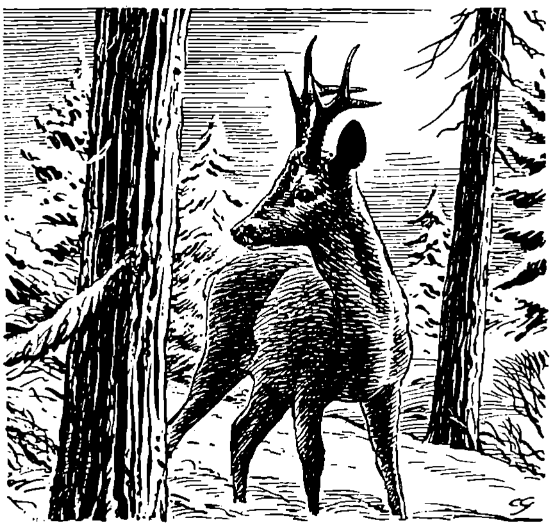
JOURNAL OF THE FORESTRY COMMISSION

No. 36 : 1968-69



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Continued on the Inside Back Cover

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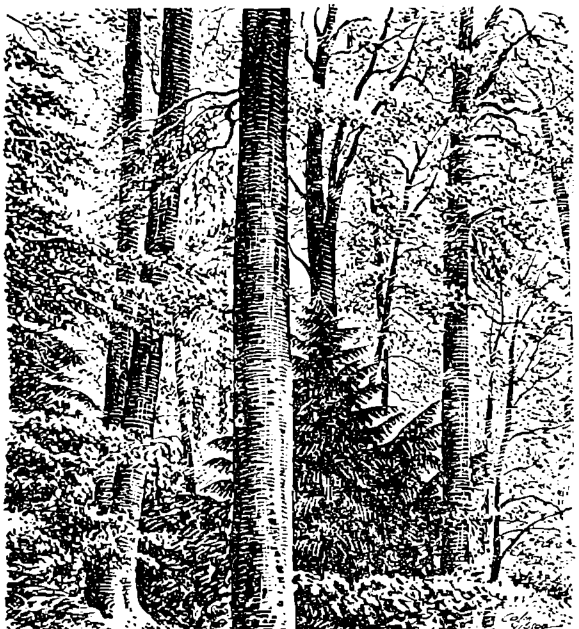

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CONTENTS—*cont.*

ACKNOWLEDGMENTS

We express our thanks to the editors and authors who have kindly allowed the re-use of certain articles.

Photographs

Leyland Motors Ltd., contributed Plate 11, modern tree feller. The photo of the planting gang above Loch Leven is by A. D. S. Macpherson. The two views of motorway planting were kindly provided by the *Wolverhampton Express and Star*. The portrait of girl tree planters at Loch Goil is from the *Scottish Sunday Express*.

Mr. W. O. Wittering took the photo of the cable-car, surprisingly carrying logs, at Marhofen in the Austrian Tirol. Messrs. Danarm Ltd., provided the picture of the giant oak (felled of course with a Danarm chain saw!) crashing to earth near Andover, Hampshire. Messrs. Stenners of Tiverton supplied the view of a giant Californian redwood log, *Sequoia sempervirens*, being sawn-up by a Stenner bandsaw in Devon. The picture of road-making at Charmouth Forest in Dorset is by Roy Harris, while Mr. K. Stott provided the photo of willow-growing on Sedgemoor in Somerset. The remaining six photos are drawn from the Commission's own historical collection at Alice Holt.

Drawings

The Front cover picture and title-page decoration are by Colin Gibson. The back cover picture is by Miss Hazel Turner, a staff photographer at Alice Holt.

Drawings within the text were kindly made available to us by the respective authors, as follows. Sketches illustrating articles by Mr. R. J. Jennings are by Miss Irene Williams, except for the scribe, which is by Ian Hay, and the cartoon "Watch out . . . . . .", which is by Jennings himself.

James Symington and the National Union of Agricultural Workers provided the sawing cartoon, while Mr. E. A. Crofts of North-East England Conservancy depicted "Forest Operations—pre-Mechanisation". Charles Howarth drew the sketches of the prehistoric sawyer and the sad Forest Worker below the mistletoe bough.

JOURNAL OF THE FORESTRY COMMISSION
No. 36, 1968-69

EDITORIAL

Our Last Number

With this, our thirty-sixth issue over a span of fifty years, from 1919 to 1969, the *Journal of the Forestry Commission* ceases publication.

At a recent review of publications policy, the Commissioners decided that the effort its production involves could be applied to better advantage elsewhere. There are two sound reasons for this decision.

First, the topical news of events and staff moves which this *Journal* carried, at the leisurely pace of annual issues, in the past, can be much better handled by our monthly staff magazine, *The Slasher*. This is now being expanded under the editorship of the Chief Information Officer, Lt. Col. D. B. Rooke, and will provide a lively successor to this aspect of our departing *Journal*.

Second, the more heavyweight technical articles that made up the bulk of our past issues can no longer be limited in circulation to members of the Commission's own staff. The Commissioners have always aimed to support the private forestry sector and to make the results of their own research and development known to all concerned with its application in the woods. With over one million acres of productive woodlands now covered by grant-aided Dedication Schemes on private estates, there can be no continuing role for any substantial technical journal that is not freely available to landowners, estate agents, forestry consultants and members of the home timber trade.

There are nowadays a number of well-produced and ably-edited independent forestry and timber journals available to everyone, and together these suffice to meet the overall needs for publication and circulation of new knowledge. The Commission's Librarian at Alice Holt, Noel Blatchford, has developed an effective system of referencing for all the published work of our own staff, and the latest papers on any topic can quickly be found. At the same time, our Publications Branch has extended its sphere of work into *Forest Records* and *Research and Development Papers*, which together reproduce much of the material once directed to the *Journal*, with less delay and wider availability to the general forestry public.

When this *Journal* was first conceived, by the late Lord Robinson, away back in 1919, these alternative channels for carrying word of recent developments to our own staff were not available. During its fifty years of active life the *Journal's*, three successive editors, Fraser Story, R. G. Broadwood, and Herbert L. Edlin, have aimed to make it a useful aid to the Commission's efficiency, lightened by the occasional touch of humour and personal reminiscence or appreciation.

Since publication began, the Commission has grown from a struggling new Department with inexperienced staff, few in numbers, to a major concern responsible, taking its own forests and the private estates together, for three million acres of woodlands. Today it is well equipped with the latest technological aids, and staffed with experienced men, skilled in many professional fields. We take this opportunity of thanking all our contributors, over the years, for the part they have played in aiding this remarkable growth.

The Commissioners

Maurice Compton, who was appointed as the first Commissioner for Administration and Finance in 1965, retired in June 1969. He was succeeded by Mr. P. F. R. Beards, who came to us from the Ministry of Defence, but was unfortunately obliged to retire on health grounds.

Andrew Watt, who became our first Commissioner for Forest and Estate Management in July, 1965, retired in November, 1969. Watt had spent all his career in the Forestry Commission or the related war-time Home Timber Production Department, and had previously been Director of Forestry for Scotland and Director of Research.

His successor, George Stewart, joined the Commission after distinguished war service, and after a spell in Research has been our Conservator of Forests for West Scotland.

Mr. Ralph Bruce Verney, D.L., J.P., a leading landowner in Buckinghamshire, who is High Steward of that county and a Past President of the Country Landowners' Association, was appointed a Commissioner in September, 1968.

At the same time Alderman E. Gwynfryn Davies, Major Sir William Strang Steel, Bt., and Lord Taylor of Gryfe were re-appointed.

The Earl of Carlisle retired on completing his term of appointment in the autumn of 1968.

At the close of 1969 the Commission was constituted as follows*:

Mr. Leslie A. W. Jenkins, *Chairman*
Mr. J. A. Dickson, *Deputy Chairman and Director General*
Mr. E. Gwynfryn Davies, J.P.
Dr. F. C. Hummel (*Harvesting and Marketing*)
Major Sir William Strang Steel, Bt.
Lord Taylor of Gryfe
Mr. R. B. Verney, D.L., J.P.
Mr. H. Watkins
Mr. G. Stewart (*Forest and Estate Management*)

Honours

In the New Year Honours List for 1968, Mr. Tom Taylor, who has been a Commissioner since 1960, was made a life peer. Lord Taylor of Gryfe, as he is now known, is President of the Scottish Co-operative Wholesale Society, and has also served on the Glasgow City Council.

Walter Watson, S.E.O. in the office of the Deputy Surveyor, New Forest, became an M.B.E. During his long service in the New Forest, he efficiently dealt with many difficult and intricate problems which arise in the administration of this particular area.

Mr. William Fairburn, Chief Forester at Devilla, was also appointed an M.B.E. Apart from managing the forest with considerable skill he has pioneered heathland nursery techniques.

Mr. Francis James Johnston, Senior Clerk of Works in the South Scotland Conservancy, was awarded the B.E.M. after serving the Commission for 20 years. He played a large part in developing the design of a locally built house which was eventually adopted as a standard model for Foresters in South Scotland.

Mr. Francis Parsons, Chief Forester at Wareham, Dorset, was awarded the M.B.E. Mr. Parsons had been with the Commission 42 years and his outstanding work in fire control resulted in the development of Wareham into a flourishing and valuable forest of some 8,700 acres.

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* In July, 1970, Mr. Jenkins retired and Lord Taylor became Chairman, Mr. P. Nicholls was appointed Commissioner for Administration and Finance in June of the same year.

Also this year, our Director General, Mr. John A. Dickson, was honoured with the degree of Doctor of Laws (LL.D) of Aberdeen University.

The New Year Honours List for 1969 included awards to following members of our staff:

Mr. C. A. J. Barrington, Conservator of Forests for South-East England, who received the O.B.E.

Head Forester A. Rose, of East Scotland Conservancy, well-known for his work on the mechanisation of transplanting at Ledmore Nursery, who was awarded the M.B.E.

In the Birthday Honours for 1969, two of our staff received the well-merited award of the British Empire Medal. They were Mr. H. D. R. Largent, a Production worker at Thetford in East England, and Mr. D. More, Warden of the David Marshall Lodge at Aberfoyle in West Scotland.

We offer our congratulations to Mr. J. A. Dickson, the Director General, on being made a Commander of the Order of the Bath (C.B.) in the New Year's Honours 1970; also to Mr. H. P. Wilbraham, Vice-Chairman of the Forestry Commission Whitley Council, on being awarded the M.B.E.

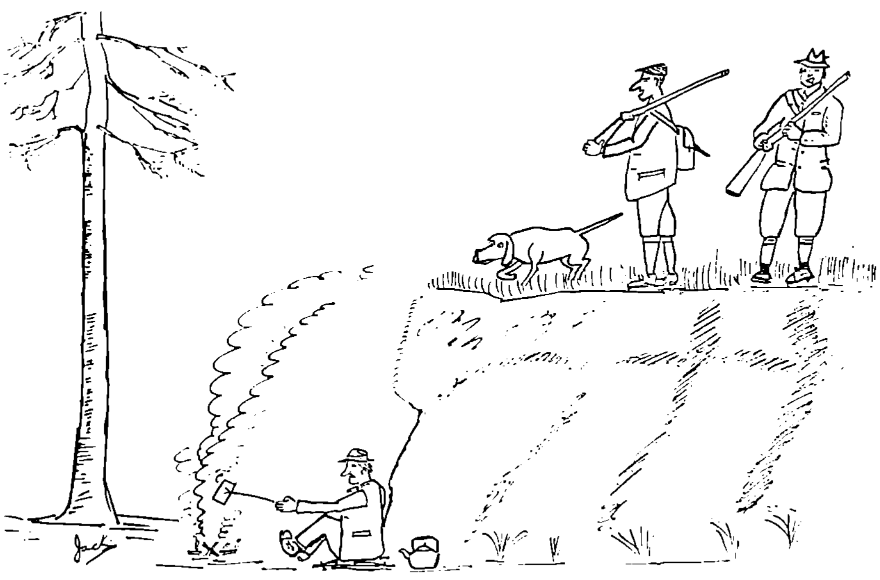
Recent Promotions and Transfers

Our congratulations go to the following people on their promotion to higher positions in our organisation; or transfer to fresh spheres of duty.

David Johnston, who has become Director in charge of Management Services, and is now stationed at Alice Holt.

Brian Holtam, who was promoted to the Conservator grade in June 1968 to become Chief Research Officer, North, at the Commission's new Northern Research Station on the Bush Estate, Edinburgh.

Geoffrey Rouse left the Harvesting and Marketing Division in London in October 1968 to become Conservator of Forests for South West England.



"Watch out! He's on the scent of something!"

Retirements and Departures

During the past two years we have said goodbye to the following senior members of our staff.

James R. Thom, who had been successively Director of Forestry for Wales, England, and Research, resigned in April 1968 to take up a challenging post with the United Nations Food and Agricultural Organisation, in Guyana, South America.

E. M. Conder, Assistant Conservator for Harvesting and Marketing, North East England, resigned in March 1968.

Dennis Healey, the Commission's first Information Officer, and a member of this Journal's Editorial Committee, retired in April 1968.

Others who left us during this period were:

R. G. Sanzen-Baker, Deputy Surveyor of the Dean Forest from 1954 to 1968 and well known for his enthusiastic sponsorship of outdoor recreation; Charles Connell, Conservator for South West England from 1950 to 1968, and previously in charge of the North East England Conservancy; Robin Drummond, Assistant Conservator at Aberystwyth, whose service had included spells of duty in India and Northern Ireland; Arthur Cadman, Deputy Surveyor of the New Forest, who had formerly served in the Welsh Directorate at Aberystwyth; A. M. Petrie, Assistant Conservator in East Scotland, who had also served in Eire, West Scotland and North East England; Walter Watson, Administration and Finance Officer in the New Forest, and an expert on that region's laws and ancient codes.

Peter Garthwaite, Conservator for Forest Management at Headquarters, retired on 6th January, 1970. He had established a reputation for conserving wild life, and promoting Forest Trails, that is sure to endure. Two articles by Peter appear in the Wild-life Section of this issue.

Obituaries

We record with regret the deaths of the following serving or retired members of the Commission's staff:

The Earl of Radnor, our Chairman from 1953 until 1963.

Sir William Ling Taylor, one of the founder members of our Staff, who became Director General in 1947, and served as a Commissioner from 1938 until his retirement in 1949.

Allister Holloway, Forester in the New Forest, in January, 1968, after 33 years service; Arthur Hickleton, S.E.O. at Headquarters, Savile Row, also in January, 1968. W. A. Evans, Head Forester in South Wales, in February, 1968.

A. E. Harwood, Head Forester at Edensmuir, East Scotland until early 1968. R. Macdonald, District Officer at the Faskally Forester Training School, in February, 1969.

J. T. Fitzherbert, Assistant Conservator in South Wales, in February, 1969. J. W. Hughes, Head Forester at Ystwyth Forest in North Wales, early in 1969. A. G. Bowie, Forester at Bin Forest in East Scotland, in June, 1969. J. D. Chisholm, Chief Forester at Kielder, South, in North East England. J. N. Wiblin, Head Forester at Coed-y-Brenin Forest, North Wales.

OUR GOLDEN JUBILEE

The main event was the comprehensive three-day Forestry Exhibition, which was held in the grounds of the Edinburgh Centre for Rural Economy at the Bush Estate, near Edinburgh, in June. Though located in Scotland, the exhibition reflected the Commission's work throughout Britain and a high proportion of the exhibitors came from south of the Border. In all, 36,000 people attended, 32,000 of whom paid for admission, including 10,000 school children.

Among these thousands of visitors the Commission was particularly happy to welcome those from 26 overseas countries, including Professor Steenberg, the recently appointed Director of the Forestry Division of F.A.O. At a reception held in Edinburgh Castle by the Secretary of State for Scotland, Mr. William Ross, Professor Steenberg kindly said that he spoke for all foreign visitors in congratulating the Commission for the excellence of both the exhibition and its 50 years of achievement.

On entering the exhibition, visitors came first to the Commission's exhibit area, in which were illustrated the many different aspects of the work of the Commission as both the managers of the national Forestry Enterprises and as the nation's Forest Authority. These were broken down into tents with the following titles:—*Creating our Forests; Recreation and Wild Life: Research; Production; Into the 1970's; Information*, and *Publications*.

Progression beyond the Commission's area took visitors to that reserved for the private organisations, and others concerned with wild-life conservation and outdoor activities. Among these exhibitors were the forestry societies, private woodland owners, and timber merchants associations and also the Department of Agriculture and Fisheries for Scotland, who demonstrated the potential of multiple land-use for the benefit of forestry, agriculture, recreation and amenity.

The largest area of all was occupied by the 200 commercial exhibitors, all connected either directly or indirectly with Britain's forest industry, who had leased stand space in which to show-off their various products and services; although it was not the intention to stage a civil engineering exhibition, this was said to be the largest of such a character ever to be held in Scotland. Close to this trade area continuous demonstrations of the most advanced techniques of forestry practices took place.

