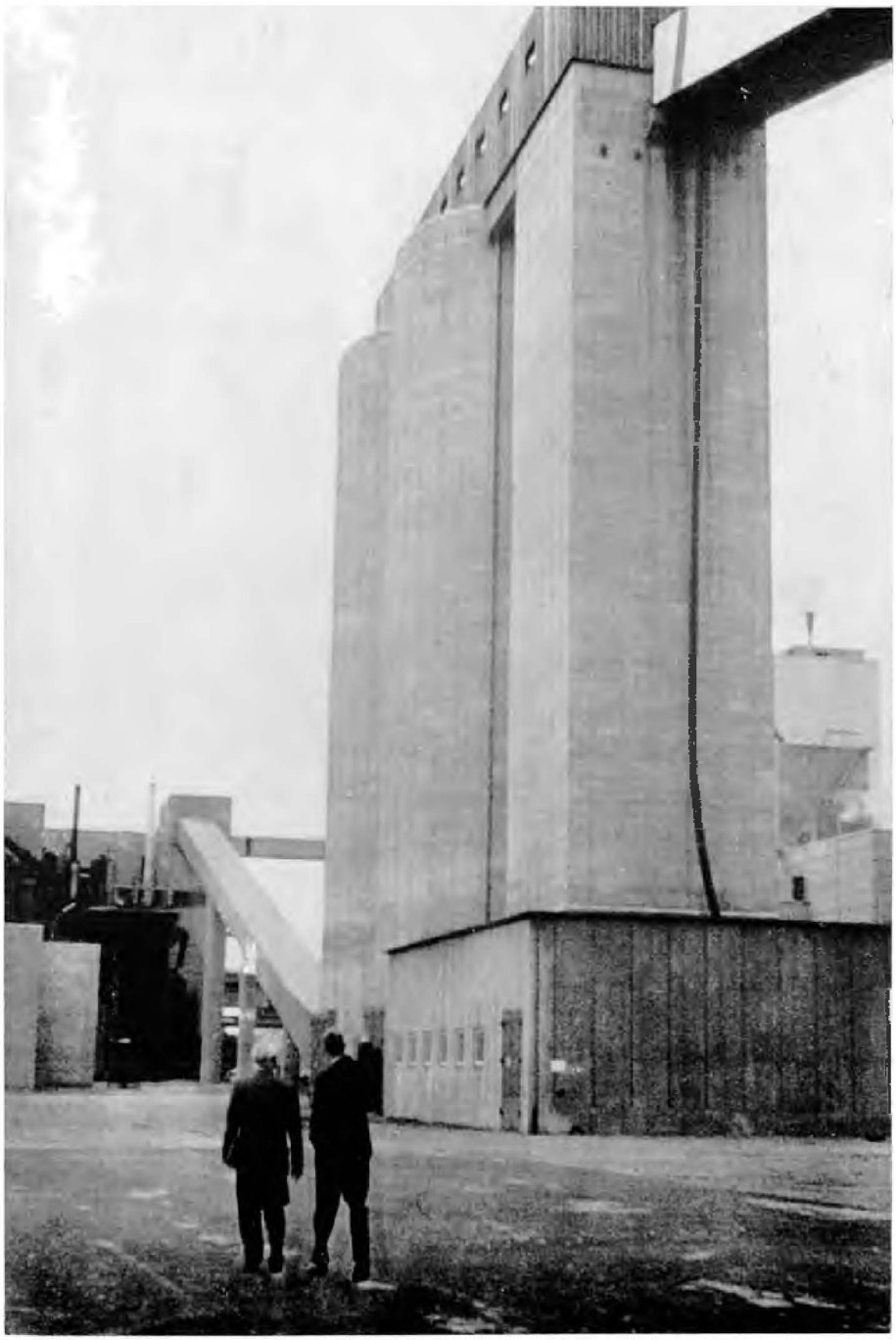


PLATE 1: Three silos for storage of wood chips at Morrum sulphate pulpmill; one tower holds hardwood chips, one softwood chips and one holds bark. Sweden.

PLATE 2: Outside storage of wood chips at the new sulphate pulpmill at Morrum, Sweden.

PLATE 3: Three of the eight Cambio barkers at Morrum pulpmill. Mr. Plym Forshell in the foreground. Lord Waldegrave and Sir Henry Beresford-Peirse (carrying papers) are in the middle of the picture.

PLATE 4: This transplant line weeding machine mounted on the three-point linkage of the tractor and fitted with hydraulic lift has 6 stirrup-shaped blades rotated by 6 flexible drives. It almost eliminated hand weeding in the stone-free soil of Sya Nursery, near Mjolby, Sweden.

PLATE 5: The log pond at Skinskatteberg sawmill, Sweden.

PLATE 6: A Boxer 350 tractor fitted with a third pair of intermediate wheels and half tracks, equipped with a hydraulic hoist and grab, and towing an Ösa 126 'timber wagon' trailer which could extract 250 hoppus feet at a time along tushing tracks. Forest district of Malingsbo, Sweden.

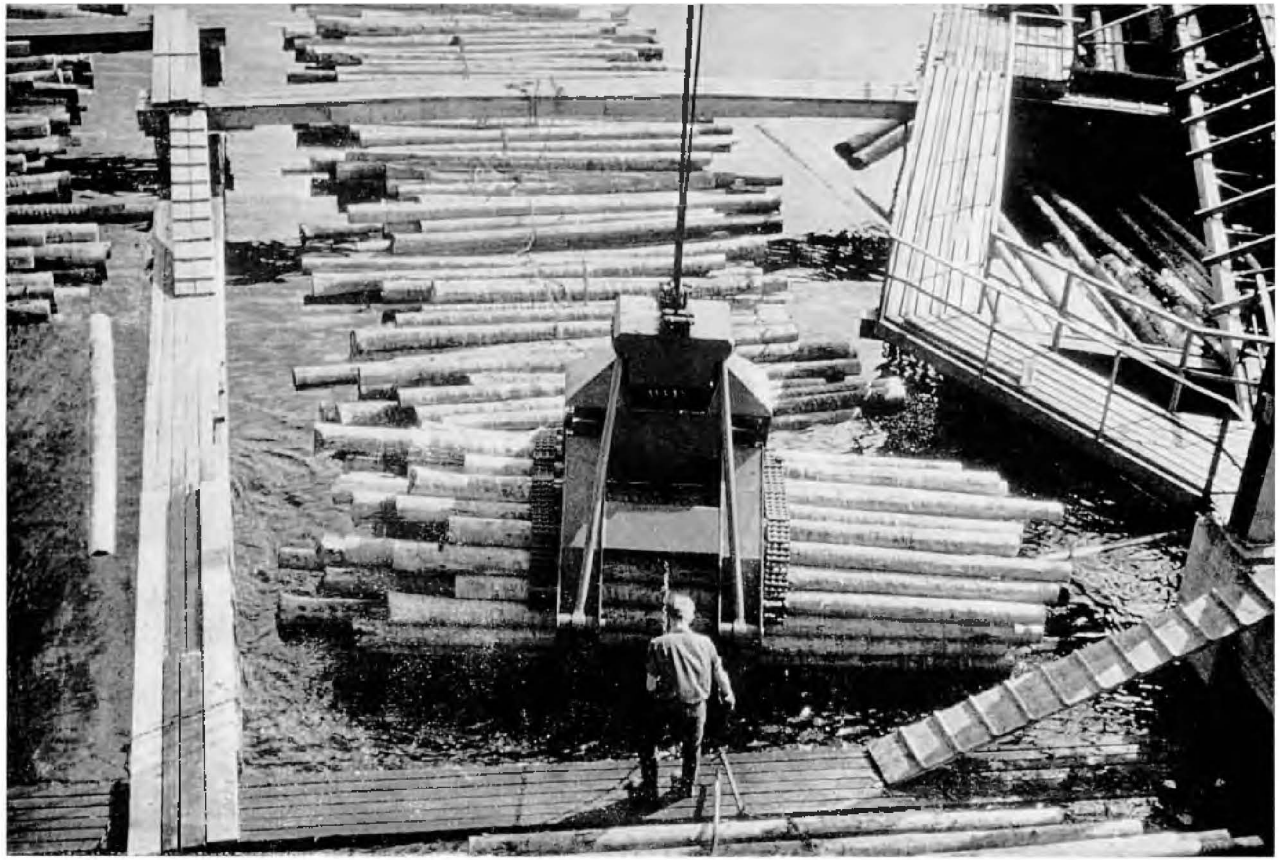


PLATE 7: At Skinskatteberg sawmill the logs are taken from the log pond and barked in Cambio barkers. They are then returned to water runways and graded for size, and bundled. The picture shows a grab lifting about 10 tons weight of logs from the pond to the sawmill floor. Sweden.

PLATE 8: Logs chained to trees of low commercial value are used to train workmen in chain saw felling techniques. Sweden.

PLATE 9: Demonstrating the use of the Tree Bicycle at the Forestry Exhibition, Blackbushe.

PLATE 10: A Transplanting Machine digs up an established tree complete with its root-ball.

PLATE 11: Transplanting a partly-grown tree, complete with its root-ball, to a new site.

PLATE 12: A Swedish Log-arch for tushing logs behind a horse.

PLATE 13: A Speed Loader raising logs onto the bed of a timber waggon.

PLATE 14: Children of Chaulden Junior Mixed School, Hemel Hempstead, demonstrating tree planting on their school plot at the exhibition.

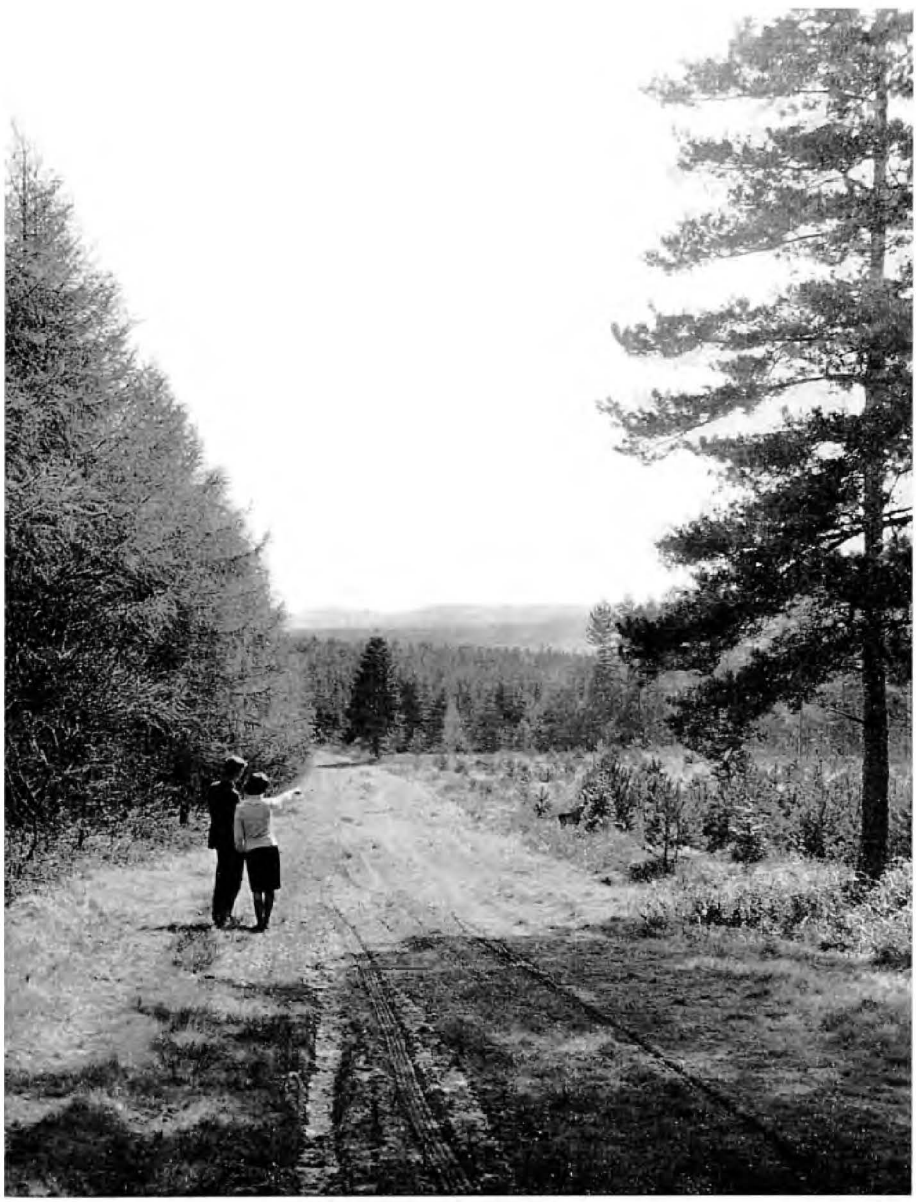


PLATE 15: In Alice Holt Forest, Hampshire. One of many studies by our official photographers, displayed at the exhibition.

PLATE 16: A general view of the Blackbushe Forestry Exhibition.

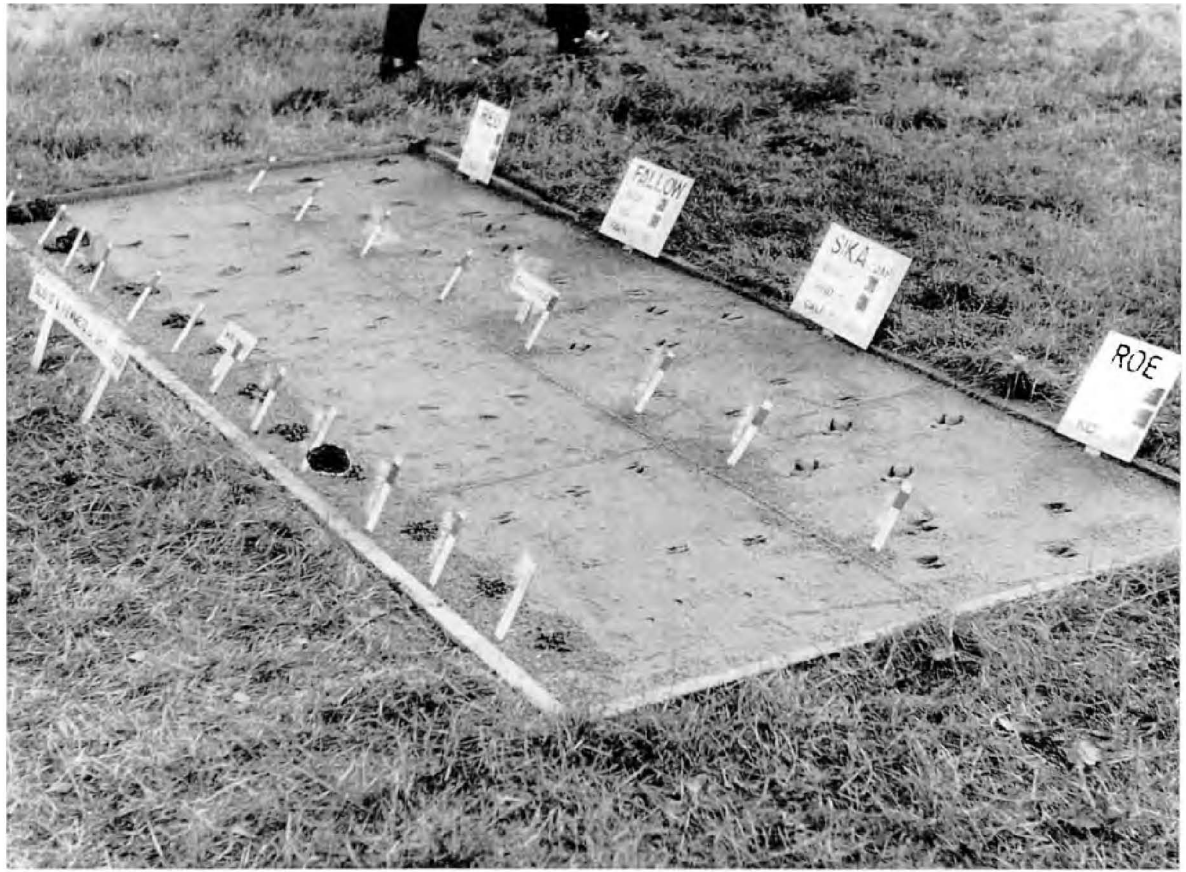


PLATE 17: Plaster casts of deer tracks shown at the Scottish Game Fair, together with fewmets. A colour code indicates age and sex; the front row of tracks show walking imprints while the rear row shows galloping imprints.

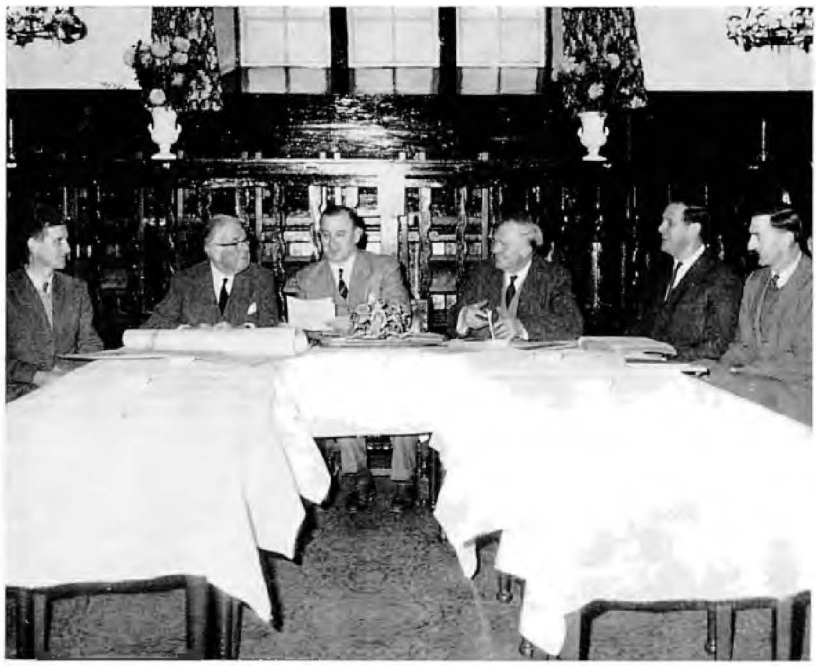


PLATE 18: The Verderers in Session at the Speech Court. Left to right: R. E. Crowther, (District Officer, Dean); J. H. Watts, (Verderer); Dr. Cyril Hart, (Senior Verderer); R. G. Sanzen-Baker, (Deputy-Surveyor); J. R. Haines, (Steward to the Court); J. Jardine, (Land Agent, Dean). The Speech House, now used also as an hotel, was built by Charles II and is the Commission's oldest building in the Forest of Dean.

PLATE 19: Planting of Progeny of Newland Oak. Left to right: J. Lingwood, (Head Forester, Dean); I. Falconer, (Forester, Dean); R. G. Sanzen-Baker, (Deputy-Surveyor); Dr. Cyril Hart, (Senior Verderer); J. H. Watts, (Verderer). Photographs of this remarkable tree (remains seen in background) appeared in our Journals for 1960 and 1962.

PLATE 20: A one-year-old seed bed of Douglas fir showing the correct density for undercutting, about 300 plants per square yard. August.

PLATE 21 Fantoft Stave Church, near Bergen in Norway.

PLATE 22: Marking an oak wood for thinning in the Vosges Mountains. The forester carries calipers for measuring diameters, and a marking hammer.

PLATE 23: Nylon webbing stretched amongst Silver fir regeneration as a deer deterrent in the Vosges Mountains.

PLATE 24: Sitka spruce in Alaska. When growing space permits, as along this meadow's edge, branches of Sitka spruce become long and graceful as the tree matures. Note the dense stand of young spruce saplings on the right. Note the figures, bottom left.

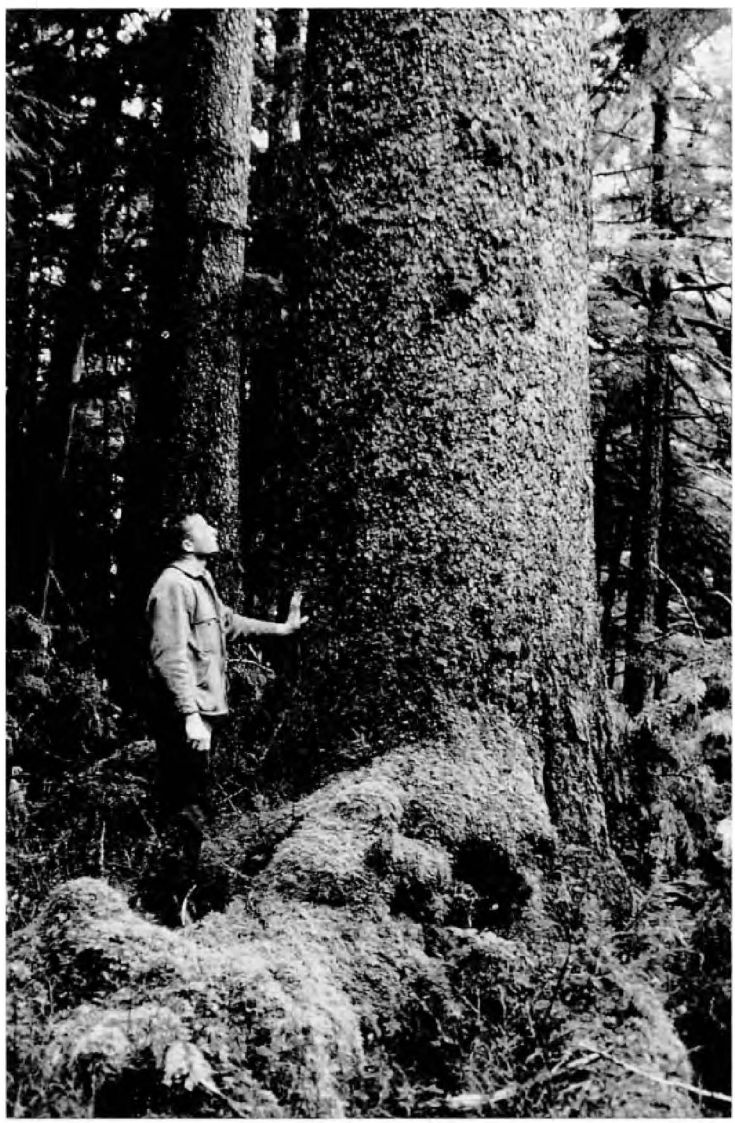


PLATE 25: Virgin Sitka spruce. Trees of this size are common throughout Southeast Alaska. Mr. A. S. Harris, who contributed our article, is seen in the picture.

PLATE 26: The Parkgate tine plough in use.

PLATE 27: A Red deer stag trapped with its antlers entangled in wire netting. Dunwich Forest, Suffolk.

PLATE 28: A stand of Japanese larch in West Norway. Growth rates and general character resemble those found in West Scotland.

PLATE 29: A stand of Grand fir, *Abies grandis*, at Moberglia, near Bergen, West Norway.

PLATE 30: Log-floating channels at Rannoch Forest.
The upper-most collecting basin and the remains of one of the haulage canals (circa 1800) built by a firm of Timber Contractors who undertook some felling and extraction. It is believed the logs were drawn along the canals by horse rather than floated. Elevation 1200 ft. Sitka spruce P. 49 on ploughed ground in deep heather on right. Compt. 8. Rannoch Forest, Perthshire. May, 1961
This floating system was described by Athole Whayman in our 1949 Journal, p. 77.

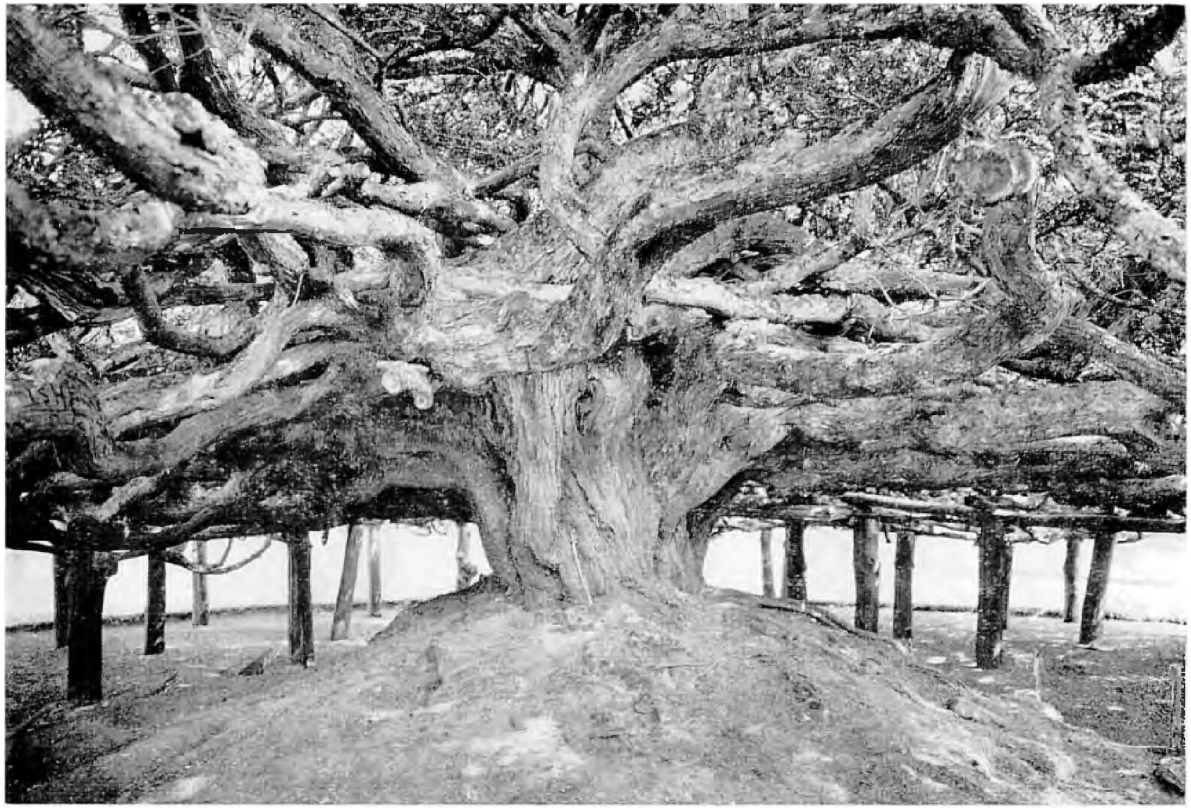


PLATE 31: At Crom Castle, Co. Fermanagh, stands the greatest yew of Ireland, shaped like a gigantic green mushroom. It is said that an O'Neill, in the reign of Queen Elizabeth I, took leave of his lady love under this tree, already ancient four hundred years ago.

PLATE 32: A freak growth of cones on the leading shoot of a Corsican pine, Dunwich Forest, 1956. Found by the forester, Mr. John Parker. Apparently every 'dwarf shoot' initial bud, which normally bears only two needles, has developed into a cone. Excellent for seed supplies, but would it not father further freaks?

PLATE 33: The new County Primary School built by the Northumberland County Council Education Department at Kielder Forest Village. The school is also used for recreation and meetings of societies, in the evenings.

PLATE 34: One of the classrooms at the new Kielder School. Most of the scholars are the children of Forestry Commission staff.

PLATE 35: The demolition of the old engine-house chimney and blast furnace at Parkend, Forest of Dean, in 1904. The factory building on the right was converted into the present Forester Training School.

PLATE 36: The new chipboard factory at Hexham, Northumberland seen through the old bridge across the Tyne. This factory, though operating mainly on sawmill waste, is a potential user of thinnings from coniferous forests.

PLATE 37: The Dean Forester Training School as it stands today. (The ivy has recently been stripped off to facilitate re-painting).

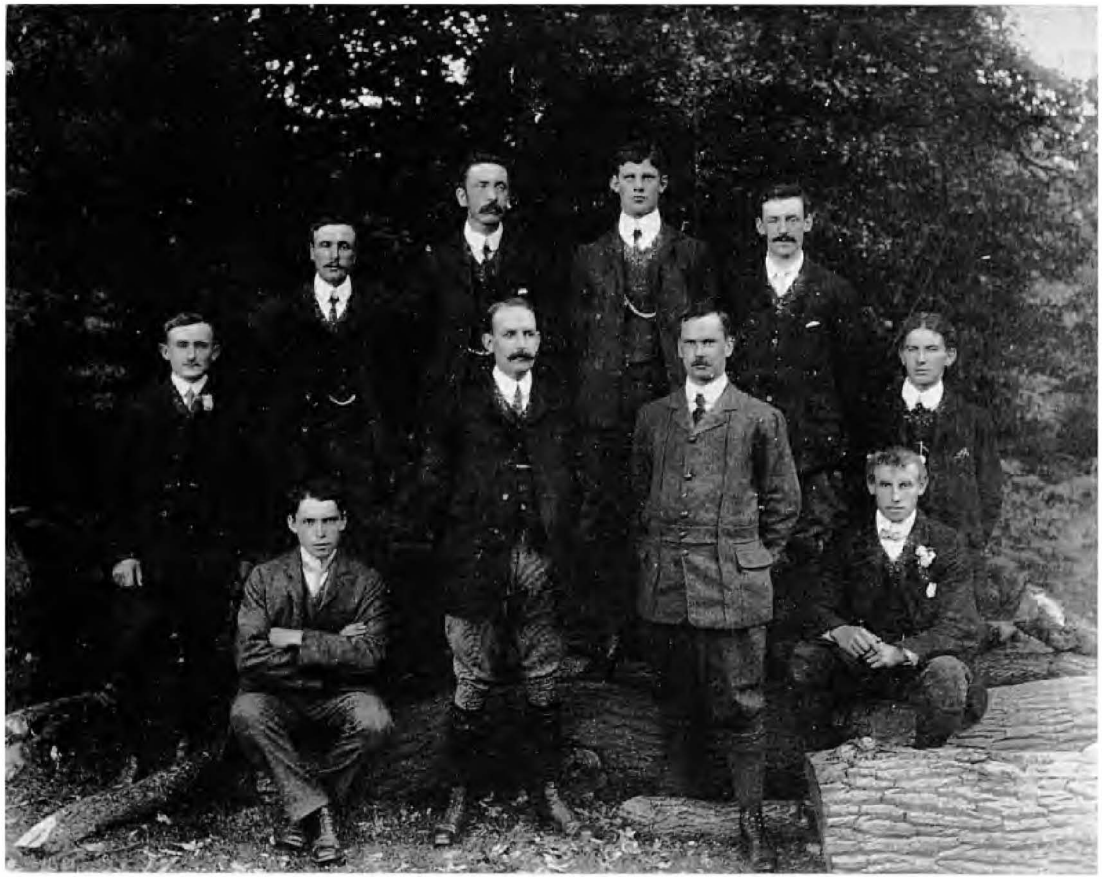


PLATE 38: An early class, 1906–1908 at the Parkend School of Forestry. Left to right, back row, O. R. T. Aston; L. T. Jones; D. Jamieson; G. E. Nelmes; S. S. Arkell; P. N. Davies; front row, R. Butter; J. Roper; C. O. Hanson (Instructor) and W. Tribe.

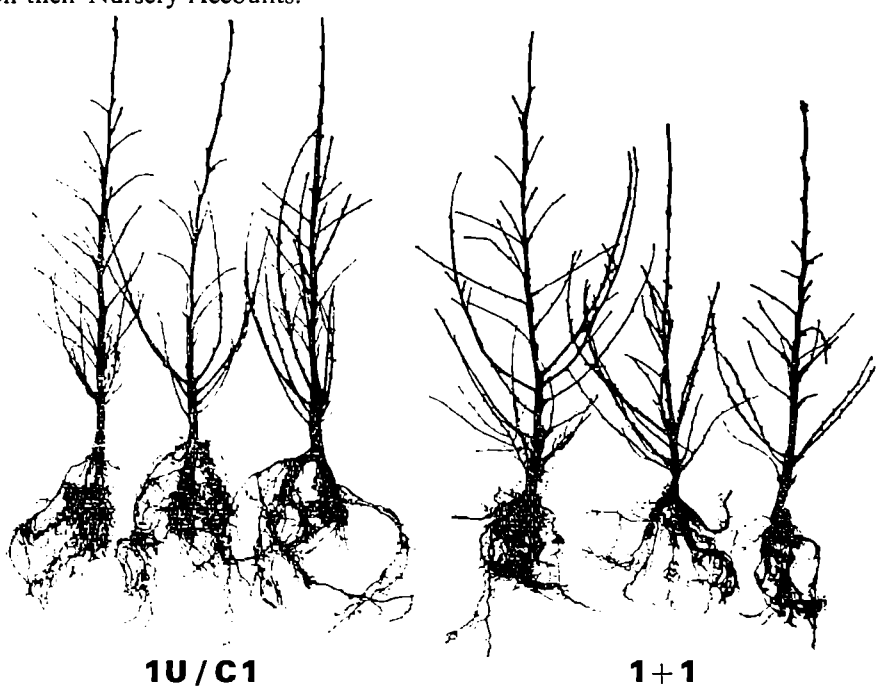
The soil of a nursery is vitally important. No forester tries to grow Corsican pine on a peat bog or Sitka spruce on a sand dune, so why try and make a nursery grow every species and by techniques that do not suit? Light, sandy soil nurseries have so many advantages over the heavy soil types that they should be able to compete equally well with transplanting.

Mechanisation has come to stay and rising labour costs demand its ever increasing use if plant costs are to remain stable. Machinery is a great help but it must be devised and engineered by a forester who knows what he wants it to do. By all means start with any existing machine if it is akin to your 'brain child' and adapt it to *your* conditions. Too often it has been assumed by those not closely associated with the working of soils that one machine will serve for all areas.

Accounts are apt to criticize the Forest and Nursery Plant phraseology on the grounds that the individual stages cannot be costed. Does it help anyone to know the cost of a suit at the cutting stage provided the finished article is satisfactory? We must try and avoid unnecessary figures, stock-taking and other calculations for the sake of maintaining old records and customs. All these operations cost money and help to increase the cost of plants.

A simple Costing record as shown in Tables A, B and C, will give the forester on the job all he wants to know.

Finally we would like to suggest that having established a fairly static price list for plants of varying sizes and sturdiness (at present denoted by age of transplant) future prices should not differentiate adversely against undercuts compared with transplants. Quality irrespective of treatment should be the criterion (See below). Only by encouraging the cheaper undercutting techniques will the prices of plants come down. The quickest way to achieve this is to give Nursery Foresters the incentive of at least showing a 'paper profit' on their Nursery Accounts.



Undercut Japanese larches, left, compared with transplanted Japanese larches, right. All plants are two years old.

RHODODENDRON CLEARANCE AT DARK WOOD, GARELOCHHEAD FOREST, WEST SCOTLAND

By

D. R. MACGREGOR

Forester, West Scotland

Dark Wood, covering 31 acres bordering the Gareloch, was formerly part of the grounds of Rosneath Castle.

The mixture of hardwoods and conifers which covered the area was felled by a timber merchant in the early 1950s, and the density of the rhododendrons at that time was such that it was found to be impracticable to remove many of the logs, some of which were of considerable size.

The Forestry Commission acquired the land two years ago and by that time about 90% of the ground was covered by very dense rhododendron, most of which was 14 feet to 18 feet in height, intermixed with remnants of the former tree crop and under which were the numerous logs abandoned by the timber merchant. The old estate drains had not been cleared of the lop and top from the felling and had become thoroughly choked over the years, until the water from surrounding higher ground lay in stagnant pools on the generally flat site.

The work of clearing the rhododendron was given to a contractor who provided a Drott 175 with a 4-in-1 bucket and agreed to do a trial run over 5 acres at £28 per acre. The results of the trial were satisfactory to both contractor and F.C. and the work proceeded.

The total area cleared by the machine was 24 acres. The limiting factor was the bogginess of the ground aggravated by exceptionally wet weather during the operation.

The work was completed in 18 working days (8 hour day) and output was therefore 1⅓ acres per day.

The technique used was as follows:—

1. The Drott was driven forward into the bush with the bucket fully raised.
2. The heavy bucket was lowered, breaking and crushing the rhododendron into a compacted heap.
3. With the bucket lowered, the machine was reversed, dragging the bush on to open ground and spreading it by gradually raising the bucket.
4. The Drott moved forward to the next "bite", crushing and mulching the debris with its tracks.

When old logs were encountered, they were pushed aside. Old stumps did not greatly impede the work and the very few which did were uprooted by the machine. The standing trees were avoided as much as possible but where an occasional one obstructed the movement of the Drott it too was uprooted and pushed aside.

The result of this technique was that no burning was required, no spoil heaps were left, no disturbance of the ground was caused other than that resulting from the turning of the machine; and the crushing action of the vehicle was so effective that no problem will arise in planting through the spoil.

Where the tractor could not operate, hand clearance and burning in the same area is currently costing £65 per acre.

Following the clearing, the area was sprayed with ammonium sulphamate with a mixture of 3 lbs. weed-killer to 1 gallon of water applied at the rate of 25 gallons per acre. This was carried out with plastic watering cans and controlled by pegged lines at a cost of £2 3s. per acre for labour.

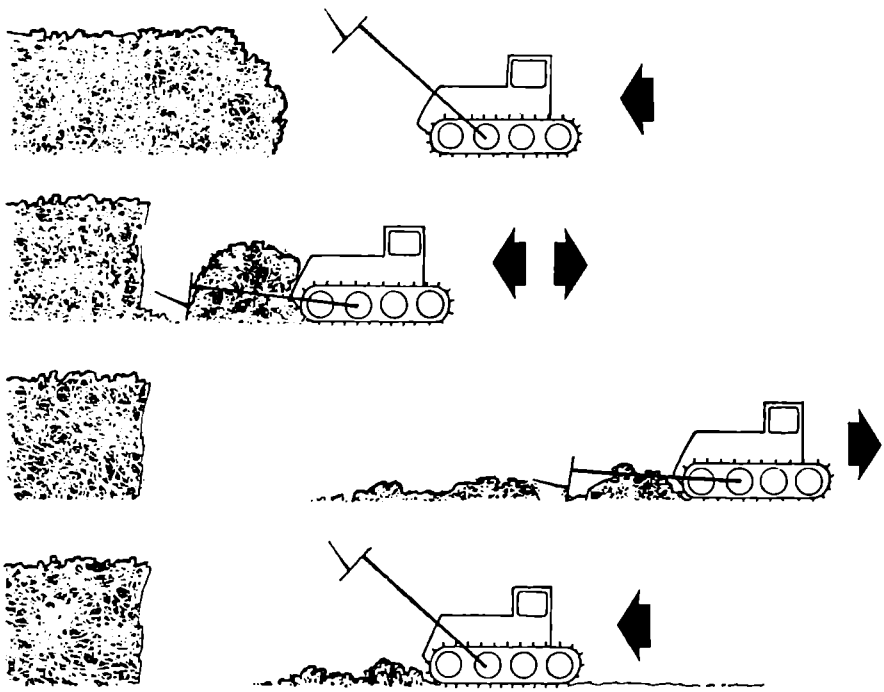
The final operation of draining will be done with a Cuthbertson plough.