Her Royal Highness Princess Alexandra attended the exhibition on the second day, and showed particular interest in the School Forest Project laid out in a wooded streamside by pupils of Penicuik High School.

A second large forest exhibition took place early in July in Coed Morgannwg Forest near Port Talbot in South Wales. The main exhibits were laid out on grass areas on either side of the main forest road at the highest point of the forest. All aspects of forestry were shown and many demonstrations took place. One exhibit, particularly apposite in this area, showed, on the surface, the uses to which mining timber is put underground.

The exhibition, which ran for a week and attracted 12,000 people, was opened by the Under-Secretary of State for Wales, Mr. Davies, who later planted a tree to commemorate the occasion. He was followed by some 20 other dignitaries so that a permanent glade shall remain to mark the Jubilee.

Throughout Britain the many Conservancy exhibitions and Forest Weeks aroused considerable and encouraging interest from the public and the Press. The Open Days at the Commission's Research establishment at Alice Holt Lodge were very well attended, both by specially invited forestry people and by the general public.

Particularly encouraging was the very good attendance by organised school parties at the great majority of these Jubilee events. Indeed in some Conservancies the demand for visits by schools was so great that arrangements had to be made to accept school parties well after the actual Weeks themselves. In all some 100,000 school-children took part in conducted tours of the forests in 1969.

It seems certain that the public goodwill and understanding of the Commission's roles—and those of all other organisations and concerns represented—resulting from all these activities will endure.

50 YEARS ON —

COMMEMORATIVE TREE PLANTING CEREMONY AT SITE OF FORESTRY COMMISSION'S FIRST PLANTING

The first tree planting by the Forestry Commission took place 50 years ago on December 8th, 1919, at Eggesford Forest, Devon; to commemorate this a planting ceremony took place at this same site on Monday, 8th December, 1969.

The Commission was set up by the Forestry Act which became law on the 19th August, 1919; the Commissioners held their first meeting on 7th December of that year. The late Lord Lovat, who was the Commission's first Chairman, had arranged a formal ceremony for the first planting at Monaughty Forest, Elgin (on the Moray Firth) for the next day. However, Lord Clinton, one of the Commissioners and later Chairman of the Commission, travelled back to Devon overnight where he and a small group planted some natural seedlings in Eggesford Forest in the early hours of the 8th December; Lord Clinton was thus able to send off a telegram for delivery to Lord Lovat as he got off his sleeper at Elgin, telling him that the Commission's first trees had already been planted.

At the ceremony on 8th December, trees were planted by the present Lord Clinton, grandson of the first planter; Mr. Leslie A. W. Jenkins, Chairman of the Forestry Commission; Mrs. Roach, daughter of the late Mr. Tom Brown, who was the original forester of Eggesford Forest; Mr. Fulford, the present Head Forester; Mr. Henry Williamson, the author of such well-known books as *Tarka the Otter* and *Sala the Salmon* who lives near the Forest and was also present at the first planting in 1919, and nine men now employed in the Forest. In all, an area of 3 acres adjacent to the original site were planted. Photos of the first plantation, formed in 1919, appear in Plates 6 and 7 on our centre pages.

Eggesford Forest today extends to 1,207 acres and the trees first planted are ready for felling.

A COUNTRYMAN'S VERSE

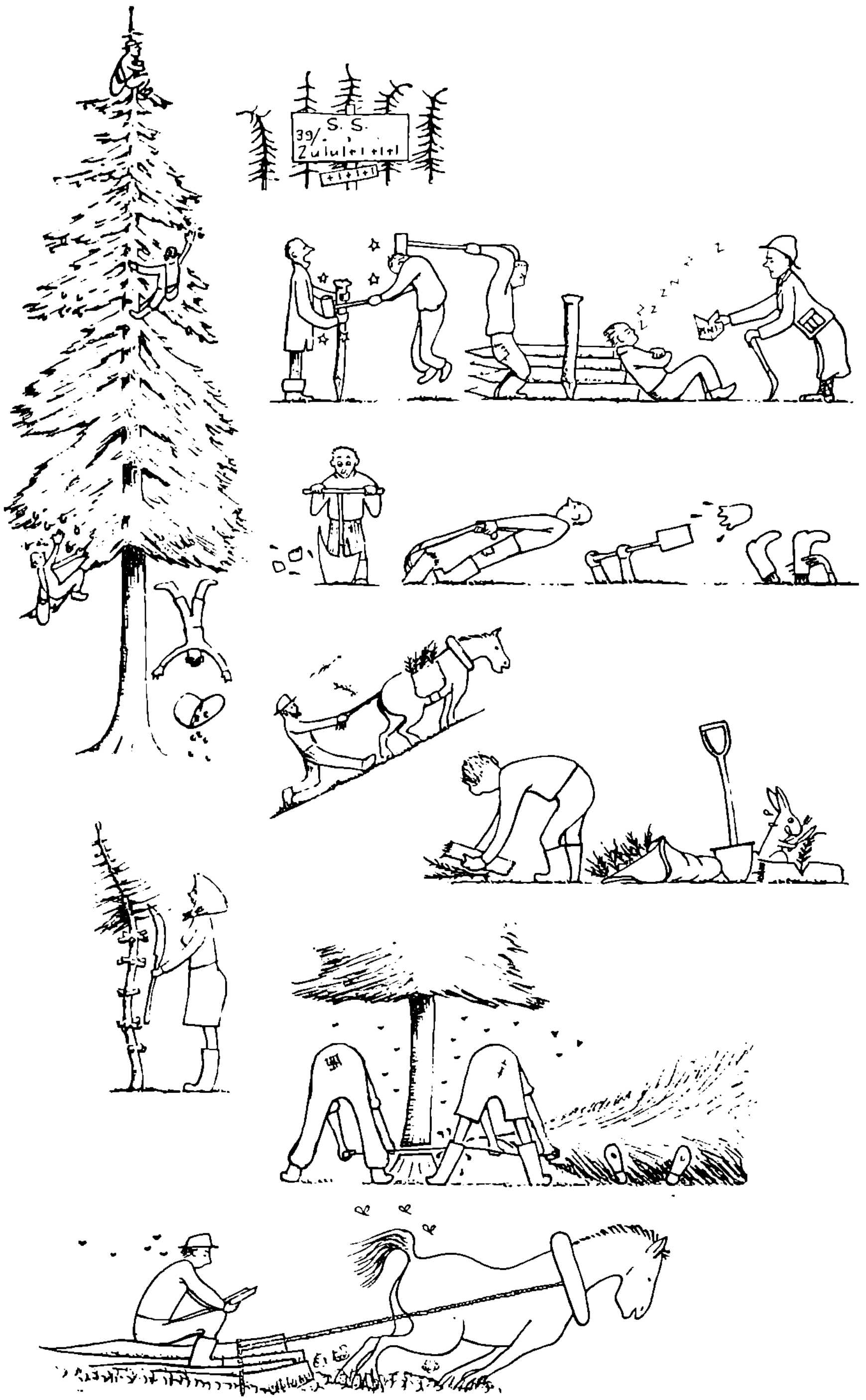
"There's likewise a wind on the heath.
Life is very sweet brother"

George Borrow:—Lavengro

When rooks are cawing in the elms on a bright midsummer day
And foxglove bells and blackberry flowers make field and garden gay
When bees hum in the lime tree groves and moths are on the wing
And in the rivers lakes and streams there's life in everything
When cornfields turn from green to gold and pheasants hatch their brood
Then everyone's a countryman for life is pretty good.

When autumn scents lie in the air and bracken growth is dead
And hawthorn bushes in the hedge are coloured vivid red
When fairy rings grow in the grass and willows round the ponds
Wear skirts of grey surrounded by a mat of copper bronze
When blue tits whisper in the pines and owls hoot in the wood
It's fine to be a countryman and life is pretty good.

When winter comes and days are short and the sun is seldom seen
The ground is hard with hoar frost and the north-east wind is keen
When thrushes strip the berries from the yew tree on the hill
And woodland paths are deep in mud and ears and fingers chill
Dame Nature shows intolerance, she's in a sullen mood
For countrymen the going's hard and life is *not* so good.



Forest operations — pre-mechanisation

When in the spring the earth is warm as sunshine follows rain
Just like the seasons and the wind Dame Nature's mood will change
Then daisies and anemones will star the banks with white
And fern owls sing their mystic tune out on the heath each night
Dame Nature's passions and her moods are clearly understood
By all true countrymen who think their life is pretty good.

R. J. JENNINGS

HOW SPRUCE WAS MY SITKA!

Most reference books describe "Sitka", which gives its name to our most widely-planted tree—the Sitka spruce, *Picea sitchensis*, as "a small fishing port on the coast of Alaska". This is true enough, but the town has also a place in world history.

In 1804 the Russians, pushing eastwards from Siberia, decided to make Sitka the capital of their new American empire. Alexander Baranov sent an expedition to capture it from the native inhabitants, the Tlingit Indians. These Indians built a stockade and kept the Russians at bay for six days—then ran out of gunpowder and slipped away at night. The Tsars ruled Sitka for 63 years, and in 1819 built a cathedral there, a log-and-lumber building with a bulbous spire. This is still the seat of the Russian Orthodox Bishop of Sitka.

In 1867 the United States of America bought the whole of Alaska from Russia for 7.2 million dollars, and on October 18th in that year the Tsarist flag at Sitka was hauled down, in the presence of Russian and American generals and Indian chiefs, and replaced by the stars-and-stripes of the U.S.A. The capital of Alaska was later moved north-west to Juneau. Sitka had had its day, but it is curious to reflect that our familiar tree was first imported, not from America's 49th State, but from Russia's Alaskan colony.

WHAT'S GOING ON

Contributed by
R. J. JENNINGS
Chief Forester, South Wales

"I only ask for information."

Dickens:—David Copperfield.

Most people engaged in a sizeable business or industry would surely agree that properly organised lines of communication are essential so that all concerned in the various departments know what is going on.

Different folk, of course, have their own well-proven method. The Red Indian sends out smoke signals; ships at sea use flags and radio. Military personnel on manoeuvres use the field telephone or carrier pigeon while the broadcasting authorities beam messages around the world by means of satellites such as Telstar.

Nearer home in the animal kingdom the humble rabbit lets his fellow travellers know that he is taking evasive action by showing the white scut of his tail as he dashes into the undergrowth. Woodpeckers drum out messages to their colleagues on the dried-out limbs of dead trees, and further down the scale the Death Watch beetle, boring his way through the oak carving of the church pulpit, taps out a conversation in morse code with his head to his girl friend such as "Freda . . . meet me behind the font at five-forty!"

Sometimes the lines of communication break down and then things may go wrong. We have all heard the sad story of the little man in uniform who went round Waterloo Station with a hammer tapping the wheels of locomotives.

"How long have you been tapping wheels"? a visitor asked him.

"Forty years" he replied.

"Why do you tap them" was the next question?

"I don't know" he said . . . "No one ever told me"!

Now it seems to me that in these days of functional duties, when field specialists and office staff work on particular projects, it is more important than ever to keep in touch with our next-door neighbours and not to take it for granted that they can guess what is going on. Few of us are thought-readers and unless we are careful some of us may get so wrapped up in our own line of investigation or sphere of activity that we begin to behave like Trappist monks and lose touch with the outside world. Failure to liaise to the maximum with our colleagues may not only hamper their work but it may lead to a loss of important and relevant information.

Let me give an example of the kind of thing that I mean. I was once asked to catch several dozen field voles alive for an experiment to be carried out by a zoologist at Oxford University. This was during the war when I was in charge of a forest in North Wales.

The scientist concerned sent me his instructions, along with the containers and equipment, explaining when he wrote that it was important to bait the box traps. When I wrote asking for a supply of the appropriate bait I had no further word but a month or so later I received a nice box of Cox's Orange pippin apples. As the label bore a consignment mark from Oxford and arrived in mid December I thought how kind a man was the student of Comparative Anatomy to send me such a welcome Christmas present as at that time apples were scarce and expensive.

In a fortnight when I had eaten most of them I wrote and thanked the sender telling him how much I had enjoyed his fruit. To my astonishment I received a letter by return of post couched in uncomplimentary terms informing me that the apples were never intended for human consumption but were sent for the sole purpose of baiting mouse traps!

Well! . . . I ask you . . . how was I to know that voles were partial to a pippin? I was rigid with anxiety for the poor starving rodents . . . Now, if that chap had used his imagination and sent me a card I should probably only have eaten half of them!

On another occasion during the war when weather forecasts were a security matter because of aircraft activity, foresters were informed of fire hazard from the Meteorological Office.

Three words were sufficient to indicate the degree of danger, they were in code and meant a visit to my house daily by the police. If the hazard was extreme the local P.C. 49½ would slink furtively around the corner of my garage when my wife was busy in the pantry and like a high-ranking officer in the Mafia would put his hand up to his cheek and from the corner of his mouth would say . . . "Psstt . . . EDWARD" . . . Edward being the code word for "High fire risk". A moderate degree of danger would bring him round on his bicycle to whisper "George" and if he came sailing into the yard and just shouted "Charlie" I knew that rain was on the way. On more than one occasion my wife said that it was about time that I told him that my name was Jack and that I was all right, but with all the important security that was attached to the matter at the time I let it ride. When the scheme began a member of the Research Branch asked me to keep records of these warnings in the simple code terms as he thought that the details might prove to be useful at a later date when he wrote a thesis on "Fire Hazard".

I kept the records carefully for three years, but on being transferred to another forest and having heard no word from anyone for that time I gathered that the records had eventually been regarded as a waste of time and abandoned the idea of keeping any more.

Several years later when I had pretty well forgotten about the code, "Fire Risk", and the original request, I received a letter out of the blue from the man who had asked me to keep the records. He wanted the details that he hoped I had been filing away for him. He was naturally very disappointed to learn that I was unable to oblige. Now here was another chap with no imagination; a card every twelve months saying . . . "Please keep records until further notice" would have kept me in the picture and he would have obtained his information.

What forester has not returned home at dusk to find a load of plants at his front door and the driver hungry and itching to get back home, having been waiting two hours for instructions? This need never happen if the consigning forester gave the driver instructions to unfailingly telephone the receiving forester when he was on his way. Or a card or a letter the day previous would save endless delay and running about.

For some years I had charge of a sizeable nursery and kept in touch with many of my friends in the field by putting a note in the same envelope as the warning of the despatch of plants. It maintained a friendly relationship and I knew the conditions under which they worked which seemed quite sensible to me.

Failure to give notice of intent to regrade or repair forest roads may lead to friction in the woods. The Roads Engineer is prevented from carrying out his programme with very expensive machinery if the forester is blocking up the road with lorries loading pulp or timber, which means idle plant and a waste of public funds. Alternatively the Engineer will operate his bulldozer and the forester may be prevented from completing an urgent order. If the timber is left in the wood until the work on the road is finished it will doubtless dry out or perish, and lost weight is lost revenue. If the Engineer buries the produce with a dozer in a fit of pique or frustration it amounts to the same thing.

When heavy machinery on a low-loader is going to a forest it is essential that both driver of the vehicle and forester at the receiving end know exactly what is going on. It is just as important too that the man at the receiving end ensures that the roads that the vehicle is to traverse are suitable for heavy traffic without let or hindrance, that any gates across the road are wide enough to allow the machinery uninterrupted access, and that should the low-loader have to return via the same route that he has adequate turning space.

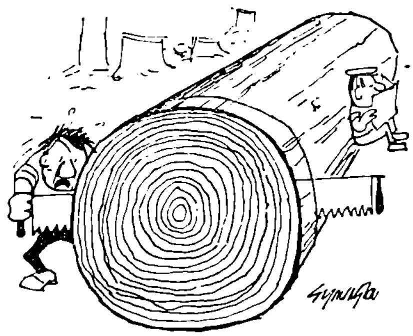
As our work expands and gets more complex it is all the more essential that every one of us, whether we work in the woods, the office or the laboratory avoid shutting ourselves off behind a little water-tight door. If linked up to another project our jobs will be much more interesting, and surely the wheels of the caterpillar tractor, the Isaachsen winch and the centrifuge will turn more smoothly and with greater speed if we consult our colleagues frequently and let each other know what's going on.

RECIPES

The Recipe Book compiled by Mrs. Jean Stewart, and illustrated by Mrs. Ella Neustein, has been a roaring success with both Forestry Commission employees and the general public.

The book consists of about 600 recipes collected from Commission wives all over Britain. Most of them are traditional favourites which have appealed to many housewives after a BBC radio broadcast—"Woman's Hour"—when the book was mentioned.

For 12/6 (plus 1/8 postage) *Recipes*, a real bargain and an ideal gift, is available, while stocks last, from West Scotland Conservancy or the Publications Officer at Savile Row.



"Just can't understand it, Fred. I had it sharpened only last week."

BOOK REVIEWS

Forestry in New Zealand by A. L. Poole. 112p. 33 illustrations. Published by The English Universities Press Ltd., Saint Paul's House, Warwick Lane, London E.C.4. Price 30s.

In little more than a century New Zealand forests have seen more changes than have occured during a thousand years in those of Europe. The story is a dramatic one—from the wholesale clearing of land for farming and the exploitation of valuable native timbers that at one time seemed inexhaustible, through to the planting of huge exotic forests that are now the basis of one of New Zealand's most exciting industries.

There are many other threads in the story: The part played by forest in protecting land from erosion; the battle against introduced pests and diseases; the development of forest parks for recreation; the counter-claims of farming and forestry.

In an illuminating survey, A. L. Poole shows how New Zealand's forest policy has developed since the early years of European settlement. He also tells how the once-despised *Pinus radiata* has become the most important timber tree in New Zealand, with its products finding markets in Australia, Japan and other parts of the world.

Now Director-General of the New Zealand Forest Service, A. L. Poole has himself participated in many of the most significant events in the development of the industry. His book is for all those—students and laymen—who want to know something of the story of New Zealand forestry and its place in that country's developing society. The author has visited Great Britain on several occasions and is well known to many members of our staff.

Natural History of the Lake District, edited by Canon G. A. K. Hervey and J. A. C. Barnes. Warne, London, 1970. Price 60s. 240 pages, 8 pages of colour plates, 24 pages of black-and-white photos, 4 pages of maps and many drawings.

For a century and a half those who loved wild country have judged the Lake District supreme in England. In the 866 square miles of this largest of British National Parks are the highest mountains in England, the quietest valleys, the deepest lakes and the most varied landscapes. Every year an increasing number of visitors from all over the world come in cars and coaches, on bicycles or on foot, to savour its delights; many indeed return to live there. For all of them, visitor or resident alike, this book will add considerably to their interest and enjoyment.

It is the first time that a survey of the wildlife of this lovely area of England has been attempted in such depth. The contributors have not been content to merely give a catalogue of plants and animals. They have attempted to show the changes, biological and geological, that have taken place in the past and are still continuing, not least through the activities of man.

Among the variety of landscape in the English Lake District are included sea coast and sand dune, moorland, bog and fell, woodlands of many types, clear streams and raging torrents as well as the better known mountains and lakes that are, perhaps, the main attractions to the visitor. All these provide an unusual diversity of habitats for a rich variety of plants and animals, contained moreover in a comparatively small area and thus within easy reach of one another during a short stay.

The formidable task of presenting the natural history of this fascinating area has been entrusted to a team of naturalists who share a common love of the Lake District. They have tramped its fells and describe what they are familiar with at first hand. Each has made a special study of its life and development and brings this knowledge to the book.

Unfortunately Canon G. A. K. Hervey did not live to see the publication of this book for which he provided so much inspiration. A keen naturalist, it was his driving energy that led to the formation of the Lake District Naturalists' Trust. He was its first Chairman and encouraged not only the acquisition of nature reserves but the spreading of information giving a wider appreciation of the meaning and value of nature conservation.

Mr. J. A. G. Barnes who undertook the editorship after the death of Canon Hervey is a well-known northern ornithologist and has contributed the section on Birds in this book. He is already noted for his editorship of 'Birds of the British Isles and their Eggs' by T. A. Coward, where he was widely praised for his skill in producing this classic work, in a single volume.

The general plan of the book is as follows:

Section I begins with a consideration of the rocks of which the Lake District is built and how they may have reached their present state. Section II gives a description of the plant life of the Lake District as a whole, habitat by habitat, from mountain top to seashore. Section III describes plant and animal life in the lakes, tarns and streams of the Lake District. The following section, dealing with the terrestial invertebrates, is subdivided under the headings of molluscs, insects and Arachnida, and the final section on vertebrates is divided into three parts covering reptiles and amphibians, birds and mammals.

THE FOREST WORKER

The trees he planted when a boy
Are now full grown. From youth through years
Of quiet growth, two woven threads of green
Alongside green. A tapestry on ancient slopes
Whose latent earths have grown new crops
And mould the skills of generations gone
To new-found tasks.

The tree he planted when a boy
Has strength and grace. His nurtured child,
His secret love, his sheltered haven
From city spells. Beneath its mantled gown
His thermos tea and tuppered bread
Are happy feasts, his choice each day
To canteen soup in factory or mine.

The hills he planted when a boy
Resound to raucous daily dins
Of men at work with tractors, saws.
Loud revving lorries use the roads
His fathers never dreamed could be.

But peace returns to end each day
As mini-bus turns homeward.
Another cycle is complete, another stitch is woven.
And when his day is ended too,
When zestful greens are mellowed gold,
His patterned threads will stronger be
For all the love he gave them.

EUROS JONES

TOURS

INTERNATIONAL COURSE ON CONSTRUCTION AND OPERATION OF CABLE CRANES
AESCHI, BERNE, SWITZERLAND
17th June—6th July, 1968
REPORT NO. 1

By T. L. RAINEY

Report on an International Installation and Operation Course of Long-Distance Cable Crane Systems

Introduction

The following brief non-technical report describes the combined FAO/ECE/ILO Course held in the community forest of Aeschi, near Spiez, Canton of Bern, Switzerland from 17th June—6th July, 1968.

25 participants, representing 14 countries, attended the Course, which was organised by the Swiss Forest Research Institute under the leadership of Mr. R. Wettstein, Chief, Logging Branch, assisted by members of his staff.

The general programme of work followed during the Course consisted of 2½ days theory, entailing field and office work, and 12 days practical work on installation and operation.

To overcome the language barrier, the Course, for the practical work in particular, was divided into English, French and German speaking groups. The English group, in which I participated, installed a Baco Cable Crane, the French a Wyssen, and the German group an Arlberg.

Field Work

This was concerned with the determination of valley and mountain stations, the setting out of extraction lines, and the surveying of longitudinal profiles.

The general planning and layout of short, medium and long-distance cable crane systems are basically the same, and can often be combined with other extraction systems where slope and ground conditions permit.

Regarding topography, it was recommended that on steep, but even, rectangular areas, the extraction lines were best to run parallel to each other, but where basin-shaped areas were encountered, they were better to converge into the narrowest point, either top or bottom of the area.

The importance of adequate valley stations was stressed. With very large quantities of timber being extracted to a central depot, the stacking, re-conversion, loading and disposal operations must be geared to clear the area as quickly as possible, and thus avoid a build-up of material at one point.

In the layout of extraction lines, the method recommended and used was to set out the lines going uphill, and to measure the longitudinal profiles going downhill. This met with general approval as did the instruments used, the compasses and clinometers being all of Swiss manufacture. The clinometers especially were very accurate and simple to use. It cannot be overstressed that, when visiting possible anchorage and support points during field work, as much information as possible be recorded. Standing trees at or near these sites should be utilised if at all feasible, and thus avoid the extra cost involved manufacturing and transporting artificial materials.

Office Work

It is during this period that all remarks made in the field concerning possible anchorage and support points can be appreciated and utilised. It must always be born in mind, from a time and financial viewpoint, that supports be kept to a minimum. The following work, much of which is calculated from predetermined formulas, is divided into phases. Deviation from these phases can lead to difficulties.

PHASE I

(i) Plotting of the longitudinal profile.
(ii) Distribution of supports (situation, number and height).
(iii) Approx. calculation of the sag of the carrying cable.
(iv) Possible correction of the distribution of support.

PHASE II

(v) Determination of technical data (diameter of carrying cable, total load, tension).
(vi) Exact calculation of the sag of the carrying cable.
(vii) Choice of support constructions, calculation of support pressure, and calculation of dimensions for support elements.
(viii) Calculation of dimensions of anchorages for the carrying cable.

Practical Work

Practical work was concerned with the erection, operations and dismantling of the three cable crane systems.

All installations had valley and mountain stations at approx. 3,000 ft. and 4,600 ft. above sea level respectively. The terrain generally was very steep, and treacherous in places, especially in the extraction lines, where there was no tree cover. The crop was mature Norway spruce (*Picea abies*) being thinned on the selection system.

All valley and mountain anchorages were to standing trees, apart from the Arlberg installation, which had a dead-man anchorage at the valley station. The types of supports erected were varied and interesting in their construction. They were two single pole supports without cross-beams, a single pole support with cross-beam, a cross-standing A-support, a two-tree support with cross-beam erected on two standing trees, and most interesting of all, the end mast for the Baco installation. This comprised a standing tree, strengthened by strapping another tree to it, then bending the former into correct alignment of the extraction line. This especially demonstrated what could be done when standing trees were available for use as supports. All single pole supports were made from timber harvested as near to the support points as possible, and they had the advantage over standing trees in that they could be fully rigged with saddles and guys before erection. It has been found that provided suitable support material is readily available close to support points, the time factor is negligible in erecting a one-tree support from a standing tree or otherwise.

The tensioning of the Baco carrying cable was measured by a dynamometer which is not considered satisfactory nowadays, having to remain in situ for too long a period. The Arlberg carrying cable tension was measured by a tensionmeter, which is reputed to be the best method at present, as it can be attached to a loaded cable at any time. It is also the most expensive. Also demonstrated was Pestal's rule-of-thumb formula, which involves the striking of a loaded cable, and the recording of the returning wave of vibration over a given span of cable. Security factors vary from country to country, but all operators stay well on the safe side of any given security factors.

Communication was by telephone and installation and dismantling of this proved an arduous task, due to the steepness of slope. Telephone systems have the disadvantage of requiring an operator constantly on hand at chokering points in the extraction line, whilst separate connections are needed for each move, and add to the expense of the operation. Radio, which did not function properly on the working area due to topography, should always be attempted initially. The radios tried during this course were of the Swiss Army type, and would have proved large and cumbersome to transport. Attempted communication with radios such as the Storno pocket sets used by the Forestry Commission in their fire and field operations, would perhaps have yielded better results. It must be emphasised, from the safety angle, that any communication system must be completely dependable.

The time and cost expenditure of long-distance cable crane installations can never be rigid, due to a variety of factors, mainly number of supports needed, ground conditions and the type of cable crane being used. It is also difficult to compare operation time due to the different silvicultural systems used in some countries.

Discussion and Conclusions

The possible introduction of long-distance cable crane systems poses many problems when applied to Britain at the present time. The main one is the fact that forest topography in this country generally makes roads a much less expensive proposition than in Switzerland, where road construction in many of the mountainous forest regions is often unthinkable. Swiss installations, due to their general length of 700—2000 metres, tend to serve the same purpose, but essentially lack a road's versatility in introducing other traffic and machinery. Furthermore, the convex nature of much of our steeper slopes make long installations difficult. A good minimum length appears to be approx. 1,200 metres down a concave slope.

British forestry practice, working with largely uniform coniferous crops of yield classes averaging 100—140 hoppus feet, leads to frequent thinning cycles, and generally ensures the full utilisation of a roading system. Contrary to this, much of the mountainous forest areas of Switzerland are protective, mature woodlands, being worked on the selection system, and producing large volumes of timber at much longer intervals than in Britain. The Swiss, after dismantling a system, may not install again on the same site for at least 10 years.

Basically the effective use of long-distance cable cranes demands the extraction of big loads over long distances with a high volume of timber being extracted. Low volume output proved a limiting factor when the Wyssen long-distance cable crane underwent trials in West Scotland in 1953/54. Figures quoted as a good minimum volume to be extracted start as high as 13,000 hoppus feet over a length of 1,200 metres. As regards load size, the carrying capacity of most long-distance cable crane carriages is approx. 1½—2 tons. In Swiss forests, this is often achieved by one or two pieces. In Britain, these loads would probably entail much uneconomic work collecting and stacking prior to chokering.

A further problem is the fact that tree-length extraction does not suit this system, if cable to ground clearance is to be fixed at an economic height. Loads hang vertically, and for maximum safety, the Swiss plan to clear the highest point in an extraction line by at least 10 feet. During the course, length of pieces was approx. 16 feet. This put the minimum height of supports as approx. 30 feet. The dimensional requirements of standing tree supports at this height posed no problems, but would create many in British plantations at present, and may even necessitate the manufacture of supports outwith the working area. This, added to the transportation of these supports from one set-up to the next, would greatly increase installation costs.

Finally, although unfamiliar with any areas in Britain at present where long-distance cable cranes could work economically, I suggest they perhaps warrant trials in suitable areas of North and West Scotland where they may substitute for expensive roadworks, especially in North Scotland where Fort William pulp is being extracted to specification. They could also prove effective in clear-fell areas, and in any future catastrophic windblows such as occurred recently. Apart from this, I foresee no widespread use for them in British forestry.

Being a newcomer to this type of extraction, I was very impressed by the whole course. Mr. Wettstein and his staff are to be congratulated on the manner in which they tackled this difficult project. The instructors were specialists, leaving nothing to chance in the installation, operation and general handling of all the expensive equipment used. I should like to thank especially Mr. Müller, who was in charge of the English speaking group, and Mr. Plieffer, whose aid in translation was invaluable. I also wish to thank the International Labour Office in awarding me a Course Fellowship, and the Forestry Commission for the recommendation that I participate.

INTERNATIONAL COURSE ON CONSTRUCTION AND OPERATION OF CABLE CRANES AESCHI, BERNE, SWITZERLAND

17th June—6th July, 1968

REPORT NO. 2

By T. G. QUEEN
Work Study

In April, 1967, a Study-group of the Joint Committee FAO/ECE/ILO discussed Mechanisation of Forest Work, and decided that international courses should be organised in the summer of 1968 to cover two aspects of work on long-range cable-cranes in mountainous country: first, the installation and operation of the cranes; and second, the planning of crane systems. The Swiss government offered facilities for theoretical and practical work at Aeschi, and charged the Swiss Forest Research Institute with the preparation and organisation of the courses.

Very broadly, the two courses were organised in this way:

(a) Installation Course 17/6—6/7/68

2½ days of office and field work, which included surveying and plotting the longitudinal profile of a trace or rack; and calculations of numbers and types of supports needed, loaded and unloaded cable-sags, saddle pressures, tension pressures and pressure on supports.

6½ days field work, when the winch and cable-crane accessories were transported onto the work-site, and the cable-crane installed as a going concern.

1 day to demonstrate cable-crane installations and operation to members of the Planning course.

1 day to visit Vinje winch set-up in a neighbouring district.

5 days to dismantle the cable-crane set-up, and return the winch and accessories to the roadside.

(b) Planning Course 24—29/6/68

3 days of office and field work, when the economic and operational aspects of cable-crane systems were considered.

1 day to see cable-crane set-ups completed by Installation-course members.

1 day to see Vinje winch set-up, in the company of Installation-course members.

Swiss timber-exploitation systems

There are three general categories of timber exploitation; namely simple sledging; wheeled transport or axle transport of one kind or another; and cable systems.

(*a*) Simple sledging is regarded as a dying, almost dead means of extraction.

(*b*) Wheeled transport is considered an important means of extraction, and becomes more so as time goes on.

(*c*) Cable systems are the most important means of extraction, and these in their turn are further considered under three titles:

(i) *Seilriese.* (Literally "rope-travel"). A very elementary, and relatively unimportant system used only for poor quality timber such as firewood. The loads are simply hooked on to a tensioned cable and driven downhill by gravity alone to an off-loading point.

(ii) *Seilkran* or cable-crane. A system where a carrying cable or skyline is supported and tensioned in such a way that a wheeled carriage connected to a winch drum by a hauling cable and carrying a load of timber may run freely over its length, usually between any loading point and a roadside depot. Special features of the system are that only one carriage is used; the carriage may be stopped and locked at any point on the line; downhill travel of carriage or carriage and load is by force of gravity, and uphill travel is powered by a motor; the winch is always situated at the top end of the set-up; and a strip on either side of the skyline may be tapped. A *Seilkran* or cable-crane may complement a *Seilbahn* or cableway in a more complex extraction system.

(iii) *Seilbahn* or cableway. This is another example of a supported and tensioned skyline, but it differs fundamentally in function and operation from the cable-crane. The cableway is used to transport gathered timber from one point to another, where the initial gathering has usually been done by cable-crane, but may also have been done by tractor, horse, sledge or any permutation of those methods. Its special features are that no loading or unloading is done except at two termini; an endless rope allows the downward force of the loaded carriage to haul the empty carriage back uphill to the loading terminus; and it may be used over extremely long distances. A typical situation where this method would be used is where an exploitable forest is growing on an intermontane plateau, at such a distance from a depot that roading costs are prohibitive, and cable-cranes alone are an inadequate solution to the problem. Then cable-cranes or other means would be used to gather the timber to a central dump on the plateau, and further transport would be effected by cableway. Cableways were said to be in operation over distances of up to 40 km.

Preparatory Work—Field

The Cable-crane Network

Where timber has to be extracted by cable-crane down to a road or depot, the area is looked at as a whole, and a decision is made as to the layout of the cable-crane network. The decision is made in the light of 5 factors.

(i) *The Topography.* In general terms, 3 land-forms are recognised, and these are blackboard, cone-shaped, and basin-shaped forms.