Conclusion

This method of rhododendron clearing is very effective and though, in this instance, the ground was fairly level, its waterlogged condition required caution on the part of the driver. In similar conditions it would be advantageous to have two machines working together or to have a powered winch mounted on the tractor. As regards slope, the operator's opinion was, that in drier conditions, fairly steep slopes could be worked and I would judge that 1-in-4 would be the limit.

Note on the equipment

The International 175 loader with Drott bucket is a larger version of the 80 at present used on road-building in West Scotland. The '4-in-1' bucket has a capacity of $1\frac{3}{4}$ cubic yards and may be used as a bulldozer, a raker, a bucket or a basher.



SUMMARY	
AREA CLEARED	31 ACRES
HEIGHT OF RHODODENDRON	14'–18'
MACHINE USED	DROTT 175/4 IN1
OUTPUT	1⅓ ACRES PER DAY
COST	£28 PER ACRE
HAND CLEARING	£65 PER ACRE

THE DISTRIBUTION OF WIND-BORNE SALT OF MARINE ORIGIN IN SOME WESTERN AREAS OF WALES

By

R. S. EDWARDS and Miss S. M. CLAXTON

Dept. of Agriculture, University College of Wales

Extracted from: Memorandum No. 7 (1964) *University College of Wales, Aberystwyth. Edited J. A. Taylor.* This is a summary. The full version of the Aberystwyth survey is in the press and will appear in the *Journal of Applied Ecology* in due course.

The paper opened with an introduction and short review of literature which made the following points:

1. That wind-borne material of marine origin is important:
   (i) As an accelerator of corrosion of metals.
   (ii) As nuclei for the formation of raindrops.
   (iii) As sources of nutrients for plants and animals.
   (iv) As a cause of damage to plants in littoral areas.

Literature was cited to show that injury to plants can be attributed to the salt which impacts on them during high wind. This was followed by a description of the mechanisms by which salt nuclei are formed (mainly from bubbles bursting on the surface of the sea) and transported. Some information was given on the effect of the shape and aerodynamic properties of an object on the number and size distribution of the particles which impact on it at any given wind speed. Finally the object of the work being reported was given as—'To gain some information on the distribution of wind-borne salt (NaCl) in an area of N. Cardiganshire extending inland from the coast some five miles. Data was collected over a period of two years, March 1961—March 1963'.

Method

A target of filter paper 1 inch square was suspended in a tube which was made to face into wind by means of a vane. The papers were collected weekly and analysed for sodium by washing and flame photometry of the leachate. After allowance for the leachable sodium of the blank paper the results were expressed as ugm/NaCl/cm^2/week.

The instruments were sited in four lines distant approximately 1, 2, 3 and 4 miles from the coast, each line consisting of three instruments in sheltered, moderately exposed and very exposed sites.

Results

The results of the survey showed:

1. That the deposition of salt in the "1 mile" line was significantly higher than in any of the others.
2. That while a fall in level occurred between the 2, 3 and 4 mile lines, it was not significant.
3. That exposed sites collected two or three times as much salt as sheltered ones.
4. That exposed sites five miles inland collected as much or more salt than sheltered sites near the coast.
5. That there were significant positive correlations between run-of-wind (anemometer data) and salt deposition.

Some sporadic observations and measurements taken during severe gales were reported.

(i) Clippings from a hedgerow 1 mile from the sea showed very high quantities of salt on the windward side but only a quarter as much on the sheltered side.
(ii) Samples taken from a grass field after a severe gale showed that the quantity of salt deposited in 24 hours on two occasions was 2½ lbs./acre and 1¼ lbs./acre.

A brief description of work still in progress at Newborough Warren in Anglesey was given and acknowledgment given to the assistance of the Forestry Commission in the project. Some interim results showed very high levels of salt deposition on targets placed on the coastal dunes, of the order of 20 to 30 times those found at Aberystwyth. (The sites were, however, much nearer the sea.) It was shown that the importance of distance from the sea and of height above ground level increased rapidly with increasing wind speed. For example at a mean wind speed for 30 knots the amount of salt deposited at 4 ft. above ground was double that deposited at 8 ins. above ground, whereas at low wind speeds there was very little difference between these heights in terms of salt deposition. When this investigation is complete it is hoped to publish the full results in collaboration with the Forestry Commission.

PREDATORS AND FORESTRY

By
P. F. GARTHWAITE
Divisional Officer, Director (England)

Background

1. Up to the Middle Ages, when a large part of this country was covered with forest, the fauna included the wolf; before that, but still in historic times, the bear was found in Britain. With forest cover now returning to part at least of its former realm, though these large predators will not, it is to be hoped, return, some of the rarer mammals, notably the pine marten and polecat, are regaining ground and spreading outwards in the shelter of the growing forest from a point near extinction.

2. The Forestry Commission's estate now extends to 2½ million acres, of which over 1½ million are under trees, the balance either awaiting planting or being unsuitable for tree growth, and retained as hill grazing, deer forest or open space for recreation. These properties are distributed throughout the country and include nearly every main site type. On them are to be found most of the species of plants, insects and animals occurring in this land.

Diversity of Structure

3. The new forests started in the 1920's are now developing that more complex structure associated with sustained forest management, providing a still greater variety of habitat for wildlife. In this rich and diverse environment, a considerable proportion of the total population of mammalian predators dwell. Before discussing policy towards them, it must be understood that the Commission does not have exclusive rights on all its holdings; the terms of leases, conveyances, restrictive covenants and reservations limit, and in some cases inhibit, the implementation of a wholly consistent policy throughout the Commission's properties.

General Effect of Mammalian Predators on the Forest

4. The majority of mammalian predators do no significant direct damage to trees. In conjunction with predatory birds and other factors, they help to

maintain the health of the forest by balancing surplus populations of pest species which, in the absence of predation, could reach damaging numbers more often than they do.

5. It is the effect of the predators on farming and sporting interests in and around the forest area that the forester must consider when assessing the status of those which inhabit his forests or use them for shelter.

6. These are not the only considerations involved and a proper assessment cannot be made without taking account of some other relatively new factors. One is the great increase in the last decade of the agencies causing direct death and destruction to animals—toxic chemicals, cars, guns and other manufactured hazards which destroy both predator and prey. Even more important perhaps, is the destruction of habitats by developments of many kinds, and increasing disturbance even when no actual destruction takes place.

7. Against these adverse pressures can be set the great advances in knowledge of animal population dynamics and predator/prey relationships through scientific studies both in this country and abroad. This is leading to a reappraisal of traditional attitudes to many predatory mammals and birds, and a realisation that their indiscriminate slaughter is against man's best interests.

Principles of Policy

8. Against this background it has been possible to frame certain principles to be interpreted in the light of local circumstances, which as has already been stressed, vary greatly. Emphasis can therefore change from forest to forest. The policies arising from these principles are in process of evolution; some inconsistencies are to be expected during this process.

(a) The creation or retention of a favourable habitat for a desired species can be more effective in maintaining that species than the destruction of its predators.

(b) Selective control worked to a plan based on a study of the animals concerned, is more effective than indiscriminate killing.

(c) Absolute prevention of damage either by a pest on crops or by predators on prey is an impracticable aim.

(d) Methods applied to the crop, whether of trees or birds, to protect it when vulnerable, may be more economic and effective than attempts to control the animals liable to damage the crop.

(e) No species of animal should be molested unless there are good reasons for doing so, and then only to the extent and for the period needed to achieve the objects of the interference.

(f) As a public body the Forestry Commission has a special responsibility for the conservation of wildlife within the framework of its main objective of producing timber.

Effects

9. An increasingly responsible outlook on the wildlife of the forests by staff in general and those directly concerned with forest protection in particular, is evident. The Commission staff contains many good field naturalists and full use is being made of their knowledge.

10. In the standard sporting lease the tenant is prohibited from molesting badgers, otters and pine martens, in addition to legally protected animals. The list could well be made more flexible by local additions.

11. The use of the word 'vermin' is being discontinued; it is an imprecise term capable of many interpretations and traditionally includes species now fully protected by law.

Notes on individual species

12. In the following paragraphs notes on those species of mammalian predators with a forest habitat are given; these notes are brief and are not intended as a guide to methods of control or anything of that sort. I have attempted to indicate the Commission's attitude to each.

13. *Fox.* In hunting country, control is left to the hunt, supplemented if necessary, and in consultation with the hunt, by control by Commission staff. In non-hunting country the Commission kills about 5,000 foxes each year, 2,000 each in Scotland and Wales and 1,000 in England. About half this number are cubs.

14. *Badger.* The badger is entirely beneficial in its feeding habits in the forests; in addition to many insect and mammal pests of trees, it seeks out and destroys many wasps' nests, which are the bane of the weeding party's life in a young plantation. Now that the technique of training these animals to use badger gates in fences has been learnt, the one barrier to the forester's complete friendship has been lifted. In one of our woods containing 27 active setts, 77 gates are in regular use in 420 chains of perimeter fencing. I have had no reports in recent years of badgers from Forestry Commission land harming either poultry or game. Shooting tenants are not permitted to molest badgers.

15. *Otter.* Generally beneficial to the forest, eating a number of terrestrial pests. Shooting tenants are not permitted to molest otters, and Forestry Commission staff do not interfere with the population except in exceptional circumstances.

16. *Stoat and Weasel.* The forester's most valuable allies in checking surplus rodent populations—rabbits, rats, mice and voles. Local control is necessary near game rearing pens and where poultry farms adjoin forest land. In general, however, in average forest conditions predation on rodents is certainly likely to predominate.

17. *Hedgehog.* In forest conditions a useful member of the community, feeding on a number of pest species.

18. *Pine Marten.* A recent census recorded the presence of this attractive animal in 16 forests in north-west Scotland, one in the Lake District and 7 in North Wales. It is protected in all Commission forests.

19. *Polecat and polecat ferret.* These are grouped together owing to possible confusion of identification. Recorded recently in 2 forests in Scotland, 30 forests in Wales, with one record from Shropshire and one from the Forest of Dean. Protected in all forests.

20. *Wildcat.* Recorded in many forests in Scotland, usually living in dens outside the planted area high up among rocky crags. Controlled only if predation on lambs is established.

21. *Mink.* As an escape and a voracious riverine predator, and proscribed by the Ministry of Agriculture, every effort is made to contain its spread wherever it appears.

22. Two more predators remain to be dealt with, both of which are also pests.

Rat. Not common deep in the forest, but controlled wherever found by all means at all times. As the most costly of all animals in its relation to man, predators on the rat need a greater protection where rats are known to be present.

Grey Squirrel. Generally classified as a pest, but will also prey on eggs and young of all birds, particularly game birds. Attempts to exterminate it by currently available means have failed; control therefore, is confined to vulnerable areas, in the spring and early summer. The *Red Squirrel's* predation on birds' eggs is of little significance.

Research

23. Continuing research on population dynamics and prey relationships of mammalian predators in forest conditions is required. There is a great deal to be learnt. Large blocks of new forests which have yet to achieve their permanent and stable structure, afford a wonderful opportunity for such ecological and biological study.

Conclusion.

24. The Forestry Commission is evolving a long term policy designed to maintain, in so far as this is possible, a balanced wild life population, in which only the unquestionably undesirable elements are removed. In this nearly all the mammalian predators will play a part in a stable community.

THE SHOOTING MATCH

By

R. J. JENNINGS

Head Forester, Forest of Dean

"For every Jack must study the knack"

W. S. Gilbert. (Yeomen of the Guard.)

By noon on Boxing Day the clay pigeon trap had been placed in position in the little field by the side of the cottage. Talbot the keeper had fixed it firmly on the ground with wooden stakes driven deep into the peaty soil. The trap was well sited on the slope of a gentle hill so that the targets would rise into a clear skyline and the competitors standing lower down on a strip of level ground with an uninterrupted view would be in no doubt as to whether or not they had scored a hit.

A screen of corrugated iron had been erected around the trap to shield the man who worked it from the keen east wind that swept in from the rolling moorland or from the danger of injury from an accidentally discharged gun.

The competition took place regularly on Boxing Day every year by Talbot's house and all workers from the forest were invited. The keeper made a special point himself of asking anyone who he thought owned a gun, to come along as he saw them working in the woods when he was attending to his vermin traps. "You'll be coming to the shoot this year won't you lad" he would say . . . . "Let's have a good turn out again and see which of you is the best shot" . . . . and his blue eyes would twinkle mischievously and a broad smile would spread across his tanned face.

All the locals thought he was crazy to spend money in this way, the prize was only a hundred cigarettes and did not cost much, but there was no entry fee and box upon box of cartridges would be fired into the air at the clay birds and that all had to be paid for.

However, most of them came along all the same, to watch if not to take part. They enjoyed the afternoon as it gave them a grand opportunity to poke fun at their neighbour's marksmanship, and was a topic of conversation in the wet weather shelter for a long time afterwards. Most of the leg pulling and witticisms came from spectators who preferred not to enter the competition, not because they were unused to handling a gun but because they were afraid of shooting badly in front of a crowd and being at the receiving end of the jibing.

Talbot of course had a good idea what they thought but said nothing. He was a gamekeeper employed by the Commission's sporting tenant with some ten thousand acres of moorland and isolated hill farms for his territory. He reared

a few pheasants every year, but most of the bag consisted of hare, grouse and blackgame, creatures that bred naturally on the hills. The sport was fair provided the foxes were not allowed to get too numerous and the known local poachers were kept under observation.

Around two o'clock the competitors began to arrive. The first to put in an appearance was Jack Nutt, a brawny six-footer with a freckled face and auburn hair. Having celebrated over Christmas he had not felt inclined to shave and the stubble on his cheeks shone a golden red like the fresh rust on a garden spade. His square jaws moved continuously as he chewed his twist tobacco. He seemed surprised to find that he was first there. Having just cycled two miles from the 'Farmer's Arms' it occurred to him that he would have had plenty of time for another pint before leaving. This grieved him a little and he made a mental note to try and not make the same mistake again next year.

A motor-cycle combination snorted into the yard, shortly after Nutt had dismounted his bike, ridden by Dave Humphries, a shifty-looking character with sallow complexion and pinched features who lived on a workers' holding with his brother. Both of the men were sullen, brooding fellows, unpopular with their workmates. They were however shrewd and energetic fellows who could hold their own with any man in the forest and as is so often the case, were disliked only because in their own way they were a little more successful than their neighbours when it came to buying or selling. Every Christmas a whist drive would be organised in the village and one or other of the Humphries brothers would come away with a prize. It had been said that this was due not to their skill at cards but to their particular way of marking up the number of tricks that they had scored, such as altering a three into an eight. But no one had mentioned it directly to them, and as they were quick-tempered and well able to look after themselves, it was unlikely that anyone would.

A sheep dog jumped out of the sidecar and after sniffing around the legs of various other dog owners who were arriving, made a bee-line for the back of one of the keeper's sheds where it knew Talbot boiled up food for his retrievers and setter, hoping to pick up something tasty.

By half-past-two the competitors had all arrived and stood chatting for a while in small groups with guns under their arms. Bob Lloyd the Commission warrener was there, a tall muscular man in well-cut breeches and an expensive tweed jacket. Billy Williams the tractor driver too, a little man with a large family known locally as "Williams the Bull". The older people in the village said that this was because his father had kept a public house called The Bull; his workmates though said that it was for another reason. Williams' mate was there as well, a motor cycling enthusiast called Dick Parry. His driving experiences over the years had earned him the name of "Parry full-pelt". He had brought his son along with him on the pillion seat, a young man of seventeen who had just begun work in the Commission nursery. Soon the field and yard was crowded with men, and their laughter and chatter might be heard from a long distance.

Talbot went into his game larder with Lloyd and shortly afterwards they both re-appeared carrying large cardboard boxes. Lloyd did not compete but worked the trap. In his opinion his job put him on a higher plane than that of the worker. He felt that he was in the professional class and had no desire to compete with the amateurs. Secretly he knew that he could not afford to be beaten in a shooting competition by any of the workers present, or his life on a wet day in the shelter, when the men's sarcasm reached a high level, might be quite unpleasant. He made his way over to the clay pigeon trap, while Talbot distributed cartridges in small yellow boxes marked "Special Trapshooting 12 bore 7 shot". "Here you are lads" . . . he was saying . . . come and get your ammunition . . . . there's plenty for everyone . . . . then follow me and let's get started".

Wooden pegs spaced a few yards apart had been numbered and driven into the ground. Talbot walked over towards the men who stood lined up, facing the corrugated shelter, with their guns now loaded. "Now" said the keeper, . . . "You all know the rules . . . and you all know how to shoot. When you're ready, shout PULL . . . . and Bob Lloyd in the trap will throw you a bird . . . if you break it with the first barrel it counts two points . . . . second barrel one . . . . it's just getting the knack of it . . . . I'll show you" . . . he lifted his gun, lowered it and lifted it again . . . . "are you ready Bob . . .PULL"! . . . . Behind the screen a click of metal was heard as Lloyd released the spring and a small circular object was catapulted swiftly into the air. Simultaneously a shot rang out and the clay target was shattered.

Talbot's face lit up . . . . "you see how to get them don't you boys . . . . as soon as they rise from the trap" . . . . he turned to the man at the first peg. "Right you are then young Parry" he said " off you go!"

Parry full-pelt Junior stood at peg number one with his left foot forward. He was very nervous and licked his lips and swallowed his Adam's apple frequently. He realised now why the men had manoeuvred him to peg No. 1. No one had wanted to be the first to fire as all eyes would be on them. Being the youngest competitor, and not having handled a gun much before, had given him stage fright and he looked worried. He moved forward the safety catch on his gun and his heart thumped . . . . "PULL" he called.

Up went the target . . . . a pause . . . . then a report from his gun as it bounced loosely in his hands. To his immense relief and everyone else's amazement a piece broke off the side of the clay pigeon. "Well done lad" said Talbot winking at a spectator . . . . "who's next?" . . . . "Go on Jack" shouted a voice from the rear ranks . . . . "don't forget to load your gun and don't bend the corrugated iron!" . . . .

Jack Nutt smiled benevolently . . . . he was still chewing tobacco. The beer that he had consumed on his way to the shoot had made him feel good-natured but had slowed up his reflexes considerably. "Pull" he shouted . . . then once . . . . twice he fired, but the target sailed away in an arc to land unbroken in the grass some sixty yards distant.

A ringing cheer went up and Jack chuckled quietly as he removed the spent cartridges from his gun. Talbot chided the spectators . . . . "now lads . . . . no barracking . . . . we can't hit them all . . . . fair play for everyone . . . who's next . . . . who's next?"

All eyes were now on Humphries, known to be a good shot. No one expected him to miss and there was no surprise or comment when his bird was shattered in expert fashion. Perhaps a little too expertly for Talbot's liking. Not that he failed to appreciate good marksmanship but he knew this man for a slippery customer. Whilst crossing Humphries' land he had seen things that had displeased him. A sheaf of oats thrown in a corner of a field. The odd handful of wheat scattered on the edge of a forest ride where the plantation joined the farm land. Rabbit snares set in the hedgerow too close to the ground and with far too small a noose to allow anything other than a bird to enter. The smell of burning feathers coming from the cottage chimney. All these things are the signs of a man who must be closely observed by a gamekeeper. Talbot's meditating though was interrupted by a single shot. Williams the Bull had hit his clay with a single barrel. The shooting match was off to a good start.

As the afternoon advanced and the heaps of spent cartridge cases on the ground became larger, and the novices were eliminated, the competition became keener. Eventually Nutt and Humphries proved to be the best shots and were the only two left in the match. After several excellent shots Nutt made a clean miss . . . . "Jack can hit 'em best in the dark can't you Jack" called a humourist from the

crowd—a hint that Nutt was not above looking for a dinner at night with his gun. Talbot frowned a little . . . . it occurred to him that the remark was received in silence . . . . you could never be certain . . . . he had heard from the ironmonger in town that Nutt's wife purchased a box of four-ten cartridges now and again . . . . he would have to be watched. Now Humphries was preparing to shoot. As he raised his gun an irate female voice was heard coming from the cottage accompanied by the yelp of a dog. "Outside you brute" . . . . called the voice . . . . I don't want your trade mark in my kitchen!" . . . . "PULL" shouted Humphries as his sheep dog scuttled through the crowd and took refuge under his master's feet. Another yelp and an oath from Humphries as he trod on the unfortunate dog as he fired and missed with both barrels. A derisive cheer went up from the crowd and excitement rose to a high pitch. After leading all the afternoon Humphries was no longer ahead. He and Nutt were level. This was now the final round and the first man to miss would be the loser. Tall Jack became calmer and more serious, but Humphries began to get annoyed with himself and edgy. He imagined that he would run away with the prize but he now realized that he might just as easily lose.

He put his gun to his shoulder . . . ."PULL" . . . . he shouted . . . . a double report before the target was shattered.

"PULL" . . . . called Nutt directly afterwards and smashed the clay with a single shot. A round of applause, Jack Nutt had won! With a grin he shook hands with Humphries and the keeper.

Talbot handed him a box of cigarettes which he opened immediately and began to hand round. Soon afterwards the most confirmed pipe smokers had turned over to cigarettes with the exception of Williams the Bull who had removed the thin paper from his free gift and had begun to chew the tobacco shreds.

The winter afternoon had now begun to close in. Groups of men in close conversation started to break up and make their way homewards.

Everyone save Humphries had enjoyed the afternoon. Even his dog had found a sack of hound meal in one of Talbot's kennels and helped itself to a feed.

Humphries' dark face bore an expression of discontent and exasperation as he removed a number of heavy stones that some of the younger lads had concealed in his sidecar. He looked carefully at his tyres.

Jack Nutt, smoking a cigarette, swung his long leg over his cycle and free wheeled down to the main road.

Talbot and Lloyd collected up the unbroken clays, went into the house for tea and as they sat by the fire talking the keeper seemed pleased. He spoke to Lloyd . . . . "Well, it was a good afternoon Bob . . . and thanks for working the trap". Lloyd looked at his friend for a moment, "I don't know why you spend your money like this" he said . . . "they don't appreciate it . . . . they're a grabbing lot!" Talbot smiled . . . . "Boxing Day is a sportsman's day" he said "the boss buys the cartridges and the clays . . . he agrees with me that it's much better to have all the fellows and their guns shooting in one place at clay birds as an outlet to their sporting instincts than scattered about the fields and round the hedges in ones and twos where you can't see them, all looking for something to fill the pot. Besides" . . . he went on . . . "it's the only opportunity I get to have a good look at their guns!"

The two men relaxed as shadows from the log fire in the hearth made pictures on the wall.

Outside an owl hooted in the trees, and soft misty rain blew in from the moor.

OBSERVATIONS ON THE WINTER ROOSTING OF STARLINGS AT SLEBECH FOREST, PEMBROKESHIRE

By
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Forester, S. Wales

General

These notes are intended to add to the information recorded by District Officer J. Kellie (S. W. England) in his article published in the Forestry Commission Journal 1957 (pps. 146–151).

The general observations made in this article on population density, size of roost and subsequent damage to plantations apply broadly to these now being experienced at Slebech Forest. There are, however, a number of differences both in topography and type of crop which are worthwhile recording:—

(i) The crop being used as a roosting site is P.51 D.F. on average 25 ft.—30 ft. tall.

(ii) The area had been 100% brashed, giving good air circulation.

(iii) Elevation 100 ft—150 ft.

(iv) The roosting site is within a forest area of about 1,200 acres with a wide range of species and plantations in varying stages of development, ranging from first-year plantings to first thinnings of Japanese larch and Douglas fir.

(v) The forest is adjacent to a tidal estuary with a considerable area of reed beds.

(vi) Starlings had not roosted in this block of the forest for at least seven years prior to 1964.

Behaviour Pattern

It is believed that migrant and native birds begin to congregate in small flocks in late October and each flock at this time has its own roosting site. At this stage they cause little concern. In early November the separate flocks abandon their roosting sites and all concentrate into a selected permanent winter roost. Unless disturbed they will remain in this site until the flocks disperse in March.

From local observations it would seem the various flocks which use the permanent winter roosting site retain their identity within the roost, and at dawn each flock disperses to a different feeding area. The individual flocks leave the roost at intervals and it has been noticed that small batches of birds seemingly in the wrong flight will return to the roost and fly out again as the next flock rises. Some individual birds, apparently unable to identify their particular flock, fly about in a confused fashion until they finally find their place. It has been said that the organisation within the roost itself is even more complex and that it is possible to prove, by ringing birds, that each bird has its own place within the roost. It is also evident that some individual birds which fly and feed with the flocks do not use the roost, but seek shelter in woods near to but not within the roost itself.

Although the birds disperse and feed over a wide area (it is estimated that feeding grounds may extend up to 30 miles from the roost), they collect together just before the light fades and approach the roosting site in long columns, miles in length and many yards wide, flying into the roosting area along the same line of flight each evening. In the early part of the roosting season (October to November) the birds take a last feed in adjacent fields before entering the roost,

but it has been noticed that later on when the weather deteriorates and/or the local food supply is exhausted, the birds enter the roost immediately on arrival. The tenacity of these small creatures is quite amazing, and during the hurricane force winds experienced during mid-January 1965, flew into these winds to reach the roosting site. When winds are strong, and the light poor from low cloud, the birds fly only a few yards off the ground or at tree-top height, many fall casualty to telephone wires when they are travelling in this fashion. It is difficult to understand why these birds will exhaust themselves battling against head winds of 70 m.p.h. flying over sites identical to those in which they are roosting.

Numbers of Birds

Any assessment of numbers by visual observation is quite impossible and one can only think of the birds in terms of millions rather than thousands. Perhaps the best guide is the personal experience of the Ministry of Agriculture's Pest Officer of Montgomeryshire (Mr. E. M. Nicholas) who has counted 20/25 birds per tree on 8/10 ft. Sitka spruce. Using this as a guide he would expect a population of some 200 birds per tree on Douglas fir 25 ft. in height, with its greater extent of crown. This would then give an estimated population of 200,000 birds per acre; with a roosting site of 15 to 20 acres, a number of millions are involved.

Damage Caused

Although, at the time of writing, we are only half way through the estimated duration of the roosting season, extensive defoliation of Douglas fir is taking place. Many trees are heavily coated with excrement and at a minimum, there is threequarters to one inch of droppings covering the forest floor. The foliage coated with excrement will undoubtedly die-off since the droppings harden to a cement-like consistency impervious even to heavy rain. Much mechanical damage is also caused to the foliage by the claws of roosting birds as they occupy all the space to the apices of branches and side-shoots.

The accumulation of droppings on the forest floor may not be of so much concern as was previously felt. The release of phosphates may even be beneficial to that part of the crop which survives.

Some trees are beginning to go down under the weight of birds. The numbers involved are not many and it is primarily those trees slightly wind-blown which afford the opportunity for birds to perch on the main stem itself.

Extent and Pattern of Infestation and Attempts to Evict

The sequence of events at Slebech Forest is as follows:—

1. A small flock entered Douglas fir, Compartment 23, in late October. This flock started to increase in size but was driven out by a local farmer on whose fields they were feeding. Method of dispersal was by revving-up a chain-saw. It is interesting to note that some farmers are convinced that foot-and-mouth disease is spread by these migrant birds.
2. This flock and others then moved to a permanent roosting site on the reed beds adjacent at Lammasford on the Eastern Cleddau, a tidal river.
3. In the first week of November a change in the tidal pattern meant that large areas of reed were under water at dusk when the birds were seeking the roost. This drove the birds back into the forest.
4. The site the birds chose for the roost was P.51 Douglas fir 25ft–30 ft. in Compartment 23. So numerous were the birds that at dusk 10 acres of Douglas fir changed colour from green to black. Rockets (150 in all) and beaters were used at this stage in an attempt to drive the birds off. The only success achieved was to break the roost into two, so that by late November half the birds were in Compartment 23 and half in Compartment 24; they then were spread over 20 acres. Further efforts to move the birds were abortive since under dense canopy

over some 40 acres, it was quite impossible to follow the birds' movements. After dark, movement, even with torches, became dangerous. The best that could be achieved was to move the birds from one Compartment to another.

5. At this stage, and with damage beginning to increase, the help of the Ministry of Agriculture Pest Control Officers was sought. Both Mr. I. B. Jones and Mr. Hill of the Ministry were quick off the mark, and, after seeing the extent of the problem, arranged for the loan of specialised equipment.

This equipment consists of a Dutch recording of a starling's distress call played continuously through a Trix Sound Amplifier powered by a 12-volt battery. The amplifier is specialised equipment designed to contain the sound in a narrow beam effective up to several hundred yards. Unfortunately the equipment was already in use and was not available until early in January.

6. In the intervening period a change occurred in both numbers and the behaviour pattern. During late December a further flock of birds appeared, which had presumably been driven south by the colder snowy weather to the north. This flock, whilst following the general flight lines, established a separate roost in 10 ft–15 ft. Sitka spruce adjacent to the Forestry Commission Housing Site at Minwear Wood. Suffice to say that unless immediate and successful action was taken there was a distinct possibility that the houses would need to be evacuated since the smell from an established roost is intolerable.

After some eight nights of disturbance in which carbide guns, ten men, four tenants and their families were involved, the flock was driven off and joined up with the main roost in Compartments 23 and 24. Starlings are, however, most persistent and although by December 23rd it was thought the housing site area was safe, it only needed two quiet nights on the 24th and 25th for them to make another attempt to re-occupy the site. On December 29th and 30th the birds were finally cleared from the Minwear Housing Sites.

7. On Tuesday 5th January the distress call and amplifier was received. This equipment was positioned on the forest boundary between Compartment 23 and 24, i.e. halfway between the two main roosts. The distress call was played continuously from 4 p.m. to darkness (usually 5.30 p.m.) for 5 nights with seemingly little effect, except to clear the birds from an area some 50 yards either side of the equipment. On the 10th January the equipment was moved to a site where the sound could be bounced off the hillside, thus increasing the effective area. Ten men were also placed in the general area of the roost with instructions to make as much noise as possible. A Pye transistorised loud-hailer was also brought into use. Under the attack the birds moved from Compartments 23 and 24 into Compartment 25, an area of pole stage Douglas fir and hemlock with smaller crops of Lodgepole pine, Sitka spruce and Lawson cypress. Whilst the distress call had no apparent effect on the birds, the volume of noise from the powerful amplifier could be used to deflect the birds from their line of flight. Similarly a high-pitched whistle through the loud-hailer would deflect the column of birds. Continuing the method of flight deflection we were able, after 2 weeks effort, to drive the birds to the extreme west of the Forest. By this time the available labour and equipment were stretched over half-a-mile of forest to prevent the birds re-settling on cleared areas. The final attempt to push the birds back into the reed beds was made on Sunday, January 17th when all available labour and equipment was brought to Compartment 25. The offensive ended in disaster as the birds took off, swept in a wide circle, and re-entered the Forest at the original roosting site. (Napoleon tasted no bitter a fruit.)

Conclusions and Recommendations

1. Starling roosts can be moved effectively from small woods up to 40–50 acres. Trix amplifiers (possibly with a high-pitched oscillating sound) are

effective in preventing birds from settling in small areas. (The cost of the complete equipment is of the order of £75 with record player).

2. A labour force of one man to 4–5 acres on the ground is a necessary back-up.

3. Over large forest areas it would seem impossible to move the birds out completely unless large numbers of people are available and several recordings and amplifiers are used. (The position may be eased in areas with roads where the equipment could be made mobile, say in the back of a Land Rover).

4. Brashing to induce cold air circulation is no deterrent.

5. Damage can be substantial. Col. Corbett Winder of Montgomeryshire estimated at least £1,000 damage on his estate during 1963.

6. Starlings are increasing to pest proportions. (A situation which already exists in North America).

7. Eviction from particular areas is, in the long run, no solution. The problem is merely transferred to our neighbour.

8. Research is needed into the subject unless forest management is prepared to accept losses that may range up to several thousand pounds in a year.

9. Reductions in numbers have been achieved by Ministry of Agriculture Pest Officers in Montgomeryshire by trapping and gassing the birds, but one would hesitate to extend this solution without an investigation into the possible acceptable limits of destruction and the effect upon insect control that these birds may exercise.

DETAILS OF COSTS INVOLVED IN MOVING STARLING ROOSTS FROM PERIOD JANUARY 5TH–17TH

Day	No. of Men	Total Hours	Cost Industrial Labour £ s. d.
5	2	3	19 7
6	2	3	19 7
7	2	3	19 7
8	2	4	1 6 9
9	4	8	3 3 10
10	9	22½	11 12 7
11	9	13½	4 14 7
12	11	13½	4 10 11
13	10	14	4 17 7
14	11	18½	6 2 3
15	11	20¾	7 2 8
16	11	20¾	8 3 4
17	2	3¼	1 17 10
			£56 11 0
Add 60% Overhead Charge for Industrial Labour			32 19 0
			89 10 0
1 Forester 22 hours at 9/4			10 5 4
1 Assistant Forester 22 hours at 8/-			8 16 0
1 Assistant Forester 15 hours at 8/-			6 0 0
		GRAND TOTAL	£114 11 4

FISHERY DEVELOPMENT IN OUR FORESTS

By
K. FRYER
Assistant Forester, West Scotland

One of the many subsidiary and diverse roles that the Forestry Commission is being called upon to play as we pursue our primary aim of producing timber, is that of providing a source of recreation and amenity for the benefit of the general public. It has been said that recreation means many things to many people, but not the least of these that we are in a position to provide is:—Fishing.

The Forestry Commission is by far the most extensive fishery owner in Britain and as we continue to acquire land for planting, so will the number of our fisheries increase. This poses quite a problem if we are going to exploit them successfully, especially since much of the fishing lies in the more remote parts of the country where it is little fished and lack of management has allowed the quality of sport to deteriorate until few anglers would wish to visit it.

This is rather sad when one considers the growing problem of over-fishing that exists in other parts of the country. There is widespread concern about this state of affairs and eventually, no doubt, steps will be taken on a national scale to rectify it but, in the meantime, the Forestry Commission can do much to ease the situation by making fuller use of our resources to help cater for the growing army of anglers in Britain.

To do this the Commission faces an extensive development programme; just how extensive cannot be determined until a survey of all our fisheries is undertaken to assess their potential.

Most of the fishing we own is in lakes at fairly high altitudes and often far off the beaten track, such as the hill-lochans of the Scottish Highlands or the llyns of the Welsh mountains. Here the problem is usually one of too many fish rather than too few. The remoteness of these waters and difficulty of access has discouraged all but a few of the more hardy souls from casting a line on them, and where natural spawning grounds are good the fish have become too numerous and the average size has fallen to the 'tiddler' stage because there isn't enough food to go round.

This is the basic issue of all fishery management, that of maintaining a suitable balance between the fish population and the food supply in order to produce the size of fish desired.

The Food Supply

The importance of the food supply is well illustrated by what happens when a loch is subjected to a hydro-electric scheme and surrounding ground is flooded, thereby creating new feeding areas. One such loch I know, which formerly held countless fish averaging three to four ounces, showed a steady rise in average size to half a pound in the first year after flooding and three quarters of a pound in the second. After holding steady at this for a year or two it started to decline somewhat as the new feeding grounds became exhausted and if it weren't for heavy fishing the average size would probably drop to what it was before, as numbers got out of hand.

Naturally, every piece of water varies in the amount of food it can supply for the fish, depending on several factors such as situation, elevation and particularly on the composition of the bed of the lake. Generally speaking, the food supply is poorer in those that are acid than those that are alkaline, and for many years the pH value of the water has been considered one of the most important factors in fishery development and management. There are complications however.

Some waters are acid even though they lie over an alkaline bottom, some North Country tarns for instance where the feeder streams flow out of peat. On the other hand, waters with a high pH value may have beds which have been made acid due to decomposing vegetable matter lying on the bottom. It was eventually realized that since many stages in the food chain of the fish live on the beds of lakes and streams, rather than in the water above, closer attention would have to be paid to this factor.

However, increasing the food supply can be an involved and long-drawn-out process, and more immediate effects can be gained by reducing the fish population to suit the existing food supply. This way, a reasonable average size can be maintained even in a 'poor' loch, which after all, is what most anglers want; a bag of ten or so half-pounders is, to most, infinitely preferable to twenty or thirty three-ounce fish.

Population Control

How then, can the Commission cope with the problem of reducing numbers in over-populated waters?

A very useful development that has come about in recent years is the use of rotenone, a chemical product which induces a temporary paralysis in fish by acting on their nervous system, thereby allowing unwanted fish to be picked out, leaving the rest to recover with no ill effects. It is particularly effective in enclosed waters such as lakes, far more so than netting or electrical fishing. The equipment for this technique is not too bulky and could be packed out to even the more remote waters by ponies. Rubber dinghies can be used where boats are not available and would prove easily transportable.

The whole area of a lake need not be treated. Use can be made of the fact that the fish tend to inhabit the shallower water along the shores, out to the maximum depth that enough light can penetrate to permit underwater life to flourish. This, except in the case of small, shallow lakes, would be a comparatively narrow fringe which would contain a large proportion of the fish population.

A useful rule to stipulate on these waters to help complete the treatment would be for anglers to kill every fish *under* a certain size until the desired balance has been achieved.