The Blackboard form is self-explanatory, and a layout is planned on a series of more or less parallel lines, suitably spaced, from individual winch stations at the top of the area, down to individual landing-places at the bottom.

The Cone-shaped form calls for a central winch-station at the top of the area, with a layout of lines fanning out downhill to separate landing-places.

The Basin-shaped form demands the reverse of the latter, and from a central landing-place at the bottom of the area, lines fan out uphill to separate winch stations.

A look at almost any mountainside, either here or in Switzerland, will show that all 3 land-forms are frequently continuous. Swiss experts say that good integration of the 3 types of layout is the true art of network planning.

(ii) *The landing places.* They should be selected or sought out bearing in mind the need for as much mechanical conversion as possible at a central depot, since all work done on the steep hillsides is dangerous and costly. Landing places should be identified on the ground.

(iii) *The possible side-haul distance.* This should take due regard of the relatively high cost of the side-haul element of extraction.

(iv) *The position of the winch.* This should be identified on the ground.

(v) *The situation of the felled trees.* Slopes of 40°+ are common in Switzerland, and felled trees frequently come to rest at a distance of up to 200 m below the stumps.

Surveying the Longitudinal Profile of the Trace or Rackway

The field-work is done in 2 stages.

(*i*) Starting from the anchor tree at the landing place, a compass-bearing is taken on the line of the anchor tree at the winch-site or on some intermediate point in line with that anchor tree. The survey may be a protracted affair, and that bearing is best jotted down for future reference. The compass-man directs an assistant along the bearing, and a third man hammers in pegs and serves as factotum to the team. The pegs are placed at intervals where they may easily be seen, and on all pronounced knolls. The bearing has to be read and followed extremely carefully, for the ground is steep, difficult and dangerous, and extra work caused by carelessness or accident is most disheartening.

(*ii*) Assuming that all has gone well, and the winch anchor-tree reached, the second stage is to return along the line pegged out and record relevant data. The oblique distances between pegs are measured with a tape, and the slopes measured with a clinometer. The pegs are identified by consecutive numbers from the top of the line working down. On this downhill journey, possible anchor trees and support trees are noted at appropriate points, and their dimensions estimated or measured.

The instrument used for compass-work was the Wyssen Compass, which is specially designed for rough, steep country (the makers say for slopes of $\pm$ 120%). The team leader swore by it, and although most team-members found it a bit awkward initially, probably it could soon be used with confidence.

Preparatory Work—Office

Plotting the Longitudinal Profile, and Distribution of Supports

From the data recorded in the field, the longitudinal profile of the trace or rackway is plotted on a suitable scale; and then the distribution of supports is considered: where, how many, how high, and what sort? This stage of the work is a matter of trial and error, but is greatly assisted by experience. Supports of a given height are plotted on what appear to be the most favourable points of the profile, and the approximate sag of the carrying-cable or skyline is calculated. From the relationship between the profile and the cable sag, corrections may be made to the distribution of the supports, or their heights. The instructors stressed most emphatically the need to keep the number of supports to an absolute minimum; and once the course-members had partaken in the erection of one of those supports in the field, the message was driven home for good: most work connected with natural or artificial supports is heavy, awkward and dangerous.

Technical Calculations

Once the carrying-cable diameter, total load and tension are established, the exact sags of the carrying-cable may be calculated and plotted. Then the most suitable of a number of different sorts of supports may be chosen, and their necessary dimensions calculated according to the pressures to which they will be subjected. Finally the dimensions of the anchorages for the carrying-cable are calculated.

The preparatory field and office work is laid down in a tried and proved sequence which should be held to.

Installation Work

The job to be done

A cable-crane was to be erected to run between an anchorage at a valley landing-place at 1080 m and an anchorage on a mountain ridge at 1560 m above sea level. The length of trace or rackway was 1300 m. 2 supports were needed: 1 as an endmast on the ridge, and 1 as an intermediate support; of these, 1 was a standing tree and the other was a felled tree dragged to the approximate support position. The skyline was 24 mm diameter. The winch used was a 50 HP BACO SW30, with an automatic mechanical carriage.

Preliminary organisation

At the valley landing-place a list was compiled, based on office preparatory work, of all cable-crane accessories needed at the intermediate, endmast and mountain-anchorage positions. Those accessories were loaded onto a sledge, on the basis of last on, first off. Axe, saw and sappi, etc., were placed conveniently about the sledge. The sledge was then hitched to the winch, and the train set off uphill by the best route. Transporting the winch and sledge to the mountain ridge was a simple, if strenuous, operation. The winch was anchored to a tree up the path, winched itself in, and so on. A cranked fairlead allowed some steering, and it may be worth remarking that for all preliminary manoeuvres and rough work the winch drum was fitted with a separate length of cable, and no duty cables were used. Accessories for intermediate stations were unloaded from the sledge at appropriate points en route.

Setting-up in the Trace or Rackway

When the winch and sledge had arrived on the mountain ridge, and then moved across to the appointed mountain anchorage for the skyline, the first jobs were to install a telephone link between the mountain and valley anchorage points, and to anchor the winch so that it could be used to full advantage for all haulage.

Work began on the endmast support. There was a standing tree well-placed for support, but it did not meet the girth requirements for the tension exerted. That tree was brashed up to 20 m, and then topped at that height. Another of similar length was felled and sned, and then hoisted, butt-end uppermost, alongside the standing tree, and lashed to it. Slings were fitted to the top of the support to carry the skyline saddle at the prescribed height; and then guy-lines were attached so that pressure on the support could be evenly spread. The support was not in the exact position required by the specification, and some means was needed to pull it down and over into the centre of the rack, so that the skyline would be central and at the right height. That end was achieved by making oblique saw-cuts into the base of the standing tree and thereby weakening it, and then pulling the whole support into position under power of the winch and then guying it firmly in the correct position.

Between times, the rough-work cable was removed from the drum of the winch, and a light cable fed on. This cable was pulled manually down the trace to the valley anchorage, where it was spliced to the hauling-cable proper, a cable of 9.5 mm diameter. The hauling-cable was then towed up the trace to the winch; the light cable was wound from the winch-drum onto a spare reel; and the hauling-cable was wound onto the winch-drum. Similarly, when the last of the hauling-cable unwound from the reel at the valley anchorage, its end was spliced to the 24 mm skyline cable, and this in its turn was hauled up the trace to the mountain anchorage. At that stage the skyline was anchored (but not tensioned) at the mountain anchorage according to specification. Although the foregoing describes the aims and ends connected with the different ropes, it gives no indication of the extremes of effort, care and patience required in this phase of setting-up.

The next stage was to erect the artificial support at the intermediate point of the trace. This support was 22 m long and contained 2 cubic metres. It had been felled, sned and peeled, and had been hauled to its approximate position, so that the butt-end lay 2 m from the centre line of the trace, and the small end lay obliquely downhill. As with the endmast, guy-lines and saddle-slings were fitted according to specification; and in addition, climbing staples were hammered into the stem at approximately ·75 m intervals. A pit was dug on the exact site for the support, and the support was winched into a position where the butt-end would heel itself into the pit while the support was being hauled into the upright position. A suitably-placed adjacent tree was then brashed to 14 m, and guyed back in a way which fitted it to take the strain while the support was being hauled erect. That adjacent tree was then mounted with a pulley system, whereby the support could be raised. The guy-lines from the support were made fast in the appropriate directions; the hauling-cable from the winch was fed through the pulley-system to the thin end of the support; the winch wound in, and raised the support; and as the support was rising into position, so the man on each of the guy-lines took up the slack and kept the support under control. The support was thus raised to its position, which was leaning slightly into the centre of the rack and downhill. The guys were made fast, and the support stood independently.

Next, the saddle which carries the skyline was put together. Some slack was taken on the skyline by fixing to it the hauling-cable and winding in; then the skyline was clamped into the saddle, and together they were hauled up by the winch hauling-cable to the calculated height on the support and made fast to the support sling. The skyline was similarly raised at the endmast support, and the set-up was ready for tensioning.

Tensioning was done at the valley anchorage, and a close watch was kept at each support and anchorage so that if anything threatened to go wrong, it could be checked quickly. When tensioning was completed, the securing clamps were removed from the saddle and the line was open to traffic.

Each aspect of the work related to the supports must be undertaken most carefully and skilfully, whether it be in the office or in the field. Bad work, or miscalculations of one kind or another may only show up once tension comes on the skyline, and they are extremely costly and disproportionately dangerous to put right at that stage.

With regard to whether natural standing trees or felled trees make the best supports, it should be borne in mind that although there is an element of erecting in the case of felled trees, almost all of the rigging work can be done on the ground before the tree is erected; whereas, when standing trees are used, 2 to 3 hours heavy work may have to be done standing in an awkward position 20—25 m up from the ground with a 50° slope stretching away below.

The installation was declared a going concern when a light test-carriage transported the hauling cable to the valley anchorage and that cable was attached to the automatic carriage which had been mounted on the skyline.

Carriages

Once the labours of the installation work were left behind, it soon became apparent that one of the most important features of the system as a whole was the timber carriage. The carriage should be mechanically- or hydraulically-controlled so that it can be stopped and automatically locked at any desired pick-up point along the length of the line; the choker-hook should be automatically lowered once the carriage is locked in position on the line; and at the landing-place, the load should be automatically released and the carriage free to return to the loading point. The carriages which the writer saw operating during the course were the Baco and the Nesler-Arlberg: while both performed the first two functions well, neither was seen to operate efficiently at the landing-place. That observation is based on only 6 or 7 loads in each case, and it may well have been that the machinery was new to the instructors as well as the course-members; however, no really concrete explanation was given, and the failure of the release-mechanism was vaguely related to the amount of slack in the hauling-cable when the carriage arrived at the landing place. Further, a Wyssen carriage was seen operating most efficiently at the pick-up point, but was not seen in action at all at the landing-place; however, this was reported to be working extremely well.

A very limited number of loads were extracted, and those mainly for demonstration purposes; therefore extraction as such by cable-cranes is not discussed in this paper.

Dismantling Work

The job to be done

All cables, supports and cable-crane accessories were to be dismantled; the cables were to be rewound on the appropriate reels at the valley anchorage; and the winch was to be transported to roadside.

Dismantling

As a preliminary, all gear at the mountain anchorage which was not needed for the dismantling phase was made fast to the sledge, and the whole sent down on the crane.

At the valley anchorage, the tension was taken off the skyline; the hauling-cable was removed from the carriage; and the carriage was removed from the skyline.

Work began on dismantling the endmast support. The hauling-cable was fed through a pulley system up the support, and onto the skyline; then the skyline was hauled clear of the saddle and lowered to the ground. The support-tree, which had been weakened by earlier saw-cuts to facilitate positioning, was now felled and the guy-ropes were released simultaneously. The support head-rigging was dismantled once the tree was on the ground.

At a convenient spot not far from the mountain anchorage, the skyline was made fast to a strong tree-root by means of a wire strap and shackles. The skyline was then gradually released from its mountain anchorage, and its end placed adjacent to the winch with a view to splicing it to the hauling-cable later on. For the moment, the hauling-cable was pulled manually down the trace to the intermediate support, which was lowered and dismantled much on the lines of the endmast support. The hauling-cable was then rewound to the winch, and spliced to the end of the skyline. The hauling-cable was braked, and the skyline released from the tree-root. The skyline now had to be wound onto a reel at the valley anchorage. Because of the length and weight of cable, and the steep slopes, both mountain- and valley-work had to be co-ordinated as closely as possible.

Very briefly, the system used was this. On a flat piece of hard ground beside the valley anchorage, a lorry hitched onto the skyline where it sagged along the ground. A signal was telephoned to the winch-man at the top to release the brake; and simultaneously the lorry-driver hauled a stretch of skyline towards the reel while the men on the reel wound on the slack. Stop-and-go-signals had to be responded to instantly, for an unbraked skyline would have become inextricably kinked. Following the skyline, the hauling-cable was wound onto another reel; then at the mountain-anchorage, preparations were made to transport the winch downhill.

A winch from a neighbouring set-up was due to go downhill at the same time as the BACO, and it was decided in the interests of safety and economy to transport both winches in tandem. They were cross-hitched, back-to-back, with one winching the tandem downhill to preselected hitching points, while the other faced uphill and acted as a brake. Thus the winches and all odds and ends were brought to roadside. A stocktaking was done, and the exercise was closed.

Summary of the main points which arose on the course

Preliminary field and office work

In the widest economic sense, the cable-crane network is vitally important, and many areas to be exploited will call for a skilful integration of the three types of layout already mentioned.

In the technical sense, the surveying and plotting of the longitudinal profile, along with the subsequent calculations, should be done with great care at each stage, and in the sequence recommended.

From the physical standpoint as well as the economic one, the number of supports should be most carefully calculated and kept to an absolute minimum: they are costly to erect and can be a source of extremely hard and difficult work.

Installation Work

Because of the distances and steepness associated with cable-crane installations, field work must be carefully planned so that machine-power is exploited to the full, and man-power is not abused.

There must be good, clear communications between stations.

Anchorages and all cable-fastenings must be made properly and securely.

All anchorage- and support-points should be observed while the skyline is being tensioned.

Careful thought should be given to the case for using either standing or felled trees as supports.

Carriages

It seemed as though the type of carriage used would be a major factor in extraction economics; and a good carriage would well repay its extra cost.

Dismantling Work

All cables to be rewound should be kept under some degree of tension compatible with the effort required to rewind them.

Application of the Knowledge Gained on the Course

Long-range cable-cranes on the Swiss model are not yet in use in Great Britain. However, high roading-costs are felt here, albeit not so acutely as in Switzerland, and the trend is ever towards longer-range extraction systems and reduced roading-densities. A medium-range BACO winch is currently on trial in West Scotland, and the principles of long-range crane-systems can be applied and examined in that particular case, and wherever else extensions to current working are contemplated.

TRACTOR SKIDDING COURSE

Sonsterud Forest Worker's Training School, Gjesasen, Norway

By J. WADE

This course was intended for experienced forest workers. Number on course should have been four or five members but only three, including myself, actually attended. The machines and methods in the order in which they were taught are described below.

1. Bolinder Munktell Boxer Half-tracked Tractor

Equipment

Four-Drum Igland Winch with hydraulically-mounted butt-plate.

Ground conditions

High stumps, ground very wet and rocky in places.

Timber—spruce, primarily converted to 3 metres+ sawlogs, 3 metres+ pulpwood. No stacking of large material or grouping of lighter pieces to give a tush.

Extraction Routes

Needed absolute minimum of preparation. Only exceptionally high stumps cut low on extraction routes. Some lack of planning evident at this point. Routes had not been selected before felling and lop and top broken down. This meant routes had to be prepared as extraction progressed.

Winch

Worked very well, but clutch system could be improved if handle had pulled towards operator rather than having to be pushed away. Brakes were primitive but reasonably efficient ratchet type. Each drum had approximately fifty yards of rope with two sliding chain chokers. Rope terminated with a single chain choker fastened to rope end either with an eye splice and thimble or bulldog clamps and thimble.

System of Work

Tractor driven into area to be extracted. Tractor reversed at centre of pick-up area and stopped close to front of potential load. Brakes applied and butt plate dropped.

The individual winches were numbered 1 to 4. The cable and chokers were taken out from No. 1 winch on a line up to 45° from centre line extended backwards from tractor. The sliding chokers were dropped by a log, or logs if two ends conveniently placed. The fixed choker is fastened first, the sliding choker farthest from the winch next, and lastly the remaining sliding choker. Chokers are always connected in this way. If reverse order of attachment be used the rope has to be pulled out through two sliding chokers to connect up last part of load. This is hard work and unnecessary.

The other three winch ropes and chokers were connected up in a similar way in ascending order of numbers, making sure that none of the ropes entangled by fanning the ropes up to 45° the other side of the centre line. The winches are then wound in, in the order 1, 2, 3, 4, until very close to the butt plate when winches 1 and 4 are pulled in, until load tight up against butt plate, and brakes applied. Winches 2 and 3 are then pulled in and brakes applied. During the winching-in operation the tractor foot throttle is used with discretion to speed up the operation.

Butt plate now lifted on hydraulics and tractor moved forward several yards. At this point some of the logs may settle into different positions. Load should be checked and any of winch loads lifted if this appears necessary.

If pulpwood was to be removed the driver had to prepare the load himself. Single pulp pieces did not make a pay-load so pulp had to be piled into 2, 3 or 4 piece heaps. This gave a rather large turn-round time in the wood if driver working alone. If cutter had piled these pieces extraction would have moved more quickly. In our case a choker man was available so he had to prepare heaps.

Loads of sawlogs or pulpwood are then removed to roadside where they were stacked in suitable heaps.

One advantage of this type of winch was that in a mixed produce area, mixed loads could be carried, e.g. two winch loads of sawlogs and two of pulpwood, or three sawlogs and one pulpwood. They did not mix and could easily be separated at the unloading point.

2. Bolinder Munktell Buster Tractor

Equipment

Double-drum Igland winch with hydraulically-mounted butt-plate, chained wheels.