Re-stocking

We now come to the other problem that faces us, that of increasing stocks where they have fallen low, or in some cases re-introducing them where they have disappeared entirely, as in some lakes once polluted by lead-mining in North Wales.

Artificial re-stocking is expensive, especially if it has to be carried out frequently, and it has obvious difficulties where the fish have to be transported a long way over rough ground. It is essential therefore, that full use should be made, where possible, of any natural spawning facilities that may exist, and these should be improved or created where necessary. It does not take much work to clear feeder streams, clean and rake gravel, which may have to be introduced in some cases, to make spawning redds that the fish will soon take advantage of. The results of such work will be slower to come but more lasting and far cheaper in the long run.

Where artificial re-stocking must, of necessity, be carried out, recent improvements in technique once more make this far easier than it would have been at one time. The old way was to transport the fish in metal containers for which the water had to be changed frequently to renew the supply of oxygen. Even then there were mishaps and long, rough hauls could not be taken with any convenience.

The method used now is to put the fish in polythene bags partly filled with water, pump in oxygen and then seal the bags tight. This way the fish can be transported long distances with little or no ill-effects, even with comparatively rough handling. The bags are more easily handled and could be packed out to less accessible waters again by ponies, or by hand, without the tiresome bother of having to renew the water every so often.

To achieve quick results, re-stocking would have to be carried out in every case of depleted stocks, and a little 'new blood' would do no harm. But the only sure way to maintain a healthy, thriving population is to make sure that the natural spawning facilities are brought into a good state of repair.

Weed control

Weeds are always a problem and the normal method of controlling these is by laboriously cutting them back each year once they have grown up enough to be a nuisance. Some weed is essential because it harbours some of the forms of under-water life that fish feed on, but if it is allowed to grow unchecked it spreads and cuts down the fishable area of the loch.

Experiments are going on however, in fishery management circles, to find a selective weed or brushwood killer that will act on the different types of aquatic weed. This would have more efficient and lasting effects than manual control and will be a big advance if something effective can be found.

Access

Difficult access is slowly becoming less a problem as our plantations creep out into the remote valleys or towards the high ground where the lakes or lochans lie. Once forest roads are put in to serve these plantations the fishing is brought within easier walking distance of the car and more anglers (they can be lazy types) will be encouraged to take advantage of the improved facilities.

These are only some of the factors that go to make up the broad framework of fishery development and management but they are the ones which must be dealt with initially if we are to bring our fisheries to a condition which will enable us to exploit them profitably.

This then should be our aim. To develop and manage our fisheries to their full potential so that the largest number of anglers possible is catered for. This will require publicity but once anglers know that we have something good to offer at a reasonable price, they will be only too glad to fish our waters—to our mutual benefit.

WORK STUDY AND MANAGEMENT IN THE FOREST

By

S. FORRESTER

District Officer, Work Study

By the time this appears in print I shall be again in charge of a district, after seven years spent with the Work Study Section of the Forestry Commission. I feel rather like the new District Officer looking forward to his first charge with a sense of keen anticipation. Not that I regret those seven years. It has been an interesting spell in a position which managers so rarely enjoy. Work study men are in a curious position; they are on the sidelines looking on, and yet they see every detail of the game. Their detailed study of the operations and organisation

of an undertaking gives them a keen insight into what goes on, and a fund of ideas on what *should* go on. Yet they also see the whole picture, the consequences of each move in the pattern.

This is what makes work study so useful, and so fascinating. Work study is outside the organisation yet is looking at every part of it. As the British Standard Definition (3138: 1959 no. 1001), puts it:—"Work Study—A generic term for those techniques, particularly *Method Study* and *Work Measurement*, which are used in the examination of human work in all its contexts, and which lead systematically to the investigation of all the factors which affect the efficiency and economy of the situation being reviewed, in order to effect improvements".

With such a wide remit, the work study man would be at his wits end in a firm the size of the Forestry Commission and with such wide diversity of operations, wondering where to start. To see how things work out in practice, we can look at the history of one assignment.

The top management in a firm makes the first decisions on work study. In our case they considered that North Scotland Conservancy had not had the benefit of any work by the work study section. Further, there were considerable difficulties in making ends meet on the produce account, chiefly as a result of geographical and physiographical factors which work study might help to alleviate. The proposal was made that a work study team should be assigned to South Strome Forest, which had one of the largest Forestry Commission production operations in North Scotland.

This immediately reduced the problem to one of reasonable proportions. A preliminary reconnaissance by the work study staff in collaboration with the local management started to set the picture. Clearly, as far as the operation itself went, extraction was the main difficulty. In this steep hill country, the horse was the means most generally used and even that could not cope with the worst conditions. Costs were high in relation to other areas which had been studied. Conversely, the forest squad were already using felling methods evolved in other parts of the country and in these cases the costs were reasonable. The other great difficulty in balancing the account was the distance from the main timber-using areas. Already there was talk of a pulpmill; negotiations were in hand and it was considered only a matter of time before a market for timber was much nearer.

All this fitted in well with the plan for work study in the country generally. Plenty of study had been done on felling to give us clear ideas of what was involved, but little progress had been made on extraction, though a lot of ground work had been put in. In addition, the possibility of a fixed outlet to a pulpmill gave us the basic industry to which to work; we had found that the best results from work study of production operations were obtained when there was a steady output to a regular customer. At this stage then, a detailed report was drawn up and terms of reference suggested for approval:—

1. To review the production operations in South Strome, North Strome and Achnashellach Forests, in particular considering:—
   (a) What are the best extraction methods and their relationship?
   (b) Are felling methods efficient or how can they be improved?
   (c) What are the best methods for ancillary jobs, e.g. measuring and booking?
   (d) Are the piece rates fair, and having the desired effect?
2. To consider future methods of working involving conversion, loading and transport with particular reference to pulpwood.

Now, the work study team started to fill in the detail on the canvas. The team in this case consisted of a District Officer, a Forester and an Assistant Forester. The stop-watches were used to find out just how the time was used in each operation in various circumstances. Very early, small improvements were

suggested to the workers on felling, and to some extent on extraction. Even the forester's job did not escape scrutiny; suggestions were soon proposed for an alternative method of assessing the volume of standing thinnings, and assistance was given in introducing the tariff system, of which we had considerable experience in other areas.

This left the main problem, extraction, largely untouched. The method used was tushing, the hauling out of poles on the ground, simply chained to a swingletree behind the horse. This is a crude method; the resistance to pulling is high; the poles frequently jam against obstructions and the damage to the drag route is considerable, rendering it impassable in many cases. We had tried in other areas to improve the method by using sledges, but with success only in small thinnings in gently sloping country in the Borders. We had tried devices with shafts but found them too unwieldy in our dense plantations. We had also been trying to use a double-drum winch but so far had had little success in thinnings though outputs in clear falls and windblows had been reasonable.

At the time we started at South Strome, we had decided to invoke outside help, to get new brains on the problem. A group of consultants on extraction were brought from Scandinavia to advise us. After seeing several parts of the country they thought that the methods they used were fully applicable in our hill forests. They advised:—

1. The cutting of racks straight downhill for easy extraction by the horse, harnessed in shafts and drawing some sort of sledge device. The clear racks would get over the difficulties we had had with shafts, and would allow for better control of the load by the horse.

2. Crosscutting at stump to allow the feller to lay the timber conveniently for loading on to sledges.

3. Work with the double drum winch with the same sort of preparation as for the horses.

This was the new approach which was required. After little success with partial acceptance of the Scandinavian methods, we decided to "go the whole hog".

By this time too, the emphasis of the assignment was swinging to work on the production of pulpwood; plans for the mill at Fort William were under way. Now we could consider the cutting at stump into a specification which could be arranged to suit both ourselves and the pulpmill.

Preliminary trials showed us that racks should be about 20 yards apart. Greater distances between the racks were found to involve rather heavy work for the feller in dragging timber to them. Even with this close spacing, the volume of timber in each rack would be reasonably high, 200–300 h.ft. in a 150-yard rack, with thinnings of 300–450 h.ft. per acre. We also found that pulp-wood, the timber under about 6 in. diameter, should be cut to lengths of about 10 or 12 feet. Longer lengths were again heavy for the feller and this length was suitable for loading sledges in the wood or lorries on the road. In the extraction itself we found our own Border Sledge drawn by chains, not shafts, was insufficiently controlled on moderate or steep slopes and we waited eagerly for the Swedish models. When these arrived we found our hopes had been placed too high. Our first selection consisted of sledges on to which the timber had to be lifted. The time spent in doing this and in lifting it off again more than offset the savings through lack of snags on the route out, and through having larger loads. These were up to 40 h.ft. with one model as against the tushing load of 8–10 h.ft. It appeared that our relatively shorter drags and somewhat larger timber sizes than in Sweden, meant that we could not get the benefits that the Swedes had obtained.

The problem was obviously in the loading, and, searching for a way out, we found the Norwegian Bundle Yarder, a light arch sulky on shafts with a winch

device for lifting the load. This cut the time appreciably, but except on the best possible ground its instability gave too much trouble; shafts were being broken every two or three days.

It was while we were in a thoroughly dejected state over the lack of success that we took the greatest stride forward yet without realising at the time how big a step it was. The double drum winch had been working away in various parts of the country, extracting poles in the length or cut into "sawlogs" and "pole lengths" (i.e. with only the saw logs cut off). It had been arranged that we would stage a trial at South Strome as soon as possible. After a very short period extracting poles in an open field to let the operator get the feel of the controls, we moved into the wood and immediately reached 400 h.ft. per day, a figure other operators had taken some time to obtain. Further, it was apparent from time study that we could expect 600 h.ft. or even 1,000 h.ft. per day if the work was organised properly. The main point was that the preparation of the timber in loads for the winch had to be right. We very quickly sorted out the difficulties and improved the output. We demonstrated the machine to our own Forestry Commission staff, to timber merchants, foresters and landowners from several parts of the country. We found a revolution on our hands as the possibilities of the winch were foreseen. Now, within two years, there are about twenty double-drum winches in Scotland.

In studying the preparation of loads by the fellers, we had another opportunity to look at their work generally. Chain saws were being used for the cutting off of the tree and for the cross-cutting, but this involved two visits by the sawyer to each tree, as the snedding was done in between. We tried the Scandinavian method of cross-cutting before snedding, managed to persuade one man to adopt it, and again a resounding success. Two incidental advantages of this method are that the tree is more easily rolled to sned the under side, and no snedding is carried out on waste material at the top of the tree nor is any material wasted because the snedding did not go the extra foot or so required to make a full length piece. Success seemed to breed success; we got some new axes, 1¾ and 2 lb. We had got men down to 3 lb axes some time before, but had not succeeded in selling them the idea of axes the same weight as Scandinavian ones. It was largely a matter of design, as the new ones were accepted after a superb bit of salesmanship by the local forester, and no one will now use anything heavier.

Back to the horse. Work still goes on. The bundle yarder idea appears most promising, and a prototype skidding arch, more stable than the bundle yarder, is now under trial while the first production models are on order.

Parallel with the work in the woods, a great deal of thought was being given to the haulage of the pulpwood to the pulpmill. Calculations on the cost of different types of vehicles, problems of organising fleets of lorries, types of loading device to avoid heavy work in hand loading, the legal aspects of loading on lorries, the physical capacity of vehicles, were all hammered out. Experience from different parts of the country was assembled, and small trials were carried out on one or two of the likely types of vehicles. Then a 12-ton tug unit and semi-trailer, fitted with a "HIAB" hoist equipped with hydraulic grapple, was obtained for extensive trials.

A most refined scheme was suggested, involving a fleet of vehicles, one tug of which was equipped with the hoist and would deliver loaded trailers to a suitable transfer point on the public road, while plain tugs would do the main road haul. Other methods, a tractor-mounted loader to load rigid lorries, and the use of lorries each with its own hoist, are still under consideration and it now looks as if this last will be the most satisfactory method.

So much for the actual operations, the method study part of this work study assignment. Sound methods have been evolved and are being applied throughout

the area to supply the mill. But it is an accepted principle that sound methods alone are not enough to ensure the maximum efficiency of an operation. A fair incentive payment scheme to encourage the workers to give of their best is equally, if not more, important.

The normal incentive payments in the Forestry Commission are by piece work. Such payments should always be related to the amount of work in a task, and not necessarily to the quantity of produce. For example, trees of 8 h.ft. take about twice the time to fell as those of 2 h.ft. Thus the rate per hoppus foot for the smaller size should be double that for the larger. These relationships are obtained by time study, or work measurement, the job on which we are now concentrating. This can be the most tedious part of work study, but it has its satisfactions as the times begin to form a pattern and the final shape of the piece work becomes apparent. It is, too, an extremely important part of any work study assignment even if it does lack the glamour and excitement of method developments.

Work Study, by definition, is ". . . the examination of human work in all its aspects . . ." Not only do we look at the operations themselves, but we consider the control of these operations. In the present case we decided that the key points were the rate of production and the proportion of pulpwood to saw logs. Standard times obtained from time studies will give us the rate of output we can expect, while tables produced by the mensuration branch give us the proportion of different sizes of material in particular circumstances. A simple record has been devised to show how the actual performances match up with the targets. Provided the piece work rates are reasonable, and there is agreement between the actual performance and the targets, the costs and returns will be as satisfactory as we can expect them in the given circumstances.

The days when a worker's allegiance could be sought through the fear of being sacked are gone. Some managers may regret it but we in work study accept and welcome it. The alternative is to secure the loyalty of the worker to a thriving enterprise. Part of that "loyalty" is the desire for a steady high wage on piece work. This is where fair piece work rates come in, as well as an organisation which allows steady year-round work on piece work. But this is not all. Few workers will not respond to the boost of morale through being part of a vigorous, well-run, business. If they feel they are part of an enterprise which knows where it is going, if the supervisors give the impression of knowing their job, if instructions are always clear and reasonable: then workers will respond. This I have learned from my experience in work study; it is not in itself a part of work study, but forms the solid base without which no efficient operation can be run. All the innovations and improvements in the world cannot compete with the distrust engendered by poor relations. To try to alter methods or rates of payment in such circumstances, is only likely to increase whatever distrust there is already.

As I look back, and forward, I am determined to make my new District one in which all levels of the staff from myself to the youngest boy in the squad, all know what is their job; in which each level is helping the one below to get on with the job. This starts with long-term planning by the District Officer, comes down to the detailed planning and training of workers if necessary, by the Forester, and down again to the forest worker doing the job. Only when the work is actually under way do we start up the other side of management's function, the supervision, and control at different levels, exercised by Forester and District Officer.

To sum up, I would say that the manager's job could be expressed as—"Give them the tools and let them get on with the job". "The tools", of course, are more than just the ironmongery but also the plans, training and direction, while "They" are the most important men on the forest, the forest workers.

ROAD AND EXTRACTION PLANNING

by

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A Study Group consisting of Forest Officers and Civil Engineers met at Northerwood House under the leadership of Mr. Macmillen, Chief Engineer and Mr. Chard, Conservator N.W.(E). In this period fifteen papers on different aspects of the problem were presented and discussed. The group was remarkable for the identity of view between engineers and forest officers. It is impossible to reproduce here the full range of the discussion but it may be of value to reproduce the agreed summary of the conclusions reached at the end of the group study.

The inter-relation of extraction roads and drainage systems is so complex that those three systems should be designed in detail for new plantations before establishment commences.

There are two main levels of road requirements (a) for establishment and management and (b) for extraction. There are two corresponding main periods for construction, before the establishment of the forest and prior to first thinning. Construction during the thicket stage for fire protection should be avoided. If a fire protection road is required it should form part of the pre-planting system so as to give the maximum return by minimising labour and machine cost from establishment onwards. There is at present no real evaluation of the density of roading economically justified for pre-planting. Actual figures range from nil (due to lack of funds) to one mile to 300 acres. Increased mechanisation and increased labour rates make the penalties for an inadequate pre-planting road system even greater, through non-productive payments such as walking time and through loss of machine production. Messrs. Johnston and Grayson agreed that it is both possible and essential to assemble data and give guidance on the rules to be observed in calculating pre-planting density.

For pre-planting purposes the roads may be Category I or Category II depending on ground conditions. Over most of the country Category I is necessary. The planting season is at a peak when roads are sodden and subject to frost action and losses in transport not getting through can be high.

Where roads are to be used for fire protection and the fire plan envisages support by the Fire Service then the road must be Category I because Fire Tenders are maximum-weight vehicles. Roads should be linked where possible as the Fire Service are unwilling to risk tenders in blind alleys.

Messrs Johnston and Grayson emphasised that Working Plan Technical Instruction No. P.20 was only withdrawn for tidying—not because of any doubts as to validity. Spacing of extraction roads should be based on minimising total extraction cost. Spacing is powerfully affected by the decision to thin or not to thin. Generally it will pay to road and thin, except in low-yield-class crops subject to windblow. Not thinning may keep such crops on their feet longer. Messrs Johnston and Grayson hoped that the Study Group would help them to produce some simpler system of deciding road extraction density than Working Plan Technical Instruction No. P.20. This has not been realised, as discussion showed that the factors are more variable and inter-related than we thought at the outset. The calculations and consideration involved in preparing a guide will now be very complex but there is no reason why a simple form of field guidance instruction should not be prepared.

Roads must be designed not only for removal of timber—they must also serve for stacking, conversion and loading. There is evidence already of difficulty in handling some delayed first thinnings because of lack of road space. Clear fell, with ten times the volume, requires much greater space. Handling and storage problems are increased by winches on either thinning or clear fell, because they

canalise the timber to specific points on the road. The problem is accentuated by increasing road spacing. The increased spacing results in increased volume being delivered to the road. The road must therefore be wider and, particularly on steep hillsides, wider spaced roads will cost substantially more per mile. Due weight to this must be given in estimating the economic effect of wider spacing. Sales at roadside make it well nigh impossible to co-ordinate transport with winch delivery to road-head. Some thought that problem could be solved by the integration of winching and transport, but the consensus of opinion was that some increase in road width and improved turning and stacking areas were necessary. The necessity would increase with wider spacing, and was a significant factor in assessing the economics of wide spacing.

Future trends in extraction techniques must largely control road spacing. There was general agreement that the winch was the long-term solution for extraction on steep hillsides. Techniques are in their infancy and the trend will be to increase the economic range of the winch. There was less unanimity of the ultimate solution in flat country. Some doubted whether the winch would not replace even the latest types of tractors on all but the hardest ground conditions. However, in all types of terrain the pointer is towards greater spacing, but the ultimate may well be limited by stacking problems and the other essential purposes for which a road network is required.

Timber is now being produced for major customers, e.g. Scottish Pulp. Haulage cost is a significant part of the final delivered product. Such exploiters will press the Commission to provide high standard roads and equally it will be worth their while to pay us more where we do give these facilities. Conversely it is essential that the Commission prepare a standard set of conditions for the use of their roads and in a form which is capable of being enforced.

The Commission road systems must be linked up with the public road systems. This involves a careful evaluation, in many areas, of the comparative costs of contributing towards public road improvement and the additional cost of adjusting the internal system to avoid haulage on weak public roads. The density is controlled by the characteristics of the extraction system and topography. These are, in most practical cases, more significant than the P.20 formula in its present form.

Where winch extraction is to be used, new considerations arise in the detailed siting of roads, e.g. convex slopes. Good winch positions are as important as longitudinal gradient.

It is most important that, if there is to be an economic evaluation of roads, then we must know both what past roads have really cost and be able to give reasonable estimates for future construction. This can only be done on the basis of unit costs.

Road construction on peat forms a significant part of our annual mileage. Research must be carried out into methods of estimating bearing capacity, e.g. the new Swedish shear test. We must keep in touch with practice in other countries.

Axle load determines the pavement design of roads. Number of vehicles has only a small effect which can be entirely neglected over the range of traffic intensity foreseeable on forest roads.

On road standards, there is an argument for greater widths, based not on the earlier argument of stacking space but on the difficulty of maintaining the largest vehicles on a 10 ft. pavement. There is a strong body of opinion in favour of increasing this width to 12 ft.

A consideration of the new vehicle regulations indicates that the road should be widened on our minimum radius curves—possibly to 20 ft.

Surfacing standards are generally too low for modern and future vehicles. We therefore pay a penalty in high repair costs. Better surfacing could save

annually something of the order of £60,000 in Commission vehicle operating costs. As our fleet grows, so the saving, or loss, will increase. It was agreed that it was well worth spending a proportion of this sum annually on surface improvements. These are technically possible because of the acquisition of mobile crushers. The improvements should be concentrated on the major arteries where the financial return is greatest.

Road maintenance cost will become an increasingly important factor in our budget, with the dual effects of expanding road mileage and increasing the number of vehicles using them as our production rises.

Costs will be minimised when there is the fullest co-operation between foresters and engineers. Foresters, as local managers, have the prime responsibility for ensuring that the causes of damage are removed, and advising engineers promptly when damage occurs, or is about to occur. With current and projected mileage it is essential to mechanise maintenance as far as possible. In order to justify the capital expenditure machines must be used to the maximum, with permanent, and therefore skilled, operators. This means that mechanical maintenance must generally be organised on a larger unit than the Forest. The general view, supported by Conservancy representatives where the system is in operation, is that mechanical maintenance is best controlled by the Engineers.

SOME NOTES ON SETTING OUT ROADS

By

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Surveying is the art of making such measurements of the relative positions of points on the surface of the earth that, on drawing them to scale, natural and artificial features may be shown in their correct horizontal or vertical relationship. The methods used to ascertain relative altitudes are referred to as levelling, the results being shown either in vertical section, used mainly by engineers, or conventionally in plan.

Geodetic surveying makes allowance for the fact that the earth's surface is a spheroid and consequently, the directions of plumb lines suspended at different parts of a survey are not parallel but radial. Some idea of the rate of convergence can be gained from the fact that if two mine shafts are sunk absolutely vertical to a depth of 1,200 yards (just about the maximum depth in this country at the present time) with centres one mile apart on the surface, then the distance between the centres underground will be approximately eleven inches less than one mile. This means that the horizontal plane, given by the line of sight of a properly levelled and adjusted surveying instrument, at one point, does not coincide with that through any other point on the earth's surface. Geodetic surveys are of a national character, using the most refined instruments and methods of observation to produce accurate maps of wide areas, and for the science of geodesy, which treats the size and form of the earth.

In surveys of small extent, the effect of curvature is negligible and the earth's surface is assumed to be a horizontal plane. This is known as plane surveying. As applied to Civil Engineering, these surveys include rapid reconnaissance to select the approximate site, followed by detailed surveys of the selected site or route. The latter are used in the design work and production of the working drawings. These in turn are used by the setting out engineer to place the pegs and marks to define the lines and levels of the work. Setting out, therefore, is the

reverse of plane surveying in that data are transferred from the drawings to the ground, and is only made possible because of the previous survey and design work.

It has often been said, and in fact has been written, that setting out scarcely merits the name of an exact science but is better described as the exercise of technical skill, common sense, patience and perseverance. Patience when people and plant, and in the case of Forestry Commission work, trees, obstruct the line of sight, perseverance when measurements or bearings or levels will not check up and the temptation is to swear, leave it and be satisfied with an inaccurate result.

The importance of correct setting out is brought home when one considers that everything else which goes into a construction job, whether it be road, bridge, culvert, building, plant, railway, tunnel, or what-have-you, irrespective of size, is in the majority of cases, almost completely wasted if the construction is in the wrong position in either the horizontal or vertical plane. So that line and level are of prime importance for function, cost, and appearance. Further than this, I know of, and have been indirectly involved in, instances in mining where incorrect setting out or survey work has been the direct cause of loss of life.

The setting out must be done so that the work is not held up, say a few days ahead of construction. This avoids expensive and inconvenient waiting periods and also having to do the setting out in a rush, so increasing the possibility of errors. I well remember sweating on the top line, standing on the edge of a large excavation in the rolling mills at Stewarts and Lloyds steelworks, Corby, lining up a giant framework of bolts destined to hold down the new mill manipulators, whilst the ready-mix concrete lorries were already pouring with the chutes adjacent to the theodolite tripod. This procedure is a direct cause of stomach ulcers and is not to be recommended, there being no time for check observations. The extra cost and time wasted should any errors be translated into concrete and steel can be phenomenal.

It goes without saying that line and level pegs should be distinguishable one from the other and should also be distinguishable in themselves. Profiles should be conveniently situated so that they do not interfere with or restrict the work in any way.

Tools for the Job

Drawings

These are obviously the first requirement for setting out in line and level, in view of the fact that setting out is the art of transferring from a drawing on to the ground. As already stated, the drawings will normally be the results of the survey and subsequent design. They should not always be accepted at face value, but should be cross-checked by the setting out engineer for possible errors in the figuring. Scaling should be resorted to as little as possible; for example, in the case of skew structures, the skew distances must be calculated. Thus, for setting out a skew bridge, the skew span and lengths of the abutments are calculated, not scaled, from the given square span, square width and the angle of skew. To set out such a bridge, the centre line is located, the angle of skew set out from the centre line, and points established on the faces of the abutments using the calculated lengths. Pegs are located on the lines of the abutment faces, extended clear of the excavation and at a known distance from the abutment corners. The end of each wing wall can be set out by means of a peg on the abutment face line and an offset distance.

Chainmen

Although most chainmen would probably resent being referred to as a 'tool for the job', a good chainman is of great value to an engineer. Unfortunately, the

supply of chainmen to the setting out engineer is invariably a haphazard affair. Usually, a labourer is supplied, being one who can be most easily spared and who is probably quite useless for the job!

Theoretically, a chainman must have good eyesight, be sound in wind and limb, able to carry bundles of pegs or wield a heavy hammer. He should be intelligent, have initiative and be of the co-operative type. The relationship between an engineer and his chainman should be that of a two-man team, in which the chainman can interpret the engineer's wishes as expressed by a wave or signal, and not stand waving back as one very pleasant but rather dull-witted chap did on one occasion.

Another chainman we had was very short-sighted and could not see our signals at all. After a hectic first week with him, he showed some initiative by obtaining a pair of binoculars and it was quite funny to see him looking intently at us through the binoculars so that he could see the signals and act accordingly.

I will always remember the very first chainman I ever had as a young setting out engineer for the National Coal Board. We were working at a non-gaseous mine where naked lights were permitted and the miners used either candles or carbide lamps, which in those days they had to buy for themselves. Having a carbide cap lamp which gave rather a good illumination, it rather shook me when the chainman, an old miner set in his ways, turned up for work with a candle in an old tin box with an open front, referred to in those days as a 'midgy'.

It was our job to set out and maintain the alignment and gradient of the vast network of underground roads or tunnels according to the drawings issued by the planning surveyor. This we did by hanging strings from the roof on the appropriate line set out by instrument. It was the devil's own job to try to see his candle through the instrument or for finally lining up the strings at some considerable distance in the inky blackness of the underground workings. This state of affairs carried on for some weeks, and although I tried and even begged, I could not persuade this old miner to buy a carbide lamp. He said he had only two years before retirement and he did not need one of those 'new fangled things'. The only alternative was to exchange lamps with him and endeavour to read the instrument by candlelight though having a bright light for the target. Unfortunately, to add insult to injury, I was struggling to read the bearing on one particular occasion and trying desperately not to cover the instrument with candle fat to an accompaniment of the usual underground swear words, when the Colliery Manager, accompanied by the Area General Manager, 'big brass' in army terms, chanced to come into the tunnel where we were working. On seeing me trying to read the instrument by candlelight, they passed quite a few caustic remarks about junior officials who should do less swearing and be sufficiently interested in the job to buy a decent lamp. My ears burn to this day.

On chainmen, I conclude by saying that a regular man, properly trained, is much better than a casual labourer unused to the job.

Instruments

To quote one civil engineer, the old type of brass theodolite resembling a miniature howitzer should be avoided like the plague. They are sometimes made in sections which have to be assembled, and they have too many points at which wear and tear can take place, and can take half an hour to put back in the box. His sentiments are echoed by all, and it is my considered opinion that just as we have to keep up to date with vehicles and machines, so we should advance with the times and take advantage of modern developments in surveying instruments. For speed and accuracy coupled with economy, the best instrument for general setting out available at the present time is a compact microptic tacheometer with glass circles and an optical plummet.

For the non-technical reader, I will expand by saying that the old theodolites had the degrees etched on metal circles, and fractional parts of a degree were read by means of a vernier. A modern microptic instrument has glass circles through which can pass rays of light thus allowing the circles to be read by means of a microscope. The microscope magnifies the circle to such an extent that, on some modern instruments, fractional parts of a degree can be read direct to one minute and estimated to six seconds. This is sufficiently accurate for even surveying of a fairly high order. For further accuracy, to one second of arc, some modern instruments are fitted with a micrometer, used in conjunction with the microscope.

For Forestry Commission work, the best available instrument, having due regard to cost and required accuracy, is the Watts Microptic Transit, reading directly to five minutes, and accurately interpolated to one minute of arc. This instrument, whilst it would not be my choice for primary underground work or for setting out on a construction site, where the included angle method is usually employed, is ideally suited to the continuous azimuth method of surveying. This is, in my opinion, the quickest, and most expedient, method either to set out or survey a forest road, the accuracy of the included angle method, which takes more time and requires reduction of the readings, not being necessary. Continuous azimuth traverses can be made to an accuracy of 1:3000, provided the instrument is properly adjusted, especially for collimation in azimuth. The instrument should be fitted with a tubular compass so that the setting out or survey work can be correlated with the magnetic meridian, to an accuracy of one minute of arc, by centering the arrow-head of the needle between two vertical lines viewed by a magnifying eyepiece.

Tacheometric measurements at 300 ft. are correct to $\pm$ 1 ft. and at 500 feet are correct to $\pm$ 2 ft. with the Microptic Transit. Tacheometry implies rapid measurements and involves the measurement of distances between any two stations in a straight line through the air, by measuring the staff intercept with the special diaphragm with which the instrument is fitted, supplemented by a measurement of the inclination of the line in order to reduce the inclined length to the horizontal. This makes measurements by chain or tape unnecessary, and in fact, except for small setting out distances or offset distances, chain and tape measurements are now almost completely outdated, even for ordinary survey methods. Reasonable results can be obtained by conventional tacheometric methods, which are particularly applicable to Forestry Commission work. With the advent of modern microptic theodolites, reading accurately to one second of arc used with a subtense bar, results can be obtained, even for base-line measurement, which compare favourably to measuring conventionally, and with much less trouble. This entails measuring the horizontal angle to two fixed targets on a horizontal bar; the distance between the targets being known, the horizontal distance is computed direct. With a one-second instrument, this method gives ten times the accuracy obtained in tacheometry using stadia lines. The use of tacheometric devices is quite simple and the saving in labour, dispensing with manual linear measurements, is considerable. The instruments and methods used can be directly related to the accuracy required consistent with economy.

For Forestry Commission work, the readings to one minute are ideal for use with traverse tables, most of which are printed with one-minute intervals, should it be required to plot using rectangular co-ordinates. However, protractor accuracy consistent with the one-minute instrument readings, can be achieved with a Bocking Protractor, which uses three arcs from a 40-inch diameter circle, graduated to 10 minutes, interpolations to one minute being possible. This is possibly the best method for Forestry Commission purposes, consistent

with the accuracy required, being quicker and less tedious than co-ordinate calculations and plotting.

The Microptic Transit is ideally suited to level survey on steep ground for longitudinal sections, cross sections etc., using tacheometrical observations, in order to design road gradients to balance 'cut and fill', set out road gradients, survey bridge sites etc.

For all setting out in level on a construction site, for a tunnel connection, or setting out profiles for drains in flat country, the best instrument is an engineer's tilting level or precise level with a three-screw base and micrometer screw adjustment.

Other equipment, e.g. staves, ranging rods, etc., are merely a matter of personal choice, keeping in mind that the choice of levelling staff must be consistent with the accuracy of work required.

Setting Out Forest Roads

The probable permanence of location of roads means that a large measure of the effort expended in preparing schemes should be devoted to the selection of the most suitable routes. The choice of route will depend on the general topography, with respect to choice of economic gradients to suit vehicle operation and requirements of balancing 'cut and fill', the foundation conditions (avoidance of or otherwise dealing with unsound ground), the efficient serving of the forest with respect to management and extraction, and the accommodation of local features to break the monotony of long straight stretches from the point of view of aesthetically blending with the surrounding terrain. After all the preliminary discussions, arguments, planning and design work, then the road must be set out according to the position and gradients decided upon.

The first job is obviously to set out the centre line and this can be done with the Microptic Transit, using the continuous azimuth method and, if necessary, correlating the readings to the magnetic meridian, preferably by using an attached tubular compass. The distances can be read tacheometrically, taking care not to exceed 500 feet for distance reading. Ideally, the pegs could be fixed at 100 ft. intervals. Slight deviations from the theoretical position of the alignment may be necessary to avoid, for example, small bogs in the negative sense, or to select the hardest terrain in the positive sense.

On steep slopes, the maximum allowable gradient of 1 in 10 obviously takes precedence over horizontal bearing, and the instrument can be used to set out a contour gradient of 1 in 10, or a designed gradient requiring balancing of cut and fill. Ideally, sight rails should be fixed on either side of the road, opposite each peg, facing across the road. In this way, the formation level can be 'boned in' at each 100 ft. position and then, from the levels established transversely, the formation can be boned longitudinally. However, because of the time factor and other considerations, it is a practical proposition for Forestry Commission alignments, to fix profiles along one side with the sight rail at right angles to the direction of the alignment. In this way, a boning rod can be used to fix the formation level of the road.

Where cuttings or embankments exceed about six feet in depth, the limits of the cutting or filling should be marked on the ground. If sufficient cross-sections are available, these limits can be determined from the drawings and set out accordingly. Otherwise some site determination may be required, the formation level being determined from the longitudinal section.

When stringing a line through tall standing timber, where absolute accuracy is not required, a magnetic bearing can be set out with a prismatic compass. If the job is required to be more accurate, then the microptic transit should be used either to set out a magnetic bearing, using the tubular compass attachment, or a grid bearing. Tacheometric observations are not a practical proposition

through standing timber, and the distances to fix bends etc., can be measured by conventional chain or tape. If absolute accuracy is required, then a special point-to-point traverse can be made via the most convenient route, and a closing bearing calculated and set out accordingly.

In conclusion, I would like to point out that the principles of setting out hold good whether they be applied in the dark depths of a coal mine, in the hot smoky atmosphere of a giant steelworks, on a busy construction site, a giant bridge, or in Forestry Commission work. The two main differences are the standards of accuracy required and the environmental conditions under which they are applied. This latter is brought vividly to light in a poem written by one of my colleagues when I left the hot, smoky, giant steelworks of Stewarts and Lloyds to come to the Forestry Commission.

Ode to a Setting Out Engineer

Farewell to thee thou venturous man,
Whose feet are wearied treading these mills
E're long will travel o'er vales and hills
Thine eyes the countryside to scan,
Then softly falling on thine ears
The-gentle call of birds and beast,
Peewits, curlews, cows and sheep,
The flowing river so clear and deep.

Amid the pine trees tall and straight
Thy feet will walk with leisurely gait,
The snares around thy wrists entwined;
Pheasants—partridges thou wilt find.
Pigeons coo-ing from branches high
Reynard watching with cunning eye;
Mallard—Widgeon—Teal and Kite
To be observed by theodolite.

Hedgerows blossoming forth in May
Will help thee to forget the day
Thy feet were planted in these works
Where smoke at every corner lurks:
Blast furnace, Bessemer and rolling mill
Will change to woodland dale and hill.
Primrose—Coltsfoot—Wild Dog-rose
May soon disperse thy many woes.

When on these works thy back is turned
Think of those who oft have yearned
To do again the things once done,
Fishing, poaching with the gun.
Watching badgers at their set,
Catching rabbits with ferret and net.
Farewell to thee thou engineer
Thy lungs will breathe in air more clear.

A SIMPLE UNLOADING RAMP FOR PITWOOD LORRIES

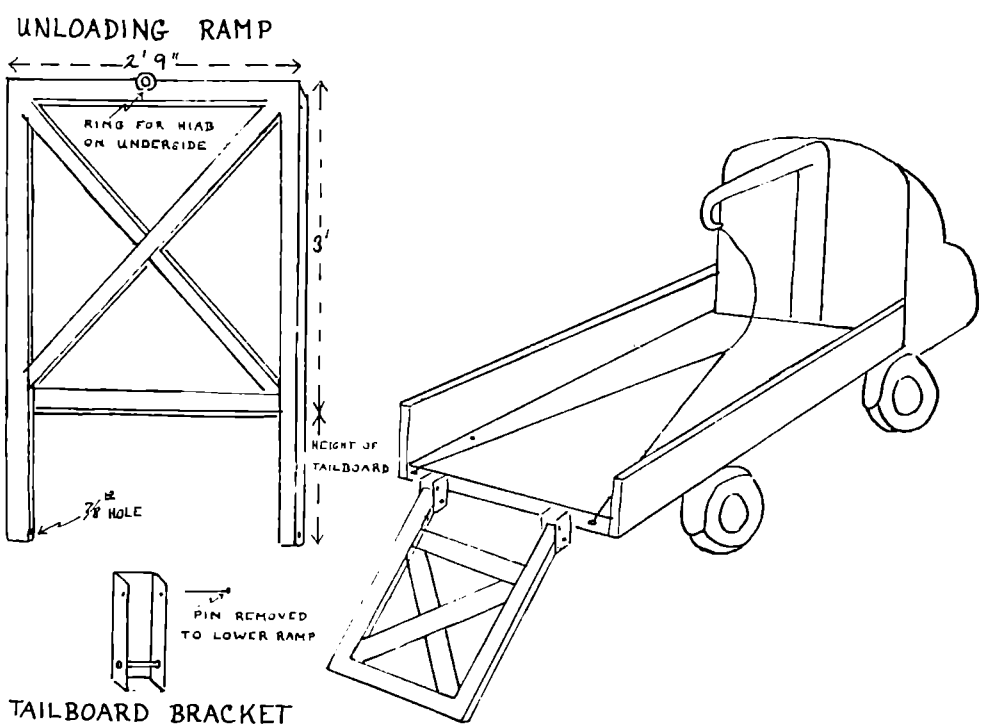
By

W. D. MILSOM and E. H. M. HARRIS

Forester and District Officer, South Wales

With the object of speeding up the turn-round of pitwood lorries an unloading ramp was designed at Llantrisant Forest and made at Tair Onen Machinery Workshops. It has greatly eased, and thereby speeded up, the unloading of short pitwood carried across the lorry bed.

The ramp, made of boxed steel, is fixed to a Bedford 5-ton flat lorry in place of the tail board. It pivots on two supports held in steel boxes fixed to the back of the lorry, and functions both as a tail board and unloading ramp. When the ramp is lowered, with the Hiab hoist, about a third of the logs roll off by gravity. If the lorry is drawn forward a short distance, more logs roll off. Finally the remaining logs are removed by attaching the Hiab hoist to a pair of wire ropes, fixed to the rear of the lorry bed and which have been laid on the lorry before loading. When the joined ends behind the cab are lifted by the hoist, the remaining logs are rolled down the ramp. It is important that the length of these two ropes, which are joined together at a ring at the front of the lorry bed, is exactly right. When unloading is complete, the ramp is raised again to its tail board position, with the Hiab hoist. The whole operation can be carried out quickly and easily by the driver alone.



A PLOUGH WITH A PROMISE

By

R. A. ALLISON

Head Forester, East Scotland

Subsequent to the publication of Bulletin No. 32—*Afforestation of Upland Heaths*—by the Forestry Commission in 1960, a modification of the well-known subsoiling Tine plough has been produced. This plough is now known as the Parkgate Twin-tine. This is a mis-nomer at present, since the plough has only one subsoiling tine and a prairie-buster body. Nevertheless, it has been agreed that Mr. Clark, the maker, will modify this machine so that an additional subsoiling tine will be working in front of the plough board and in place of the traditional sock. By using two sub-soiling tines, an increased amount of soil will be disturbed and thereby made available to the tree roots, but greater traction power will be required to pull the plough.

The history of this plough goes back to 1951, when 700 acres a year were being planted on Speymouth, and the subsoiling tine, as we know it today, was first used on a large scale. After some discussion, permission was granted for modifications to be made to one plough in an effort to get something resembling the results which the twin-tine now produces. An ordinary farm plough body was bolted on to a piece of armoured steel plating cut at the desired angle, and this, in turn, was bolted on to the main beam of the tine plough. This rather flimsy apparatus was quite successful for a short time, but, since all of that year's programme was on old woodland with many large roots in the ground, it was not long before the steel plating was twisted out of shape and discarded as an unwelcome time-waster.

1952 brought more old woodland to plough and then the '53 gale knocked all thought of ploughs out of our heads for some years. Eventually, in 1960, a serious problem arose with the blowing down of fairly large numbers of trees which had been planted in the tine line in the bottom of the furrows. Investigation showed that, in the case of Scots and Lodgepole pines, particularly, the main roots were travelling along the tine line and thereby making the trees vulnerable to wind blowing across the furrows. This became very serious if it happened at a time when the furrow bottom was wet. It was soon noticeable that trees which had been planted on top of the ridge were much less vulnerable to wind-blow, and root investigations which were being carried out at the time produced evidence that trees planted on the ridge were forming a much more natural root-system than were those planted in the furrow. But it became clear also that the roots of trees planted on the ridge were not penetrating downwards as readily as we would have wished them to. A mock-up along the lines of the twin-tine was tried out by using an unploughed ride-line, removing the plough body from the tine plough and using only the subsoiling tine; a number of lines were sub-soiled to a depth of 20 inches. Ground mineral phosphate was then spread at the rate of 1½ ozs. per plant along each line, and a furrow thrown on top of the tine line with an agricultural plough. The trees were then planted on top of the furrow. There were no deaths, but, because the surrounding area was past the stage of damage by hares, the possibility of this happening was overlooked and most of the plants were damaged to some extent.

A number of people saw this modest experiment, and following a discussion on ploughing and root development generally, we were instructed to put our ideas on paper, and these would be passed to the engineering department of the Forestry Commission with a request that they produce a plough capable of giving the results which were described.

The Twin-tine and How it Works

This plough is designed to subsoil with a 4 inch wide sock to a depth of approximately 20 inches, and then to throw a broad ridge of about 6 inches in depth centrally on top of the subsoiled line. The plough is so constructed that the line is sub-soiled in advance of the plough board, so that the tractor track can roll along the subsoiled line and level out any irregularities before the plough board throws the ridge, and thereby prevent any undesirable air pockets being formed in the area where the tree roots will become active. This plough gives us almost all the advantages of complete ploughing. Some 24 to 26 inches of rooting depth is available to the plant. The minerals derived from the decomposing vegetation under the ridge will percolate downwards into the subsoiled area and the roots will follow, giving a balanced root system working in a greater amount of disturbed soil than can be obtained by any of the earlier single furrow methods of ploughing.

In the traditional tine ploughing the subsoiler works down to about 20 inches, but the plough board throws out about 8 inches in the form of a ridge, and it is seldom on upland heaths that a full spade depth can be found in the bottom of the furrow in which to plant the tree. The twin-tine leaves the subsoiled 20 inches and adds on top of it a further 6 to 8 inches of ridge.

I made a great many tests of depth with a walking stick and most of them were 28 inches deep and none less than 24 inches. This must have an effect on stability and may well have a lasting effect on growth.

The disadvantage mentioned earlier is the need to plant the trees on top of the ridge, which leaves them open to exposure and may well cause a number of deaths in the first year. It would perhaps be wise to remove a slice from the side of the ridge and to plant in the recess formed, for the shelter benefit this would give.

The name of the plough is—Parkgate Twin-Tine Rutter. Maker—Wm. Clark & Sons, Parkgate, by Dumfries. Price—£450. Method of Traction—By B.T.D.6 or 8 (Tracked Vehicle).

THE NORWEGIAN PLANTING SPADE

By

K. J. RAMSAY

Ass. Forester, South Scotland

This tool was issued to be tried out at this forest along with other units, and it was primarily claimed to be a combination of 'boxing' and Planting spade on its covering data. Extensive use has been made of it on over 80 acres of varying types of peat and it has proved to be a first class tool in its capacity of cutting a box in a deep Cuthbertson furrow.

It was not accepted by the men as a V-notch planting tool, being too cumbersome; the rake of the flange did not permit of a 'V' being cut out cleanly, but left it hinged which meant that two movements were required instead of the one claimed. Boxing and planting at the same time has not proved to be a success at all, and therefore all attempts to do anything but boxing were dropped.

One of the first essentials is a very sharp edge and it was found necessary to do the sharpening with an electric grinder, due to the toughness of the steel. This achieved, the tool was easily kept in good condition with an eight-inch mill saw file. Extreme keenness of edge is necessary, as in certain types of peat the fibres lay over the cutting edges and build up in the corners; this build-up has to be cleared away.

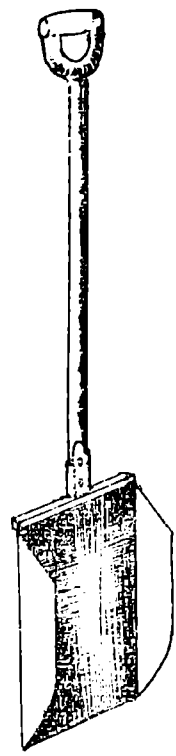
The spade is effective in almost all peat except the hard red fibrous material, when it has no advantage over the normal spades. It has been found that the work is much less arduous in every way if the boxing is done as the plough turns out the furrow. This is true also of boxing with conventional tools, and is the most important factor in keeping the cost of the job low.

There are varying opinions on the value of boxing, and there is certainly some doubt about the extra cost of £2—£2 5s. per acre achieving any purpose. Nevertheless circumstances may demand the ploughing of very heavy furrows for both planting medium and drain, as is the case in the Skelloch Flow in the south of this forest where the work has been carried through 1964.

The advantages claimed for boxing here are that it enables normal sized plants to be correctly planted at the proper depth ensuring growth and stability, and in addition provides a season's shelter which is of paramount importance in this area of great exposure to strong winds, and at an altitude of 1,000 feet or more. An ancillary use has been that fertiliser may be placed in the 'box', where it will not be disseminated over the surrounding area, and wasted to a certain extent.

The use of this spade has enabled the cost of boxing to be kept at 6d. per chain overall, in spite of recent rises in costs. It should be added that not all the men were persuaded that the spade was to their advantage, but those who tried and subsequently used it extensively have not gone back to the old methods. It is understood that it has not been received with favour in other areas, but where boxing is still necessary then it deserves to be persevered with.

The method of working is extremely simple and almost any worker should be able to get into a rhythmic style with little practice. The spade is cut vertically into the furrow, and if the peat is soft then the 'block' may be quickly levered out without removing the spade. If however this is not possible, then a second cut is made at the desired height horizontally meeting with the previous cut.



Norwegian planting spade

This spade, more than any other, *must* be kept clean and particular attention paid to this, since it has three cutting edges.

A SERVICEABLE FIRE BEATER STAND

By

R. J. JENNINGS

Head Forester, Forest of Dean

with illustration by B. G. ELLEY, *Draughtsman, Forest of Dean*

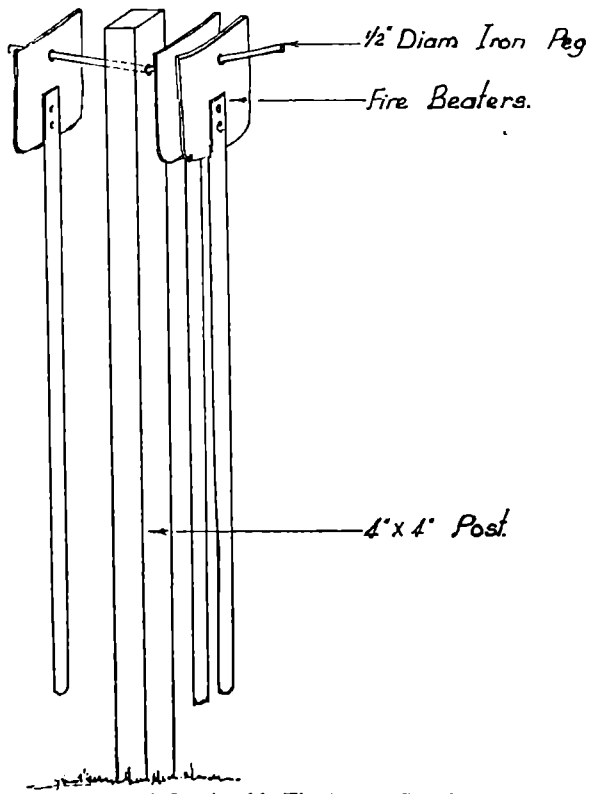
'What goes up must come down' is an old saying that is brought to the minds of the destructive types of youth in the Forest of Dean the moment that they catch sight of a newly erected fire beater stand during their courting displays and parades in the spring.

Stands of some description however, are essential to hold beaters made of conveyor belting if the rubber is to keep its shape and remain firm and serviceable for any length of time.

The accompanying illustration shows a stand that we are trying out this year. As may be seen the beaters hang on an iron peg ½ inch in diameter which has been driven into a wooden post through holes previously punched in the conveyor belting.

The weight of the beater keeps the rubber composition flat and rigid and the simplicity of the stand which costs little to erect, gives us reason to believe that it will withstand rougher treatment than have those of more complicated design that we have erected along the roadside in past seasons.

If the post is 2 ft. or more longer in length a Fire Notice can be fixed to it as well.



A Serviceable Fire Beater Stand

FORESTS ATTRACT TOURISTS

By
N. BANISTER
District Officer, South-west England

The solitary walker who carries his lunch in his pocket, or the father who transports food for the whole family in his rucksack, has no need of a specially appointed picnic site; for him the stile, the rock, or the log is a seat, and the grass is his table top.

The family coming by car to Exmoor may indeed travel light, but more likely there is a folding chair and table in the boot, and possibly it is not a

ready-made sandwich that is eaten at lunch-time but, instead, an *al fresco* kitchen and dining room is created. The meal is often one of the main features of the day's outing, with the man of the house taking over as the chef, whilst the wife or girl friend relaxes from her normal chores.

It is to provide facilities and accommodation for all comers, whether walker, cyclist, motorist or pony trekker, that the Forestry Commission is now creating picnic sites in its forests. There is always ample space somewhere within the forest for the walker and pony trekker along the many foot and bridle paths, but the motorist is a less fortunate visitor. He is confined to the public road and the roadside verge, and since neither is conducive to relaxation nor safe for children, he tends to explore the bridle paths and tracks across the moor or within the forest. Unless these tracks are public rights-of-way for vehicles and are thus reparable by the Highway Authority, the visitor is, in fact, trespassing. One peculiarity of a forest road is that it does not necessarily go from place to place, for it is designed and constructed to enable timber to be extracted from the whole of the wood. The road will, therefore, weave across the hillside in parallel sweeps, and even if the explorer manages to get past the horse or tractor hauling logs, or the lorry loading timber, he may well find himself at a dead end and be obliged to turn round and so retrace his route without having found the haven he was seeking.

A picnic site is chosen, therefore, with considerable care and must have these essentials:—

It must provide space for parking cars—this does not necessarily mean a car park, for each site has its own character and is treated individually.

It must be readily accessible from the public road or from a Forestry Commission road that has been opened for public use.

It must be dry, sheltered, level and, preferably, with a view.

These are the basic points, but they are not enough; we know that the number of cars is increasing yearly, and we must devise some means of accommodating large numbers of cars and at the same time preserve those natural features of open countryside and forest that the motorist has travelled so far to find. We achieve this by creating small clearings in the forest, by felling the trees, grubbing up the stumps, and grassing down the openings. The grass may have to be cut, but sheep, ponies and deer are very helpful in keeping the sward tight.

We find, by felling several small areas, interconnected by rides or paths, that there is space both for the large party and also for the visitor who likes to be alone. An example of this is to be found above Whits Wood Steep on Croydon Hill.

Any large concentration of people creates the problem of hygiene. The number of visitors to Ramscombe in Quantock has grown over the past few years, and with it the unpleasantness that inevitably remains after a holiday period; this creates a very real danger of pollution, for this valley, in common with many others, lies within the gathering grounds of the West Somerset Water Board catchment area. It is most pleasant to record that the Water Board, the Planning Authority, the County Council, the Rural District Council, the Parish Council, and The Friends of the Quantocks have approved the Forestry Commission's proposal to erect a carefully sited flush lavatory and toilet building and to provide water taps in 1965. Whereas Ramscombe is not on Exmoor, it does indicate how the concentrated enjoyment of one part of the countryside can harm it seriously unless provision can be made, not only for the existing visitors but also for the increasing number of people who will come in future years.

Whereas it is clear that facilities must be provided, it is equally essential that these very facilities should not by their design and situation harm the locality that they are intended to benefit.

The levelling and grassing of the picnic site at Whits Wood Steep should also be completed by 1965 and its subsequent development will depend on the extent to which it is used. It has been chosen for its shelter and for its excellent views to the north of Porlock Bay, Selworthy, Wootton, Avill Ball, and Dunster Deer Park. It is a happy coincidence that the panorama from here illustrates the very close integration of forests and Exmoor farmland.

It refutes much of the criticism that commercial forestry is foreign to this landscape, and goes further to show that even commercial trees do produce colour, light and shadow, and that by contrast with the green farm land they enhance the general scene. The forest is an immensely vital and living being.

On any day the forest may seem quiet and still, perhaps dark, but time only stands still in relation to the age and stature of the trees; there is much activity both in the soil and within the wood. We hope to help visitors by providing a Nature Trail from the site. This will be a signposted trail, similar to those already marked by the Park Warden, but on a smaller and more intensive scale. The aims will be to illustrate:—

The geology and natural history of the area, with special reference to nesting boxes, badger sets, deer tracks and the vegetation.

Beyond these more obvious factors we shall demonstrate something of silviculture, the art of growing forests, with the involvement in the complex community of soil, climate, animal, plant and tree. As an added point of interest the commercial woodland of previous centuries, oak coppice, can readily be included within a walk from the picnic site.

An informative article on swaling in the 1963 *Exmoor Review* prompts a mention of the forester's worst enemy—FIRE. No-one who has experienced a fire, or who has come after, can forget the awful desolation of a burned out wood, wet and cold when it has been extinguished. The immediate reaction is one of financial and personal loss, the wood planted and tended with such care and at such expense has gone, albeit in a blaze of glory. The less apparent results of a fire are the death or loss of wild life through having their habitat damaged; but possibly more long-lasting is the sterilisation and destruction of the living soil, with the consequent loss of cohesion and danger of erosion under heavy rain.

Carelessly thrown matches and cigarettes can indeed cause such fires, but so can the paraffin stove or the wood fire, particularly if it is ignited behind a conveniently sheltering gorse bush.

To enable the gourmet, who relishes the taste of wood smoke in his tea, to burn his fingers without endangering the surrounding countryside, shallow trenches with stone sides will be provided in the picnic sites. The fires built on these will be easier to light, to cook on and to extinguish. There will be an adequate supply of dry kindling within easy reach.

Because there has been no demand for camping facilities, none have been provided. This is due to the high elevation and to the lack of water and to the existence of more suitable sites in the valleys. If the demand should arise, the Forestry Commission is prepared to meet this on Exmoor as it has in the Forest Parks that it has created throughout Britain.

The Forestry Commission is proud of its forests on Exmoor and welcomes the visitor, whether he comes as a native and by custom, as a professional forester to study the inherent problems of the moor, as a farmer with strong views on shelter, or as a tourist in need of recreation.

Some 3,000 years ago the Prophet Isaiah cried: "Woe unto them that join house to house, that lay field to field, till there be no place that they may be placed alone in the midst of the earth"—so far as the forest is concerned there will always be a "place to be alone".

A NOTE ON WOODEN LADDERS

By

J. J. MACK

Commonwealth Scientific and Industrial Research Organisation, Melbourne, Australia

At a Conservative estimate, some 30,000 extension ladders are currently in service in Australia. Considering the very wide range of conditions of use, differences in quality of manufacture, and the varying periods of service, it is perhaps only to be expected that a few ladders will fail each year. Because of the very nature of a ladder and its use, its failure may result in serious personal injury, and occasionally in loss of life. Thus, even if only one ladder in every 1,000 were to fail in any 12 months, apart from the personal cost in injury or worse, the cost of accident compensation would be heavy and of considerable concern to the employer.

The basic question is should failure occur even in as few as 1 in 1,000 ladders? Must such a failure rate be accepted as reasonable in a fabricated structure that has been designed to be as light as practicable, and in the use of which there is always some small element of danger? The answer is no! Given well-made ladders of good quality timber, proper use, care in handling, and adequate maintenance, there should be no reason why the failure rate should not be as small as 1 in 30,000 or even less.

In a test made at the Division with a new 21-ft. extension ladder supported against a wall at the recommended 70° angle, a load of 450 lb. at mid-height was sustained without any sign of failure. This load is equivalent to a 16 stone man carrying 126 lb. which, it will be agreed, is a most unlikely loading. The deflection at the centre of the ladder under this load of 450 lb was approximately 6 in., which is not considered severe. Several single sections of old extension ladders, the other sections of which had broken in service, were also tested, and the breaking loads were so high that it was clear that some reason other than an inherent weakness of the timber was responsible for the failures.

The Standards Association of Australia's Code of Recommended Practice for the Use and Maintenance of Portable Timber Ladders (A.S. No. CA29—1959) amply covers the scope conveyed by its title. However, from inspections of large numbers of ladders it is apparent that their treatment in service is often not up to the desired standard. There is evidence of ladders having been retained in service after damage resulting from falls, from incorrect carriage on vehicles, and even from being run over by a vehicle. Clearly, some form of regular inspection should have been carried out to ensure that such damaged ladders were discarded.

Occasionally, timber which should have been rejected has been used for ladder manufacture. Although Australian Standard No. A90 limits sloping grain to 1 in 20, grain slopes of up to 1 in 12 have been observed in many finished ladders, and in some cases slopes were even steeper. Severe sloping grain reduces considerably the strength and stiffness of the wood and, when present, can seriously reduce and even eliminate a ladder's margin of safety.

Also, characteristically brittle types of Douglas fir, not allowed by A.S. No. A90, have been detected in some ladders; this material can usually be recognized by inserting the point of a knife into the wood and lifting out a small splinter. If the splinter is short in length and brittle in appearance, then the piece of wood is probably also generally brittle and should be rejected as unsuitable for ladder construction. It is known that very fast and very slow-grown Douglas fir have markedly inferior strength properties to timber of medium-growth rate. Thus, it is advisable to select this timber for ladder stiles only if it has more than about 8 and less than about 30 rings per inch.

It is common practice to insert a steel wire of about 10 gauge into a groove on the under-side of each stile. The purpose supposedly is to hold the ladder together for a sufficient time, in the event of failure of the timber, to allow the user to jump clear. Some, however, mistakenly consider that the wire adds to the ladder's strength and stiffness. Tests made by the Division on matched stiles with and without the wire have shown positively that as normally fitted the wire in no way improves either property. In fact the fixing is generally so ineffective that, after a few severe flexings of the ladder, the wire becomes quite loose.

Standard A.S. No. A90 specifies that wire-reinforced ladders are not suitable where electrical hazards exist. Also, as no increase of stile size is suggested when a wire is not used, the Standard implies the ineffectiveness of the wire on the strength and stiffness of the ladder. However, an interesting development has been the recent attempts by several ladder manufacturers to increase these properties by gluing fibre-glass cord into the groove in place of the steel wire. Tests conducted on some experimental stiles indicated that, although no appreciable increase in stiffness has been achieved, the fibre-glass has slightly improved the strength. It is quite probable that with correct gluing technique and cord size, a significant improvement in properties will result.

Despite any such improvements in ladder design, the fact still remains that ladders, particularly long ladders, are really delicate structures compared to other forms of construction. If properly made they should have an ample margin of safety. When improperly used and badly cared for, they are potentially dangerous. Complacency with this state of affairs can only lead to trouble. Almost invariably, the blame for a ladder failure is placed on the quality of the timber, but more often than not the fault lies instead with the user.

PREVENTION OF ACCIDENTS IN TIMBER PRODUCTION, TIMBER HAULAGE AND OTHER FORESTRY WORK IN AUSTRIA

translated by Miss E. V. CHAMBERS

Ministry of Agriculture, Northern Ireland, from an article in "Allgemeine Forstzeitung", Vol. 73, May 1962 (Vienna) by **H. MACHLER**

N.B. It must be remembered that this article refers to Austrian conditions —*Editor.*

I. Introduction

The main theme of the World Health Organisation Conference held in Geneva in 1961 was the prevention of accidents. The importance of this in connection with Austrian agriculture and forestry is clear when we consider that 61,826 accidents (404 fatal) were reported for the period 1959 to 1961.

An analysis of the forestry figures for 1959 gave the following causes:—

Machines in forestry	70	
Circular and belt saws	791	
Slides and floats	68	(2 fatal)
Use of motor cycles	861	(22 „)
Use of bicycles	1,470	(11 „)
Falling trees and branches	486	(20 „)
Snapping trees and branches	439	(5 „)
Rolling timber	1,670	(12 „)
Forestry implements	2,152	(1 „)
Pointed and sharp objects	5,451	(4 „)
Falls	16,675	(102 „)

The age groups which were most susceptible to accidents were 20 to 29 and 50 to 59. This suggests that the younger workers ignore danger and the older ones are more exposed to it because they are not as active or as strong as they used to be. The main cause was generally carelessness or lack of knowledge.

II. Prevention of Accidents

1. Every forest management (employer or his representative) must inform the workers of the regulations for the prevention of accidents before work begins, he must repeat the instruction from time to time and draw the workers' attention to any special risks in dangerous operations. Work must be kept under constant supervision to ensure that safety measures are properly observed. But it is also the duty of each worker to know and to observe the regulations.

2. Dangerous work must only be done by suitable persons. Forestry workers who suffer from dizziness, defective hearing or other infirmities must not be allowed to do work which would expose them or their fellow workers to special risks because of their infirmities.

3. Forestry apprentices (up to 16 years of age) must only be employed on subsidiary tasks in felling operations, i.e., collection of brushwood, clearing of stems, etc. They must only be employed for cutting light timber (up to 15 cm. diameter) as part of their training under the supervision of an instructor who is in charge of and responsible for each apprentice. Forestry assistant workers under 18 years of age must not be employed alone on the felling of heavier timber (over 15 cm.), on splitting, moving or sliding timber, but must only do such work under the supervision of a trained worker.

4. Persons who are not directly concerned with the work, including relatives of the workers, are prohibited from staying at the site of operations except for some special reason.

5. Before starting work the forestry worker must check that his tools and implements are in good condition. This applies particularly to axes which should be well fixed at the handles, etc. Ridges on wooden wedges must be removed in good time, otherwise the wedge may spring loose. The foreman must check the implements frequently and ensure that any unsuitable ones are withdrawn from use. Iron wedges must not be used as bits of iron may fly off when striking with the sledge-hammer. Only the use of the small iron cutting wedge for splitting is permitted.

6. On the way to and from the work areas all sharp implements must be provided with a protective covering and must be carried with such care that injuries are impossible. When using vehicles, particularly motor cycles and bicycles, the implements must be fastened on in such a way that they do not interfere with safe driving or riding. Special care must be taken when skis are used.

7. Roads must be laid out and maintained so that they are as safe as possible. Paths, bridges and steep banks must be protected by railings. Places which are closed off must not be entered.

8. All work must be carried out quietly, carefully and without undue haste. An excessive working pace only brings an increased yield for a very short time and because of early fatigue increases the risk of accidents.

9. The excessive use of alcohol is expressly prohibited. Drunk workers must not be allowed in the work areas.

10. The smaller the number of men who are working together the less is the risk of accidents. Consequently the work groups should be kept as small as possible and should be placed with sufficient space between the work areas.

On the level, two-men teams should be the general rule, on the other hand in the mountains several teams should form one work-party at the felling place. The teams should be placed so that there is a distance between them of at least two tree lengths. They should never work one above the other on slopes. When larger groups are needed for hauling or sliding timber they should include more than 6 men only in exceptional cases. The basic rule should be: the two-men team on the level, and in the mountains the 4- (or at most 6-) man team combined into a working party. Even in the two-man team the men must keep at a proper distance from each other.

11. Dangerous work should never be carried out on Monday or at the end of the week (Friday) as experience has shown that on these days the power of concentration of the workers is lower. It is also well known that on these days the yield is the worst of the week. The daily hours of work should never exceed 10, otherwise fatigue increases the risk of accidents. Organised overtime must be reserved for catastrophes (gales, floods, etc.).

12. There should be an adequate mid-day break (at least one hour). Short breaks (about 5 minutes) during work not only raise production but reduce fatigue, renew energy and lessen the risk of accidents.

13. Dangerous operations must always be carried out under the directions and supervision of the foreman, unless the work has been specially entrusted to the head forester or in exceptional cases to a professional worker.

14. Clothing should have no bits that can blow about and might hinder movement if caught. Footwear should not have smooth soles as these increase the risk of slipping. Protective head covering (crash helmet or lined cap) must be worn as protection against falling branches.

15. There is a great risk involved in getting accustomed to constant defects in implements, or in faulty work procedure as long as no accident occurs. Such defects must be noticed and remedied by the supervisor because the worker will not recognise the danger when he is used to working with it.

16. Workers who have to work on their knees must wear knee protectors to guard against rheumatism.

17. The throwing of implements from one worker to another is prohibited.

18. Special care must be taken when there is wind, fog, snow, frost or ice, when the light is poor, on slopes, in scrub or undergrowth.

19. In busy periods in the forest it will not be possible for the forest officer to devote his time to the prevention of accidents. Consequently special safety men must be appointed whose duty it is to visit the work places and check precautions for accident prevention. All defects must be reported to the employer at once.

(a) When felling standing heavy timber

20. The first phase in felling is the determination of the direction. Generally this is uphill as this shortens the falling distance and so reduces the falling speed. Downhill direction should only be chosen in exceptional cases. On level ground the direction should generally be against the prevailing wind.

21. The forest worker must decide the proper felling direction for each tree taking into account the lie of the land, re-stocking and the shape of the tree. Timber which has already been felled in the direction chosen must be removed. On level ground the removal of the timber should be taken into consideration.

22. After deciding on the felling direction, the worker should place his tools to the left and right side so that they do not get in his way when working, but are still easy to get at. They should never be placed above and below the trunk, in and opposite to the direction of fall. The foot of the tree should be cleared of

branches and weeds, in winter of snow. Any young growth in the vicinity should be bent down with branch forks, stones, etc., but in such a way that the worker will not be likely to trip if he has to jump aside quickly when the tree falls. Branches which are within reach should be cut off. Dead trees should be struck with the back of the chopper so that dead branches will fall off. The worker must jump back at once after the blow.

23. The felling notch (undercut) is now made in the felling direction side. This may be wing, tangent or heart shaped. With the wing shaped notch the workers cut a piece out of the trunk to the left and right as low down as possible (felling height at most a third of the diameter), this produces a point ("nose") in the centre. If the worker neglects to chop away this nose the tree will turn on this point when being felled and will lean over in whatever direction it is forced by an eventual gust of wind or the overhang of the tree. It is impossible to maintain the exact direction of the fall. This method is therefore wrong.

The "tangent" undercut is made with a correctly placed saw (with two firm screw handles) and this is technically correct because this produces a straight notch tangent which finishes at both ends with the angles. The tree bends at this notch and the felling direction can be kept fairly accurately. The further the end-points of the undercut are from each other the more certain is the direction of fall. However, in order to make quite sure of keeping the direction, particularly with large deciduous trees (oak, beech) a piece is cut out from the heartwood in the middle of the tangent which gives the heart-shaped felling notch and moves the rotation of the tree on to the two angles.

The distance between the angles should be 6 to 8 tenths of the diameter to avoid tearing. The depth of the notch should be a fifth to a tenth, at the most a third of the diameter, and the cut (mouth) should not be too high (at most the width of a hand) because the measurement for length is taken from the centre of the undercut according to timber trade custom. The undercut must be made so that the tree gives at this side. If there is no notch it splits and bends anywhere.

The position etc., of the notch should be checked after it is prepared. The worker places himself with his back to the tree in front of the undercut, puts his forefingers at the angles, looks at the tree-top and assesses the felling direction. This is the only way of keeping the direction required quite accurately.

24. When placing the undercut, the fact is often overlooked that the fibres at the root neck run crooked. Consequently if an existing root swelling is not cut or sawn off, and the undercut is made in this, the end of the felling cut and the start of the undercut often lie in the same annual ring. The tree has no grip any more; it is completely cut off and the felling direction is therefore uncertain. It is best to remove the root swelling completely from the standing tree; otherwise the bole can split easily and is hard to turn and store, and transport is more difficult. But if the trunk is rotten this chopping-off must not be done as the healthy sapwood is all that is holding the trunk. This also applies to the undercut so that wedging can be done sooner.

25. Two or three fingers higher than the base of the undercut the felling cut is made on the opposite side, and as soon as possible two to three wedges are inserted in the cut at a good distance from each other to ensure the felling direction and to reduce jamming. If this is omitted the tree settles on the cut and it is difficult and sometimes even impossible to insert the wedge. This is particularly the case in winter when the timber is frozen, the iron of the wedge must sometimes be heated. When sawing the felling cut, the workers must look in the felling direction so that they can keep an eye on the felling area. The felling cut is continued until two or three finger-widths remain uncut to the start of the undercut; this part we shall call the "breaking border". If this is

cut through the tree is "cut dead" and falls anyway at all. If the felling cut is made without the "breaking step", i.e., at the same height as the undercut, the falling tree will tear pieces out of the trunk. The same thing happens if the felling cut is made lower than the undercut.

26. The "breaking border" (or "hinge") is the part of the trunk which is not cut through and must break at felling. But only the central part of the timber is dry and breaks, not the sappy outer part, the sapwood. This must be separated with two blows of the chopper "splint strokes" before the tree is actually felled. It is forbidden to make these strokes when the tree is falling. However, if the interior of the tree is rotten, which can be seen from the chips while sawing, the healthy sapwood must not be cut through because it is all that is holding the tree. If the sapwood is not cut, long strips are torn out of the trunk at this spot.

27. When all preparations are finished the saw is removed from the cut and a loud shout of "Danger—tree falling" warns the people within range to leave the danger zone. This extends to twice the height of the tree. The warning must be sufficiently loud. The tree is now made to fall by "wedging". The feller moves backwards and watches the crown of the falling tree and of neighbouring trees for falling branches. The "timber beard" is cut off from the tree when it is lying on the ground.

(b) **Felling in difficult conditions**

28. With the "forward leaning tree" which is inclined in the felling direction, the pressure side is on the side of the undercut. It is therefore essential for the feller to make the undercut first. If he makes the felling cut first then the tree splits up on this side. The simple sapwood stroke is not enough with large "forward leaners", the angles must be well cut through with the saw (sapwood cut) and the felling cut well cut into both sides in advance. The heart-shaped undercut should be used. Wedging is usually unnecessary with "forward leaners", as the tree breaks quickly because of the angle. The felling stroke must be made quickly. Special care is needed.

29. If the tree is leaning in the opposite direction to the felling direction (backwards leaning tree), the pressure side is on the felling cut side on which work must therefore be done first. By the use of wedges in the felling cut an effort is made to bring the tree into a vertical position and then fell it in the normal way. In this case the breaking ridge must be kept wider. But if the tree is leaning backwards to such an extent that it cannot be got into a vertical position by wedging, the rope of the "pulling line" must be fastened to the tree to be felled in the middle. The "pulling line" is attached to a standing tree and the leaning tree brought into the desired felling direction by the use of the "pulley rope". The rope must be 10 yards longer than the height of the tree and must run over guiding rollers, otherwise the worker will pull it towards himself.

30. With "cross leaners" which are leaning sideways to the felling direction a wider "breaking border" must first be left and the root swelling retained on the pulling side. On the pressure side only the sapwood stroke must be made, the root swelling removed and the wedge inserted in a slanting direction in order to get the tree into a vertical position. The "sapwood stroke" must on no account be made on the pulling side, otherwise the tree may lean over sideways to an even greater degree.

31. A "fork" which reaches to the ground is treated in the same way as a "forward leaner", the saw cut is made from the outer side in its whole width. Wedges are placed sideways to keep the cut open. A small undercut on the incision side helps to make the pressure side give more easily. The fork always leans to the outside and therefore does not need to be made to fall by wedging.

However if the "fork" is higher up and the tree is being felled as a whole it must not be allowed to fall on a fork arm, because it may split or separate during the fall and each part go in a different direction. In this case the forked tree must be held together with a chain. The undercut should be made over both fork arms.

32. A "lodged tree" can arise when the tree has no free-felling direction. This is generally the case in dense stands. The feller will first of all separate the "lodged tree' from the stump and then try to turn it down from the "holding tree" with the aid of the turning hook (always one man with a light turning hook). It is very dangerous when several men wish to turn the trunk with a heavy turning hook, as the turning lever strikes back very easily. If it is not possible to get the tree down, an attempt is made to pull the tree "over the stump" with the pulling tackle, and on soft ground on supporting timber so that it doesn't sink into the ground and then can't be turned any more, or to lift it with crossed lifting trees and push it forward. The yard-long cutting up involves the risk, if the tree does not fall, that it gets more into the vertical position and finally falls in the wrong direction. The final possibility would be to pull the tree down from the stump with the "pulling line". The "throwing" of a second tree standing to the side often produces two "lodgers" and is therefore prohibited. It is also forbidden to climb the tree to cut loose the branches which are holding it, or to cut round the "lodger" or to lift it with the shoulder.

33. Timber which has been cut with axe or saw must not be left standing during breaks or overnight, but must be felled before work stops. Staying in the felling area is prohibited.

(c) Felling of small timber, cutting round with axe or saw, low cutting

34. Light timber (about one foot through at breast level) should always be felled by a one-man unit. Production is higher and the work is less dangerous. The more men there are the more risks there are. However, there must always be at least two men at any one work area so that they can help each other in the event of an accident.

35. The biggest trees can also be brought down by cutting round them with the chopper. This causes a considerable loss of timber and the felling direction can never be kept accurately. The insertion of several wedges above and alongside each other gives no guarantee.

36. Valuable trees (e.g. walnut) can be "low cut" in order to get the beautifully grained part at the root swelling for veneers. The trunk is dug free and the felling cut made very low, the strong roots are cut off. The tree is braced beforehand in the desired felling direction with a rope. It is finally pulled to the ground after the felling cut.

(d) Working of wind and snow breaks

37. In the case of gale and snow breaks all the trees are under strain. Consequently danger is high! In order to reduce the strain the trees are worked from the top by removing branches and tops. Trees which are in a state of strain must be supported. The "root plate" in particular must be secured, this is best done with the "pulling line". The "plate" is attached to a standing tree with the rope. The trees must be tackled from the pressure side, otherwise they will tear. Where the danger of tearing still exists, the "trunk clamp" should be used. This is placed just above the felling cut, after root swellings, irregularities and heavy bark have been removed. With light timber a chain with stretching apparatus may be adequate. However, there is less risk of accidents with ropes than with chains.

38. It is particularly difficult to deal with single and group breaks. The trees lie on top of each other. Work must start on the uppermost windbreak after the stump "plate" has been propped up. The procedure is the same as for lodged trees. If the trunk is broken within reach of the ground, and the tree top is actually lying on the ground, the tree should be cut through with axe or saw at the break. If the break is higher up the tree must be felled with undercut and felling cut. Trees which are bent down with snow will straighten up again when the weight is removed and must be worked like "forward leaners".

39. Generally the "windbreaks" lie here and there in all directions. Strain is very severe in the individual trees and working is very dangerous. Work starts on the wind side and proceeds in the direction of the wind. "Trunk plates" must be secured and work starts at the top with removal of branches. Cutting is done from below until the saw binds and then from above, wherever possible by one man with a foxtail saw with a long handle until it is cut through. Finally the props are removed and the "root plate" pressed back as far as possible.

40. Trees which have lost their crowns must be felled with particular care, because the force of the fall is not slowed down by the crown.