Ground conditions

Used on similar site to Boxer but drier extraction routes had to be chosen and many more stumps had to be cut low.

Winch

Each drum had sixty to seventy yards of rope with one fixed choker and four sliding chokers. Operation much better than four-drum winch. Payload slightly less than Boxer and of course terrain a little easier.

System of Work

Similar to Boxer but both tractor and winch less flexible as to use.

3. Holder A20 Four-wheel drive, Frame-steering, Small Tractor

Equipment

Isachsen single-drum 'Handy' type winch. Also hydraulically mounted draw-bar with swinging butt plate and six choker chains. Rear wheels only equipped with chains.

Ground conditions

As for Boxer and Buster, also material presentation.

Extraction Routes

Greater care needed for extraction route lay-out than for normal agricultural tractors. Stumps had to be low and slide slope—particularly where tractor had to be turned—kept to a minimum. When turning across a slope the wheels on the low side must always be closed. If not, the danger of the tractor turning over is very real.

Work Method

Tractor driven to loading area. Turned through 180° to face downhill and reversed to centre of area where load to be picked up. Pieces to be winched to tractor should be laid in an arc 35° either side of a centre line drawn from rear of tractor. Brake applied and choker bar and butt plate dropped.

Winch rope and one choker chain pulled out to first load which should be near one edge of pick-up arc. Chain is placed around load and rope hooked to it. Operator then walked back to tractor, winch clutch released. Choker hook is removed from chain and chain clipped into choker bar. This process was repeated for each choker chain and load.

When all loads have been connected to choker bar, the bar is lifted and load driven to off-loading point. At roadside, hydraulics are dropped and choker bar lock disengaged. Tractor was then driven forward, disengaging chains from choker bar. Tractor stopped, choker bar locked in position again and chains disengaged from loads and placed on choker bar ready for use again.

This tractor is rather small and under-powered. It is therefore rather slow. Its use appears to be rather limited to possibly thinning in crops which are heavily stocked and where pole sizes are rather small.

4. Double-Drum Skyline

Equipment

Double drum Igland winch with tower mounted on Ford 3000 tractor.

Ground conditions

For purposes of course, ground was very easy. Instructor had to be able to keep in contact with choker man and winch operator. Material primarily converted spruce with no load preparation at all.

Equipment and set-up

Tower anchored forward down centre line of tractor to stump or well rooted tree. Tractor reversed until anchor rope as tight as possible. Up to sixty yards from tractor a spar tree equipped with a pulley, high up it. Spar tree and block anchored back to another convenient stump or large tree. Spar tree anchor, spar tree, tractor tower and tower anchor point all in line. The rope from one drum of the winch, called the haul-back drum, was passed over a pulley at the top of the tower, under a pulley on a carriage equipped with two pulleys, over the top of the pulley on the spar tree, and back to the carriage, where it was fastened to a swivel on the carriage chassis. The rope on the other drum of the winch is passed over the top of the other pulley on the top of the tower, through the other carriage block and terminated in a choker chain eye spliced to the rope. This is called the haul-in line. Each drum of the winch is equipped with a hydraulic clutch and band brake.

System of Operation

(i) Haul-back clutch engaged and, by braking on haul-in line, the carriage was carried towards the spar tree, above the ground. At an appropriate signal from the choker man in the wood, the brakes on both drums were applied. The haul-in brake then released completely. Choker man pulled out haul-in rope to selected load and fastened rope to load.

(ii) He then moved clear of the load, and from a position from where he could see the operator and operator could see him, he signalled for load to be hauled in. To do this, the operator engaged the haul-in clutch and braked hard on haul-back clutch. The haul-back line and attached carriage travelled forward, came under tension and lifted. When tension was sufficient to overcome the inertia of the load, the load moved towards the carriage. As the carriage was high, the load tended to lift and therefore moved easily. When the load met the carriage the haul-back brake was released slightly. The carriage moved towards the tractor. Haul-back brake was applied sufficiently to keep front of load just clear of obstacles. At the landing (stacking point) the load was dropped and disconnected from line by operator. Carriage then sent back to choker man. Whilst he was connecting next load operator stacked previous load.

Comments

Speed of operation is relatively slow. Effective operative distance a severe limitation. However, where ground conditions are such that other methods are too costly or impossible, this is the only practical method providing ground is concave or flat.

5. Double Drum Cable Crane

Equipment

Isachsen double drum winch and tower, mounted on Ferguson 35 tractor. Skyline and hand operated winch to tension Skyline. Carriage with 2 to 1 reduction on haul-in.

Ground conditions

Steeply concave hillside. Material presentation: whole poles felled downhill steeply angled towards direction of extraction. Extraction distance maximum 300 yards, 60 yards wide.

Method of Erection

Tractor standing near landing point with nose pointing away from area to be extracted. Tower of winch anchored twice at approximately 45° from tractor on either side, away from area to be extracted. Spar tree anchored back twice at angle of 45° from line of haul. Haul-back line pulled out manually and fed through pulleys supported by straps to trees outside the extraction area. Enough supports are needed to keep rope from ground under slight tension. Rope passed through a pulley on spar tree and hauled back to winch. Skyline and haul-in line then attached to haul-back rope.

Haul-in and skyline pulled out to spar tree by winch. Skyline is supported on spar tree and anchored back to a suitable anchor. Haul-in line pulls in haul-back line. Skyline fixed over tower and carriage placed on skyline then tensioned, using a Tifor hand winch suitably anchored. Haul-in line then wound on to carriage and haul-back line fastened to carriage.

System of Operation

Winch operated as described for Skyline Double Drum Winch technique. Communication by two way radio sets, one at tractor and one in wood. A 'dead man', which can be a sawlog or unconverted pole, was equipped with a sling in the extraction line and on landing area.

Carriage winch line was fastened to 'dead man' and carriage hauled back until sufficient free rope as indicated by choker man was wound off. This rope was then clipped to haul-in rope. Carriage then hauled up to choker man who indicated when it should be stopped. Choker man then connected carriage to haul-in line to selected load. Winch man hauled in when signalled to do so. When load reached conversion bay, man doing conversion signalled operator when to stop. Choker man told winch operator how much rope he required for next load. Operator hauled back the carriage until required length of rope was paid out. Converter signalled operator to stop and once again connected carriage haul-in to tractor haul-in line, and process repeated.

Conversion

After carriage despatched, converter attached a small winch rope to load, walked to winch and hauled load parallel to conversion bay. He then converted poles, and stacked produce. This produce was sawlogs 3 metres+, and pulpwood 3 metres+.

This method of conversion and system of felling I intend to apply to our own cable crane, which is to be used on clear-fell and promises to be the most economical method for clear-fell cable-crane technique in the Northumberland part of the Border Forest.

6. Whole Pole Skidding with Ford Super Four

Equipment

Four-wheel-drive tractor with power-assisted steering, also independent brakes for steering under load. Two-drum Igland winch with hydraulically mounted butt plate. Log roller hydraulically operated on front of tractor.

Winch

Equipped with 60 yards of rope per drum, each rope having four sliding chain chokers, and rope terminating in a chain choker.

Ground conditions

Dry heath with occasional wet patches. Average extraction distance one-third mile. Poles felled with tops predominantly away from extraction direction. As soil in area had a high sand content, trees pulled butt-first to try and reduce contamination of saw logs by sand. If ground hard, frozen or covered in snow, poles would have been pulled tip-first.

System of Work

This tractor used in a timber producing team. Team consisted of three to four cutters, tractor driver and converter. Trees felled in required direction by cutters. Tractor operator chokers his load in similar manner to methods of chokering described for Boxer and Buster. Material hauled to roadside, where the poles were dropped on to bearers laid at right angles to road. Operator disconnected load and drove back to wood. Converter measured and converted poles and stacked light pieces of pulp. Tractor meanwhile has fetched another load which he dropped on another conversion site close by. While converter working on these poles, tractor stacked any sawlogs to be stacked on first site before travelling back into wood. Process continuous, alternating between conversion sites.

Comments

On steeper or wetter ground tractor would need to be equipped with chains. If poles pulled tip-first, load could have been increased by approximately 30%.

7. Garrett Tree Farmer for Whole Pole Skidding

Equipment

Tractor was a four-wheel-drive, frame-steering tractor equipped with chains on rear wheels. Single drum hydraulic winch. Log roller hydraulically operated.

Winch

Equipped with 60 yards of rope and 10 sliding chokers.

Ground conditions

Rocky and wet in places. Poles felled as for Super Four but average pole somewhat larger.

System of work

Once again as team work. Method as described for Super Four.

Lectures

The majority of lecture time was taken up in discussing and explaining the complete workings of all types of tractor engines, a typical gearbox and back axle.

One lecture was given on winch construction. Two types of winch were discussed—single and double drum.

A lecture was also given on safe working methods which covered most aspects of forest work. Stress was placed on the use of helmets. This was somewhat ironic as so few instructors actually wore helmets.

One Saturday morning was spent on the mounting of a winch on a tractor, with the School mechanic as instructor. A beautifully equipped workshop showed its worth here.

A full day on long splicing was a day well spent. The instruction was broken down into simple stages. With examples of each stage abounding in the workshop, this meant that splicing could be learnt very quickly. An extremely good series of three booklets was supplied on rope types and splicing.

Conclusions

The course was very comprehensive and covered, with certain limitations, a great number of extraction techniques and extraction equipment. The course couldn't and wasn't intended to produce skilled operators on all the forms of extraction taught. However, sufficient information was available to enable a good worker to tackle a great number of extraction situations in the correct manner and become a skilled operator more easily and quickly.

An interesting point here which was very apparent. No forest tractor was complete unless equipped with a foot throttle and a winch—a single drum one or preferably two or more drums.

For my part, while not seeing a complete method not previously seen, I did learn many useful tips and techniques which I may be able to utilise in the future, especially medium-distance cable-way techniques that I can use on the F.C. extended Isachsen No. 3 winch.

I would like to thank Herr Brock, the Principal of the Sonsterud School and his staff for having me and making my stay so pleasant. After staying in such a beautifully equipped school I can only think that perhaps in forestry education we have a great deal to learn from our Norwegian forestry colleagues.

SOME NOTES ON SWEDISH FORESTRY—JULY 1968

By ALAN P. WATERS

Forest Worker, South East England

I travelled by the England-Sweden Line ship *Saga* from Tilbury to Gothenburg, which is on the west coast of Sweden. With me went my motorcycle. The ship arrived at 6.30 a.m. on the 9th July, and I rode straight up to my relatives who have a summer-house on Koön which is one of the Marstrand group of islands. Marstrand is thirty miles to the north of Gothenburg. The journey took me through alternating agricultural and forestry areas. The forests were mixed Norway spruce (*Picea abies*) and Scots pine (*Pinus sylvestris*), with birch scrub. In places, for a distance of about 30 feet, the undergrowth had been cut flat to the ground, and the trees brashed. This was obviously a precaution against forest fires and seemed necessary because the forest ended almost at the edge of the road in places.

The rocks of Marstrand are mainly grey gneiss and red Bohus granite. I expected the water to be acid but this was not the case because in the past, the sea had washed large quantities of sea-shells over the low lying islands, and so now the soil is basic. The woods here are in fact deciduous, consisting of oak, aspen, birch, alder, mountain ash, lime, elm, and underplanted with Norway spruce. I was told by my aunt, who is a school teacher, that the school children had planted these spruce and that it was part of their education. On the western sides of the islands the trees were suffering from exposure and they gradually gave way to heather (*Calluna vulgaris*), heaths (*Ericaceae*),wortleberry(*Vaccinium myrtillus*), bog-myrtle (*Myrica gale*), and numerous wild flowers and rock plants.

Butterfly collecting is my hobby and I was very pleased to see many butterflies here, although I was told that they are not as common as they used to be because of chemical spraying on the land. In fact I saw no evidence of chemicals being used in forestry. Unlike English weeds, Swedish weeds are not vigorous, and so weed-control is not important.

In Marstrand harbour there was a timber ship moored and I estimated it to contain 100 tons of spruce logs each being 2 metres in length. I enquired and found that the wood was for a paper-mill.

On the 12th July I rode 330 miles across Sweden, in the afternoon and evening, to the Baltic side. On the way I stopped at a place near a town called Ulricehamn and caught a butterfly which was new to my collection. It was flying over damp flower-covered land which was interrupted by clumps of 4–8 feet high Norway spruce which looked as though they had been planted on the higher parts of the area.

I took the "40" road east to Jönköping, and then joined the "E4" road which runs along the south-eastern side of Lake Vättern and then on north-east to Stockholm. Nearly the whole of the journey was through mixed Norway spruce -Scots pine forest. When I was not far from Stockholm I saw an elk in a clearing. The elks eat young deciduous tree-shoots and I think this must be beneficial to the conifers.

I stayed with friends at a place called Huddinge which is a suburb of Stockholm to the south and is situated in beautiful spruce, pine and birch woods. In this area I also caught several butterflies which were new to my collection. On the 14th July I went to see the 17th century warship *Wasa* which is being preserved in Stockholm after being brought up from the seabed in 1959 after 333 years. It was made from oak and lime. The oak had kept in a better condition than the lime.

In a part of Stockholm there is an oak tree called *The Birger Jarl's Oak* and it is older than Stockholm itself.

On 19th July I visited some friends at a place called Björkvik, and explored the surrounding countryside in the days that followed. Björkvik is an island to the east of Stockholm and although the land is mainly rocky, it is almost completely covered in forest; its name means "the creek of the birch trees". In hollows between the outcrops of rocks, Norway spruce had been planted at one metre spacings and were in straight rows. Wherever there were streams and ditches, alders and birches had been left to grow naturally.

There are two kinds of alder in Sweden. *Klibbal* (*Alnus glutinosa*) is common in the south but rarer in the north. It is the alder commonly found in Britain. *Gråal* or Grey alder (*Alnus incana*), is common in the north but rare in the south. It is often planted in Sweden.

There are three species of birch in Sweden. *Masurbjörk* (Curly-grained) (*Betula pendula*) is common all over Sweden on dry ground. *Glasbjörk*—Glass birch (*Betula pubescens*) is common on damp ground. *Dvärgbjörk*—Dwarf birch (*Betula nana*) grows as a low bush in boggy land at high elevations but is rare elsewhere.

Some areas of conifer had been clear felled and because of the rocky nature of the land the wild seedlings were being relied on to make a forest again. It would be extremely difficult to plant such areas.

The large Swedish match companies use *asp*—aspen (*Populus tremula*) for their matches, but I only found scrubby aspen wherever I went.

On 27th July I rode back across Sweden, this time along the "E3" road which runs past the south east side of the Lake Vänern. Most of the journey was through forests, and I got the impression that most of Sweden must be one large forest, and I would recommend anyone connected with forestry and interested in wildlife to take a holiday there.

I left for England on 1st August. The weather had been sunny with temperatures in the seventies and eighties most days and I was sorry to arrive back at Tilbury in pouring rain.

REPORT OF VISIT TO TREE BREEDING ESTABLISHMENTS IN SCANDINAVIA

By A. M. FLETCHER
District Officer, Research

During June/July 1969 a three week visit was paid to several tree breeding stations in Norway, Sweden and Denmark. This was the first comprehensive visit to tree breeding establishments in Scandinavia by a member of the Forestry Commission Genetics Section and it was unfortunate that Finland had to be omitted from the general itinerary because of limited funds. The Scandinavians have thirty years experience in tree breeding and have numerous experiments and experiences of relevance to Forestry Commission problems.

Most of the Scandinavian breeding work is concentrated on Scots pine, Norway spruce and larch and both the Norwegians and the Danes are becoming increasingly interested in Sitka spruce as a species for planting. These two countries have started serious Sitka spruce breeding projects during the past two years and because of the limited knowledge of breeding in this field it is hoped that a small group, involving the Norwegians, the Danes, and ourselves, will be formed for the exchange of information and plant material both to further our knowledge and to speed the work. It would be of great benefit to the individuals concerned if such a group could meet periodically to see and discuss matters of mutual interest.

Arising from the visit certain observations on techniques suggest that some aspects of our breeding work might profitably be re-examined. The general conclusions are summarized below.

1. Grafting

Throughout the tour examples were seen of both under-glass and outside grafting of Norway spruce and Sitka spruce. To date, we have almost exclusively restricted ourselves to inside grafting of Sitka spruce (except for Drumtochty Experiment 26 P64 and Newton Experiment 1 P.64) but from the evidence provided in Scandinavia and more especially in Norway, it is recommended that we should re-consider our methods and techniques of grafting. In future, it is suggested that a proportion of Sitka spruce grafting for seed orchard purposes should be done on site and onto rootstocks established two to three years in advance of grafting. The scion material for grafting these orchards could be provided from small scion banks on the seed orchard site.

In addition, we should establish experiments in the greenhouses to carefully compare different techniques for grafting both spruce and Douglas fir since our present techniques are not quite so advanced as those used by the Norwegians and the Danes.