(e) The use of mechanical saws

41. Particular care must be exercised when mechanical saws are used because of the speed at which they work and the noise they make. The driver must never let himself be hurried or harassed by the machine or the men but must work quietly and with due care. The service instructions of the suppliers must be carefully observed. A firm head covering (crash helmet or lined cap) is essential since driving the machine can reduce the attention paid to falling branches. Leather gloves with sufficiently wide tops and palms with no stitching should be used on account of shaking and burning.

42. The engine must be switched off when filling up. Smoking and open fires in the vicinity are prohibited. Because of the risk of explosion the mechanical saw must not be set up near open fires or heated stoves. Running the machine in a closed shed is prohibited. When opening the fuel container the face should be turned away as gas is bad for eyes and lungs. Care should be taken not to get any water in the container or tank. Empty, or almost empty, containers should never be left in the sun. The engine should never be started up in a closed shed; when the engine is running the chain should not be oiled, the tension of the chain should not be tested nor the chain changed.

43. Holding work (carrying the saw without work yield) is to be avoided as far as possible because it is very tiring. Always go forward with the blade pointing backwards and never with the chain running. The engine must not be running when the saw is being carried with a carrying strap. The carrying strap must be removed before the engine is started. In transport the chain should be taken off or at least protected with a leather or wooden cover.

44. When a mechanical saw is in use no one should be within a radius of two yards. When starting up, the motor must be firmly held with a foot or knee. Care must be taken to see that the starting strap or rope does not hit anyone. It must only be started up on firm ground, never on stumps, stones or roots and only with the blade in a vertical position.

45. A loud call of "Danger" must be made before cutting starts, as a warning will not be audible because of the noise once work has begun. When cutting on a slope the driver of the mechanical saw must always stand on the upper side of the trunk. It is imperative that only wedges of wood, light metal or plastic materials should be used. The use of iron wedges is forbidden even with separation cutting. Normally cutting is done from above, only exceptionally and only for a short time from below as this method is uncertain and very tiring.

Cutting should be done only with a back-running chain. The "stab-cut" should be started with an oblique blade point, i.e., directly as the saw slips off easily. The engine must be switched off if the saw is being passed on. The machine must be fixed so that it cannot be pulled forward. Full throttle must not be used when it is running free. It is always essential to have a safe stance for any mechanical sawing work.

46. Protective glasses should be worn when using the sharpening apparatus. With the two-man mechanical saw the upper side of the chain, the chain drive and the guiding roller must be covered over. The second man on the hand piece must stand sideways to the extension of the band.

47. The running sound of the mechanical saw expressed in Phon. (a scientific measurement of sound intensity) is about 110 with full throttle. Since a noise of over 70 Phon. can cause nervous tension and the effect of a noise of over 95 Phon. for several hours a day can affect the hearing, it is absolutely essential to arrange for a constant change of drivers. The lighter the machine is, the less is the inconvenience to the worker. But below 20 to 24 lb. the vibration is so great that a further reduction in weight would bring no further advantages. With normal work in the open air the exhaust fumes are no trouble because there is no dangerous concentration of carbon monoxide. However, care must be taken to ensure that the exhaust fumes get away well. Particularly in the case of the two man team there is a certain risk to the worker on the belt head.

(f) Lopping, debarking and shaping

48. After the tree is on the ground the branches are removed. With heavy timber this is done with the chopper, with trees with light branches up to one inch through it is done at the same time as debarking with the peeling iron. This should be about 2 lb. in weight for light timber and 3 lb. at the most for heavy timber. If the weight is excessively high the worker will get tired and the risk of accidents will be increased. The handle must never be longer than arm's-length. It is pushed through the "lug" into the "bed" of the chopper and wedged. The "lug" must be wider towards the front so that the vertically placed holding wedge can be driven in. It is important whether the chopper hangs forwards or backwards. If the former is the case (the positioning wedge is nearer the neck) the chopper has a higher swing which increases the risk of accidents; therefore, this chopper must only be used by trained workers. The only chopper that should be used by trainees is one with a backwards hang, with this it is also easier to make a true blow. The handle must be dry, otherwise the hand will lose its grip, and there must be a knob at the end so that the hand will not slip off. The shape should be simple but it is better if it is double-balanced as it will not rebound so easily. The blade must be sharp, a blunt blade can be dangerous.

49. When lopping the worker must stand so that the trunk is between him and the place to be lopped. If he must lop at the side on which he is standing because of the size of the tree trunk, and does not want to change his position, he must lop away from his body or at least must place himself so that the chopper cannot hit his leg if he slips or when the branch is cut through. "Chopping over the hand" is technically quite wrong.

50. Debarking is done with the peeling iron which must be angled and sloped at the blade, so that the worker does not have to stoop too much.

51. When the upper side is lopped and debarked the trunk is turned with the turning hook and the lower side is worked. On steep slopes the risk of slipping is very great, particularly in summer, when the tree is pulled on to the debarked upper side. It is absolutely essential that the trunks should be made secure against slipping.

52. Each tree must be worked immediately after felling. Working in series is forbidden and also working in the felling area during felling.

53. When cross-cutting or shaping the trunk, it must always be remembered that on slopes where the trees are lying crossways the worker who is standing below could easily be crushed by the separated piece. In this case the last piece of the dividing cut must be cut through by the worker standing on the upper side, working on his own. With the dividing cut of strained trees which are supported in the middle the wood splits as soon as the cut is finished. Therefore, cutting should be done in from the pressure side until the saw binds and then the tree cut through from above. If the trunk is lying supported only in the middle with two ends in the air, the one end can fall down after the final cut and the other end spring up. In this case the cut from above must meet the lower cut exactly to prevent the upward spring and the cut should be made as close as possible to the point of support. The use of a "trunk press" is advisable to prevent tearing. Tension can be reduced if the free parts are strongly supported. The turning hook must always be used for turning the trees.

Timber hauling

This includes bringing the timber from the felling place to a place where it is stored in non-permanent sites ready to be taken away.

(a) **Extraction**

54. In favourable positions and with short distances light trees can be carried to the removal road or preferably pulled with the "dragger". It is not advisable for one man to transport timber by putting one end on his shoulder and hauling the logs along; this is too tiring. If several workers are carrying logs the one at the end should give the signal for lifting and laying. The log must be carried on the same shoulders (on slopes on the side towards the lower level), the workers should keep in step and the log must never be thrown over their heads. If the log falls unevenly it may spring up and injure the workers. Heavier logs should be hauled to the road by animals or with the help of the pulling rope. The front end of the log should be smoothed down before hauling starts, otherwise the sharp corners of the cut surface might tear. The use of a "hauling hood" or metal cover is recommended.

55. In mountain areas it is often difficult to get the timber from the stump to the nearest collecting area, because each log will have its own hauling path. Standing trees are also a handicap with single tree felling, they are often on the hauling path and so add to the difficulties.

56. Logs will slide downhill, depending on the nature of the ground, the type of timber and the gradient. With a gradient below 5° timber will only slide in the most favourable conditions (smooth ice). Between 10° and 15°, essential conditions are freshly felled timber and wet weather. However there is a considerable risk of the logs splitting and breaking. A gradient of about 20° is the best. Above this, extraction should only be done in the stand in dry weather and above 25° it is absolutely essential to leave the bark on.

57. The timber must be well lopped and "worked" on both sides. The root swelling should be removed. Crooked logs are dangerous because they keep no fixed direction. Shaping is of special importance for hauling, the hauling distance must be prepared according to the length of the logs. When preparing felling operations the method of hauling should be settled for each tree and the felling direction and hauling direction considered together. Paths and roads should be closed off with warning notices.

58. The worker should always use the "tongs" for extraction. This is particularly useful because the barked timber is generally smooth and slippery. Moving the logs by hand involves the danger of injuring the hands, by crushing. Using the hands also means getting into a bent and uncomfortable position. The "tongs" are therefore used for lifting, pulling, rolling and finally as a lever. To prevent them from slipping off the support they must be fitted with an edge at the back. The use of "foot irons" is absolutely necessary especially on steep ground. These should be 10 inches with double hinges, allow bending at the foot and have blunt calkins. Sharp calkins grip too deeply into the wood and make it more difficult for the worker to move about. The eyelet holes in the straps should be arranged on the outside. On steep slopes a stout rope about 8 yards long should be available for attaching the logs to stakes or trees so that they will not slip down too soon when the workers are busy with them.

59. On a steep slope there is a tendency for the timber to slip down after felling. This can damage not only the felled timber but trees which are still standing and must be prevented at all costs. With individual tree cutting the felling direction should, therefore, be determined with future extraction in mind and the timber should be got to the transport paths as soon as is possible. These are either natural hollows or ditches or else 2 to 3 yards wide haulage paths opened up at 100 yards intervals before the first thinning operations. These paths must not only be kept clear of logs, but also of sticks and stones to avoid any damage to timber which is being hauled over them. If the speed is too great the logs must be brought out in dry weather. In very steep areas the bark must be left on. Where steep slopes alternate with level ground the timber should be de-barked, but checked every 50 to 100 yards by logs placed transversely, or even by building a "trap". The worker will naturally prefer to use dry weather for felling and it is therefore hard to persuade him to leave the debarking till after the logs are extracted, because the bark has dried out then and does not come off as easily. It is not advisable to have large working parties together in a small area, this has the effect of hindering careful extraction and also increases the risk of accidents.

60. With clear cutting, felling is carried out in "fields" and the trimmings (brushwood) placed at the edge of these "fields". When felling is being done more or less simultaneously in several "fields", the work in one field must on no account be in advance. A piece might fall over into an adjoining "field" and endanger the workers who are already working lower.

61. The risk of accident is increased by the speed of the logs which is often very high. Consequently, it is absolutely necessary to stop extraction work when there is fog or snow.

62. In order to prevent the logs from going in the wrong direction, the previously determined haulage direction must be properly "fixed". The felled timber must be brought as soon as possible out of the stand into the haulage path. If the slope is not steep enough, timber is placed on the ground. This makes sliding easier. The lay-out is made herring-bone shaped to keep the logs in the required direction; this arrangement is also useful in the haulage paths.

(b) **"Runs" and slides** (Rarely used in Britain—*Editor*)

63. If the above-mentioned operations are carried out in one continuous process we speak of a "run". With this the logs which have been felled are taken out and the "run" removed again after extraction. In its basic form a "run" consists of two to four small tree trunks on the ground and two heavier side trunks. The width of this "run" must never be greater than the heaviest of the logs to be moved, otherwise these may swing round in the "run" and bounce out. In curves the side trunks are strengthened on the outer side. In

particularly sharp curves the side trunk in the inner curve is left out to make room for the sliding timber. There must be no projection on the bottom or side trunks otherwise the logs would knock against them and be thrown out of line. At its bottom end the "run" must be well secured to roots, trees or stones to keep it from being carried away with the logs which are passing through. On slopes it is necessary to fasten it even more securely and it should be sloped inwards. If the gradient is too steep and the speed too high as a result the bottom trunks are left out so that the bare ground acts as a brake on the logs.

64. If there are special difficulties, e.g., gullies, a timber slide must be constructed. Unlike the "run" this remains in position for several years (up to 6), the logs are mortised together and the slope carefully graded. These timber slides used to be regarded as a cheaper substitute for road construction but now they are constructed less often and generally only for short stretches.

65. The limits of gradient for timber "slides" are 5° to 20°. If the fall is too steep some means of braking must be available in the slide. This can be done by "breaking" the slide or by building in a "stop". Two logs 8 to 10 yards long are built into the slide in such a way that the lower end can be raised or lowered as required according to the weather. It is important that these "stop logs" should be long enough so that the timber in the "slide" does not come too quickly into the "stop". The "slide" is usually sprinkled with water in the evening to increase the speed so that in the early morning there is an ice slide on which the timber runs down quickly. This has the effect of increasing the danger of the operation. If the slope is too steep the "slide" must be broken by building-in checks. The slope must be carefully graded to prevent the logs from bouncing out. At sharp curves there must be some protection at the outer edge. The workers who are responsible for looking after the slides must not be hard of hearing, they are placed at important points and must always stand on the inner side of the curve and should keep their eye on the upper part from which danger threatens. When there is anything wrong the watcher must stop the operation by calling to the men above him and so on to the man at the top of the "slide". The operation must be stopped until the trouble is cleared up. It is forbidden to try to sort things out without stopping the whole operation, as is sometimes done with a view to saving time. During the interruption, the workers at the mouth of the "slide" must not prepare the timber on any account, as this might slide into the "slide" and endanger the workers there. No worker is allowed to go on the "slide" during active use.

66. The "runners" are nailed down and fastened, but the side logs are only held by "saddle pins" which must give to the logs when they are passing through. The end of a "timber slide" must open high enough into the storage place. It is provided with a small counter slope.

(c) **Sledge transport** (Rarely used in Britain—*Editor*)

67. Sledges form a useful means of transport, either directly from the stand or on firmly constructed haulage paths. The "half-sledge" is used on steep slopes. There is less risk of accident with the double sledge which can be used with a slope of only 3 to 5 degrees. With the "double-sledge" the width of the path should be equal to the width of the outer edge of the runners (widened at the curves) and for the half sledge 5 feet or more. The double sledge thus has a fixed rim between the trees. With the half sledge the back part of the load slides along on the snow. To reduce friction the ends must be protected.

68. The sledge itself should weigh about 120 lb. To ensure adequate braking, which is essential for the prevention of accidents, strong braking "claws" must be fixed on each side, when used on one side only these help to steer the sledge. These "claws" should be made from hazelnut timber which is particularly

tough. An extended "claw" facilitates braking, but this is only possible if the sledge driver does not sit on the usual seat but higher up on a raised block. From this raised position steering and braking are easier and safer. If the raised seat is not used the "sitting-board" must be strong enough not to break. Braking with hanging blocks is only possible on less steep paths, on steep paths these would make steering difficult. Braking chains may also be used to reduce the speed, these are placed about half a meter in front of the back end under the blocks. These braking chains are also placed below the trailer if this is pushing up too much. Where firewood is also being hauled by sledge, bundles tied together with chains can be put on the load and in very steep places thrown on the track suspended by the chains. On completely frozen steel tracks the "stopping chains" which are placed under the "hand piece" make particularly effective brakes and can be dropped into the runners' track in the event of danger. This brings the sledge to a stop at once. In mountain haulage the sledge man can use a hauling belt to pull with. This must be removed when going downhill as otherwise in the event of an accident the man could be dragged along by the sledge. Where the sledge track is more level it is often necessary to help the sledge along, this is done by inserting iron covers which are easily put in and removed.

69. When loading the sledge a log must be placed in front of the runners across the track to prevent the sledge from sliding away. The load must be tied on carefully with chains. The lower layer of logs on the movable "saddle" are tied down with a chain (binding chain) and then the logs lying on top with the same chain. The end of the load of logs is fastened with a "continuous chain" so that the ends can move when the ground is uneven. For the same reason the chain over the end of the load is not stretched too tight.

70. Riding as passengers on the sledge is forbidden. Sledging must be stopped when there is smooth ice or fog or when it is dark. There must be a distance of at least 50 yards between sledges, the height of the load must not exceed 5 feet.

71. The use of thick stranded rope instead of chains would be cheaper and the rope would weigh less but it would be more difficult to load and fasten the logs.

(d) **Stacking**

72. At the end of haulage, the logs are stacked in storage places along the removal road. If these storage places are at the same height as the road, stacking with proper foundations presents no special difficulties and involves no special danger, but when the removal road is on a slope the timber is best stored on the hillside. In this case the first log must be secured with stakes, stones or pegs to prevent slipping and in addition pegs should be inserted between the logs on the bottom level. On a steep slope foundations must never be arranged perpendicularly to the stack and to the road as this increases the danger of rolling. The stacks must never be more than 12 feet high. In difficult positions the lower logs may be fastened with clamps to the higher ones or even attached to standing trees with pulling ropes. It must be remembered that on slopes after heavy rain the stack can be undermined by the water and might roll. Consequently, timber should never be stacked in the vicinity of torrents. If it is not possible to stack timber on the side towards the hill a foundation must be erected on the slope side and well supported towards the slope. Several small "gantries" are better than one large one which would only increase the risk of accidents. When stacking is in progress, no worker must ever go underneath the stack.

Timber transport (draught animals)

73. The bogies, particularly for the transport of long timber must be firmly attached to the cart and have a rough surface (if possible iron spikes) so that

the logs cannot move lengthways. One axle front- and back-carts must have a fitment to prevent them from tipping during loading. With front and back wheels the braking apparatus must be self checking and adjustable. Back axle steering with the transport of long timber must either be done with a rod (or stake) fixed on the short back carriage or with a pole (or shaft) behind the wheels. A steering arrangement on the back carriage of rope or chain is not permitted because the worker would have to carry out a change of direction on the opposite side with his foot and could easily fall below the back wheels. Also he would have to hold on to the long timber which would be possible if he had fixed a log for this purpose. On difficult ground the worker should be behind the wheels. The wagons must be kept in good condition and must be fitted with mountain supports.

74. During loading the wagons must have the brakes on, or be well chocked. The draught animals are unroped, the bogie fitted in the right direction, the single axle carts placed in a horizontal position. Where loading logs are used these must be strong and must be attached by chains to keep them from slipping from the cart. Strong rungs or guard poles must be used opposite the loading side to keep the logs from rolling off. With hand rolling the logs slip off the loading log quite easily. Bars must be available to stop the logs from rolling back. Because of the danger of this method of loading use has recently been made of a special crane or of the "Glogger" twin engine rope pulley, this is less strenuous for the workers and also reduces the risk of accidents. The load must be put on evenly so that the weight is properly distributed. The logs must be clamped at the front side and fastened with chains so that they are firmly attached to the wagon. Projecting ends of long logs must be fastened together with chains, or ropes to prevent them from swinging about. Assistance with loading must be only from the front, never from the side. During the loading operation the wagon must never be pushed to the next loading place until the load is firmly secured. The load must never be more than can be safely braked on steep slopes. The workers are forbidden to get between the loading logs during loading or unloading.

75. The driver and his helper must not sit on the load during transport, they must walk alongside the wagon. Only reliable, healthy drivers should be used for the transport of long timber. The helper has to look after the loading, back axle steering etc. When driving in the dark the wagons must be well lighted and have cats' eyes at the back. Ends of timber which project more than 2 yards must be marked (by day with a red flag and at night with a red lamp). Work on the wagon and load must never be done when the wagon is moving; it must be stopped and the brakes on. During long stops the draught animals should be unharnessed.

76. When the wagons are being unloaded no person must be on the load or on the unloading place from the moment the fastening or chain is undone. The chains and tipping fixtures must not be loosed from the unloading place or from above but only by using the special safety catch or other fixture from the safe side. Loading logs must always be used for unloading as well.

Tree climbing for lopping and for collecting cones on standing trees (In Britain the Tree Bicycle is now preferred to climbing irons—*Editor*)

77. These jobs are suitable only for young, brave and active workers and must always be offered only to volunteers. They must not suffer from dizziness, they must like and enjoy the work and must not be more than 40 years old. The most suitable types are small, not too heavy, but strong and tough. Workers who are nervous or subject to dizziness must never be allowed to undertake these jobs.

78. The worker needs climbing irons for climbing the trees. The Wolfgang-Kirchzeller and the Tirol irons have proved very good. The first have two straps which must be sewn and must not have eyelets. A torn seam can be noticed at once whereas a loose fastener might not. The Tirol climbing irons have one side bar ("sling") which gives the climber a secure hold. All climbing irons have a side spike which the climber must press firmly into the tree before he takes the next step up or down. Since the irons are fastened to the footwear this must be of good quality. Wellington boots are no use as they do not give any grip. Firm, strong, high laced boots with leather soles and with specially sewn-on ankle protectors have proved to be most suitable. Low cut shoes are no use. The laces must not be too tightly fastened, the feet often swell during climbing and loss of feeling could result. A leather cap should be worn as protection against breaking branches, needles or bark. The cone picker should make use of the "plucking stick" to pull the branches over for picking. All tree climbers need a tree saw to remove any troublesome, dry branches. Loose clothing which can blow about should never be worn, trousers and coat should be tied firmly round the arms and legs.

79. Before starting to climb the tree the worker must check all his equipment very carefully. The side supports of the irons should be behind the ankles, otherwise they may press. As already mentioned the thongs should not be fastened too tightly so as not to impede the circulation. The tree should be climbed so that the worker is not on the over-hanging side. With straight trees the best side will naturally be chosen. Branches, stubs, damaged bark, can make the climb more difficult. Such places are full of resin and are dangerous because the spike of the climbing iron will not grip well but may break the piece off. Climbing should be free and steady. Stopping on the way up would impose a very severe strain on the feet, therefore, the climb to the first healthy branch should be done in one go. The worker can then sit on this branch and take a rest. When climbing up the climber knocks the spike of the iron with the inside of his shoe from sideways/above into the tree trunk. This blow must be sharp and strong so that the spike gets well into the wood. When the climber sees that the spike has gripped he must press it further into the wood with the weight of his body until it is really firm. The knee of this foot must never come closer than the width of a fist to the trunk, otherwise the spike will automatically be forced out. The chest must be at least two hand-widths from the trunk. Only when he feels quite secure on this foot should he pull the other foot up and repeat the process. A beginner must always use a rope for climbing (to avoid accidents): he throws this higher up with each step. The safety rope which is fastened with a fireman's belt round the body offers the climber complete protection. Only a very skilled climber should attempt to climb without the rope. Dry branches should never be chosen for supports or for gripping. These branches are unreliable, they can break off suddenly and put the climber in danger as he must then get on to any available branch or stub. Care must also be taken with green branches. An experienced tree climber only uses the trunk. The cone picker climbs up into the highest tree tops, but he must avoid shaking the top because it may be fragile or even nicked by storm. When he has reached the top the cone picker must brace himself by putting his thigh on one branch and hooking the instep of this foot onto a lower branch. With his second leg he stands in a slightly bent position on a branch. With his safety belt attached he can now get on with his work without much risk. He must keep close to the trunk when choosing his position. Reckless climbers find it too boring to climb down to the ground and then up the next tree again, and swing themselves from one tree top to the next, which is strictly prohibited under the safety regulations. The descent is technically more difficult than going up because the climber cannot see where he is going. There is danger all around. Slipping on the smooth bark is the most

likely. But the cause of slipping might also be that the spike of the irons was not sharp enough or that bark had collected on it and so prevented it from piercing properly into the trunk, or that the climber had not driven it in hard enough or was holding with his knees or his whole body to the trunk. It is essential for the climber to keep calm even if he should slip, he will be held by his safety belt and can only slip down a few yards. It is quite wrong to pull in the knees or even to cross them. Slipping is very probable during frost, rain, snow etc., as it is almost impossible to slow down in these conditions. Climbing during these conditions should not be allowed.

Special cases

80. Electric current and high tension cables. Special care must be taken when working near heavy current electric cables (local net up to 380 volts, recognised usually by 4 wires). If there is any defect, the tree or the ground in contact will become live. The place must be closed off for a radius of 50 yards and work only permitted when the current has been switched off, otherwise there is a risk of electrocution. However, if there is an accident and a worker is in contact with the wires, first aid consists in getting him away. His rescuer must stand on a dry board (without nails), or on a wooden chair, or on dry clothes and catch the victim by his clothing with his hands protected by thick rubber gloves or dry cloth and pull him clear from the wires. Touching high tension wires (long distance net generally over 5,000 volts, recognised by 3 wires) generally results in death. Electric current is dangerous if it gets a chance to flow through the human body. The danger is particularly great with wet hands or on wet ground.

81. When heavy current and high tension cables pass through forests the spacing must be wide enough for trees which fall at right angles to the cables not to touch them.

82. Lightning. A thunderstorm is dangerous if the interval between lightning and thunder is less than 10 seconds. Single trees, raised points, edges of woods, streams and their vicinity, riding motor cycles or bicycles are all things to be avoided. Hollows and the interior of forests with an even timber stand are safe places. The worker should lie flat on the ground. Iron tools should be left some distance away.

From the oak—keep away
Near the beech—you may stay
But the pine—you should shun
With the spruce—better run

83. With cultural work keep a good distance between the workers. When using sharp tools look out for the other worker. When spreading artificial fertilisers protect eyes, mouth and nose. Before and during the operation of spreading fertilisers, avoid drinking alcohol. (Take care with calcium cyanamide).

III. Behaviour if accidents occur

84. First aid in accidents is often decisive for recovery. It is therefore necessary that the other workers should be able to help the victim. Each area must make sure that first-aid is available for the victim of an accident, that medical care is obtained and that transport to hospital is available if required. The foreman is also obliged to see that the injured worker stops work at once. At suitable spots in the forest there should be provision for charts describing first-aid treatment, with illustrations (in offices, shelter huts etc.). These charts should also show where first-aid boxes, trained first-aid workers, doctor and hospital can be found or contacted. Necessary bandages, etc., should be available at the working areas, the first-aid boxes should be kept replenished and protected from dirt.

First-aid instruction leaflets must be kept in the boxes as well. A fully equipped tin box must be taken to the working areas. Splints and stretchers must be available in the shelter huts. Each worker must always have a bandage pack with him. In each area a certain number of workers must have attended a first-aid course and one or two of these workers should be allocated to each work group. The ganger or foreman must see that every accident is reported to the Forester at once. If the injury is slight it should be treated by the man in charge of first-aid. If serious the nearest doctor must be sent for.

PREVENTION OF ACCIDENTS WITH MACHINERY IN AUSTRIA

translated by

MISS E. V. CHAMBERS

Ministry of Agriculture, Northern Ireland

from an article in "Allgemeine Forstzeitung", Vol. 73, May 1962 (Vienna)

by **Prof. Dr. KARL REHRL**

(N.B. It must be remembered that this article refers to Austrian conditions —*Editor.*)

Technical advances in the use of machinery not only lighten labour and increase productivity, thus leading to higher earnings and an improved standard of living, they also increase the risk of accidents affecting the life and health of those who make use of them. Even though machines do not head the list of causes of accidents they are responsible for enough to make it the duty of everyone concerned—manufacturers, salesmen, users, supervisors, etc.—to pay special attention to the prevention of accidents.

The responsibility for keeping machines in a safe condition rests in the first place on the employer who according to the Austrian official instruction ABGB(S1157) "has to ensure that the life and health of the workers are protected with reference to any machinery or equipment in use". This responsibility is again underlined and exactly set out in the General Order for the Protection of Workers of 10th November, 1956, in which the duties of the employer are described: "work places, plant and equipment must be put into and kept in a condition which complies with the regulations of this Order."

This Order also lays down that the worker has his responsibilities too: "he must make use of all equipment installed for his protection in the proper manner and must follow all relevant directions," but even here the employer must: "not allow any behaviour of his workers which is contrary to the regulations of the Order."

Thus the main responsibility for the prevention of accidents rests on the employers. In as far as this depends on the instruction of the workers, on their selection and allocation to different jobs, and on the determination of their suitability for various types of work, this seems quite obvious and one of the fundamental duties of any conscientious employer. But when the employer is also held responsible for the technical equipment of the machines and other tools, these regulations are not so easy to comply with, particularly when we consider the rapid technical development and the constantly rising demands on the productivity of machines within the framework of new methods.

Problems of accident prevention

An agricultural or forestry employer who buys a machine to use in his business is responsible for the safety standards of the machines and technical

equipment even when these are supplied by the manufacturers without any safety equipment or with inadequate protection. It is true that under the Austrian law, up to now, a manufacturer could be sued for damages if an accident occurred due to the machinery he had supplied being in a condition where accident risk was very high. If a purchaser wanted to protect himself against unsafe machinery, and any accident claim arising therefrom, he would have to get a declaration signed by the supplier in which it was expressly stated that the machine complied with the legal safety regulations. Forms for such a declaration were available at the Austrian Social Insurance Institute for Agriculture and Forestry and their use was expressly recommended.

However, opinions on what constituted adequate safety precautions were not always uniform. It is true that the Accident Prevention Service of the Austrian Agricultural and Forestry Insurance issues leaflets and other explanatory pamphlets which describe in detail the safety requirements for different machines and the technical position. But it has quite rightly been pointed out that the employer can hardly be expected to keep himself completely up to date in the field of accident prevention and to know all about the technical problems at the present time when development is so rapid and so continuous. He must also keep abreast of the information necessary for his own work.

Conditions are particularly difficult for the buyer of foreign machinery; a machine can comply perfectly with the regulations of one country and be found unsatisfactory in another. But in this case the buyer, as an employer, would have the job of altering and fixing the machine so that it would comply with the requirements of his own country.

Safeguarding of machinery regulations

In January 1961 an Order was made which came into force on 1st January, 1962, the purpose of which is to find a solution to the above-mentioned problems by laying down that the employer and the employee can only be held responsible for the prevention of accidents to a reasonable extent, and that the responsibility for safe production and equipment rests in the first place on the manufacturer and the salesman.

The Austrian Safeguarding of Machinery Regulations of 1961 lay down that after 1st January, 1962, no machines of those set out in the list may be put on the home market which do not comply with the regulations of this Order. The phrase "put on the home market" means any delivery of a listed machine, irrespective of the place of manufacture, of the title deed on which the delivery is based and whether ownership is involved or not. The delivery of a machine which has been sent for repair does not constitute "put on the home market."

Among the machines to which these regulations apply are many purely industrial machines (for metal work, flour and bread manufacture, washing and ironing machines, etc.) but also listed for the first time are machines which are used in agriculture and forestry with descriptions of the necessary safeguards. These include along with electric machines, steam machines and power engines, mainly saws, cutting and splitting machines, clearing equipment, pulleys for hauling machines as well as purely agricultural indoor machines (threshing machines, food choppers, etc.) and machines for field work (cultivators, harvesters, etc.)

For all these machines the general safeguarding regulations apply in the first instance (section 2 of the Order) which lay down that the machines must comply with the safety requirements "of the accepted rules of technique." Protective equipment must "as far as possible be constructed along with the machine" and should "not be removable without instruments." They should "impede the work as little as possible" and "not make running the machines any

more difficult." Finally it is stipulated that "as far as their work permits they should be so made and fitted that their use does not irritate the worker either by noise, vibration or heat."

Even in these general regulations modern demands are made. But from now on the satisfaction of these demands cannot be used as a special advertising feature for a special make of machine; they are now required by law on all machines as a condition for approval to sell.

In addition a number of compulsory safety regulations are laid down for each group of machines. These regulations are not new for many of the machines; under the existing regulations (Safeguarding of Machinery Regulations 1951) a number of kinds of machinery could only be offered for sale if they complied with the regulation of this Order. The regulations of the 1951 Order, however, only applied to such machines as were intended for "industrial purposes."

Under the 1961 Regulations it is not the use to which the machine is to be put which is decisive but the type of construction, quite apart from whether it is to be used for industrial, agricultural or forestry purposes. Consequently this Order also applies to purely agricultural or forestry machines.

No check to technical development

The objection is often raised that regulations which prescribe a definite type of construction or definite equipment of machinery might check technical development, prevent types of construction which are known to be good or make the importation of modern machinery from foreign countries impossible. In order to avoid any such drawbacks to Austrian industry, section 62 of the Order allows exceptions. This lays down that "machines which do not comply with these regulations may be placed on the home market if this is in the economic interest and if the life and health of the workers are fully protected in other ways." Any manufacturer or other interested party may make inquiries to find out whether a definite machine or special type of construction in which he is interested would meet these requirements. This regulation makes the Order more elastic and should satisfy the industry because it can take account of the rapid technical development in machinery.

BASIC COURSE ON FIRE PROTECTION NORTHERWOOD HOUSE

By

J. HENDRY

Forestry Department, Northern Ireland

Instruction

The Instructors at this Course which I attended from the 13th to 17th January, 1964, were Mr. Tilney-Bassett, District Officer, East England, and Mr. D. Henderson, Head Forester, East Scotland. The Commission's Fire Code which formed the basis of the Course was referred to throughout. Since it follows our Code in many ways I shall deal only with those subjects which are of particular interest to my colleagues in Northern Ireland.

Policy

It has to be accepted by Forestry personnel that the general public should be admitted to forests and this fact must be borne in mind when Fire Plans are being made. Older areas in some cases are not suitably laid out for fire protection and admission of the public will have a bearing on any new fire protection works being carried out in such areas. It is of primary importance that all new acquisitions be incorporated in the Fire Plans *and laid out accordingly.*

Fire Towers and Patrols

These vary considerably in the Forestry Commission from the simple expedient of a man riding a bicycle alongside a railway line to extinguish sparks from passing trains, to areas like Thetford Chase where there are four 80 ft. towers and one 60 ft. tower. Spotting fires from towers varies from our method to simpler ones such as windows in the tower being marked off in degrees so that the watcher may determine the location of the fire by means of a rhumb line passing the centre of the tower. One point worth noting is that lightning conductors are fitted to Forestry Commission towers. A shed is provided for the storage of bicycles and for shelter. A telephone bell outside the office is useful.

Standby Workers

Men requested to stand by at danger times are paid the following rates:—
2/6 per evening. 10/- for Saturday and 7/6 for Sunday.
Fire Tower duty men are paid these rates if, due to rain, they have not to man the tower and have not been stood down by 12.00 noon of the preceding day.

Rendezvous Points

When choosing points the following factors should be borne in mind. There should be room for parking, turning and mustering of vehicles. Siting of points close to a telephone is useful. Forestry Commission rendezvous points are numbered consecutively not by forest but by district. This does away with place names. It is a point worth consideration since it avoids confusion when outside help is called in. It is obviously simpler to give rendezvous point No. 2 on the telephone than to say Mullinaburtlin. Complicated names may have to be repeated or spelt.

Water Supply

Where feasible, streams and loughs are utilised. The Commission also build fire dams but these appear to me to be rather elaborate and expensive. On porous soils polythene sheeting is used and is considered fairly successful. Access to water supplies is extremely important. The Forestry Commission are in favour of mobile tanks, metal or collapsible. All water supplies are marked by posts painted yellow.

Hand Tools

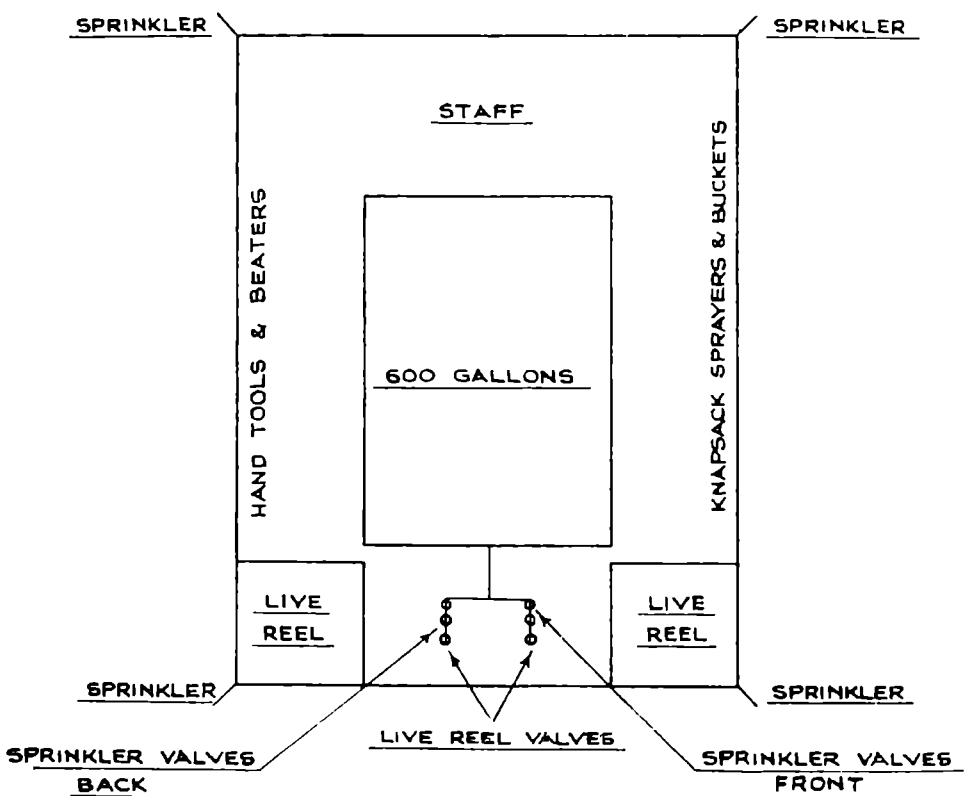
Many of these are similar to ours in Ireland. On the whole, however, the Commission's staff are not as well equipped in this respect as we are. The only tool which interested me was the Sandvik Fire Hoe. This is very useful, being light in weight and having a mattock head on one side and a cutting edge on the other. Both are detachable and replaceable. The hoe would be useful, not only when fighting fires, but also in making a small track as a baseline for controlled burning. It is possible to detach the mattock and have a useful tool *for marking thinnings.*

Fire Beaters

These range from birch, wire mesh and sacks to belting. I thought all of them were unsatisfactory having a short life and being expensive to make. I described our Irish beaters and they were impressed by them. Forestry Commission type beaters cost from 3/- to 9/- to make and have a life not exceeding two years.

Powered Equipment

At the larger forests they have various pumps but the Hathaway is accepted as the best. Hose is generally 1½ in. and made from light alkathene and is canvas covered. Consideration is being given to changing to 1 in. hose when replacement is necessary. Hose is made by Reddaway & Co. Ltd., and has a trade name—*WYPDRY* 35. In view of the liking which mice and rats have for this hose, safe storage is important. Little emphasis appeared to be put on maintenance of equipment. The Forestry Commission apparently do not use face masks. One type of mobile dam unit which I saw struck me quite favourably. It has a tank holding 600 gallons of water and one side of the vehicle contained knapsack sprayers while the other contained hand tools and beaters. On each corner under the vehicle there is a sprinkler and on the back are two live reels. (See diagram below). One drawback to this vehicle is that it can be used only for firefighting.



Canvas Packs

These vary in size holding from three to five lengths of hose. Hose is flaked into the packs by hand. Our method of using a special table was considered very useful. I was informed that the turning on of the water as soon as possible assisted the hose in leaving the pack, and also gave a bit of a push to the men going up the hill. A useful idea is being tried in one Conservancy. This is in the form of an anti-freeze cone made of metal and coated with grease. This simply floats on the water dam. Should the dam be frozen when water is required the cone may be easily withdrawn leaving an entry for the hose.

Statistics

In the Forestry Commission it has been found that 64% of fires occur in March, April and May. 75% of these fires come from adjacent property, i.e. farms. 85% of the fires occur from 10.00 a.m. till 7.00 p.m., the peak period being 3.00 p.m. Of the total number of fires, large fires which comprise 1% are responsible for 84% of the damage caused. The greatest risk is in plantations up to nine years old. Economic expenditure recommended in the Forestry Commission in 1957 was:—

Age Groups	*Amount per acre*
1—12 years	6s. 3d.
13—25 years	10s. 6d.
Older	5s. 3d.

The amount spent (not including overheads) in the forest year 1961 was 3s. 11d. per acre; in the forest year 1962, 3s. 8d. per acre. The value of damage caused in the forest year 1960 was £128,000; the forest year 1961, £28,000; forest year 1962, £65,000. Protection costs far exceed the amount of damage. One point which I find difficult to follow is that while it is agreed that stands of up to 9 years are most liable to damage by fire, the amount recommended for protection is less per acre than for the next age class.

Fire Fighting

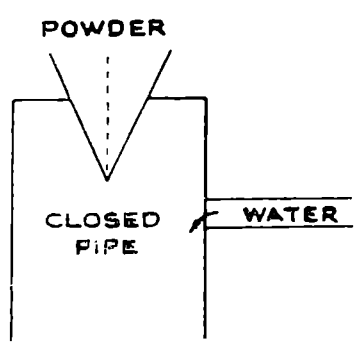
This is along similar lines to our own and is dependent on equipment on hand, type of forest, vegetation, etc. However, there are many and varied opinions on this subject and I can honestly say that I learned nothing new of any value.

Fire Retardants

Investigation on this subject was started in 1957/58 and at first the object was to aid controlled burning. A number of chemicals have been tried and scrapped for various reasons, e.g. corrosive, abrasive, toxic or on the grounds of expense. Among those which have been tried are the following:—

Calcium borate, Bentonite, ammonium phosphate, Diamodium and M.A.P. Nonidet is used to thicken water. Its value, however, has not been positively assessed. It may be useful where water is scarce. I could not obtain any cost for this chemical but did learn that it is cheap. It is important with viscous water to spray, not on the fire, but in advance of it. It is not used for mopping up as it has no penetrating qualities.

The Forestry Commission's Research Branch are experimenting in the use of sodium alginate, a derivative of seaweed as a "wetting" agent. It is apparently very effective and cheap. It is less corrosive than water alone, non-abrasive and non-toxic. A quantity of ·05 lbs per gallon or 10 lbs. per 200 gallons costs 3½d. per mixed gallon or 1/4 to spray 22 sq. yds. Mixing requires care and anything that comes in contact with it becomes slippery. The method of mixing is shown below.



Wireless

There are 38 units in the Forestry Commission of which 18 are located in England, 14 in Scotland and 6 in Wales. There are 99 portable sets and 101 pack sets. The total productive area covered is 774,000 acres. The capital cost involved is approximately £55,000 with a working life of ten years. This works out at about twopence per acre. Maintenance cost per annum is threepence which includes fares, salaries and subsistence. Most of the sets are ex W.D. made by Cosser and G.E.C. New transistor sets are now coming into use. These are lightweight, dependable and have a longer range.

Average costs for equipment are:—

Base station £200. Vehicle sets £180 each. Pack sets £125 each.

A forest area of 10,000 acres would need a base station, two vehicle sets and three pack sets; the cost per acre being about 2·2 pence excluding installation cost. Remote control costs £100 per mile. Remote control box costs £70 and Lister Startermatic £200. These added would make the cost 2·7 pence per acre. A forest of 5,000 acres would need one portable set and three pack sets at a total cost of £555 or 2·7 pence per acre.

Other Information

The following films were shown:—

(1) Smoke and Weather, Fire-fighting with Hand Tools } already shown in Northern Ireland.

Forest Fire Suppression—this is a good film showing fire-fighting using hand tools, bulldozers and a Ferguson type tractor with single furrow plough. This is a useful film to have.

At Thetford a crown fire was desired for the making of a film so it was decided to sacrifice about two acres of isolated Scots pine. The amazing thing was that, although everything inflammable, including oil, was used they could not get it going and were lucky to get sufficient fire for the film.

Fire signs are many and varied and very expensive; some forests move them around each week to keep the public interested. This might suit Tollymore Park in Northern Ireland.

The Commission had not heard of the Panama flame gun and were impressed with its capabilities.

Reports on Courses

These are not now to be written and have been replaced by an oral test.

The Instructor has a box in which he places slips of paper, each having a different subject which was dealt with at the Course. Each person draws a slip, studies the subject for two minutes and then speaks on it for a further two minutes. To speak coherently and constructively for even two minutes requires that one should have been wide awake during the Course and I thought it quite a good idea.

I came away with a very good general impression of this Course.

THE ADMINISTRATIVE STAFF COLLEGE HENLEY-ON-THAMES

By

E. J. M. DAVIES

Divisional Officer, West Scotland

The Administrative Staff College was founded immediately after the last war with the aim of bringing together men and women from industry, commerce

and all forms of the public service to study the principles and techniques of administration and organisation in civil life.

As a result of this it is hoped that participants gain a better understanding of fields of activity other than their own, and learn from other people's ideas and experience.

I was nominated by the Forestry Commission and after an interview in February 1963 I found myself along with 65 others on a three month course during which we studied, for example, amongst many other things, the structures of businesses, delegation, accountability, statistics, marketing, relations with organised labour and management development.

On arrival each student is allocated to a permanent syndicate for nearly all the subjects on the course. Each of these syndicates has been carefully selected and contains ten members amongst whom are one Civil Servant, one Banker, one Chartered Accountant and a man from a nationalised industry or public corporation. The rest came from commerce and industry. Attached to each syndicate is a Director of Studies, a member of the staff, who listens to the discussions but seldom intervenes.

Most of the twenty or so subjects studied end with a "Presentation" with each syndicate presenting a full report, its Chairman making a short speech, and a general debate. These presentations are necessary to give purpose and urgency to syndicate discussion on a subject and help to develop delivery techniques.

The facilities and amenities of Henley are first class. Each student has his own bedroom. The food is excellent. There is a fine library. The staff are very friendly and helpful and there are tennis, squash and badminton courts, a swimming pool and boats on the river.

One of the problems one has to solve early is how much work to attempt. There is a strict timetable and most subjects offer an almost inexhaustible amount of reading. One can get stale. I found that it was important to have a couple of hours off each day for squash or swimming or just walking. As a full day can last from 9 o'clock to 10 p.m. with short intermissions the value of the old tag *Mens sana in corpore sano* becomes apparent.

Henley has established a considerable reputation and therefore can attract first rate outside speakers. In my session we had, amongst others, George Woodcock, the Director of Harwell, the Chairman of the Gas Board and a Government Minister.

After completing the session one had to write a report. I have just re-read mine, after returning to Henley for the week-end refresher which is held 18 months later. In conclusion I wrote:—

"It is not possible to report dispassionately on the value of the course to me personally so soon after its completion, but I think that I have gained a good deal. As far as I can judge the benefits were:—

Firstly. I got outside the Commission for a spell and being away from it all, and from all contact with the day-to-day work, I was able to take a deep breath and assess my own shortcomings. This breathing space was invaluable. It gave one time to think fundamentally about all sorts of problems that beset both the organisation I work for and myself.

Secondly. In spite of trying to keep up to date by reading books, articles and decent newspapers, one finds that one's knowledge of many institutions is scrappy and unreliable and by being directed to authoritative sources one learned a lot more about how Britain is run in the 1960's.

Thirdly. I also got a far deeper appreciation of Britain's economic position than I possessed before.

Fourthly. A good many rather inexcusable gaps in my knowledge were repaired. I know much more about such things as balance sheets, profit and loss accounts,

company finance, accountability of nationalised industries and Government departments, etc. than I knew before.

Fifthly. One learned much from one's contemporaries on the course. One of my sadly limited number of quotations is from Tennyson's *Ulysses* ". . . I am part of all that I have met." There was a wide variety of industries represented on the session and one learned a lot from discussion of common problems, and I hope that some of the other members' experiences will rub off on me. Some of our problems have been solved in other industries. Other industries are still struggling with problems that we have partly resolved.

Sixthly. One's critical faculties were sharpened. Visiting speakers were always listened to critically and post mortem discussions on their performances were valuable.

Finally. I think one learned a little more about chairmanship, public speaking and report writing.

Kurt Hahn once said that people could pick out the boys from Gordonstoun or Salem by the gleam in their eyes.

Nobody in their right senses would make the same claim for we middle-aged that have been through Henley. But I believe most of us gained some maturity of judgment and breadth of outlook.

These things are impossible to measure in the short term.

Looking back I think that this is a fair assessment. And I thoroughly enjoyed myself!

THE DEAN FORESTER TRAINING SCHOOL 1904—1964

By

JOHN GOODWIN

District Officer, Education

Introduction

The Dean School is the oldest Forester Training School in Britain having been founded in 1904 when classes were held in the Deputy Gaveller's office in Coleford, and then in a hut near the present pavilion of the Parkend Cricket Club. The present quarters, a converted iron works, were taken over in 1912 when training to full time residential courses began. From a first class of eight men there has been a gradual increase in numbers until the late forties when some

fifty-six men found living space a trifle cramped. The present numbers under training are generally about forty.

In recent years training has been given to many Commonwealth Foresters and at the present time a course of six months duration has been especially designed for those men who have received their basic training in their own countries. In addition the school receives many visitors from abroad who are interested in both forester and worker training methods.

All students share a common pride in the school and in the achievements of its ex-members who include many foresters of high repute. The most famous ex-student is Sir Arthur Gosling C.B., until recently the Director General of the British Forestry Commission.

Objects of Training

A Forester Training School gives training to young men in the practice and theory of forestry in order to fit them for supervisory duties.

On entry these men are 19—26 years old and possess a General Certificate of Education in Maths, English Language and one other subject, or have been successful in the Forestry Commission's own entrance examination. In addition they will have spent at least two years as forest workers in a well run forest and have passed an Oral Examination Board of Forestry Commission Officers.

A Forester's Certificate is granted on the successful completion of the two-year course. Holders of this are then eligible for service as Junior foresters with the Forestry Commission, with Private Estates, or occasionally with certain Commonwealth Forest Services.

The six months' course for Overseas Foresters replaces other courses of varying length which have been given in the past. It provides advanced training for men nominated by the Forestry Departments of the Commonwealth Countries.

Curriculum

(a) Syllabus

Both the Course leading to the Forester's Certificate and that for Overseas Foresters have syllabuses which are subject to review at each annual Education Branch Conference.

The subjects and their time allocation at present is given below:—

Subject Matter	Time spent in weeks	
	Main Course	Overseas Course
Induction School routine Common forest tools Working techniques	One	One
Tool Maintenance Design, use and maintenance of selected edged tools and saws.	Three	Three
Job Instruction Principles and practice	One	One
Cultural Operations Establishment—work rationalisation and incentive schemes	Fifteen	Two

cont. overleaf

Subject Matter	Time spent in weeks	
	Main Course	Overseas Course
Surveying and Civil Engineering		
Forest surveying. Layout, design and construction of forest roads	Three	Two
Mechanical Engineering		
Principles of petrol and diesel engines. Maintenance of lorries, tractors and sawbenches	One	One
Exploitation		
Methods and costs in current use	Fifteen	Four
Conversion		
Round and elementary saw bench conversion	Three	Three
Power Saws		
Design, use and maintenance	Three	One
Operation Planning		
Work content and allocation of labour and machines. Annual and monthly forest work programmes	Three	Two
Forest Mensuration	Three	—
Tours		
As illustration of training aspects and to develop oral and written expression	Five	Three
Exchange Term		
Spent at a Forestry Commission School in Scotland or Wales	Five	—
Miscellaneous		
Fire Protection	Three	—
Labour relations in Britain, Supervision	Three	One
Protection—Other	Two	—
Research Branch Courses	Three	—
Forestry Commission Administration	Three	—
Botany and Forest Botany	Three	—

(b) **Timetables**

Both training schemes are made up of a series of closely integrated short courses consisting of lectures, exercises, tours and practical work. Each course is allocated to the most appropriate time of year and the programme for each term is made known to the students. In addition to the needs of the subject matter to be covered, this training plan also provides for the allocation of each instructor's duties, ensuring adequate time is allowed for course preparation and for a share of the school administration.

(c) **Examinations**

At the end of each short course a test is made of the student's progress. At the end of each term there is a thorough examination of the term's work, to which is added an assessment of the student's suitability for further training.

In June of each year the Forester's Certificate examinations are held and these are common to all Forestry Commission Schools. There are three written papers, a 'spotter' type paper and an oral examination by external examiners.

(d) **Visiting Lecturers**

These play a very important part in the training scheme by giving courses of a few days duration on a specialised Forestry Subject, or more general courses spread over several terms. In addition there are individual lectures designed to increase the student's general knowledge of the world in which he lives.

Short Courses are given by Forestry Commission Research and specialist Staff in Pathology, Entomology, Mechanical Engineering, Poplars, Ecology and Forest Genetics.

Botany has been taught by Mr. H. R. Jones of Lydney Grammar School since 1926. Mathematics, First Aid and English lectures are given by the Staff of the Cinderford Technical College. These courses are spread over several terms.

(e) **Permanent Staff**

At the present time there are two graduate Education Officers, three Forester Instructors and one Assistant Forester Instructor.

Each instructor conducts courses in one or more subjects although those in draining, fencing and brashing have been designed to be led by any one of several instructors.

Teaching Methods

(a) **Tours**

Tours form a very important part of the training programme and some 10% of all time is allocated to them. They are used wherever possible to illustrate methods and techniques of all branches of Forestry thereby reducing the formal lecture time and providing material for report writing or group discussions.

It is possible to show a good example of almost every aspect of Forestry, within a radius of eighty miles of the school. A large number of local wood-using industries are extremely generous in allowing visits to their factories.

(b) **Churchill—The school forest area**

Churchill enclosure together with two compartments of Oakenhill enclosure form the school forest. This area of 345 acres contains a wide variety of tree species and age classes and so provides a useful practical training ground in many aspects of forestry.

(c) **The Practice Yard**

About half an acre of land adjacent to the lecture rooms has been equipped as a practice yard to provide ready illustrations of lecture room teaching.

(i) Clamps are installed to hold logs in felling and crosscutting positions. These allow students to learn and practise correct techniques with hand tools and chainsaws before using them in the more difficult and complex conditions encountered in the woods.

(ii) Different types of fence are maintained for students to see the materials used for deer, rabbit and sheep fencing properly erected.

(iii) For planting instruction, plough furrows and turves are prepared in the yard and this allows for demonstration and discussion of the principles involved both clearly and conveniently. The effects of different planting methods on a variety of species may also be seen.

(d) **Audio-visual Aids**

Use is made of a wide variety of teaching aids and each member of the staff is encouraged to find those most suited to his subject and his own skills.

Each lecture room is provided with green chalkboard, flannel board, peg-board, pin-up board and projection screen. In addition one lecture room is fitted up as a cinema with a separate projection room.

Other aids in use include:—

16 mm. Sound Projector; 35 mm. Slide Projector (for use in daylight); Rear projection screen; Epidiascope—used mainly in production of charts, wall diagrams and enlarged models of tools; Cutaway models of chainsaws; Tape recorder, directional microphone and parabolic reflector. Experiments in the use of Taped Instruction are being developed. Programmed Learning, using scrambled textbooks prepared by members of the staff, is employed with basic subjects such as Geology and Soils, Silvicultural Characteristics, Sand Dune Afforestation and Files and Filing. Training Films, film loops and slides are prepared by members of the staff to supplement hiring.

KIELDER COUNTY PRIMARY SCHOOL

By

W. M. BROWN

Headmaster

The new forestry villages being established in the neighbourhood of the Kielder Forest to provide homes for the forestry workers in a growing industry have already become part of Northumberland's landscape. Kielder is the largest of these villages. In order to thrive, a village must be more than a collection of houses; it must have its own communal life and slowly develop its own character. To assist in the achievement of these aims Northumberland County Education Committee sought and obtained the approval of the Ministry of Education to the erection of a new school to meet the requirements of the increased child population, and an associated Community Centre to provide improved facilities for other members of the community.

In the early part of the nineteenth century the area comprising Kielder, Plashetts and Falstone seems to have been served by a school at Falstone where the Presbyterian Minister was in charge. His school was enlarged in 1820. The long distance from Kielder (about nine miles) and the growth of the population led Algernon, the Fourth Duke of Northumberland, to build a school at Kielder in 1849 to accommodate 50 children. By 1910 the average attendance at the school had fallen to 18. In 1929 the school was transferred to the Education Authority who, in 1939, to cater for the increasing numbers, erected two timber class-rooms near the original building which, in turn, was adapted to provide dining facilities.

Continuously increasing pressure on this accommodation was relieved when in 1950 the seniors were transferred to the newly built Bellingham County Secondary School, and the Kielder County Primary School was reorganized for Infant and Junior pupils only. Just as the transfer of the seniors to Bellingham was a marked advance in the educational life of Kielder, so the erection of the new County Primary School and its associated Community Centre marks a further great step forward in the provision for the educational, social and recreational wellbeing of the village and the surrounding district. The building was designed as an element in the future Village Centre at Kielder, which is to comprise a two-level Village Square with church and shops.

Accommodation provided in the school includes four classrooms, hall and kitchen, Head Master's room, Staff and Medical Inspection Room, together with the usual cloak and toilet facilities. The hall, besides providing for the school activities, was built large enough to be used as a Village Hall for dancing, film shows, and the like, and the well-equipped stage makes it ideally suited to theatrical performances. Specially designed lighting gives the best light for each activity. The plan of the school provides for additional classrooms should these become necessary when, as expected, in 15 to 20 years time, tree felling operations expand and the labour force in the area increases.

The three-storey Community Centre has, on the ground floor, a branch of the Northumberland County Library Service with an adjoining reading room. The first floor has facilities for the teaching of art, woodwork and needlework; it also has a tea-making room and toilets. The large room on the second floor is for recreational use.

The total cost of the school and community centre, including furniture and equipment, was £69,700. The structure is basically load-bearing brick walls with timber roof trusses, the pitched roof being covered with Stonewold grey interlocking tiles.

The Hall and three-storey block is steel framed with box channel stanchions and steel trusses. Externally, the walls are rendered white with timber curtain walling and natural Blaxter stone. Internally, the hall and staff accommodation are floored with European oak strip, classrooms with Hopton Wood grey granwood blocks, library and recreation rooms in cork tiles, the remainder being vinyl tile.

The school was designed by Mr. C. C. Brown, ARIBA, County Architect, in association with the late Mr. J. S. Hogg, ARIBA, former Deputy County Architect. Project Architect was Mr. J. S. Burrell, ARIBA.

The Teaching Aspect

The principal cause of most of my problems here is one of geography and employment. The only employer in the whole district is the Forestry Commission and the school children are all children of forestry workers. These workers are brought to the village by the Commission and are recruited in the main from urban areas with very little experience, if any, of country life. It would be difficult to imagine, in this country, a greater change of circumstances than life in, say Ashington and life in this isolated rural valley. Because of this terrific change many newcomers to Kielder do not settle down happily and after a short stay return to more populous areas. Thus we have here a population varied in its origins from Cornwall to Aberdeen and also a constant fluctuation of numbers.

This, of course, is reflected in school. We too suffer from fluctuating numbers and also from the varied academic level of intake. I might add here that quite a large proportion of my intake is insecure in itself because the move to Kielder is only the latest of many moves. I find, too, a communication problem exists where, within a small community, one has so many dialects and local idiom not of this locality. As so few of the children can be called locals, I find that there are no traditional activities amongst them. This is reflected more in their play where the customary activities of marbles, roller-skates, skipping etc., do not occur at regular intervals as they do in most rural areas.

The opening of the new school has, however, removed one of my main headaches. In the old school, the classes were split and scattered—one in fact, was in a converted farm kitchen 300 yards from the main school. The children referred to this class as the 'bottom school' and the main school as the 'top school.' It was very difficult to engender a feeling of 'belonging', of being a member of one corporate body. Now that we are all under one roof this separateness has gone and an entirely new and very welcome family feeling has

replaced it. The new school building provides all that one could ask in a primary school—we have now so many educational opportunities which were out of the question previously.

The building of the new Community Centre has given a great opportunity to the village and indeed, the whole area to establish and maintain what has always really been lacking—a sense of community, of belonging, of responsibility, of interest in local people and affairs. We now have an excellent building capable of catering for the educational, social and recreational needs of the community and which will be the focal point of village life.

To try to foster a proper community spirit, we decided to set up a community association to which local organizations could affiliate and could have representation on the Community Council. I am happy to report that this venture is progressing very well and that all the local groups, e.g. Women's Institute, football, rugby and tennis clubs, etc., have shown great interest and have affiliated to the association. New groups too are being formed to widen the range of activities which the centre can provide. A dramatic society and badminton club are now in being. The building itself is being extensively used even now and at least one activity, sometimes three or four, is taking place every evening. Further education classes too, are now possible for the first time and are being held four evenings a week with a total roll of over 50 students.

A school-centred youth group has been formed and meets two evenings a week in the new school. Perhaps the most pleasing feature of the whole establishment is the opportunity for complete educational continuity from school through the youth services to adult further education in one building and this in one of the most remote villages in this rural area.

I have not touched upon my hopes for further development but have tried to give a picture of what has already taken place. There is no doubt in my mind that the decision to erect in Kielder a building which is pleasant, warm, clean and aesthetically pleasing is one which the Education Authority will be able to look back on with gratification.

Architects: Contractors

Architect—Mr. C. C. Brown, ARIBA in association with the late Mr. J. S. Hogg, ARIBA.

Project Architect—J. S. Burrell, ARIBA.

General Contractor—R. Carse and Son Ltd., Amble.

Among the firms who supplied equipment are:
Educational Supply Association Ltd., Stevenage; James Galt & Co. Ltd., Cheadle; Emmerich (Berlon) Ltd., London; Bainbridges Wholesale Ltd., Newcastle on Tyne; Parker-Knoll Ltd., High Wycombe; Liberaco Ltd., London; Furniture Productions Ltd., Bradford; Byfleet Furniture Productions Ltd., Surrey and Olympic Gymnasium Equipment Ltd., London.

ANNUAL REPORT BENTWOOD FOREST

By
B. HAMMOND
Forester, North West England

Local supervision

Owing to changes in labour strength, local supervision consisting of two Foremen, two ex-school Gangers, one Leading Ganger and four Gangers, appear adequate. These are of course, in addition to Forester Bolting and Assistant Forester Whipple.

Labour

Labour strength has fluctuated during the Forest Year under review, consisting as it did of twenty eight at commencement of the period, and one during the last three months.

Plantations made during the Year

The new acquisition, 'Lord Dowsett's Spinney', which owing to the extreme shortage of plantable land in the vicinity of Bentwood Forest, was finally acquired after eleven years of negotiation, was planted, but owing to the floods which subsequently covered the area no trace of the planting stock remains, with the exception of a small area at the Northern extremity, referred to locally as 'Old Tom's Piece', and where two rows of Siberian cherry remain. It is to be regretted however, that these have been severely ravaged by Fire Blight during the summer.

Previous Years Plantations

The extent of the recent fire severely restricted the area still under plantations.

Of the remainder the extensive area of checked Oak in Cpt. 36 has shown little response to the liberal application of the decayed feathers, a consignment of which was obtained, it is understood, at a remarkably economic figure, by District Officer Wentworth.

The four Compts 21–24 carrying a crop of D.F. P12 were blown down during the gale of March 21st, and owing to the extensive subsidence that also occurred to the entrance road, it is doubtful if any of the timber can be removed.

Of the conifers still remaining a severe attack of *Ips typographus* (the first major one to be recorded in this country) occurred in the spruce plantation in Cpt. 4. The severity of the attack can be gauged from the fact that Ex-school Ganger Frost collected no fewer than 423 live beetles from one tree, and laughingly remarked that had he been allowed to remain longer and examine every log, he estimated he might have collected some three million specimens.

The small area of *Picea omorica* in Cpt. 17 appears to have contracted some form of leaf cast, the trees now being devoid of foliage, and the only other remaining area, that of the newly planted beech in Cpt. 1, has been severely damaged by attacks from the short-tailed shrew, a peculiar striped variety which appears to have colonised the area. Twenty-three specimens of this creature have been forwarded to Alice Holt for examination.

Beating up

Owing to a severe late frost the majority of the B.U. has failed. One interesting exception was the introduction of some large 2+2+3 sycamore in a portion of the checked oak area. The vigour of this B.U. stock has resulted in complete suppression of the original oak crop, and the area now carries a somewhat open crop of mis-shapen sycamore.

Thinning Progress

Due to the unfortunate accident sustained to our crawler tractor operator who was hurled from his machine whilst passing a wide load in the vicinity of Derby, thinning and extraction operations have had to be much curtailed.

The brief temporary assistance of Forest Worker Belling as operator, resulted, as has been fully reported, in the loss of the machine in the bog in Cpt. 22, and

after the unexpected death of the horse, obtained at exceedingly low cost, it is understood, by District Officer Wentworth, thinning and extraction was forced to cease in May.

Seed collection

Owing to the misinterpretation of Seed Collection Instruction Number 174, issued to Ganger Lane, 20,000 lbs. of horse chestnut seed, instead of the required 20 lbs, was collected at Bentwood. This large amount of apparently surplus seed is now stored in the spare bedroom at the home of Forest worker Adkin, who has recently complained of damage to his parlour ceiling. Instructions for the disposal of the seed are awaited.

Fire Protection

In view of the incidence of fires at Bentwood, 374 during the year under review, the loss of the 1,342 acres of plantations cannot be looked upon as excessive. The use of the surplus Swedish Naval asbestos suits obtained by District Officer Wentworth whilst in Sweden during the Autumn, have not proved a success, as their weight, almost 500 lbs, restricts mobility, and the case of Assistant Forester Whipple who was overwhelmed by a fire in Cpt. 61, he being unable to retreat fast enough, led us to reluctantly abandon their use.

Other Protection

On the whole, the year has again presented us with problems. These were not helped by the nervous breakdown of Warrener Smithers, occasioned by the plague of weasels.

Ganger Peabody has ably assisted us to bridge the gap in our defences however, and apart from the unhappy incident involving the accidental shooting of District Officer Wentworth in the leg, on Good Friday, his bag of 3,791 squirrels, 478 short-tailed shrews, and an unknown species of non-amphibious duck, must be looked on as most encouraging.

Disturbing features appear to be the considerable increase in barking deer, coypu, and rats, the latter being rife throughout the forest.

An albino rabbit was snared by forest worker Tate, on April 14th.

Preparation of Produce

Through a slight misunderstanding with the Sales Officer, 15,000 1 foot poles were prepared instead of 1,500 10 foot poles, some difficulty is being experienced in disposing of this large quantity of unusual-sized material.

The two consignments of crate rods, reported to have been lost in transit in June, have not yet been traced, nor has the flagpole, for erection on the roof of the Work Study section at Alice Holt. This latter, a Scots pine spar measuring 52 feet in length, was unfortunately dispatched in error by way of the Grand Union Canal.

Buildings

It is gratifying to report that with the acquisition of 'Lord Dowsett's Spinney' we have acquired a house for Forester Bolting. Although somewhat large, it comprising 37 bedrooms, six reception rooms, stabling for 36, and a Grecian Ice House, the Clerk of Works has been instructed to furnish Forester Bolting with the necessary paint and materials to convert the residence into a comfortable home. The removal of the roof has necessitated some expenditure on tarpaulin sheeting, but it is hoped to commence more permanent repairs in the next year

or so. The defective 'Grand Staircase' through which, unfortunately, Mrs. Bolting fell four flights, shortly after taking up residence, has now been replaced by a temporary series of iron ladders from the disused Basset Fire Tower; this has been a marked improvement.

The Forest Year Generally

The most important event of the forest year was of course the Conservancy meeting, held this year at Bentwood.

This passed off most enjoyably, being marred only by one unforeseen occurrence which was the unfortunate mishap to S.F.O. Slaughterford, who was unhappily savaged on the thumb by a weasel when examining the animal which had been placed adjacent to the new trap designed by Warrener Smithers.

This simple device, consisting of two cocoa tins (without bottoms) suspended by wires some six inches from the ground, it is claimed by Warrener Smithers, acts as an unfailing lure to marauding weasels, all of whom he states enter the first tin, and tip suddenly forward, thus cutting their throats on the second tin.

It was regretted also that, through a misunderstanding, the Conservator did not attend the meeting, travelling as he did to Ben Lomond, instead of Bentwood, this somewhat arduous journey being undertaken through an unfortunate typing error on his itinerary.

Progress on the whole, however, has been maintained steadily throughout the year. Generally the standard of work, staff efficiency and output has markedly improved on last year. The notable acquisition of Lord Dowsett's Spinney has greatly increased the potential of the Forest, and a new vista of prosperity and vigour lies ahead.

OUR AMBASSADOR

By

J. W. PARKER

Forester, East England

My previous forest was one of those places where, the moment the forester turned his back, something was bound to happen.

Our resident Red deer stag had on one or two occasions before, decided to scratch behind his ears on fencing stakes. Unfortunately, he would inadvertently choose the centre of a fifty yard stretch of netting and get the whole lot tangled in his antlers. Sometimes, if he chose an old enough fence, he would be fortunate enough to rip himself clear. On other occasions, when he chose a newer piece of netting, he would take the lot with him, stakes and all if they were not in the ground firmly enough.

One day some years ago, during my absence, he made off with a length of netting and stakes but had managed to free the stakes and broke the roll in half. This half he weaved about his antlers until it was the size of a swan's nest. Then, like a fool, instead of staying in the woods where his chum, the forester, would protect him, he goes and advertises the fact on the open heath, whereupon our local policeman phones his Inspector and gets permission to shoot him. To add more weight to his Inspector's permission, and in order to placate the forester, he enlisted the aid of his pal, the R.S.P.C.A. Inspector, but by this time, the deer had headed back to his sanctuary. They both appeared at the forester's house and requested permission to look for the deer. The forester's wife informs them that there is no worry because the deer is about to shed his antlers but they insist that the wire is trailing and may get caught up and the animal suffer, to

which she replies that if they find it, they had better cut the wire and issues them with a pair of wire cutters. They depart with the wire cutters and we later discover that they had lost themselves in the forest and walked round and round in ever-decreasing circles and were almost on their knees, and they gave up.

Though the local policeman was itching to find a legitimate excuse to shoot the deer, neither of them cared to upset the forester, particularly the R.S.P.C.A. Inspector. The last time he called for the F.C. services, he had a cat up a tree. He had already contacted the Police and the Fire Brigade and they had failed. When the F.C. arrived, the cat, which was inspecting the leading shoot, had an entourage of two fire engines, a police van and an R.S.P.C.A. van and many bystanders, but the F.C. had the cat down in ten minutes. On the Saturday following the deer hunt the R.S.P.C.A. Inspector appears and says he wants to telephone the vet. as the deer had got caught up on private land. The trailing end of wire anchored on to a snag, twirled round a tree and the stag had thrown itself.

Tom Fryer was not only an ex-Royal Navy seaman but a member of a well-known local fishing family (now a ganger on Honeywood Forest) and had a life-long experience of handling rope. I picked Tom up in the Rover and asked him to lash the deer in such a fashion that one pull on the rope would set it free. The faithfully trusting forester sat on its neck and held the head down by the antlers while the policeman and R.S.P.C.A. Inspector hacked through the netting. The animal had one large patch of fur removed from its back. Although I saw no point in the vet. attending at all, it is apparently standard practice with the R.S.P.C.A. It took quite a while to get all the wire off. Then the party withdrew and Tom pulled his rope. I still held the head down. Once the rope was free, I expected the stag to panic but the poor thing was stiff and dazed, so I helped it to its feet. After leaving it a few minutes, to recover, I clapped my hands and it trotted off.

Somehow or other, my uniformed friends really excelled themselves in spreading the news for as if by magic the printed word even appeared in London. It was then that we experienced a complete administrative, communications 'life-cycle', for surely no other Red deer has ever set the phone bells ringing from the Big Town, through to Conservancy, District, then Forest and all the way back again to the Big Town.

For a year or two things were moderate and then it happened again. Owing to the high cost of phone calls, it was deemed prudent to keep the episode on the forest, so the part-time/contract warrener, the ganger and I attended to the job as a private, unofficial matter. The poor animal was in a very bad state. Not only was the netting plus the top strand wire round his antlers and foreleg, but it was also round his neck and he was almost strangled. The wire was cut from his neck to relieve his breathing, and the animal was massaged and lifted into a more comfortable position. As the animal was extremely nervous, we decided he would be quieter back on his side before we could cut the rest of the wire, as his struggles were causing him severe pain at this stage. Our joint experience with animals covered most things from voles to elephants, but we were to learn a great deal about deer in the next five minutes. Albert (Gyp) Tilbrook had not only spent his boyhood with his Romany family and was an expert with horses, but he was as strong as two ordinary men. We discussed the matter and we disagreed on how the animal should be thrown. I said the animal should be thrown from the front and Albert from the back. Albert, in his kindest possible manner, implied that he was throwing animals while his forester was still wearing napkins. I pointed out the folly and the accident book, and Gyp, in his sturdy, independent manner, retorted that he was free-lance. Bill Briggs, who was a dog handler, was official photographer.

We never saw which back leg Gyp grabbed, and therefore we can offer no knowledge to science in this matter. What we did see was Gyp sailing past the hedge and landing flat on his back in the field. We now know that a three-legged deer can stand on two legs and give a mighty kick.

We all had a good laugh and after calling Gyp nine kinds of a bloody fool, I told him I would show him how to do it. So, with its near foreleg already off the ground, I lifted its 'off' foreleg whilst holding the antlers and intending to barge him over, but the animal had its wits about him. With one front leg tied to his antlers and the other lifted by me, he suddenly brought one back leg forward and raked me from thigh to calf. It was then that we discovered that even a two-legged deer could stand on one leg and kick.

For good measure, he stuck his antler into my hand and as the extent of the damage was only found to be a few drops of blood and a bit of skin, we again had a good laugh.

Grabbing ropes from the back of the Rover, we resorted to cowboy techniques, to the joy of the forester's daughter who had now arrived. At last the wire was cut off and the animal was disentangled and free to roam.

Unfortunately, the weather was dull and the photographs (one of which appears in the central inset) were not very clear but at least it will serve to illustrate the story, as not everybody would go to all this trouble to save a deer. After all, although I had a million trees, I only had one magnificent creature like this. This one animal seemed to give more pleasure and interest to the general public than all that million trees put together, and after all it was not my deer, it belonged to the nation. There was more to this animal than being just a four-legged chunk of venison. He was Our Ambassador, the link between public and forestry.

OUR MAN IN RUSKICH

By

A. BEARHOP

District Estates Officer, East Scotland

Pronounce it Rooskay!

"Our Man" is John Campbell-Smith, tenant of a forest worker's holding in Glen Lyon, Perthshire, in East Conservancy, Scotland. The name of the holding, Ruskich, derives from the sheep farm of that name which was bought by the Commission in 1960 and now forms an outlying detached section of Drummond Hill Forest. Glen Lyon is reckoned the longest glen in Scotland and Ruskich lies 6 miles from Fortingall at its eastern or lower end. This is an area of Blackface sheep, grouse moor and deer forest. At its eastern end the glen sides are steep and often precipitous and it is only on the valley floor alongside the river that any fertile soil is found.

The Ruskich acquisition, totalling 716 acres, was (and remains) the Commission's first incursion into the glen and for a year before planting began the farm was managed by the Department of Agriculture and Fisheries for Scotland. Once planting began the Department retired from the scene, and a Forest Worker's Holding was formed of the arable ground with a small part of the hill for outrun, and the house and steading for accommodation. The holding totals 73 acres, of which 32 may be considered arable and the remainder as rough grazing and hill. The River Lyon, well known for its salmon, forms the southern boundary, and the arable ground straddles the public road.

John Campbell-Smith came to Ruskich in January, 1963, just one jump ahead of the snow and frost of that dreadful winter which closed in for two to three months. At an elevation of 600 feet plus, winter in the glen can be expected to be particularly trying. In the relatively short time since his ingoing, John Campbell-Smith's farming methods have worked a considerable change on the traditional husbandry practised on the holding in the past, and the eye soon notices the many healthy, well-fed cattle and the particularly lush pastures they graze upon.

It is a far cry from a Perthshire glen to the different atmosphere of France, but Mr. Campbell-Smith will be the first to admit that the methods he adopts so well are those expounded at length by the French farmer, grassland scientist and writer André Voisin. Voisin calls his system "rational grazing" and while it is almost impossible to describe this briefly and do justice to the subject, the basic tenets of the system are:

1. That grass is by far the best diet for stock (and also the cheapest).
2. That for maximum production of grass, grass should be eaten down quickly and left completely alone for a period to permit the individual grass plant to recover, build up its reserves and put on fresh growth. In explanation, the traditional method of grazing a pasture for the whole growing season is wasteful, damaging and unproductive. Strip grazing as it is popularly applied makes better use of the grass, but usually the stock is still allowed access back on to the grazed section and so maximum production can never be achieved.
3. That grass should be eaten at a certain stage of growth when nutritional value is at a maximum.

Ruskich's tenant is a firm disciple of Voisin's methods, and practice appears to follow theory very closely.

The 32 acres of arable ground are now all in grass and no other crop is grown. This area is divided up into 26 paddocks, each of an area of one acre plus. Since the stock is entirely cattle, electric fencing is used extensively and entirely successfully. Watering, which is an obvious problem, is simplified with the presence of both river and streams, but in these days of polythene piping and wheeled water troughs an alternative could have been found if necessary. The paddocks are grazed in turn very intensively, with perhaps as many as 30 cows and calves in one paddock, the aim being to zero graze the paddock as quickly as possible in a period of about two days. After this period the stock is moved to a fresh area and the paddock is rested for a period of from fourteen to forty days, depending on the age of the grass and the period of the season. With this system regrowth can be remarkably quick and the grass is not grazed again until it offers from 6 to 9 inches.