2. Seed Orchard Ground

In all the Scandinavian seed orchards visited great stress was placed on establishing the seed orchards in areas where the soil and climatic conditions were most favourable for good growth and excellent flowering. They give little thought towards the expense incurred in obtaining this type of ground; the prime consideration is to obtain top quality ground. We must maintain or even improve our present standards for seed orchard sites.

3. Seed Orchard Maintenance and Management

In the majority of the seed orchards which were seen, the standard of ground cover maintenance was not nearly as high as we achieve in Britain. Many of their orchards are older than ours and once they have been established then lower standards of maintenance are accepted. In the formative years regular and complete harrowing of the soil is practiced. In addition both Norway spruce and some *Abies* species are used as catch-crops between the rows of grafts to produce revenue for Christmas trees and foliage; these plants may also provide a certain amount of useful side-shade and shelter to the grafts as well. These catch crops are also planted on cultivated ground. This type of maintenance in the early part of the orchard life has been used in several of the more recently planted orchards in Britain.

Pruning and shaping the trees in the seed orchards is only carried out where it seems advisable to artificially broaden the very narrow-crowned forms of Norway spruce and Scots pine plants. They do not recommend pruning as a general treatment, which is in agreement with current practices in this country.

4. Pollen Storage and Testing

These techniques of breeding work have not been investigated in any depth in Scandinavia but as interest in controlled pollination increases then more detailed studies will be required. Normally pollen is stored at much lower temperatures than in Britain.

5. Propagation by Cuttings

During the tour of Norway and to a lesser extent in Sweden, examples were seen of research on problems associated with rooting cuttings of Norway spruce. The results of these experiments are extremely interesting and it is now the intention of the Norwegians to use large areas of clonal material, propagated by cuttings, for the evaluation of their Plus trees both from the morphological and timber characteristics point of view. It is recommended that we persevere with experiments leading to the development of practical methods of propagating Sitka spruce in large quantities by means of rooted cuttings. In addition to the evaluation of Plus trees from cuttings, it is suggested that a comprehensive experiment is set up, using Sitka spruce, in which heritability estimates will be made using grafts, rooted cuttings, and material from open- and controlled-pollinations.

6. Inter- and Intra-specific Hybrid Spruces

During the visit to Denmark several very interesting examples of intra- and inter-specific hybrids between Sitka, Norway, Serbian and White spruces were seen. Quite clearly we should attempt to produce a hybrid between Serbian and Sitka spruces and also various inter-provenance hybrids of Sitka spruce where suitable opportunities occur. This will be a difficult and costly exercise, but from the Danish experience it appears to be a very promising line of investigation since there is the possibility that the Serbian spruce × Sitka spruce hybrid will be better suited to the poorer and more exposed sites in North and East Scotland.

7. Composition of Hybrid larch Seed Orchards

The Danes are now at the stage of reducing the number of tested clones in their hybrid larch seed orchards in order to produce very uniform hybrid larch material, suitable for commercial use. This approach will be parallel in Britain once we have determined those clones which 'nick' well (that is, readily set ample quantities of good quality seed), have well-matched flowering times and combine to produce outstanding offsprings.

8. Future Visits to Scandinavia

In 1968 the Scandinavians set up a breeding group which includes representatives of Norway, Sweden, Finland and Denmark; it meets annually for one week in the autumn to discuss certain aspects of breeding work and also to study examples of these techniques in the field. It is the intentions of the Scandinavians to continue this inter-Scandinavian breeding group and it would be an advantage if it was possible for the United Kingdom to send observers to these meetings. Although much can be gained from sending individuals on private visits to Scandinavia there is a decided advantage in the larger group meetings of making more contacts and the stimulation of broader discussions. However, the Forestry Commission approaches the aspect of visits abroad, I feel that it is essential that someone should visit Scandinavia at three or at most four year intervals.

9. Staffing

Throughout the three countries visited it was noticeable that there was normally sufficient money to carry out the projects they were engaged on but there were severe limitations on staff and especially field staff. This is in marked contrast to Britain where there is an excellent network of field stations which have been established over many years. Such a network allows more provenance and progeny trial work to be undertaken which can be solidly backed by high standards of experimental design and record keeping, which are essential.

THE HOLIDAY COTTAGE

They come Fridays for the weekend
For their rest from grime and smoke,
To enjoy the mountain freshness
And to live like country folk.
But they hurry through the village
Without pausing at the shop—
Mum was busy all the morning
Shopping cheap at the Co-op.

In the summer they stay longer
For the kids are home from school,
Time enough to walk the mountain
And to paddle in the pool.
But the village school stays empty,
And the trains have ceased to run,
For the owners of the cottage
Only wish for peace and fun.

Then on Monday they turn homewards
Back to their suburban cell,
Having rested in the country,
They can face another spell.
They take with them reels of cine,
And a healthy country tan,
And a sprig of purple heather
Picked on top of Mynydd Llan.

They have left you to your dreaming,
Dear old home with flag-stone floor,
Of the days when we were happy,
Playing by your big front door,
When the language that was spoken,
Was the one you understood,
When returning in the evening,
We came home, and home for good.

EUROS JONES

SILVICULTURAL TECHNIQUES

MICROBIOLOGICAL ACTIVITY IN SOILS AND ITS INFLUENCE ON THE AVAILABILITY OF MAJOR NUTRIENTS TO PLANTS

By T. I. W. BELL
District Officer

Fertile soils have been noted to have higher numbers of bacteria than non-fertile soils and in fact there is a relationship between numbers and relative proportions of most soil micro-organisms and soil fertility. The continual oxidising of dead plant remains by micro-organisms makes nitrogenous and mineral compounds available for plant growth. Fertile soils must either contain an adequate supply of nutrients in an available form or have a microbial population which releases nutrients fast enough to maintain rapid plant growth. An infertile soil results if micro-organisms remove and lock up available plant nutrients.

The soil micro-organisms can be roughly classified into two major divisions:

(1) The microflora which includes bacteria, actinomycetes, algae and fungi.

(2) The microfauna represented by protozoa.

In fact the division between the two groups is not always clear and there is a certain amount of overlapping.

The study of microbiological activity in soils is difficult and often only a partial picture of what the smaller micro-organisms do can be obtained. They need food, mainly carbohydrates, to supply energy for necessary vital processes and to build up their body tissues. Some can use the same supply of food for both processes while others can use quite different sources of food.

The microfauna are classified into autotrophs which are capable of using the carbon of carbon dioxide as the sole source of carbon for body tissues, and heterotrophs which are not so capable. Most algae and some bacteria are capable of autotrophic growth while most bacteria, actinomycetes and fungi can only grow heterotrophically. All micro-organisms need minerals as well as sources of carbon and nitrogen, their requirements being rather similar to plants.

The Soil Micro-organisms

Bacteria

The most important and usually the most abundant group of soil organisms are the bacteria. They are very small, about 0·5 to 1μ in diameter and up to 2μ in length, and may occur as single cells or in some forms the cells are linked into chains or joined end to end and appear as long filaments. The number of bacteria in the soil is continually fluctuating, generally constant in winter with an increase when the soil begins to thaw in the spring. Soil temperature and moisture influence seasonal fluctuation. Also exerting a strong influence are aeration, organic matter and acidity. Good aeration is essential for nitrification. Population size in mineral soils is directly related to organic matter content so that humus-rich localities have the largest bacterial numbers.

Bacteria carry out a wide range of chemical transformations. They are essentially surface feeders in their initial stages of colonization of a solid corpus of dead plant or animal tissue in the soil. Exoenzymes diffuse out from the bacterial colony and the rate of surface erosion of the substrate is determined by the rate at which enzymes are produced by and diffuse out from the colony.

Actinomycetes

Actinomycetes are usually regarded as a transition between bacteria and fungi. In the soil some of their filaments look like fungal mycelium and some of their spores like bacteria. In general appearance they are like long branched bacteria. By comparison with bacteria they are less common in wet than in dry areas and resemble bacteria in their intolerance of acidity. Unfavourable sites are peats, waterlogged areas and where the pH is less than 5. Sites high in carbonaceous materials and humus tend to have larger populations than habitats poor in organic matter.

They are mainly heterotrophic and can use a wide range of carbon and nitrogen compound e.g. celluloses, hemicelluloses, proteins and possibly lignins. Their presence is conditioned by the availability of organic substrates.

The activities of actinomycetes in soil transformations are not fully defined but there is evidence for their participating in the following processes.

(1) Decomposition of certain resistant components of plant and animal tissues. They fare poorly in competition with bacteria and fungi and are effective competitors only when resistant compounds remain.

(2) Formation of humus through the conversion of raw organic matter into the types of compounds native to the soil organic fraction.

(3) Possible importance in microbial antagonism through the liberation of antibiotics.

(4) Mineralization of the organic matter of the soil.

Their feeble competitive powers may explain their relative scarcity during the initial stages of plant residue decomposition. A few are parasitic of plants usually in the roots where they may affect the uptake of nutrients, but the majority are typical soil organisms associated with rotting organic matter.

Algae

The soil algae are minute green plants which occur either as simple unicellular organisms or organised as filaments. Generally they are few in number compared with bacteria or fungi. Being green plants they require light for their normal growth and development so that you would expect them to be primarily organisms of the surface of the soil. However, they are sometimes found not only on the surface but also several inches below the surface where no light can penetrate, possibly having been washed down by rain or carried down by soil fauna.

Near the surface they presumably function as green plants converting the carbon dioxide of the air into protoplasm and taking up nitrates or ammonia from the soil. The activities of those in the dark are not known.

The contribution of algae to plant nutrition is not clear but it is likely that it consists in part of building up organic matter in young soils. Also a few of the blue green algae are reported to fix atmospheric nitrogen (Waksman 1928).

The waterlogged soils of the tropics often have considerable growths of blue green algae and in rice cultivation the nitrogen contributed by the algae seems to form an important factor in the successful growth of the crop.

Abundant soil moisture favours an increase in the population. The addition of organic matter to the soil inhibits the growth of algae during the period of active decomposition of the material by bacteria and actinomycetes due possibly to competition for essential elements.

Fungi

Although not often the most abundant group of micro-organisms in the soil, in most well aerated cultivated soils the fungi account for the largest part of the total microbial protoplasm due mainly to the extensive network of fungal filaments. In most soils these filaments are too small to be seen with the naked eye or a magnifying glass. In some raw humus or moror soils fungi are predominant due to lack of competition from bacteria and actinomycetes for the food reserve. On the addition of organic matter, particularly in soils of low pH fungi becomes quite numerous.

Representatives of all common classes can utilize and degrade the main plant constituents, cellulose, hemicellulose, pectins, starch and lignins. In woodlands the leaf debris becomes permeated with an extensive hyphal network that helps in the decomposition of litter and thus helps in the formation of humus. As a result of using protinaceous substances fungi are active in the formation of ammonium and simple nitrogen compounds in soil. Under certain conditions fungi compete with higher plants for nitrate and ammonium and lead to a decrease of the soluble nitrogen content of the soil much of which is subsequently only slowly released in a form available to plants.

Fungi are well suited to decomposition of wood due to their intrusive hyphal growth habit—the fungal hyphae can easily penetrate the toughest wood although vigorous cellulose decomposing fungi are in a minority. Ability to decompose lignin is even less common.

The advantages of intrusive mycelial growth habit are not confined to decomposers of cellulose and lignin. Fungal hyphae are able to penetrate relatively thin cellulose walls by pressure alone.

Certain fungi form an association with roots of higher plants resulting in the formation of an organism called *mycorrhiza* or fungus root. Two types may be recognised (1) ectotrophic which forms a mantle or sheath of fungal mycelium visible to the naked eye, enclosing the roots and of fungal hyphae filling the intercellular spaces and (2) endotrophic in which the hyphae invade the cortical cells without killing them and in which a mantle is not formed.

Most ectotrophic mycorrhizal fungi appear to behave as ecologically obligate parasites and have no independent saprophytic life in the soil. The fungus gets its supply of energy as carbon substrate from the host plant. Thus supplied with energy the hyphae of the fungal sheath are able to absorb nitrogen, phosphorus, potassium and other minerals from the soil and a portion is then available to the host plant. This is particularly noticeable in infertile soils where mycorrhizal tree seedlings grow much more vigorously than do non-mycorrhizal ones, the fungal hyphae of the mantle being able to apparently compete more effectively for nutrient salts than the root hairs of uninfected rootlets.

When competition for soil nutrients is less important, as in highly fertile soils, mycorrhizal infection appears to be of little or no benefit to the host plant. The largest number of mycorrhizas are produced under shortage of available nitrogen, P, K or Ca and it is therefore in unfertile soils that mycorrhizas regularly replace uninfected rootlets as the main absorbing elements.

Kessell & Stoate (1936) found that difficulties encountered in production of conifers in new nurseries in Western Australia could be avoided if surface soil from established nurseries was spread on. Rayner (1935) cited numerous examples from various parts of the Commonwealth of the successful inoculation needed for growing exotics and in afforestation.

Protozoa

The protozoa are the simplest forms of animal life that occur in the soil. All the soil types, about 20, are microscopic in size with relatively simple acellular structure. The soil forms are grouped under amoeba, testaceous rhizopods, flagellates and ciliates, the simplest form being the amoeba.

Protozoa can feed in three ways; some possess chlorophyll and are autotrophic, some can feed saprophytically absorbing nutrients from solution in pure cultures, most normally only feed by capturing and digesting solid particles such as bacteria. Since bacterial development is important to soil fertility protozoa have a detrimental influence on crop production. Partial sterilisation of the soil by heating with steam or burning or adding sterilizing solution increases the fertility markedly for a time. The explanation is thought to be that the protozoa are killed off thus allowing the bacteria to decompose the soil organic matter more vigorously. This has not however been proved.

When the edible bacteria are no longer available or the environment becomes unfavourable the active protozoa enter the cyst stage in which form they can persist for many years.

Major Nutrients

One of the most important functions of soil organisms to soil fertility is that, by feeding on soil organic matter, there is the continuous conversion of nutrients from a relatively immobile and unavailable form into a form in which they are mobile and available to the plant. The soil organisms slowly release the plant nutrients from the organic matter into a mobile form that is available to the growing crop. The major plant nutrients derived from the soil are nitrogen, phosphorus and potassium and in lesser quantities, calcium, magnesium and sulphur.

Nitrogen

Plants require nitrogen in greater quantities than any other soil nutrient. It is a key building block of the protein molecule upon which all life is based and is therefore an indispensible component of the protoplasm of plants, animals and micro-organisms. It is assimilated mainly in the inorganic state as nitrate or ammonium and is one of the few nutrients that is lost by volatilization and leaching.

In what is known as the nitrogen cycle, nitrogen undergoes a number of transformations in which it is shuttled back and forth at the discretion of the microflora. Part of the reservoir of nitrogen in the atmosphere is converted to organic compounds by certain microbial-plant associations or by a microbial-plant association that makes the element directly available to the plant. The nitrogen present in the protein of plant tissues is used by animals where it is converted to other simple and complex compounds. When the plant or animal dies and decays the organic nitrogen is released as ammonium which is then used by the vegetation or is oxidised to nitrate. In this form it may be lost by leaching, may serve as plant nutrient or may be reduced to ammonium or gaseous nitrogen which escapes to the atmosphere thereby completing the cycle. The individual steps in the cycle are as follows:

Nitrogen Mineralization

Conversion of unavailable organic nitrogen to inorganic nitrogen is essential to soil fertility and the process is called nitrogen mineralization. As a consequence of mineralization ammonium and nitrate accumulate and organic nitrogen disappears. The microbiology of protein breakdown in soil is not fully understood but it is probable that bacteria dominate in neutral or high pH soils but fungi and actinomycetes also contribute to the transformation. On low pH sites the main agent is fungi. The ammonifying population includes aerobes and anaerobes and organic nitrogen is mineralized consequently at moderate or high moisture levels.

Nitrification

In older literature the term was used in the same sense as mineralization but it is now thought of as the transformation of ammonium to nitrate. The transformation of organic nitrogen to ammonium is called ammonification. The organism responsible for transformation of ammonium liberated by ammonifying micro-organisms are the nitrifying bacteria. The first stage carried out by species of genus *Nitrosomonas* consists in oxidation of ammonium to nitrate. The second stage, oxidation of nitrate to nitrate is mediated chiefly by species of genus *Nitrobacter*.

In soils too acid for the nitrifying bacteria to tolerate, soluble nitrogen remains in the form of ammonium salts. These can be taken up by the roots of some plants and there is evidence that a number of species grow better with ammonium than nitrate nitrogen.

Nitrogen Immobilization

Adding, for example, excess sawdust as a seedbed cover almost invariably leads to a decrease in inorganic nitrogen content of the soil. This results in a marked depression of nitrogen uptake by the plant and decrease in crop yield. This immobilization of nitrogen results from microbial assimilation of inorganic nutrients. As new cells are formed not only must carbon, hydrogen and oxygen be combined into protoplasmic complexes but so must N, P, K, S, Mg and Fe, thus each of these elements is immobilized. This is the converse to mineralization which returns microbial and plant nutrient elements to the inorganic state. The immobilization or tie up of nutrients is only temporary.

Denitrification

The steps that lead to gaseous loss of nitrogen is referred to as denitrification, the microbial reduction of nitrate and nitrite with the liberation of molecular nitrogen. The major mechanism of Nitrogen Volatilization is by microbiological denitrification and may result in poorly drained soils. Nitrates are reduced to gaseous nitrogen by certain bacterial organisms to obtain oxygen. The denitrifying bacteria are all aerobic.

Many micro-organisms in addition to the dentrifiers *reduce nitrogen*. In the process of photosynthesis any micro-organism that utilizes nitrate as a nitrogenous nutrient is able to reduce it to ammonium as it is ammonium which enters into the organic combination necessary for protein synthesis within the cell.

Non-symbiotic Fixation of Nitrogen

A number of free living nitrogen fixing organisms are found in soils, the main ones being the blue green algae and photosynthetic bacteria. So far the chemistry of the nitrogen fixing process is not known. A small amount of molybdenum is required for efficient working and the nitrogen fixing only takes place when the level of available nitrogen is low.

Symbiotic Nitrogen Fixation

Nodules in the roots of many leguminous plants contain bacteria living symbiotically with the plant. The plant leaves supply the carbohydrates and the bacteria the amino acids for the combined organism. These nodules are more efficient fixers of nitrogen then the non-symbiotic bacteria. The nodule bacteria are classified in the genus *Rhyzobium*. Nitrogen fixation is also carried out by actinomycetes living intercellularly in nodules on the roots of tree species e.g. the alder.

Phosphorus

Bacteria, fungi and actinomycetes act on the large reservoir of organic phosphorus and convert it into organic forms that can be used by plants. Affecting the rate of mineralization are soil temperature and pH which affect the micro-organisms. Also important is the quantity of substrate. The mineralization and immobilization of this element are related to the analogous reactions of nitrogen.

Potassium

Although the microbial population is important in the transformations of potassium little is known of the conversion of this element that can be effected by the micro-organisms. Certain bacteria are known to decompose alumino-silicate minerals and release a portion of the K contained. Micro-organisms also liberate K from nephelite, orthoclase and possibly other sources.

Sulphur

Sulphate is the normal form of inorganic sulphur in well-drained soils. The main content of available sulphur in most agricultural soils is in the organic matter as plants take up sulphate from the soil and use them in the synthesis of the amino-acids cystine and cysterne which form a part of many plant proteins. The plant residues returned to the soil are attacked by soil micro-organisms some of the sulphur reappearing as sulphate and some remaining as humus. Little is known about the processes involved.

Root-attacking Micro-organisms

As can be seen, roots are important as absorbing surfaces for the intake of water and nutrients. Reduction in efficiency of the roots by the attacks of micro-organisms is common. An outstanding example of serious injury to trees caused by injury to small roots and root tips is the littleleaf disease of shortleaf pine which is prevalent on compact poorly aerated soils in the South-Eastern United States. The presence of the parasitic fungae *Phytopthora cinnamoni* on the roots results in the loss of so much absorbing surface that the trees become unthrifty and finally die (Kramer).

Conclusion

In this paper it has only been possible to touch very lightly on the complex science of soil microbiological activities and major plant nutrients. The importance of the degradation by these organisms of plant refuse can be appreciated when the vast quantities concerned are understood. Kühnelt quotes that in pine plantations 2,800 kg of litter containing 46.5 kg mineral matter fall per year per hectare. Scott quotes a figure of 1 to 1½ tons dry weight of forest tree litter per acre annually reaching the soil. The smaller the nutrient reserve of the soil the more significant becomes the activities of soil micro-organisms on the influence of the availability of major nutrients to plants.

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PROGRESS OF RESEARCH IN PLANT NUTRITION ON PEAT

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By D. DICKSON

This is the script of a talk given by Dr. D. Dickson at the Northern Ireland Forest Service, District Officers' Conference on the 16th February, 1968. Here are one or two definitions of terms used:

Oligotrophic Peat: Unflushed peat with a very low nutrient content.

Mesotrophic Peat: Slightly flushed peat with an intermediate nutrient content.

Eutrophic Peat: Flushed peat with a high nutrient content, relative to peats generally.

Ombrogenous Peat: An Oligotrophic peat completely uninfluenced by mineral rich ground water and relying entirely on atmospheric sources of all available nutrients.

It is sometimes a bit difficult for people like myself to maintain satisfactory contact with the practicalities of field forestry and to keep field staff fully informed of the results of our research work.

One of the major difficulties in the way of easy communication between research and field workers in forestry is that—not unnaturally—we do not want to say anything definite about a particular topic until we are sure about it ourselves. From the results of one of our experiments at Beaghs I could, for instance, state that increased drainage, by itself, had no appreciable effect on the growth of checked Sitka spruce. Now this statement is true in terms of the results of one experiment and over a period of four years. But I would like to wait for at least another four years' results before making such a statement in front of an audience of practising foresters.

This time lag in communication of experimental results in forestry is unfortunate, but I think unavoidable, although informal meetings like this morning's can go a good way towards bringing the two sides closer.

What I would like to do now is not to discuss the results of a whole series of experiments and suggest what the effect would be of applying 'X' cwts of fertiliser to a plantation—after all the practicality of any forest operation can be judged only by an economic evaluation, which we are not really in a position to undertake until the end of the rotation. I would rather ask you to take a wider look at some of the properties of peat soils and at how these properties might affect our future forestry practice on such soils.

I might state at the outset that the data presented can hardly be disputed but I suppose that the interpretation of the data can be varied to some extent—this I presume depending on whether one's general outlook is optimistic or pessimistic, or dare I add, realistic.

One very simple way of assessing the fitness of a site to produce a crop is to determine the total requirements of the crop in terms of its physiological requirements (e.g. for moisture, essential nutrients, climatic suitability, etc.). If it can be shown that the site in question can fulfil these requirements then, in theory at least, the crop will grow on that site. We need not necessarily actually grow the crop on the site. What we are doing is predicting the growth response of the crop on the site from a knowledge of the physiological requirements of the crop and of the ability of the soil to meet these requirements.

In forestry, however, this approach has not been followed until quite recently. This has been due to a lack of information concerning the total nutrient requirements of a mature tree crop—we can concentrate on these since we are fairly sure that the other environmental factors in the British Isles as a whole are reasonably favourable. Recently, however, a number of estimates of these requirements has been made. Although none refers directly to the situation on peatland in Northern Ireland, the estimates cover a wide range of soils and an average of the lower values quoted should represent the minimum quantity of nutrients required to produce a crop under our conditions.

Since phosphorus is the most critical single nutrient element governing the productivity of peat soils we shall look at it first.

The published estimates of the total phosphorus content of a tree crop at about the time of maximum dry matter production range from 22 to as high as 133 kilograms per hectare. I think if we accepted a figure of 50 kilograms per hectare as the total phosphorus content of a crop of Sitka spruce at, say the end of a 30-year rotation on deep peat, we would not be far wrong. Notice that this is the minimum quantity which the soil must supply—the actual figure might well be higher under our peatland conditions—this depending on the rate of release of phosphorus from the needles and other organic debris shed by the trees over the period of the rotation.

Starting from the premise that 50 kg/ha of phosphorus are required to grow a crop under our conditions we can consider the potential of different types of peat to supply this quantity. You will note that in this sort of analysis we are concerned only with the total quantities of nutrients in the soil at any one time. No account is being taken of the rate at which the soil can supply the required nutrients. Yet, as far as the growth of a crop is concerned this is obviously an equally important characteristic of the soil. Very often the total quantity of a nutrient in the soil exceeds the total requirements of the crop, yet the growth rate of the crop is restricted because the rate at which the soil can supply an element is less than the crops demand at a particular time. The nitrogen nutrition of spruce on peat is a classic instance of this. Although the nitrogen content of the peat is relatively very high its availability at any one time, or in other words its rate of release, is often too low to meet the nitrogen demands of the crop.

How then can we estimate the capability of a given peat soil to supply the 40 kg/ha of phosphorus necessary for the production of a 30-year old spruce crop?

The total phosphorus supplying capacity of the site is made up from three separate sources—the soil, the vegetation and the atmosphere. We shall consider each of these in turn.

It is relatively easy to estimate the total phosphorus content of a peat soil. The main difficulty in obtaining reliable information from our point of view lies in deciding the depth of peat which we should include in our calculations. We have adopted a depth of 30 cm (approximately 12 ins.) as the limit—the volume of peat above this being termed the 'potential rooting volume' of the trees. Some of you may take the view that a 12 in. depth limit is too shallow and that tree roots will exploit a greater volume than this. There is no doubt that the roots of certain of the native peat flora extend to, and are capable of nutrient absorption at depths greater than this but there is little evidence regarding the nutrient absorbing zone of trees on deep peat. I think, however, that on a short rotation and because of the vertical gradient of nutrient concentration in peat, the greatest proportion of nutrients available to a tree crop will be contained in the top 30 cm of the peat.

The first column of figures on page 47 shows the total volume of phosphorus contained in the potential rooting volume of the three nutrient classes of blanket peat (all references are to types of blanket peat—no data for basin peat are available at present). The values range from 100 to 430 kg/ha of phosphorus. Now, of these total quantities only approximately $\frac{1}{4}$-$\frac{1}{3}$ is in an inorganic form at one time and only this fraction is available to the trees. On this basis then the quantity of phosphorus available to the trees ranges from 30 kg/ha in oligotrophic peat to 140 kg/ha in eutrophic peat. The quantity in the vegetation ranges from 3-5 kg/ha. The phosphorus concentration in rainfall is relatively small and only about 6 kg/ha accrue to the site over a 30-year rotation. A fairly high proportion of this quantity is in the form of dust and biogenic particles and may not be immediately available.

As well as the quantities gained by the site we must also consider the quantities lost via leaching. From analyses of drainage water and on the basis of a 100% run-off of the total annual rainfall, we have estimated that the quantity of phosphorus lost from unfertilised peat via leaching is approximately 20 kg/ha over a 30-year period.

Thus what we might call the net phosphorus potential of deep blanket peat ranges from 20 kg/ha in the oligotrophic type to 60 kg/ha in the mesotrophic type and to over 130 kg/ha in the eutrophic flushed peat. Remembering that the total crop requirement for a 30-year rotation is 50 kg/ha we can see that to grow such a crop on oligotrophic peat is impossible without addition of phosphatic fertiliser, but that on mesotrophic peat this would just be possible and on eutrophic peat quite possible provided the trees could utilise fully the available phosphorus reserves. This does not, of course, mean that the growth of the trees on these types of peat would not benefit from the application of phosphatic fertiliser. It merely means that such sites have the potential resources of phosphorus to meet the crop's demand. The exploitation of this potential depends on many factors which we cannot discuss today.

In the oligotrophic peat, however, the nett phosphorus potential is less than half the crop's demand and we must look at this situation more closely. Here we find two distinct circumstances. Firstly, we have those areas which were planted with 2 oz basic slag per tree in the planting hole at time of planting. In retrospect, this practice had little to recommend it. In the first place when the slag was deposited at the bottom of the planting hole it tended to cement into a hard lump in which form, as we discovered, it remained for many years, its phosphorus virtually unavailable to the trees. Secondly, the slag was placed where we hoped the roots would not remain—that is, in a compact ball at the base of the planting hole. If the roots were to benefit from the phosphorus in the slag they would have to emulate that legendary bird which flew round and round in ever decreasing circles—and you know what eventually happened to it!

Apart, however, from the position of placement, it is now clear that 2 oz slag per tree does not provide enough phosphorus to meet the crop's demand on oligotrophic peat. Even assuming that all the phosphorus in the slag became available to the trees and that none was lost via leaching (and both assumptions are, in fact, invalid) only a further 20 kg was added to the 20 kg/ha nett phosphorus potential of the peat. There is still a 10 kg/ha phosphorus deficit between soil supply and crop demand.

I would hesitate to calculate the area of plantations established on deep oligotrophic peat under the old system of manuring, but it must be fairly large. From the calculations given, it would seem that it will not be possible for these plantations to reach maturity without further treatment which will increase the phosphorus supplying capacity of the site. The long-term outlook, then, is not very rosy—but what of the short-term prospects of such plantations. How many acres planted on oligotrophic peat with 2 oz basic slag are not already in a checked and phosphorus deficient condition? And this after less than 10, never mind 30, years.

What then can we do about this situation? There is a relatively large store of unavailable phosphorus contained in organic compounds in the peat. If the peatland environment can be changed so much that the present tendency towards organic matter accumulation can be reversed, a proportion of the phosphorus may become available. There is, however, no real evidence of this change taking place and I do not honestly think that we can delay treatment until the balance shifts. We must act now. But what should we do?

Both Bill Jack and myself have a number of experiments involving the treatment of checked areas but unfortunately they were laid down quite recently and no final conclusions can as yet be drawn.

It seems to me, however, that there are three basic treatments which can be applied. We can drain more effectively, we can destroy the existing vegetation or we can apply fertiliser. Combinations of any of these treatments can also be tried. Now what effect do these measures have on the nutrient supplying capacity of the site. By increasing the drainage effectiveness we seek to allow the tree roots to penetrate deeper into the peat. From the windthrow aspect this is undoubtedly an excellent idea but the nutritional advantages are probably slight. Because of the phosphorus gradient in peat, the extra phosphorus likely to be available in the volume of peat say in the 12-18 in. layer is quite small. Drainage by itself then is unlikely to solve our main problem.

The question of herbicide treatment must be looked at from both long- and short-term aspects. There is no doubt that the application of an effective herbicide to checked spruce on peat results in a very dramatic and almost immediate increase in the vigour and growth of the spruce. Unfortunately we have little information about the length of time over which this treatment will be effective, but since no addition of nutrients to the site is involved (the distribution of nutrients within the site is merely altered) I doubt if we can expect this treatment to be adequate in the long term.

This then leaves us with the further addition of phosphatic fertiliser as the most hopeful method of achieving timber production on these poor peatland sites. Again we have a number of experiments dealing with rates and forms of fertiliser best suited for this purpose but none is old enough to make economic predictions from the results. All we can say is that broadcasting seems to be the most effective position of placement; that rock phosphate either in the coarse, or finely ground, form is the most suitable fertiliser, and that rate of leader growth increases, though not linearly, with increasing rate of application at least up to 10 cwt per acre. Whether this increased growth at high rates of phosphate is economically justified we do not yet know.

What I think is beyond doubt, however, is that if we wish these plantations established on oligotrophic peat with 2 oz basic slag per tree to reach the timber production stage within a reasonable time we must be prepared to add supplementary phosphate. Other treatments such as drain deepening, mulching, herbicide application, may alleviate the problem somewhat but I doubt if they will offer an acceptable solution.

From the point of view of reserves of potentially available phosphorus the plantations on mesotrophic and eutrophic peat which received slag should be able to reach maturity. So also should the plantations established on all classes of deep peat which received 4 cwt per acre rock phosphate. For instance, the nett phosphorus potential of oligotrophic peat receiving rock phosphate is 80 kg/ha, considerably more than the 50 kg/ha required by the crop. Let me repeat that I am not claiming that a plantation of this kind will not benefit from additional phosphate. Indeed to achieve an acceptable rate of growth it may require it, but at least the potential is there. The potential is simply not there in the other situations.

I could say a good deal more about the phosphorus nutrition of trees on deep peat, but have probably said enough for one morning. I would like now to say something about potassium and the possibility of this element limiting tree growth.

If we carry out an analysis of the relative quantities of potassium required to grow a tree crop and the total potassium supplying capacity of peatland sites, such as we have already done in the case of phosphorus, we are faced with some rather startling facts.

The various estimates which have been made of the total quantity of potassium required to produce a tree crop at the end of a 30-year rotation range up to 690 kg/ha of potassium. However we could reasonably accept the figure of 200 kg/ha as the quantity of potassium required to produce a crop under our conditions.

Unlike phosphorus, the total quantities of potassium contained in the potential rooting volume of the oligotrophic and mesotrophic peat types are quite similar. The actual figures are 94 kg/ha in oligotrophic peat and 100 kg/ha in the mesotrophic type. There is a greater difference in the potassium content of the vegetation of the two types. On oligotrophic peat the vegetation contains approximately 20 kg/ha potassium whereas there are 34 kg/ha in the vegetation of mesotrophic peat.

Compared with phosphorus, the potassium content of rainfall is relatively high, the average quantity contained in rainwater being approximately 3.3 kg/ha. Over a 30-year rotation we can, therefore, expect about 100 kg/ha to be added to the potassium capital of the peat.

Summating these quantities, then, we find that the gross potassium potential of oligotrophic peat amounts of 204 kg/ha and to 234 kg/ha in the mesotrophic peat. In contrast to phosphorus, the bulk of this quantity is freely available to the trees. Since the total potassium requirement of the crop is 200 kg/ha, it might appear that we should be able to grow a crop on either type of peat without recourse to the addition of potassic fertilisers.