About 14 acres of the rough ground on the hill have been improved by liming and slagging and this area will be brought into the grazing sequence and so release paddocks for silage making.

The holding is now carrying 40 breeding cows, all Aberdeen-Angus crosses, producing 40 calves annually from an Aberdeen-Angus bull. The calves are all sold in the back-end of the year, newly speaned. The cows remain, to be out-wintered, calving in February and being fed on 60/70 tons grass silage made off some 20 acres of the grass. The silage ration is boosted by some bought-in nuts and a little hay.

It goes without saying that a fairly liberal manurial programme is required, but it is worth noting that Campbell-Smith is certain that with proper management he will never need to plough up and resow the grass. He can also point to the advantage of having no cropping programme to consume so much time and effort—no risky hay to make, or corn to harvest in the inclement weather that can so often be expected in these "airts". It is also claimed that the grass which

eventually 'develops' under the system is a much healthier, more nutritional and better balanced pasture than that often attained under more traditional methods.

'Foresters' reading so far may be excused for wondering how such a blatantly agricultural article has slipped into the *Journal*. They will be relieved to learn that 'our man' still works virtually full time with the forest squad. Last year he had thirty days leave to include all holidays. His greatest period of activity is the silage-making, and this comes at a time which does not interfere with the forestry programme to any extent. While Campbell-Smith's interests must dwell primarily on his agricultural pursuits, it is obvious that the purpose of the holding is being served—that is, to provide forest labour.

It need hardly be said that the whole enterprise has involved a fair capital investment, and one which we cannot expect many of our holders to copy. Nevertheless, the principle along which the holding is being run, that is, the principle of rational grazing, is capable of adoption on lesser scales. And similarly the system is one which should be commending itself to the agricultural community at large, and it is therefore rather satisfying to find one of our own employees in the forefront of such advancement.

It is interesting to note that on acquisition the farm stock totalled 17 cows and calves and a hirsel of 410 ewes. Having planted 500 acres of the ground, the holding has been made to carry 40 cows and calves.

It is small wonder that not a few people have been watching Ruskich with interest.

FOREST FIRE

By

R. J. JENNINGS

Head Forester, Forest of Dean

An orange tongue that flickers in the leaves
Turns to a crimson flame with crackling roar.
Dancing aloft fanned by a rising breeze
Like shooting stars the red sparks leap and soar.
Needles and branches withering in the heat
Flare incandescent in the blazing pine,
The air is filled with acrid fumes of smoke
Mingled with pungent smell of turpentine.
Thousands of fluttering moths are burned to ash,
A myriad ants incinerated lie.
On scorching earth tormented grass snake writhes,
Forsaking partridge leaves her chicks to die.
Primrose and bluebell wilt and droop their heads
By singed and wingless corpse of humble bee,
And frenzied squirrel leaves his burning drey
For safety in the trunk of hollow tree.
With aching limbs men beat the fiery sward
Thrashing the flaming embers to the ground,
Fountains of water gush from squirming pipes,
Quenching the dying glow with spluttering sound.
The linnet in the gorse bush sings no more,
Cremated with its nest a funeral pyre.
In blackened woods all now seems strangely quiet
After the holocaust of forest fire.

BUT WHIT'S A MUIR? A PUZZLE FOR THE LAWYERS

By
T. S. L. FINDLAY
District Estates Officer, South Scotland

"Aye, but whit's a muir?" The gruff, but not unkindly, voice of Jock rent the somnolence of the afternoon session like a buzzing bluebottle. Notices anent muir-burning and this and that had been thoroughly chewed over and swallowed—all except Jock's "muir." That stuck.

"Well, of course it's a moor, a muir is a Scots term, well—it's a place where heather grows, er—" the answer trailed off into uncertainty; the provocative question lingered.

Searching for the answer led into refreshing byways of old law, a pleasant change from the incomprehensible statutes of modern times when our city societies must burst at the seams into "overspills" and "developments" and "conurbations." But back to the "muir" and muirburn.

Robert III was the first one to have a shot. A long time ago, in 1400 to be exact, with the idea of protecting his Sunday lunch, he enacted under the title "Burning of Muris." "It is a statute to be keiped and observed throu' the haille realme, and there sall be na muirburne or burning of heder bot in the month of March, and not thereafter induring the time of somer, or of harvest under the pane of fourtie shillings."

Despite the unconventional spelling, which you could get away with in those days, the meaning was plain. It will be shown, however, that the "burning of heder" didn't survive as a definition.

With occasional polishings, the old Act plodded along quite happily until 1772. Then the Game (Scotland) Act superseded a number of statutes which had prohibited muirburn "from the end of March till all the corn was shorn."

No one until now had had any difficulty in defining a muir and the poor prosecuted had taken their medicine quietly.

Not so, however, Thomas Gibson, tenant of the farms of Shaw and Hindhope, in the Parish of Yarrow. On a fine spring morning in the month of May, 1839, he was out looking the back hirsel. Head down, the soles of his kips firmly on the slope, he swung up the hill. But his thoughts were out of the usual run, so much so that Ben took advantage of his pre-occupation to have a sly nip at Flo.

And what was taking the mind of the herd off his sheep on such a morning? Nothing very far from sheep you may be sure. His eyes were on the subject—bent, blow grass, the muir, feed for sheep. The Laird, or rather his factor, puir man, was on him again about burning. Suddenly the answer came to him. With a gleam in his eye Ben and Flo were brought sharply to their work.

The proceedings that brought Thomas Gibson at least a local fame, are bare, and larded with legal phrases—but it is not hard to imagine the background. A night round the ingle with a few slow but clear-thinking friends.

"Whit's a muir, John?"

"We a ken whit a muir is, but is yon wee bit o' blaw grass a'tween the tap dyke and the lees a muir?"

"Shair a muir's flat."

"The factor says that its a muir but he's mair concerned with the Laird's game than our stock."

"Hoo can we pay a rent and no get feeding for the sheep?"

"I've never seen any game in yon corner."

"And why should we no burn it?"

How to prove it? Quite simple—he started a fire.

Thomas Gibson of Shaw and Hindhope, like the true Scot he was, put his case to the test, and so on May 10 and 11, 1839, judicious fires were lit on Shaw and Hindhope.

In due course he was charged, in a Complaint laid before the Sheriff of Selkirkshire, with making muirburn in contravention of the Act; 13th Geo. III cap. 154. In his answers he denied contravention of the statute, but admitted that at the period libelled "he had burned a good deal of withered grass which he considered not to come under the denomination of heath or muirburn."

How his eyes must have twinkled, behind the bland expression of the experienced market man, as he gave his lawyer that explanation.

The Complaint referred to Sections 4, 5, 8 and 10 of the Act. Section 10 provided that "one moiety of the penalties or forfeiture shall be applied to the use of the poor of the parish, or to the repairing of the high roads." At least he would be doing some good whatever happened.

The Sheriff, after proof, dismissed the Complaint. His rambling interlocutor attempting to define muir and heath ended up: "Upon the whole, though I have formed no very confident opinion, that opinion, such as it is, is against the Complainer." Then regretfully: "It does not seem that the statute gives power to award expenses."

Jubilation in Hindhope! May the Sheriff's ewes aye be milky.

But the deer stalker hats were rising on sporting heads; the Sheriff's interlocutor was almost an invitation to appeal. It was presented to the Court of Justiciary and was heard in the High Court on March 12, 1842.

They really had their money's worth from the law in those days. Nothing so simple as defining a heath or muir! A corpus delicti was dragged in at one point—covered with burnt heather! And so on to the locus delicti—delicious phrase—but this one was really important.

Five Judges

Five learned judges heard the case. The thought on the hill had come a long way. As the case wore on the gowns and wigs melted away to reveal the tweeds and brown boots of men who could not be entirely disinterested.

Counsel for the Appellant droned on. (He was agin us, in case you have trouble sorting them out, as I had). Was the Respondent (that's us) informed of the particular nature of the ground with the burning of which he was charged? He wasn't but it didn't matter.

Everybody agreed it was not heder (sorry, heather) that was burnt but that the grass or bent burned was the resort of game. Now we are getting somewhere.

On page 89 of the law report we find "muir is the important word." Marvellous! Tom Gibson had thought that one out already. But then his brain had not been beaten to a telly jelly, or tortured by the sophistry of national economics like ours.

Counsel for the Respondent (that's us) had his turn. I quote: "The Statutes as to muirburn have in view the preservation of game, substantially for recreation or amusement, an object which the Respondent (you know who that is by now) unqualifiedly admits, is perfectly legitimate; but then, in order to attain this object, these statutes necessarily impose a restraint or prohibition upon the ordinary and beneficial use of property."

Well put, Sir!

The judges stopped doodling and got down to business. The Lord Justice-General was "for," the others, I'm sorry to say, "against." Latin and Greek and Anglo-Saxon were bandied about but commonsense won the day.

Rankine sums it up: "Muirburn as defined in the Act is held to apply not merely to ground on which heath or heather grows, but to all moors or uplands whatever may grow thereon, and though covered only with rank grass. The only practical test furnished by the Court is that it shall be a place which moor-game frequent for breeding."

"Aye, but whit's moor-game?"

STRINGS O' HEMP

By

R. J. JENNINGS

Head Forester, Forest of Dean

"O, bid him never tie them mair,
Wi' wicked strings o' hemp or hair!"
Burns

The keeper was digging at a rabbit bury in a bank on the edge of the wood when the boy came across to him from the footpath that led to the village.

With shirt sleeves rolled up to his elbows, the man jabbed at the hole with a shiny semi-circular spade, grunting occasionally when the steel struck a tree root that jarred his wrists and the palms of his hands. Now and again he paused to draw out stones and brown earth which he threw behind him down the bank, all the time enlarging the mouth of the hole.

On top of the bank, tied to an oak paling fence by a length of string, was a small brown rough-coated terrier. The dog was alert, with ears cocked up and shining eyes it watched expectantly at every movement the man made. Sometimes it uttered an impatient whine and its whole body quivered as it strained at the leash which held it back from the bury. After a while, though, it relaxed, tired of watching, and after scratching in the leaves and grass it turned around three times before finally settling down by a canvas game bag and the keeper's jacket.

Presently the man straightened his back, and after laying the spade down beside the dog knelt down in the freshly dug earth of the bury and began to examine the hole that he had dug.

The boy now came up closer and stood beside the man. A thin shy lad with sensitive features, he felt more at ease now that their heads were level.

He spoke to the dog that jumped up, pleased that it was at last being noticed. The boy looked around at what appeared to be of interest to him. The game bag, a heap of purse nets and a double barrelled twelve-bore gun.

His face brightened with admiration as he stared at the man's hairy muscular arms. He gazed at the lined freckled bronzed face and his eyes rested enviously on the broad shiny leather belt and brass buckle around his waist. Being so close to this tough hard-looking individual gave him confidence to speak. He had a great urge to say something, to be associated with the keeper who seemed to him to be an important man, and to let him know that he understood what was going on.

He took a deep breath. "Are you ferreting mister?" he said.

The keeper was now kneeling by the side of the rabbit hole, holding in his hand a long length of string that was buried in the soil. Now and again he pulled it steadily as though testing it. There was resistance, the string was fast. The man now lay down at full length on the warren, and putting his ear close to the ground stayed motionless for a while, listening and concentrating.

The silence worried the boy. He felt that he was an intruder and unwelcome.

He spoke again.

"Is there a rabbit there?" he said.

The man's reply made him feel no easier.

"Hist" was all he said . . . . "Listen!"

The terrier stood up and watched the string with great interest. It began to move down into the rabbit bury in a series of jerks, at the same time as a sharp hollow knock was heard in the ground underfoot. Deep in the bury at the other end of the line, the ferret had moved a rabbit and the knocking was its alarm signal.

Rising to his feet the keeper took several steps towards the wood and picked up a double-barrelled gun from the ground, pulling back the two hammers with his thumb at the same time as he lifted the weapon up level with his chest.

The click of the firing mechanism was a familiar sound to the terrier. Pulling on the string, it crouched tense and excited. It gave a quiet bark, inclining its head first one way and then the other.

The keeper pushed it away roughly with his foot. "Sit . . . sit" . . . he growled to the dog, then turning to the boy . . . . "You'd better get behind me m'lad if you don't want to be shot!"

They waited expectantly.

Suddenly there was a movement at the mouth of one of the holes and a little white animal with pink eyes and pointed nose poked its head inquisitively out of the bury, and then disappeared again into the ground like lightning.

The dog yapped and the keeper raised his gun to his shoulder as a grey brown furry ball with white scut of a tail scampered over the bank towards the wood.

The man fired and the boy closed his eyes and flinched as the report from the shot sang in his ears. Looking again, he saw the rabbit roll over and over limply, thirty yards distant, and lie still in the bracken and leaves. He felt excited and elated yet strangely sad. Admiration for the man's skill as a marksman mingled with a feeling of resentment and pity for the insignificant animal that now lay lifeless, the white fur on its belly stained red.

The keeper's gruff voice soon brought his day-dreaming to an end.

"Didn't get far did he?" said the man laughing.

The boy shook his head not knowing what to say.

"Pick him up and put him by my bag then" the man said.

The boy did as he was told, feeling upset as he lifted the warm soft animal and then looked at the terrier. "What's your dog's name?" he asked.

"Tim" said the keeper. "Do you like him?"

"He likes me" said the boy . . . "I wish he was mine."

The man though had no inclination to waste time talking. He had been digging at the bury for an hour and all that he had to show for his labour was one rabbit. He spoke roughly and was deliberately abrupt to put an end to the lad's chatter.

"Tell you what, then, son" he said . . . . "you clear off and one of these days when I've finished with him you shall have him!"

The boy remained silent. He sensed the changed tone of the man's voice. He knew now that he was unwelcome and wanted to get away from the keeper who he had now begun to dislike. Gradually he edged away from the wood, and when he saw the man once more lay down and put his ear to the ground, he made his way to the footpath and started to walk towards the village.

Down inside the bury two feet below the keeper, the ferret was hunting again. It had found another rabbit. Scared by the noise of footsteps above it and terrified by the vicious little white animal that gave it no rest, but pursued it relentlessly, the rabbit hopped aimlessly through the maze of tunnels. Ears

laid back, eyes starting from its head, it seemed almost paralysed with no further power to fend for itself. Crouching in the end of a blind hole it waited for the inevitable.

Suddenly the ferret came face to face with it. There was a scuffle and a struggle as two strong jaws met in the rabbit's jugular vein, and soon the earth beneath the rabbit was stained red. The keeper heard the animal's dying squeal as he listened at the mouth of the bury, and saw the end of the string line vanish out of sight as the ferret left the dead rabbit.

He began at once to dig vertically into the earth, knowing that the ferret had killed directly beneath him. He wanted to locate the line so that he could trace it to both ferret and rabbit. But in his digging he had severed the string with his spade and unknown to him the ferret was outside the bury trailing it along the ground, watched only by the terrier.

The keeper was now lying on his side with his right arm deep in the hole. In his hand he held a long pliable hazel stick which he thrust into the ground following the direction of the bury, trying to locate the rabbit.

The ferret, now running over the ground, had come upon the scent of the shot rabbit. Clambering over the stock of the twelve-bore gun lying in the short grass, cocked in one barrel and loaded, it was held fast for a moment when the trailing string caught in the trigger. Then, as the little creature pulled and the tension on the line became greater, the hammer fell, the gun was fired, startling the dog that jumped up and broke the string that tied it to the fence.

The keeper did not move. He felt nothing as the full charge of the cartridge tore into his neck and the base of his skull, but down in the earth his fingers released their grip on the hazel wand and soon the soil above the rabbit was stained a deep red.

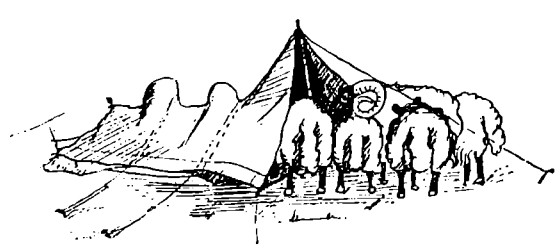
Crossing the field on his return from the village, the boy deliberately avoided the bury. He had heard another shot and recalled the shooting of the first rabbit.

As he walked along the footpath he glanced quickly across to where the keeper lay, quite still on the ground with his head down by the mouth of the bury. When he looked behind him, he was surprised but glad to see the brown terrier following him.

The boy hesitated for a moment and then held out his hand, "Good dog" he said . . . . "Good dog."

Uncertain at first, but then quickly recognising a friendly voice, the terrier wagged his tail and went to the boy. "Come along Tim" he murmured quietly as if he was afraid the keeper would hear him, and then boldly, as though he had suddenly remembered a sound reason for encouraging the animal . . . . "he said I could have you when he'd finished, didn't he?"

They walked away leaving the field through the gate, the boy leading the dog by the length of string.



A REVIEW OF "EXPEDITION GUIDE"

(DUKE OF EDINBURGH'S AWARD SCHEME)

By

S. H. SHARPLEY

Executive Officer, H.Q.

The Duke of Edinburgh's Award Office has brought out a pocket booklet called *Expedition Guide*, edited by the Olympic athlete, John Disley. It is intended for supervisors of boys' mountaineering expeditions under the Award Scheme. Disley's dedicated approach, however, makes it into more than just a text-book. It can be read for pleasure. The lore of life under canvas and in hostile weather conditions is set out in scientific detail and with infectious enthusiasm. The book should stimulate even the laziest of us, if not to pack a rucksack (scientifically of course) and go climbing, at least to follow with intelligent interest those who do.

The purpose of the Award Scheme, of which expeditions are only a part, is to suggest to boys and girls between the ages of 14 and 20 how to use their leisure excitingly and usefully. Awards—Bronze, Silver and Gold—are offered as an incentive to reach high standards in various pastimes. There is fire service, life-saving, home nursing, painting, dancing, drama, music, metal and woodwork, learning to drive a car, home-making, cooking, entertaining and so on. There are also expeditions, but for boys only.

The Expedition Guide stresses the need for safety, through proper teaching about the various skills and equipment necessary. It goes on to describe, in simple language, every detail in the preparation and carrying out of an expedition.

Campers and hikers of all degrees of earnestness will learn much from the chapter on camping techniques. On the basis that "any fool can be uncomfortable", we are told how to achieve maximum comfort in trying weather. For instance, if you arrange your gear methodically inside the tent you will not have to go bumping into each other to find the tin-opener, and then regain your balance by clutching at the tent wall, so letting in water for as long as the rain continues. After reading this chapter you will no longer rely only on the sucked finger technique for discovering the wind direction; you will pitch your tent according to the *forthcoming* weather, and the prevailing wind direction will be plain from such natural signs as shaped trees and bent grasses.

Food and cooking receive proper attention. Sample menus are suggested, and tables show how much each item of food weighs in your rucksack, and the amount of protein, fat and calories it contains. There is to be no nonsense about skimping meals: "Two hot meals are to be prepared daily". Much of the food carried is dehydrated, to be transformed into stews, hot vegetables and potatoes, scrambled eggs, rice, and stewed fruit. Old hands will be glad to see that tinned baked beans are still considered worth their weight. Incidentally, did you know that a lump of sugar will keep you going in calories for an hour if you are sitting still, but for only 80 seconds if you are scaling a mountain? The cynical may draw a moral from that.

For the serious student there are deeply technical chapters on map reading, making your own equipment, and planning the route. There are notes on various organizations, including the Forestry Commission, which may allow courses or camping on their property. The Commission is willing to let organized groups carry out expeditions on its land unless special fire risks, sporting rights, or other conditions forbid.

There is a foreword by Sir John Hunt. Illustrations, clear and practical, are by Gordon F. Mansell. His drawings on the Country Code are delightful; one of them is reproduced on page 190 by kind permission of the publishers.

Expedition Guide can be obtained from The Duke of Edinburgh's Award Office, 2, Old Queen Street, London, S.W.1., price 5s. 0d., postage 4d.

FOREST SYMPHONY

By

Miss E. JOHNSON

Executive Officer, H.Q.

For him that hath an ear the forest plays
A mighty symphony of work and praise.
Its theme—how timber for man's many needs
Is harvested from transplants, seedlings, seeds.

The wind, that maestro of the woodland choir,
Strikes boisterous chords on his arboreal lyre,
Shaking the ripened cones on mother trees
Scattering the seeds to deep dark dormitories.

From fertile seed a self-sown crop appears,
Pine and spruce seedlings, in whose tender years
The watchful forester with practised eye
Weeds, prunes, protects them—trains them straight and high.

This virtuoso of the forest band,
A man both stout of heart and skilled of hand,
With powerful strokes makes his plantations ring
(With lighter touch he heels the transplants in).

He loves the ephemeral beauties of the woods
And feels in harmony with their changing moods,
The variations each new season brings,
The deep down rhythm at the root of things.

Now the slow movement—twenty years or more—
Time for the trunk to build its timber store,
Time for the fibrous cells to test their strength,
Time for increasing volume, girth by length.

To keep the balance of the mixture right,
Selected trees are sprayed with spots of white;
The early thinnings go as pole or prop,
The best and straightest stay for final crop.

The craft of felling calls for special care;
The clangour of its music rends the air.
The ringing axe, the hissing saw, the crashing tree,
Lead the percussion of the symphony.

The wind of change sweeping the forest floor,
Brushing out time-worn methods used before,
Heralds the entrance of a theme unique—
Extraction by the double-drum winch technique!

This mounted winch is made to take the load
In moving produce from the stump to road;
See how it hauls both down and up the hills
Pitprops and pulpwood for the mines and mills!

Man and the natural forces thus combine
In raising home-grown softwood straight and fine
And so for all with ears the forest plays
A powerful symphony of work and praise.

SOLUTION TO LAST YEAR'S FOREST CROSSWORD

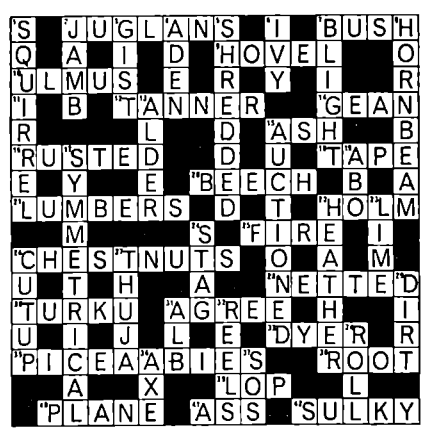
By J. R. AARON
District Officer, Headquarters

Across:

2. Nuts to the ancient Romans, they are so often pickled.
7. A man leaves a type of saw for a shrub.
9. Bob leaves a type of spade for a poor home.
10. Elm as Julius Caesar knew it.
12. Does he use oak bark in six pennyworths?
14. This cherry gets the bird from a strange animal.
15. Tree found in the Wash.
16. Infested foliage or exposed iron.
18. Atlanta peaches for measuring timber.
20. Timber used for Toynbee chairs.
21. Jack leaves the timber men and Bob leaves the sleepers for sawn wood.
22. A type of oak.
25. The forester's worst enemy.
26. Old jokes by the blacksmith's shop.
28. Against rabbits?
30. Finnish University Town which exports timber.
31. Yes, from a greenwood tree.
33. Handy Eric changes colour.
35. Christmas tree (5: 5).
38. Kangaroo teeth marks at the bottom of the tree.
39. Cut branches from sloping ground.
40. Lacewood from a distant planet.
41. Were you one to start this puzzle?
42. Sullen timber extractor.

Down:

1. Grey or red?
2. Wooden door frame used at a jamboree.
3. The main idea.
4. A fox's home in a treeless part of Asia.
5. Descriptive of woodwool and certain breakfast foods.
6. She loves climbing.
7. Tea with the captain of the *Bounty* causes a disease.
8. A ray from a musical instrument for a strong timber.
13. Oral derision about a waterside tree.
15. Timber sold by the audit once method.
17. The approximate shape of conifers and poplars.
19. An alternative name for 30 across.
22. Warm the lady up for a moorland plant.
23. Fruit flavoured timber.
24. A forest mammal fond of parties.
26. Sad preparation of firewood (3: 2).
27. Useful for wreaths.
29. Only welcome on a compost heap.
31. A vestment made from *Abies alba*.
32. Scottish dances from a wood turner.
34. A unit of wire netting.
36. Forest tool favoured by Dr. Beeching.
37. Help!



TWO FORESTRY CROSSWORDS

By Miss E. JOHNSON

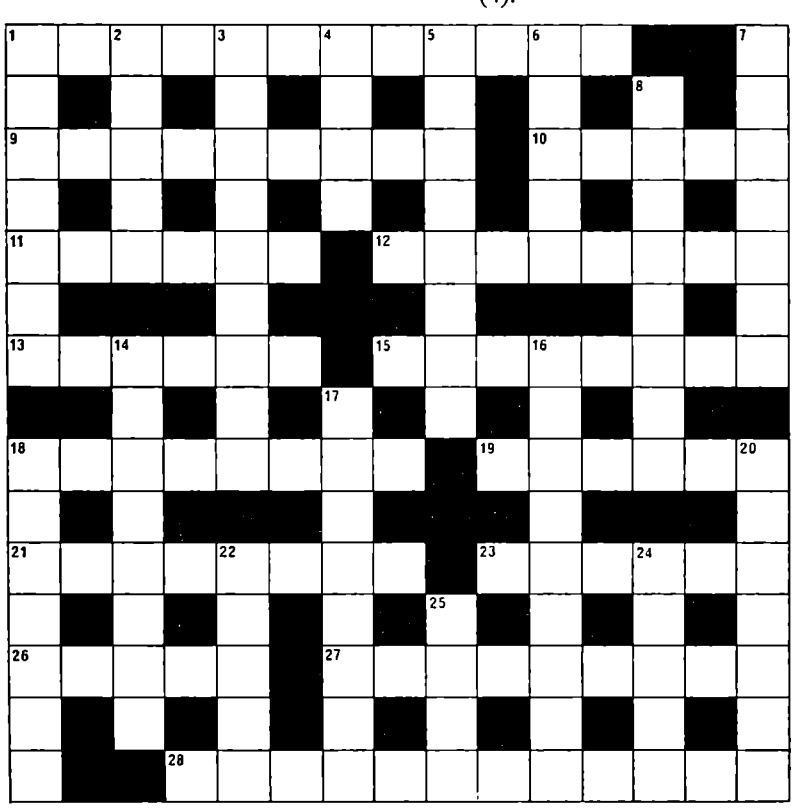
Executive Officer, H.Q.

Across:

1. May kill the tree when up or carry it off when down (12).
9. Woods just acquired yet long in Crown control! (3, 6).
10. Go and aim for the adult insect (5).
11. The outer bark (6).
12. Legal aspect of conifers (8).
13. Resinous (6).
15. To survive a transplant must (4, 4).
18. A pirate's reformed for the mycologist to study (8).
19. Pride's upset the arachnid (6).
21. Operation producing 18 down (8).
23. May keep one from seeing the wood or the trees (6).
26. They run for miles through F.C. forests (5).
27. One of the family perplexes the chimpanzee (9).
28. What Solomon did with the cedars of Lebanon (4, 2, 6).

Down:

1. Not really the shape of most conifer fruits! (7)
2. Wrote for a change in the fire look out (5).
3. Colonies of black birds (9).
4. The holly family (4)
5. The Latil with heart rot goes back to a site for Maritime Pine (8)
6. Cause to grow (5).
7. An engraving or the result of work in the forest (4, 3).
8. The American lime (8).
14. Lactic or resembling bark (8).
16. Ten square unplanted deserted chains (5, 4).
17. A large coppice tree (but could it be 165 cu. ft.?) (8).
18. O trip very softly round—there's vital timber here (3, 4).
20. Red deer around the seat (7).
22. Residences for forest dwellers (5).
24. What deer do to the bark of young firs (5).
25. Its volume is measured in inches (4).

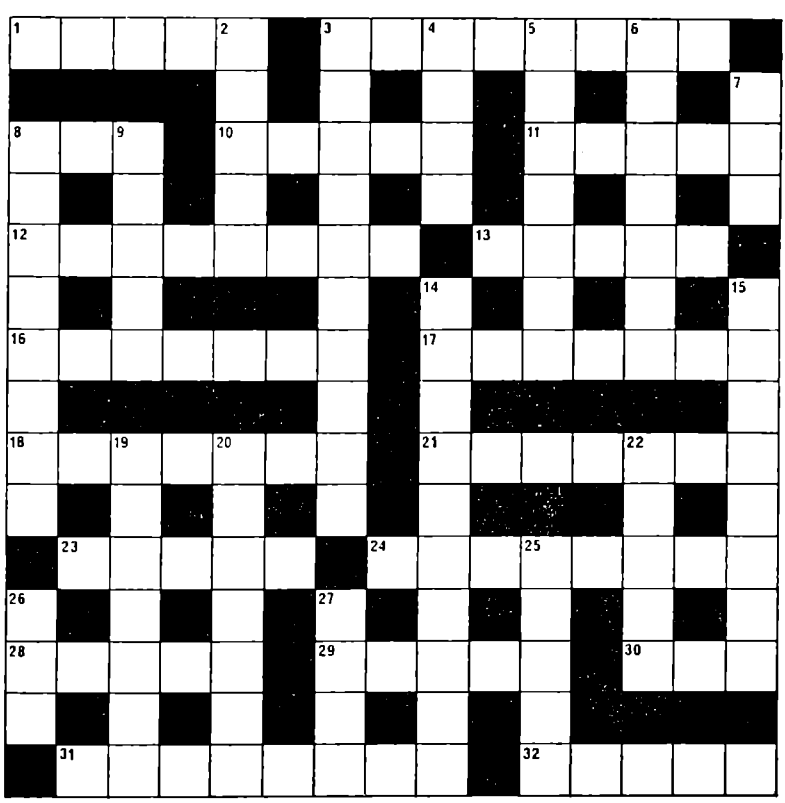


Across:

1. After wind it makes trees of altered worth (5).
3. Forest home of outlaws (8).
8. May be private or official from 16 (3).
10. Trunk made from twisted roots (5).
11. Tool made by the French and English (5).
12. Rats bore to make small trees (8).
13. Presses for information from the forest fire front. (5).
16. A Conservancy H.Q. (7).
17. Ask of the beeches (7).
18. French forest—does it bring back "the old familiar faces?" (7).
21. The Oak (Lat.) (7).
23. "To swell the gourd and plump the — shells"— *Ode to Autumn*— Keats (5).
24. The tree needs its salts. (8).
28. I rose reformed (as a wicker basket perhaps?) (5).
29. Two hundred perches to five (5).
30. You expect to catch vermin when traps are thus (3).
31. Trees whose identity sounds in doubt (8).
32. What S.P. may be to N.S. (5).

Down:

2. Well produced, this fire extinguisher (5).
3. Describes seed stored in sand before sowing (10).
4. Black, like a certain hardwood (4).
5. They belong to the Juglans family (7).
6. Pole cut in eight sections (7).
7. Winged fruit of ash (3).
8. A Larch Co. produces a form of carbon (8).
9. With 21 is the pedunculate oak (5)
14. Does it still describe the rabbit in unfenced woods? (10).
15. Spanish horse varieties—may be sweet and spreading too! (8).
19. In all seriousness timber's extracted by it. (7).
20. A throne upset and lack of roothold for the tree (2, 5).
22. Could it take a hundred centuries to make squirrel traps in this form? (5).
25. Conifer product (5)
26. "The winged seeds where they lie cold and — "—*Ode to the West Wind*—Shelley (3).
27. Seed's overcoat (4).



FORESTRY COMMISSION STAFF

At 1st January, 1965

Notes: The stations of individual officers are shown only where they are different to that of their main office. The list should *not* be read as a seniority list; it has been compiled from returns submitted by the various offices to the Establishment Section.

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Howell, E. A. (P. & E.)
Maisey, A. J. (Field party (W.) P. & E.)
Mobbs, I. D. (Field party (E.) P. & E.)
Straiton, J. (Field party (S.) P. & E.)
Wilkinson, E. J. D. (Agricultural Show Unit)

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Bell, D. A. (Field party (E.) P. & E.)
Bond, P. (Field party (E.) P. & E.)
Boyd, J. R. (Field party (S.) P. & E.)

Boyd, R. D.
(Field party (S.) P. & E.)
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(Alice Holt (Machinery Research))
Bruce, G.
(Field party (S.) P. & E.)
Brunton, J.
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Carter, J.
(Field party (W.) P. & E.)
Cooper, S.
(Field party (E.) P. & E.)
Elger, W.
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Embleton, H. N.
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Embry, I. C.
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Fryer, K.
(Field party (S.) P. & E.)
Hall, E. R.
(Field party (E.) P. & E.)
Harrison, D.
(Field party (E.) P. & E.)
Harrison, G. E.
(Field party (E.) P. & E.)
Jones, G. J.
(Fie d party (W.) P. & E.)
Jury, E. B.
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Kearns, G. N.
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(Field party (S.) P. & E.)
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MacGregor, T. B.
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Smith, R. N.
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Whyatt, J. G.
(Field party (W.) P. & E.)
Wigzell, M. R.
(Field party (E.) P. & E.)
Williams, J. L.
(Field party (W.) P. & E.)
Witts, M. D. (P. & E.)
Wood, C. W.
(Field party (W.) P. & E.)

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Gray, D. (Audit)
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Telephone: Regent 0221

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WORKSHOP MANAGER: Gawn, S. (T.W.G.III) (Lightmoor)

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Windle, D. (Haslingden)
Woollard, R. P. C. (Sherwood)
Yates, H. (Kershope)

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Birch, T. (Mortimer)
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Bowdler, A. C. F. (Cannock)
Collings, P. J. (Sherwood)
Corfield, J. S. (Grizedale)
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Townson, P. (Grizedale)
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Wood, D. (Grizedale)

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Wragg, J.

ENGLAND, NORTH-EAST CONSERVANCY

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SENIOR EXECUTIVE OFFICER: Chaplin, L. A.

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CIVIL ENGINEERING ASSISTANT: Grant, V. (Bellingham)

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Fox, T. F. (Kielder)
Gough, W. R. (Pickering)
Hislop, J. J. (Wark)
McCavish, W. L. (Kielder)
Sharp, G. A. (York East)
Simpson, C. N. (Kielder)
Snowdon, L. (Allerston)

FORESTER

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Ainsworth, P. H. (South Yorkshire)
Baird, R. L. (Fountains)
Bardy, D. A. (Widehaugh)
Bartlett, R. F. E. (Allerston)
Bewick, T. (Widehaugh)
Bolam, T. W. B. (Hambleton)
Bowns, A. (Hambleton)
Brown, W. C. (Harwood)
Charlton, E. (Widehaugh)
Collier, T. E. (Wark)
Cumming, J. (Jervaulx)
Dawson, K. J. (Selby)
Edes, D. S. (Harwood)
Fawcett, E. (Allerston)
Featherstone, C. (Helmsley)
Fowler, N. L. (Rothbury)
France, J. (South Yorkshire)
Gledson, J. G. (Rothbury)
Hammond, D. (Kielder)
Harbin, W. B. (Wynyard)
Hartley, A. (Knaresborough)
Haw, G. (Widehaugh)
Heaven, S. F. (York West)
Hird, J. T. (The Stang)
Hodgson, M. (Hambleton)
Jane, T. A. (Kielder)
Johnstone, T. (Hambleton)
Lancaster, R. A. (Allerston)
Marchant, R. E. (Allerston)
Marsh, E. W. (Redesdale)
Marshall, J. A. (Hamsterley)
Martindale, J. M. (Hambleton)
Metcalfe, J. E. (Kielder)
Moore, W. (Kielder)
Moules, T. R. (Allerston)
Parker, G. W. (Chopwell)
Robinson, P. D. (Hamsterley)
Salmond, M. P. (South Yorkshire)
Scott, G. H. J. (Allerston)
Scott, J. J. O. (Kielder)
Scott, T. I. (Allerston)
Stanley, W. E. (Allerston)
Stephenson, F. (Hambleton)
Stokoe, G. (Slaley)
Straughan, J. G. (Wark)
Straughan, W. (Redesdale)
Tait, J. (Kielder)
Taylor, C. E. (Hambleton)
Telford, J. W. (Chillingham)
Terry, T. N. (Allerston)
Turnbull, M. T. (Kielder)
Webster, F. (South Yorkshire)
Wilbert, G. N. (Kielder)
Williams, K. D. (Hamsterley)
Woodcock, F. A. (Kidland)
Woodward, F. G. (Wolds)
Young, J. P. (Wolds)

ASSISTANT FORESTER

Barry, G. N. (Kielder)
Bartholomew, W. (Kielder)
Clark, P. F. (York East)
Davison, A. (Fountains)
Day, M. J. (Kielder)
Elgy, D. (Wark)
Featherstone, P. (Rothbury)
Fisher, H. (Allerston)
Giggall, D. F. (Wark)
Graham, M. J. C. (Kielder)
Griffin, C. R. (Kielder)
Hanafin, M. (Kielder)
Holden, R. L. (Rothbury)
Howes, R. E. J. (Wark)
King, C. J. (Kielder)
Lee, D. R. (Jervaulx)
Little, A. G. (Allerston)
Maughan, B. (Kidland)
Mills, K. (York East)
Morley, N. R. (Wark)
Pearson, A. A. (Kielder)
Richardson, I. (Wark)
Simpson, G. (Allerston)
Sivill, J. (Allerston)
Smart, J. S. (Allerston)
Spencer, J. B. (Hamsterley)
Stockdale, B. R. (Allerston)
Stonehouse, F. (Allerston)
Stubbs, R. W. (Wynyard)

FOREMAN: England, T. (Hambleton); Ruston, R. N. (Allerston)

HIGHER EXECUTIVE OFFICER: Blott, J. C.; Fisher, R. H.

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ENGLAND, EAST CONSERVANCY

Brooklands Avenue,
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Telephone: Cambridge 54495

CONSERVATOR: G. W. Backhouse

DIVISIONAL OFFICER: Ballance, G. F.; Payne, S. R.; Snook, K. R. (Estates)

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SENIOR EXECUTIVE OFFICER: Searle, A. J.

CONSERVANCY MECHANICAL ENGINEER: Cook, G. O. (T.W.G.I)

AREA CIVIL ENGINEER: French, J. (T.W.G.I)

CLERK OF WORKS (ESTATE): Foote, J. (T.W.G.III); Holmes, W. (T.W.G.III); Raisborough, R. (T.W.G.III).

DRAUGHTSMAN (CART.): Chubb, Miss W. E.; Elliott, H.

HEAD FORESTER

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Chapman, S. (Princes Risborough)
Lawson, G. E. (Brandon Central Depot)
Poll, E. A. (Thetford Chase)
Redford, C. W., B.E.M. (Thetford Chase)
Wellington, C. R. (Aldewood)

FORESTER

Acott, E. J. (Rockingham)
Adams, H. (Thetford Chase)
Axten, G. B. (Thetford Chase)
Beard, B. W., M.B.E. (Thetford Chase)
Belton, G. C. (Ditton)
Birkitt, A. (Wensum)
Bloor, C. A. (Yardley Chase)
Burnie, H. W. (Bernwood)
Chandler, R. H. (Bardney)
Clark, J. F. (Rockingham)
Dover, A. Critcher- (Thetford Chase)
Faddy, A. G. (Salcey)
Field, H. C. (Bardney)
Gladman, R. J. (Thetford Chase)
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Hamstead, E. W. (Bardney)
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Hinton, F. I. (Rockingham)
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Horn, P. (Chilterns)
Howarth, J. (Chilterns)
Hutchins, D. R. (Whaddon Chase)
Ingram, L. D. (Thetford Chase)
Irons, E. R. (Bramfield)
Johnson, H. (Burwell)
Jones, F. B. (The Kings)
Keeler, B. (Chilterns)
King, S. G. (Thetford Chase)
Kirby, P. D. (Thetford Chase)
Lane, P. B. (Rockingham)
Law, S. J. (Kesteven)
Leutscher, E. H. (Lynn)
Ling, J. (Laughton)
McLeod, E. C. (Ampthill)
Marshall, D. F. (Swaffham)
Marston, W. H. (Thetford Chase)
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Roberts, G. (Hazelborough)
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Trussell, J. (Beechwood)
Waters, C. G. (Walden)
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Wilson, B. (Ampthill)
Wood, P. (Willingham)
Wood, P. (Honeywood)
Woodrow, R. B. (Thetford Chase)

ASSISTANT FORESTER

Banks, P. A. (Aldewood)
Boughton, M. J. (Rockingham)
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Butcher, A. J. (Thetford Chase)
Cavell, E. W. (Wensum)
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Hellard, P. (Brandon Central Depot)
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Hunt, L. H. (Wensum)
Keeble, P. D. (Beechwood)
Kew, F. M. B. (Hazelborough)
Mackie, D. B. (Rockingham)
Marsh, P. (Wensum)
Marshall, G. H. W. (The Kings)
Mitchell, W. P. (Brandon Central Depot)
Nichols, A. A. E. (Tool Instructor)
Nicholson, J. H. (Thetford Chase)
Nickerson, R. A. (Lavenham)
Payne, W. C. (Tool Instructor)
Pitt, D. M. (Walden)
Proctor, W. A. (Thetford Chase)
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Roebuck, B. A. (Willingham)
Rouse, R. S. (Deer Control)
Sayer, M. J. (The Kings)
Shaw, J. K. (Bardney)
Smith, G. O. (Brandon Central Depot)
Snowden, J. D. (Wigsley)
Wainwright, J. D. E. (Salcey)
Wiseman, J. (Aldewood)
Woods, A. J. (Tool Instructor)

FOREMAN: Marsh, L. E. (Thetford Chase); Pickwell, H. (Laughton); Rutterford, D. (Thetford Chase)

HIGHER EXECUTIVE OFFICER: Bowman, L. W.; Norton, J. F.

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Chmelar, V. P.
Cutter, E. J.
Dobbie, Mrs. D. M.
Dring, D. J.
Fenn, L. W.
Foulds, G. W.
Giddens, H. J.
James, D. M.
Kimberley, Miss D. M.
Lilley, K.
Mayes, K. R. J. E.
Netherwood, K. A.
Oxborrow, Miss I. B.
Pauley, E. N.
Pratt, K. J.
Reynolds, W. A.
Rutledge, Miss J. E.
Sizer, J. W. C.
Smith, Mrs. D. E. S.
Williams, R. W. H.

ENGLAND, SOUTH-EAST CONSERVANCY

"Danesfield,"
Grange Road,
Woking.
Telephone: Woking 61071

CONSERVATOR: R. H. Smith

DIVISIONAL OFFICER: Dixon, E. E.; Stocks, J. B.

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DISTRICT OFFICER II: Cuthbert, A. A.; Dickenson, M. E. S. (Chichester); Dinning, M. (Uckfield); Gradwell, J. W. (Estate); Harrison, J. C. (Ashford); Kipling, T. H. (Ashford); Massey, J. E. (Guildford)

SENIOR EXECUTIVE OFFICER: Gulliver, H. W.

CONSERVANCY MECHANICAL ENGINEER: Crawford, P. C. R. (T.W.G.I)

CIVIL ENGINEERING ASSISTANT: White-Cooper, R. R. T.

DRAUGHTSMAN (CART.): Taylor, Mrs. G. M.; Bichard, Miss J.

HEAD FORESTER: Brook, J. W. (Slindon); Cross, L. G. F. (Bramshill); Davies, D. J. (Hemsted); King, B. H. (Hursley).

FORESTER

Arnott, W. (Andover)
Awbery, P. P. (Queen Elizabeth)
Barden, J. T. (St. Leonards)
Barling, F. C. (Vinehall)
Bashall, J. R. C. (Friston)
Batt, C. J. (Gravetye)
Bayston, P. W. R. (Bedgebury)
Bignell, R. A. (Rogate)
Brinsley, D. A. (Alice Holt)
Budgen, E. (Micheldever)
Cale, G. F. (Queen Elizabeth)
Catchpole, R. A. (Orlestone)
Cooper, J. (Slindon)
Cooper, J. H. (Bedgebury)
Cordery, E. B. (Badbury)
Davies, W. J. (Challock)
Davy, J. H. (Rogate)
Devine, R. (Maresfield)
Dineen, P. J. (Bramshill)
Drake, F. H. (Alton)
England, W. J. H. (Bedgebury)
Francis, R. E. (Chiddingfold)
Freeth, A. J. (St. Leonards)
Fulcher, D. E. (Friston)
Griggs, B. (Hursley)
Harvey, D. R. (Rogate)
Henderson, J. R. (Brightling)
Howell, W. R. (Challock)
Hyslop, R. M. (Uckfield)
Langford, D. M. F. (Abinger)
McNamara, N. A. G. (Bramshill)
Marples, D. (Slindon)
Meek, W. T. (Challock)
Middleton, W. F. C. (Arundel)
Moseley, J. (Bedgebury)
Newland, R. L. (Bramshill)
Parnall, D. L. (Orlestone)
Percy, D. M. (Hursley)
Rickards, S. W. (Slindon)
Robinson, D. A. (Hursley)
Smith, H. J. (Shipbourne)
Spiller, G. D. (Challock)
Sutton, B. E. (Chiddingfold)
Trodd, K. H. C. (Micheldever)
Usher, F. (Huvant)
Vickery, F. J. (Mildmay)
Wainwright, K. (Vinehall)
Walker, I. (Maresfield)
Watkinson, R. F. V. (Bucklebury)
Watts, F. C. (Bere)
Wood, I. E. (Chiddingfold)
Woods, W. (Micheldever)

ASSISTANT FORESTER

Ballard, B. H. (Queen Elizabeth)
Choules, C. (Andover)
Cooper, P. L. (Bucklebury)
Davis, D. E. (Alton)
Davys, J. P. (Chiddingfold)
Dickinson, J. (Bramshill)
Green, G. G. (Alice Holt)
Hinds, C. H. (Shipbourne)
Hoblyn, R. A. (Alice Holt)
Hunt, P. B. (Brightling)
Kennard, J. T. (Arundel)
Lawes, R. F. (Bere)
Monk, R. F. (St. Leonards)
Pearce, P. H. (Micheldever)
Perkins, R. M. (Mildmay)
Ralph, P. W. (Mildmay)
Seddon, T. R. T. (Abinger)
Tyers, J. D. A. (Brightling)
Vines, R. C. B. (Challock)

HIGHER EXECUTIVE OFFICER: Carter, L. W.; Carvosso, L. A.

EXECUTIVE OFFICER: Fleming, E.; Godfrey, Mrs. D. M.; Hockaday, O. C.; Pearson, W. E.; Powell, E. S.; Rance, K. A. E.

CLERICAL OFFICER

Barr, W. S.
Carter, J. E.
Cobbett, F. J.
Crowe, G. W.
Dawson, R. O.
Deal, Miss L.
Draper, F. A.
Gardner, Miss C. M.
Gathercole, M. J.
Gibbs, Miss H. R. M.
Gillanders, Miss C.
Harris, Miss P.
Jennings, Miss J. F.
Johnson, Miss E. J.
Jones, Miss M. J.
Norton, Miss G. R.
Osman, F. F. J.
Root, M. J.
Smith, Miss H. J.
Squires, T. F.

ENGLAND, SOUTH-WEST CONSERVANCY

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Brislington,
Bristol, 4.
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CONSERVATOR: C. A. Connell, O.B.E.

DIVISIONAL OFFICER: Penistan, M. J.; Rouse, G. D.

DISTRICT OFFICER I: Banister, N. (Taunton); Carnell, R.; Hughes, B. D. (Bodmin); Keen, J. E. A.; MacIver, I. F. (Barnstaple); Moir, D. D. (Estate); Rogers, S. W. (Exeter); White, A. H. H. (Estate); White, J. (Salisbury)

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SENIOR EXECUTIVE OFFICER: Coote, R.

CONSERVANCY ENGINEER: Perkins, J. S. (T.W.G.B.)

CONSERVANCY MECHANICAL ENGINEER: Inglis, E. J. (T.W.G.I.)

AREA CIVIL ENGINEER: Allright, J. C. (T.W.G.I.) (Taunton); Williams, E. L. (W.G.B.G.) (Bodmin)

SUPERINDENTENT OF WORKS: Inglis, R. E. (T.W.G.III) (Exeter); Lang, A. S. (T.W.G.III) (Halwill)

CLERK OF WORKS (ESTATE): Boundy, L. D. (T.W.G.III) (Exeter)

CIVIL ENGINEERING ASSISTANT: Payne, K. W.; Williams, J. C.

DRAUGHTSMAN (CART.): Moore, R.; Powell, R. W.

HEAD FORESTER

Beasley, G. F. (Halwill)
Bruce, J. M. (Exeter)
Cameron, A. H. (Bodmin)
Gunter, A. T. G. (Hereford)
Lewis, C. J. (Savernake)
Linder, R.
Parsons, F. F. G. (Wareham)

FORESTER

Barber, E. G. (Charmouth)
Barton, E. N. (Quantock)
Beard, A. C. (Dymock)
Bowdler, T. C. (Exeter)
Bowman, P. (Bodmin)
Braine, R. G. (Dartmoor)
Bultitude, R. (Molton Woods)
Clarke, H. F. (Pershore)
Coles, L. H. (Savernake)
Cox, D. J. (Cranborne Chase)
Deal, W. (Hartland)
Everitt, E. C. W. (Cotswold)
Fife, R. G. (Okehampton)
Fox, F. G. (Wyre)
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Green, W. J. (Blandford)
Hendrie, J. A. (Wareham)
Hibberd, E. C. (Neroche)
Hockaday, C. (Land's End)
Humphrey, A. W. (Exeter)
Humphries, W. J. (Salisbury)
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Jenkinson, G. A. (Quantock)
Judge, J. N. (Bristol)
King, R. J. (Savernake)
Lewis, W. P. (Poorstock)
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Mills, E. W. (Savernake)
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Sherrell, D. A. (Mendip)
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Stott, W. S. (Honiton)
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Walsh, J. E. (Halwill)
Walton, R. (Wareham)
Whale, R. S. (Plym)
Williams, L. H. (Bovey)
Wills, K. G. (Bradon)
Wilson, M. J. (Dorchester)
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ASSISTANT FORESTER

Anderson, J. E. (Dymock)
Ayers, D. (Savernake)
Bibby, W. B. (Hereford)
Budden, R. C. (Poorstock)
Carter, D. E. (Exeter)
Chalmers, J. G. (Dartmoor)
Devine, T. D. (Halwill)
Edwards, B. F. (Neroche)
Fruen, C. R. (Mendip)
Grenfell, R. G. P. (Molton Woods)
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Houghton, M. A. (Hartland)
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Trotter, W. (Dartmoor)
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Webb, P. J. (Hartland)
Yearsley, D. E. (Brendon)

HIGHER EXECUTIVE OFFICER: Chapman, W. L.; Rendle, R.

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Adams, Miss L. A. R.
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Durn, Miss W. M.
Edmondson, Miss D. M.
Foote, C. E.
Gibbs, Miss S. M. E.
Goddard, J. H.
Hale, E. W.
Hammond, N.
Hobbs, A. G. C.
Kerr, A.
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Lloyd, L. H.
Marsh, Miss J. A.
Milsom, Mrs. B. M.
Owen, Miss J. A.
Stevens, A.
Stone, G.
Watts, L. G.
Young, G. B.

FORESTER

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Barling, F. C. (Vinehall)
Bashall, J. R. C. (Friston)
Batt, C. J. (Gravetye)
Bayston, P. W. R. (Bedgebury)
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Cooper, J. H. (Bedgebury)
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Davies, W. J. (Challock)
Davy, J. H. (Rogate)
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Dineen, P. J. (Bramshill)
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Francis, R. E. (Chiddingfold)
Freeth, A. J. (St. Leonards)
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Griggs, B. (Hursley)
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Marples, D. (Slindon)
Meek, W. T. (Challock)
Middleton, W. F. C. (Arundel)
Moseley, J. (Bedgebury)
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Parnall, D. L. (Orlestone)
Percy, D. M. (Hursley)
Rickards, S. W. (Slindon)
Robinson, D. A. (Hursley)
Smith, H. J. (Shipbourne)
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Usher, F. (Havant)
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Wainwright, K. (Vinehall)
Walker, I. (Maresfield)
Watkinson, R. F. V. (Bucklebury)
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CIVIL ENGINEERING ASSISTANT: Allingham, J. (Fort Augustus); Cartlidge, R. G. (Dingwall); Mackintosh, D. J. (Fort William); Newton, B. E.; Robertson, G. D. (Fort William); Urquhart, T. D.

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CONSERVANCY MECHANICAL ENGINEER: Swinyard, H. W. J. (T.W.G.I).

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FORESTER

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Aitken, R. G. (Rosarie)
Allan, J. (Edensmuir)
Anderson, M. (Culbin)
Anderson, W. B. (Newton)
Armstrong, P. (Clashindarroch)
Biggar, A. W. (Elchies)
Christie, J. H. (Aultmore)
Davidson, A. L. (Kirkhill)
Douglas, W. S. (Whitehaugh)
Main-Ellen, R. (Blairadam)
Elliott, D. M. (Speymouth)
Ewen, B. A. (Bennachie)
Fraser, J. R. (Newtyle)
Gordon, W. J. (Blackhall)
Grigor, E. (Glenisla)
Guild, J. (Montreathmont)
Harwood, A. E. (Edensmuir)
Hepburn, N. R. (Hallyburton)
Innes, G. C. (Midmar)
Johnstone, W. (Glendoll)
Jolly, J. M. (Glenerrochty)
Kemp, W. Y. (Cushnie)
Kingham, H. A. (Monaughty)
McBain, G. L. (Fetteresso)
McConnachie, K. (Glenlivet)
McIntosh, W. J. (Tornashean)
McLean, J. P. (Ledmore)
McLeod, E. (Roseisle)
MacMillan, T. W. (Drumtochty)
MacPhee, H. A. (Drummondhill)
Marnoch, D. M. (Alltcailleach)
Masson, V. (Kemnay)
Maxtone, J. R. (Pitmedden)
Murray, G. M. W. (Blackcraig)
Reid, J. G. M. (Fochabers—Private Woodlands)
Reid, J. K. (Fonab)
Russell, J. C. (Kinfauns)
Scaife, C. L. (Lossie)
Seaton, J. A. (Teindland)
Skene, W. F. (Delgaty)
Stewart, G. (Tool Instructor)
Stewart, S. W. R. (Keillour)
Stuart, P. (Pitfichie)
Thomson, R. B. (Tentsmuir)
Thow, G. B. (Inglismaldie)
Thow, J. B. (Forest of Deer)
Watt, W. J. (Allean)
Webster, J. O. (Blackhall)

ASSISTANT FORESTER

Anderson, D. F. (Glenerrochty)
Bain, J. (Tentsmuir)
Bowie, A. G. (Bin)
Cotton, D. (Clashindarroch)
Findlay, J. C. (Durris)
Foggo, B. L. (Speymouth)
Fraser, D. (Blairadam)
Gale, A. W. (Forest of Deer)
Gordon, A. N. (Blackhall)
Kinnes, A. G. (Rannoch)
Lindsay, J. D. (Rannoch)
MacCallum, L. C. (Bin)
MacDonald, A. M. (Drummondhill)
Menzies, J. D. (Rannoch)
Priestley, P. (Blackcraig)
Rose, J. (Alltcailleach)
Salmean, C. (Glendevon)
Stewart, W. B. (Pitfichie)
Thirde, G. S. (Drumtochty)
Tracy, C. R. (Craigvinean)
White, P. A. (Clashindarroch)

FOREMAN: Anderson, S. C. (Keillour); Grant, A. M. (Elchies); McCann, W. G. (Drummondhill); Soppitt, J. (Montreathmont)

HIGHER EXECUTIVE OFFICER: Edward, C.; Simmonds, C. W.

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Benton, A. C.
Catto, Miss F. E.
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Donnelly, M.
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Hall, W. R. G.
Hamilton, N. M.
Newnham, F. B.
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Sinclair, A.
Stephen, J. S. J.
Thain, H. B.
Wood, R. E.

SCOTLAND, SOUTH CONSERVANCY

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CONSERVATOR: J. A. B. Macdonald, O.B.E.

DIVISIONAL OFFICER: Donald, R. R., M.B.E.; Fossey, R. E.; Gibson, W. N.

DISTRICT OFFICER I: Brown, N. M. (Peebles); Campbell, D. Graham- (Dalry); Findlay, T. S. L. (Estates) (Creebridge); Johnson, W. A. J. (Estates); Long, M. C. (Moffat); McNab, J. D. (Creebridge); Stirling, J. (Moffat); Williams, M. R. W. (Jedburgh).

DISTRICT OFFICER II: Cram, A. R. (Peebles); Fergusson, W. S. (Girvan); Forbes, D. F. C. (Dalbeattie); Robertson, S. U. (Moffat); Steel, R. P. (Longniddry); Whitaker, J. D. (Creebridge); Portlock, E. S. (Estates).

SENIOR EXECUTIVE OFFICER: Farmer, T., M.B.E.

CONSERVANCY ENGINEER: Walker, P. H. F. (W.G.M.G.).

AREA CIVIL ENGINEER: Clarkson, W. H. (T.W.G.I); Drummond, R. W. (W.G.B.G.) (Dalry).

CONSERVATIVE MECHANICAL ENGINEER: Hart, A. E. (T.W.G.I).

SUPERINTENDENT OF WORKS: Cowperthwaite, F. T. (T.W.G.II) (Dalry); Crossan, G. W. (T.W.G.III) (Castle O'er); MacLaughlan, A. M. (T.W.G. III) (Jedburgh); Smith, W. B. (T.W.G.II) (Girvan).

SENIOR CLERK OF WORKS (ESTATE): Johnston, F. J. (T.W.G.II) (Estates);

LEADING CIVIL ENGINEERING ASSISTANT: Welding, R. A. (Creebridge).

CIVIL ENGINEERING ASSISTANT: Irvine, J. (Moffat); McMillan, J. G.; Thomson, A. (Dalry).

DRAUGHTSMAN (CART.): Sutherland, J. W.

HEAD FORESTER

Armstrong, H. O. (T/P) (Bareagle)
Cameron, D. M. (Dundeugh)
Hunter, J. (Greskine)
Irving, R. H. (Newcastleton)
Jamieson, R. A. (Forest of Ae)
Mackay, W. H. (Fleet)
McNicol, F. (Wauchope)
MacRae, A. D. (Glentrool)
Parley, C. W. (Cairn Edward)
Watson, J. (Dalbeattie)

FORESTER

Amer, D. J. (Glentrool)
Bagnall, J. A. (Forest of Ae)
Bagot, W. (Clangue)
Broll, J. L. (Yair Hill)
Brookes, C. (Cairn Edward)
Campbell, D. (Penninghame)
Carruthers, J. (Fleet)
Carruthers, M. F. (Elibank & Traquair)
Chisholm, M. R. (Carrick)
Cochrane, A. S. (Dalmacallan)
Cooper, B. (Forest of Ae)
Davidson, J. R. (Duns)
Drysdale, N. (Carrick)
Duncan, D. (Kirroughtree)
Edward, R. M. (Brownmoor)
Edwards, O. N. (Glengap)
Gallacher, J. M. (Upper Nithsdale)
Gallacher, P. (Cairn Edward)
Goodlet, G. A. (Stenton)
Graham, P. (Carrick)
Gutch, J. H. M. (Newcastleton)
Harkness, J. R. (Castle O'er)
Harland, J. (Wauchope)
Harvey, T. S. (Eddleston Water)
Hogg, J. L. (Kirroughtree)
Hope, T. C. (Fleet)
Kirk, D. M. (Mabie)
Liddell, A. T. (Cardrona)
Lloyd, S. (Laurieston)
McArthur, A. (Dalbeattie)
McClelland, P. W. (Glentrool)
McGeorge, R. (Selm Muir)
McGivern, W. M. (Edgarhope)
McLaren, A. R. (Glentress)
MacMillan, A. M. (Saltoun)
McNaught, D. J. (Arecleogh)
Mowat, P. (Tool Instructor)
Murray, D. M. (Bareagle)
Murray, W. (Auchenroddan)
Nelson, T. (Kilgrammie)
O'Mara, J. P. (Moffat Water)
Park, H. C. B. (Glentrool)
Parker, J. (Glentrool)
Parkinson, J. W. (Castle O'er)
Pearce, J. S. (Cairn Edward)
Rae, W. R. (Glenbreck)
Robertson, D. (Kilsture)
Scott, J. F. (Craik)
Semple, W. K. L. (Garraries)
Slater, J. (Forest of Ae)
Swan, R. (Watermeetings)
Taylor, J. W. (Penninghame)
Thomas, A. F. (Garcrogo)
Thomson, A. (Dalbeattie)
Thomson, J. (Kyle)
Towns, K. W. (Clydesdale)
Urquhart, G. (Dreva)
Watson, A. W. (Glentrool)
Waugh, D. E. (Wauchope)
Weir, A. H. (Elibank & Traquair)
Wood, R. A. L. (Mabie)

ASSISTANT FORESTER

Anderson, J. C. (Newcastleton)
Bryson, J. L. (Dalbeattie)
Burgess, W. (Mabie)
Cooper, J. A. M. (Glentrool)
Dewey, P. R. (Glentress)
Dinsdale, E. (Wauchope)
Fligg, P. (Carrick)
Gough, T. (Laurieston)
Grieve, W. J. (Fleet)
Hibberd, B. G. (Greskine)
Highley, P. J. (Changue)
Innes, J. S. (Upper Nithsdale)
Johnston, K. H. (Craik)
Jordan, R. D. (Corriedoo)
Livingstone, J. (Carrick)
McBurnie, A. N. (Tool Instructor)
McIntyre, C. (Dundeugh)
MacKenzie, P. (Cairn Edward)
Marshall, A. H. (Garraries)
Maxwell, N. (Cairn Edward)
Paterson, W. G. (Forest of Ae)
Pickthall, H. M. (Cairn Edward)
Rainey, T. L. (Forest of Ae)
Ramsay, K. J. (Carrick)
Reid, J. M. (Arecleoch)
Robinson, W. I. (Greskine)
Schneider, H. (Kirroughtree)
Thomson, W. (Dalmacallan)
Walsham, J. A. (Bareagle)
Waters, D. C. W. (Castle O'er)
Waugh, G. (Glentress)

HIGHER EXECUTIVE OFFICER: Burnett, A. G.; Cowan, A. A.

EXECUTIVE OFFICER: Byth, J. G.; Gordon, W. D.; Jackson, G. K.; Laidlaw, J. C.; Morley, G. J.; Stewart, R. B.

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Anderson, J.
Belshaw, F. J.
Carrick, R. R.
Caven, S.
Connell, D. A.
Dixon, S. B.
Grieve, P.
Laidlaw, I.
Lobban, R.
Low, Miss E. J.
McGaw, Miss E.
McLean, R. C.
McSorley, J. F.
Martin, J. F.
Martindale, T.
Maxwell, J. R.
O'Brien, Miss T. M.
Rae, A. L.
Struthers, B. H.
Thomson, S. B.

SCOTLAND, WEST CONSERVANCY

20 Renfrew Street,
Glasgow, C.2
Telephone: Douglas 7261–4.

CONSERVATOR: J. W. L. Zehetmayr, V.R.D.

DIVISIONAL OFFICER: Davies, E. J. M.; Robbie, T. A.

DISTRICT OFFICER I: Cassels, K. A. H. (Estate, Benmore); Forrester, S. (Cairnbaan); Gillespie, I. (Cairnbaan); Goodlet, J. A. (Benmore); Gwynn, J. M. (Estate, Cairnbaan); Haldane, W. D. (Barcaldine); Macnair, A. S. (Aberfoyle); Murray, G. K.; Stewart, I. J.; Sutherland, W. B. (Benmore); Thomson, W. P. (Stirling); Townsend, K. N. V. (Knapdale).

DISTRICT OFFICER II: Bramwell, A. G. (Benmore); Huntley, J. H. (Stirling); Illingworth, R. P. (Estate, Aberfoyle); Low, A. J. (Cairnbaan).

SENIOR EXECUTIVE OFFICER: Wharam, J. B.

CONSERVANCY ENGINEER: Halliday, J. (W.G.M.G.).

ASSISTANT ENGINEER (MECH.) Atkins, F. C. (T.W.G.I).

AREA CIVIL ENGINEER: Bennett, D. (T.W.G.I) (Benmore); Hovle, H. N. (T.W.G.I) (Barcaldine); Ruthven, G. (T.W.G.I) (Cairnbaan); Stark, W. (T.W.G.I) (Aberfoyle).

SUPERINTENDENT OF WORKS: Dalgleish, T. (T.W.G.II) (Benmore); MacLeod, J. A. (T.W.G.III) (Barcaldine); Pritchard, R. W. (T.W.G.III) (Glenduror); Ross, J. G. M. (T.W.G.III) (Aberfoyle); Shepherd, F. A. (T.W.G.III) (Cairnbaan).

SENIOR CLERK OF WORKS ESTATE: MacKellar, D. L. (T.W.G.II) (Cairnbaan); McLay, J. D. (T.W.G.II); (Aberfoyle).

CLERK OF WORKS (ESTATE): McClory, J. (T.W.G.III) (Benmore); MacDougall, H. (T.W.G.III) (Barcaldine).

LEADING CIVIL ENGINEERING ASSISTANT: Holden, J. (Cairnbaan); Nisbet, J. D.

CIVIL ENGINEERING ASSISTANT: Turnbull, I. McL. W. (Cairnbaan); Underwood, M. A. (Benmore); Watson, R. (Barcaldine).

DRAUGHTSMAN (CART.): Watson, J. A.

HEAD FORESTER

Angus, R. S. (Ardgartan)
Cameron, A. (Strathyre)
Fairbairn, W. (Devilla)
Jackson, J. (Benmore)
Law, H. G. (Loch Ard)
Mackay, A. (Barcaldine)
McKenzie, I. H. M. (Inverliever)
Mackinnon, H. (Knapdale)
MacRae, D. J. (Glenbranter)
Murray, R. G. (Glenfinart)

FORESTER

Allan, J. S. (Barcaldine)
Barker, G. J. (Loch Ard)
Beaton, K. A. (Torrie)
Black, D. F. D. (Garadhban)
Blake, G. W. (Ardgartan)
Cairns, J. M. (Loch Ard)
Campbell, J. A. (Knapdale)
Campbell, M. M. (Barcaldine)
Campbell, W. W. (Loch Ard)
Cowie, F. R. (Loch Ard)
Cramb, J. (Glenduror, Ballachulish)
Cruickshank, A. (Inverliever)
Cunningham, A. J. (Corlarach)
Dye, W. E. (Asknish)
Francey, G. S. (Ardgartan)
Fraser, T. S. (Rowardennan)
Gillies, A. (Strathlachlan)
Hamilton, J. (Lennox)
Hart, C. W. (Glenduror)
Harvey, R. (Carron Valley)
Johnston, C. R. (Inverliever)
Keiller, W. C. (Garshelloch)
Lawson, D. W. (Tulliallan)
McCallum, D. (Achaglachgach)
MacCaskill, D. A. (Inverinan)
McDonald, M. K. (Devilla)
McFadyen, D. (Inverliever)
McGavin, J. M. (Ardfin)
McGeachy, R. H. (Glenbranter)
MacGregor, D. R. (Garelochhead)
Mackay, D. J. (Asknish)
McKeand, J. W. (Devilla)
Mackenzie, J. S. (Benmore)
McLarty, H. C. (St. Fillans)
McLaughlin, R. S. (Loch Ard)
MacLean, A. (Kilmichael)
McLean, R. (Kilmory)
McMillan, J. (Minard)
MacNicol, I. (Fearnoch)
MacPhee, C. J. (Strathyre)
McRorie, J. P. (Strathyre)
Martin, W. C. (Creran)
Mitchell, R. F. (Leapmoor)
Morrison, A. (Inverliever)
Morrison, I. (Carradale)
Morrison, N. (Glenrickard)
Munro, D. (Carradale)
Oliphant, R. (Glenfinart)
Polwart, A. (Glendarvel)
Proudfoot, L. O. (Glendochart)
Robertson, D. A. (Loch Ard)
Robertson, N. (Tighnabruaich)
Rodger, J. H. (Loch Etive)
Ross, D. H. (Carron Valley)
Ross, I. (Kilmichael)
Simpson, A. A. C. (Carradale)
Sinclair, L. (Glenduror)
Smellie, A. (Cumbernauld)
Solway, D. F. (Glenfinart)
Stout, H. C. (Knapdale)
Stuart, A. M. (Loch Eck)
Young, A. (South Kintyre)

ASSISTANT FORESTER

Barker, E. K. (Inverliever)
Beaton, J. M. C. (Loch Ard)
Caird, D. G. (Glenrickard)
Campbell, D. (Loch Ard)
Campbell, D. McL. (Knapdale)
Craig, J. M. (Ardgartan)
Crawford, W. (Achaglachgach)
Delap, P. (Ardgartan)
Douglas, D. A. T. (Garadhban)
Fergusson, P. D. (Saddell)
Fraser, J. M. (Devilla)
Graham, H. (Kilmichael)
Heddon, G. S. (Glenduror, Ballachulish)
Henderson, W. (Loch Ard)
Livingston, J. (Glenrickard)
Lyon, J. H. M. (Barcaldine)
Lyons, D. J. (South Kintyre)
McCallum, D. F. (Whitelee)
McDonald, W. (Inverliever)
MacDuff, R. J. A. (Inverinan)
Macintosh, A. (Rowardennan)
McKell, N. (Benmore)
Macleod, N. (Cairnbaan)
Main, D. (Inverinan)
Mason, W. A. (Garelochhead)
Maule, S. G. (Glenbranter)
Murray, J. T. H. (Glenbranter)
Murray, R. A. (Glenduror Ballachulish)
Pollock, I. (Minard)
Rae, G. W. (Glenrickard)
Ratcliffe, P. R. (Inverinan)
Reid, I. L. (Knapdale)
Robertson, J. B. (Loch Ard)
Robertson, K. (Loch Eck)
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Seniscal, B. (St. Fillans)
Shaw, M. (Strathyre)
Sinclair, D. (Dalmally)
Smith, A. K. (Strathyre)
Turner, A. S. (Cairnbaan)

FOREMAN: McEachern, J. (Kilennan); Rose, W. (Strathyre).

HIGHER EXECUTIVE OFFICER: Ettles, W.; Hogarth, J.

EXECUTIVE OFFICER: Brunton, I. A.; Clelland, Mrs. I. M.; Griffin, J.; Liddell, A. Macniven, Miss B. B.; Millar, J.

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Cullum, Mrs. M. C.
Gordon, G. M.
Gordon, J. T.
Hodgins, Mrs. R. M. M.
Hughes, J. T.
Irving, L. T.
Law, J. C.
Logan, Miss D. A.
McAllister, G. B.
MacDonald, N. M.
McGregor, Miss L. K.
McMillan, Miss E. W.
O'Hara, J. C.
Ritchie, Miss H. K.
Stewart, Miss B.
Traynor, Miss A. T.
Urquhart, Mrs. E. S. M.

DIRECTORATE FOR WALES

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Victoria Terrace,
Aberystwyth.
Telephone: Aberystwyth 2367

DIRECTOR:	J. Q. Williamson, M.B.E.
CONSERVATOR:	L. H. Williams
DIVISIONAL OFFICER:	Drummond, R. O., M.B.E.
CHIEF EXECUTIVE OFFICER:	Taylor, G. F.
DISTRICT OFFICER I:	Flynn, A. E. G. (Estates); Smith, W. A. Lindsay- (Shrewsbury); Teasdale, J. B. (Cardiff).
DISTRICT OFFICER II:	Guile, A. W. L.
DIRECTORATE ENGINEER:	MacMahon, C. D. (W.G.Sen.G.).
ASSISTANT ENGINEER (CIVIL):	Coleman, J. E. (W.G.B.G.).
DRAUGHTSMAN (HIGHER GRADE):	Bryan, F.
DRAUGHTSMAN (CART.):	Little, M. H.
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EXECUTIVE OFFICER:	Butt, A. A.; Fisher, D. C.; Hunt, T. G.; Jones, S. H.; Lipscombe, A. E.; Owen, E. G.; Trew, C. I.
CLERICAL OFFICER:	Brown, Miss M.; Davies, Miss P. E.; Jones, Mrs. H. M.; Morris, C. E.; Pope, H. J.; Rees, Miss J. E. H.; Rogerson, T. A.; Watkins, W.

WALES, NORTH CONSERVANCY

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CONSERVATOR:	F. C. Best, O.B.E.
DIVISIONAL OFFICER:	Hampson, J. R., D.F.C.; Holmes, G. D.; Williams, G. O. (Estates)
DISTRICT OFFICER I:	Keighley, G. D. (Oswestry); Osmaston, J. F. (Dolgellau); Saunders, H. J.; Spencer, J. A. (Ruthin); Stern, R. C. (Machynlleth); Stumbles, R. E. (Llanrindod Wells); Walbank, B. (Llanrwst);
DISTRICT OFFICER II:	Clothier, C. R. G. (Estate); Cumberland, J. (Oswestry); Grabasky, B. P. (Estates); Henderson, J. W. (Llanrindod Wells); Hughes, D. M. (Bangor); Peal, J. (Dolgellau); Scott, T. M. (Ruthin); Thompson, T. S. (Aberystwyth); Wallace, D. H. (Aberystwyth)
SENIOR EXECUTIVE OFFICER:	Mayhew, K.
CONSERVANCY ENGINEER:	Swanson, R. P. (W.G.M.G.)
CONSERVANCY MECHANICAL ENGINEER:	Low, W. L. (T.W.G.I.)
AREA CIVIL ENGINEER:	Baylis, D. O. (T.W.G.I) (Aberystwyth); Egerton, F. C. (T.W.G.I) (Llanrwst); Jameson, V. O. (W.G.B.G.); Thomas, P. A. (W.G.B.G.) (Dolgellau)

SUPERINTENDENT OF WORKS: Dummet, E. J. (T.W.G.II) (Llanrwst); Eley, E. J. (T.W.G.III) (Ruthin); Gwynne, G., M.B.E. (T.W.G.III) (Dolgellau); Redford, H. (T.W.G. II) (Kerry); Whiteford, G. (T.W.G. III) (Aberystwyth)

CLERK OF WORKS (ESTATE): Bush, E. J. (T.W.G.III) (Aberystwyth); Ellis, T. (T.W.G. III) (Machynlleth); Griffiths, W. E. (T.W.G.III) (Llanrwst)

LEADING CIVIL ENGINEERING ASSISTANT: Davies, W. S. (Dolgellau)

CIVIL ENGINEERING ASSISTANT: Bryant, B. J. (Aberystwyth); John, E. E. (Llanrwst); Mawer, M. F. (Dolgellau)

DRAUGHTSMAN (CART.): Michael, J. D. S.

HEAD FORESTER

Davies, A. I. (Clocaenog)
Dick, C. R. (Hafren)
Evans, A. C. W. (Kerry)
Evans, J. E. (Taliesin)
Griffiths, I. L. (Gwydyr)
Heavener, C. H. (Coed y Brenin)
Hughes, J. W. (Dovey Corris)
Jenkins, T. L. (Ystwyth)
Waters, R. W. (Dovey Valley)
Yapp, P. W. C. (Radnor)

FORESTER

Brown, R. I. (Mathrafal)
Butterworth, P. (Radnor)
Carter, T. A. (Gwydyr)
Daniel, C. E. (Ystwyth)
Davenport, J. B. (Coed y Brenin)
Davies, C. C. (Radnor)
Davies, D. D. G. (Dovey Valley)
Davies, P. G. (Elwy)
Davies, R. D. (Coed y Brenin)
Edwards, R. (Coed y Brenin)
Evans, J. F. (Lleyn)
Farrelly, F. (Clwyd)
Gardner, E. C. C. (Clocaenog)
Griffiths, C. (Coed Sarnau)
Griffiths, E. (Beddgelert)
Griffiths, O. G. (Coed y Brenin)
Griffiths, R. W. (Mon Newborough)
Hamilton, J. P. (Dyfnant)
Harrison, P. G. (Penllyn)
Hindle, H. J. (Hafren)
Hopkins, C. J.
Hughes, A. (Dyfnant)
Hughes, L. E. (Gwydyr)
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