However we must take account of the quantities of potassium lost from the site via leaching. Based on the average potassium concentration of water draining from peat and assuming a 100% run-off of an annual rainfall of approximately 60 ins. the annual loss of potassium amounts to 7.5 kg/ha. Over the rotation we lose from the site about 225 kg/ha of potassium.

In other words we lose more than twice as much potassium via leaching as

PHOSPHORUS DEMAND OF TREE CROP IN RELATION TO PHOSPHORUS-SUPPLYING CAPACITIES OF DIFFERENT PEAT TYPES AND RATES OF FERTILISER APPLICATION

1. *Total P demand of tree crop at end of 30 year rotation — 50 kg/ha.*
2. *Total P content of site (all quantities shown as kgp/ha).*

	Contained in Potential rooting volume of peat		Vegetation	Supplied via atmosphere	Lost via leaching	Nett available quantity in peat	Supplied as Fertiliser	
	Total	Available		(Over 30 years)	(Over 30 years)		As 2 cwt/acre Basic Slag	As 4 cwt/acre Ground Rock Phosphate
A. Oligotrophic	100	30	3	6	20	20	20	60
B. Mesotrophic	220	70	4	6	20	60	20	60
C. Eutrophic	430	140	5	6	20	130	20	60

Total Available Quantity in Oligotrophic Peat + 2 cwt/acre Basic Slag = 40 kgp/ha
Total Available Quantity in Oligotrophic Peat + 4 cwt/acre G.R.P. = 80 kgp/ha

Total Available Quantity in Mesotrophic Peat + 2 cwt/acre Basic Slag = 80 kgp/ha
Total Available Quantity in Mesotrophic Peat + 4 cwt/acre G.R.P. = 120 kgp/ha

Total Available Quantity in Eutrophic Peat + 2 cwt/acre Basic Slag = 150 kgp/ha
Total Available Quantity in Eutrophic Peat + 4 cwt/acre G.R.P. = 190 kgp/ha

we gain from the atmosphere. In fact from our figures, the nett potassium potential of oligotrophic peat is negative, it is –5 kg/ha of potassium.

One could mutter something about balance of payments at this point—and yet our figures are not incorrect. Obviously we have omitted some factor from our calculations since if we have been gaining 3.3 kg/ha from the atmosphere yet losing 7.5 kg/ha each year since the peat was laid down we would have no potassium at all in the peat.

Despite what has been claimed to the contrary the only source of potassium which we have excluded is the mineral soil underlying the peat.

It has generally been assumed that once peat accumulates to a certain depth (this seldom being specified) above the mineral soil the influence of that soil on the chemical composition of the upper layers of peat is negligible. This, of course, does not apply to mineral rich flushed peat but it was thought to be true of peat developed on flat or convex topography. Indeed the very term ombrogenous used to define peat of this type suggests that the upper layers of the peat are influenced, as far as chemical composition is concerned, only by minerals derived from atmospheric sources.

If we view the peat/mineral soil system statically—that is take single point samples in time—there is indeed a great deal of evidence to support this view. The calcium content of peat overlying shattered limestone for instance is relatively high in the few inches of peat lying in contact with the mineral soil but it drops dramatically in the layers above this. Evidence such as this can be obtained from any situation where deep peat overlies a mineral soil with a particular dominant chemical characteristic.

What the evidence of our results of drainage and rainwater analyses suggests, however, is that the situation is not static but that there is a continual movement of ions from the mineral soil to the upper layers of the peat. This movement presumably occurs via a process of diffusion. If this is so it invalidates any data which I have presented on the potassium nutrition of trees on deep peat. Since if a dynamic equilibrium exists with relation to potassium then the quantities lost via leaching will be made good from the potassium reserves in the underlying mineral soil. This, however, is only true for elements contained in an available form in the mineral soil in reasonable quantities. Potassium in most of our soils, is one such element. But the phosphorus status of many, indeed most, of the soils underlying our mountain peats is exceptionally low. What I have said about the phosphorus nutrition of trees on deep hill blanket peat remains in very large measure true.

THE FUTURE OF FOREST NURSERIES IN NORTHERN IRELAND

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By G. N. L. COATES

Over the past 10 years there has been a continuous trend towards new production methods in forest nurseries. These have been influenced by the increased fertility resulting from a planned regular manurial regimen, fluctuations in the availability of labour and that ever present problem, the weather. In the early 1950s there was a movement away from the small forest nursery, or the slightly larger district nursery, towards more centralised plant production. The object of this was to achieve more efficient management aided by intensive mechanisation, and the logical end product would have been one nursery which would produce all the plant requirements for the whole of Northern Ireland. However, it was found that there was a great difference between theory and practice. Large nurseries are far more prone to man-power problems than are small ones, particularly when the small nurseries are attached to forest areas. In addition, the climate has a much greater effect on a nursery with a very large programme spread over a considerable period of time than it has on a small nursery with its limited programme.

In the traditional forest year lining out was largely done in the spring, at the same time as seed bed making and sowing, and there was then a lull between the middle of May and late June, until weeding commenced. Weeding continued throughout the summer. There was then another lull until plant lifting started, and this, in Northern Ireland, tended to be an early spring job as relatively little planting is done during the autumn. The customary bad spring weather usually resulted in plant lifting being delayed, and coinciding with the necessity to commence lining out and seed sowing. This in turn meant that, except where a reasonably small nursery was attached to a forest with plenty of men, labour had to be employed on a casual basis or on loan from other forests—an expensive business however organised, involving the use of inefficient labour or high transport costs. Because of this the tendency was always to over-staff the nursery knowing that the men would be required during the rush period. This was uneconomical as it meant that these men were carried as passengers through quite a large part of the year.

Mechanisation should have solved these problems, permitting all the necessary operations to be carried out economically, rapidly and with the minimum labour force. The picture envisaged included drill sowing, permitting undercutting and side pruning of roots in the seed beds, cultivation of both drills and transplant lines to control the weeds, lining out using the Ledmore type lining out plough, or better still, a fully automated lining out machine such as the "Super Prefer" with which lining out can be boosted to around 12,000 plants per man per day against the Northern Ireland average of under 4,000, and, finally, plant lifting carried out by a modified potato lifter. All these pieces of equipment seemed logical but all had common denominators—the weather and the soil. No mechanical equipment can operate efficiently unless the soil is light, friable, stone-free and reasonably dry. Although we have nurseries which fulfil the first three conditions, our weather is unformly bad in spring and the nurseries seldom dry out until March. Often when they do dry it is due to the commencement of a cold east wind coupled with a spring drought which results in desiccated plants and very heavy losses on lining out.

The result of the above was to bring the increase of mechanisation to a halt and to end the trend towards bigger nurseries. It was found that those we have are probably, under the present conditions, the easiest size to run economically—at both Muckamore and Campsey, which are above average in size and below average in forest activities, man-power is a major problem.

To summarise:

The traditional nursery programme has been to lift the plants over the winter, line out and sow the beds in spring, and weed in summer and autumn. The end product comprises transplant stock, 2 + 1 in the case of most species, 2 + 2 in the case of Silver firs and Norway spruce, and even older plants on occasions. Under this regimen full mechanisation has proved to be impractical.

Now to look at the present picture. The plant handling methods have changed little—and the main changes may well be looked upon as retrograde steps—the adoption in several nurseries of a method of lining out in beds similar to the old bedding-out system. This method, which is completely manual, is carried out either on raised beds or on the flat ground, and was introduced to enable work to proceed under adverse weather conditions utilising a small number of men. It had been found that efficient bedding-out produces extremely good stock with a very low level of loss, although the actual cost of the work is relatively high. This may well be offset by the excellent survival rate.

The main differences between nursery organisation and that of 10 years ago are concerned with weed control and the work periods. The introduction of Simazine, a residual weed killer which can be applied to stand-over seed beds and transplant lines, and which can control all weed growth throughout a growing season without causing damage to the growing stock, has virtually eliminated weeding amongst plants over a year old. This weed killer has limitations—during the last year or two there have been cases where the effect has fallen off considerably and hand weeding has been required. In spite of the fact that Simazine is highly insoluble it may well have been that the rainfall has been sufficient to wash it out of the soil. There has also been a tendency for nursery men to be lulled into a false sense of security which, on occasions, has been rudely shattered. On the traditional weeding system great emphasis was placed on the maintenance of the nursery itself and its environs in a weed-free condition to avoid seeding, but there has been a tendency to assume that seeding is no longer important as the seedling weeds will be controlled by Simazine. Nevertheless, the saving in weeding costs was sufficient to compensate for the increases in labour charges and overheads for several years. Other weed killers are being produced and it may well be that the changes can be rung to ensure that no weeds become immune to chemical control. Still to be produced is an efficient and reliable method of controlling weeds in first-year seed beds, but even here there are possibilities which will be explored durıng the next year or two. Reference should be made to experiments carried out by Mr. Bell at Pubble and the use of Simazine. These experiments were written up in *The Forester*, Volume 3, No. 1.

The other main difference is concerned with the work periods and this promises to be as revolutionary as the introduction of Simazine. Although lining out is still carried out to some extent in spring, a second period takes place in late summer, and experiments are being instituted in its continuation throughout the summer. At Pubble plants have been successfully bedded out from early spring until late autumn without a break, and losses have been negligible. The adoption of summer lining out has to some extent reduced dependence on the weather, and it may well be that there is room now for a re-think both on the optimum size of the nursery and its mechanisation, as lining out machines unable to work during adverse conditions in the spring could well succeed under ideal summer conditions. If lining out machines were adopted, then there would be an argument for the purchase of a large central nursery of possibly a 100 acres or more in the potentially good soils of East Down or North Armagh.

There is, however, another approach to the whole problem. This depends on what, in fact, is required of the nurseries. As mentioned earlier, transplants used to be the order of the day—in the case of some species up to 2 + 2 or older. It is now found that a 2 + 1 (or 1½ + 1½) Sitka spruce may be too big for mountain planting and, although nursery growth has improved tremendously, a 1 + 1 Sitka spruce seedling is not generally available. It may become possible to produce plants of this size by combining the increased fertility which has been obtained with soil sterilisation, an extensive treatment only justified when the production of 1 + 1 stock is the object. However, a considerable proportion of 2-year seedlings has been successfully utilised for planting for several years, and it is worth mentioning that when samples of these seedlings were sent to the Forestry Commission, where supplies were wanted for lining out, they informed us that our plants were too big for their purpose, but, that in their view, they were ideal planting stock, and it was suggested that there were several buyers in Great Britain who would be very grateful for plants of this quality. This leads one to question whether any transplants are necessary. As the above would indicate, 2-year Sitka spruce seedlings can be produced which are perfectly adequate for planting under the conditions obtaining in most of our forest areas, and which will probably do as well as a transplant. Even 2-year stock may be larger than necessary—experiments carried out by Dr. Jack imply that there is a possibility of very excellent results being obtained from the use of l-year stock of some species, and in his experiments casualties resulting from the use of such small stock have been very light. Now it may well be that these experiments were carried out during a particularly good season, and, in fact, the casualties would usually be considerably higher under normal circumstances than when transplant stocks are utilised. If a reasonable assessment of the survival rate could be made, planting spacing could be adjusted to allow for such casualties and the saving in cost in the nursery, coupled with the saving in cost in planting out, even allowing for the use of an increased number of plants, could be an unanswerable argument for the use of l-year seedling stock. In Dr. Jack's experiments these seedlings have, in fact, outgrown transplants and consideration must surely be given to the fact that a man could carry a day's supply on the mountain in a haversack and that the plants would probably only need dibbling in instead of the traditional planting methods.

In the case of species such as *Abies procera* where losses at the best of times tend to be heavy, and plants tend to sit for a considerable time after planting out, the production of sturdy 3-year seedlings might well be the answer.

Certainly in so far as hardwoods are concerned, there would appear to be no justification at all for lining out, as one, two, or three-year old seedlings are infinitely better than lined out stock. It is essential, of course, that all seedling stock over 1 year old be undercut.

Surely the ideal plant is the cheapest one that will grow satisfactorily when planted out, both from the point of view of survival rate and of rapid growth. When a plant is transplanted it suffers a check, and when it is planted out it suffers yet another check; not only would it seem sensible to reduce these checks to the minimum but any gardener will tell you that the smaller a plant is when it is transplanted the quicker it recovers, everything else being equal, and in our context everything must include exposure and weed competition. Obviously one cannot adopt a single practice for all species and locations.

There is no doubt that administratively the perfect nursery system, assuming a continuance of transplant production, would comprise a single nursery of about 150 acres, (the area would decrease rapidly with any increase in the number of seedlings utilised and the reduction of their age) on a light workable soil, fully mechanised, with the smallest staff possible, centrally located, and supplied with an overall umbrella which could be opened at will! Failing the umbrella, and I fear that this is impractical, the status quo would probably be better left alone for the present until a revised policy of plant production is reached. If the supply of transplants remains the major object of management, another nursery of 40 to 50 acres of good land would be required to replace the less satisfactory areas at present under cultivation. But as for the single nursery the greater the proportion of seedlings the less nursery space is required.

The Forestry Commission has an eye to the production of plants a few months old in polythene tubes or other containers, produced in a greenhouse condition, in two or three rotations per year and planted out at any time of the year. The introduction of methods such as these would revolutionise the whole system of nursery management, and it should become clear within the next few years whether or not there is a future in such methods. Indeed direct sowing of seed may well be a practical proposition either utilising containers of compost or some form of seed pelleting.

It must be remembered that the cost of plant production is one of the basic costs in forestry, and that it must be considered in conjunction with the cost of planting and beating up. The overall aim is to ensure that the cost of all three is reduced to the minimum possible.

FERTILISERS IN FORESTRY—THE FUTURE*

By W. O. BINNS

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Introduction

It is important to outline some major differences between agricultural and forest crops which affect the way fertilisers are used. Tree crops are usually on the ground for 50 to 100 years; in this country most are felled between 50 and 70 years after planting. The age at which a crop of any tree species is finally cut will depend on its rate of growth; the faster it grows, the earlier it will be harvested, and the difference between the best and worst crops growing in a given region will range from 5 to 15 years, depending on species.

There is a very long period before there are any returns on the money invested in a crop. When thinning is practised, the first cuts are made at the 12-year stage but cuts are commonly made at 20 years, and occur at up to 30 years with the slowest growing crops. It follows that the interest on the money invested becomes important for many forest operations, e.g. cultivation, draining, fertilising, weeding. This means that the time money is invested is critical, and no operation is done before it has to be. This affects fertilisation practice in the following way: if a treatment produces a constant effect, in terms of increased yield, regardless of the age at which it is applied, then if the extra yield (or a proportion of it) has to be left until the crop is finally cleared the later the treatment is applied the more profitable it will be. There will always be financial pressure to harvest increased yields as soon as possible: the shorter the time that money is tied up the less is the accumulated cost that counts against the increased output. There is one further marked difference which follows from the longevity of trees. An agriculturist might reasonably estimate the sort of fertiliser regimes which would be used for potatoes, sugar-beet, and wheat in 1980s but would be uncommitted as to the likely acreages of these crops. In forestry on the other hand, the acreages in 1980 of spruce, Scots pine, and Douglas fir planted between 1950 and 1960 can be estimated quite accurately, although because of current uncertainty about the fertiliser responses in a wide variety of species and site combinations only approximate forecasts can be made about the sort of fertiliser regimes likely to be used on these crops at that date.

Nurseries

The total area of forest nurseries in the immediate future is likely to be 1,300 to 1,600 acres (800–1,000 acres in the Forestry Commission, and 500–600 in private hands), the total annual use of fertilisers in them is unlikely to exceed 250 tons of a 21% N fertiliser, and about the same weight of a 0–20–20 PK compound. Even if curious and unorthodox forms of fertilisers are found to be

* Presented at a meeting of the Agriculture Group, 21st November, 1967. This article, with the others presented at this meeting are reprinted as a special issue of *Journal of the Science of Food and Agriculture*, price 10/-.

effective and profitable, the amounts required are unlikely to result in manufacturers making special provision for the needs of forest nurseries.

Forests

In the forest, however, the areas are much greater. The 1943 Forest Policy Report,[1] recommended that the country should have 5 million acres of productive forest. Though the long-term strategic objectives considered at that time have become irrelevant, and economic considerations have largely taken their place, the areas already planted plus the plans announced suggest that by the end of the century there may well be about 5 million acres of forest.

Establishment of plantations

Up to the present time, the only nutrient used in any quantity has been phosphorus, usually in the form of Gafsa or other ground rock phosphates. This is now normally applied once only shortly after planting, and seldom again on all acid peat soils, and most podsolic soils (including almost all sites characterised by ericaceous plants), and on peaty gleys and gleys. There are, however, still large areas of forest on these soil types which were not treated at planting, and which urgently need phosphate. This problem should have been dealt with in the next ten to fifteen years.

The use of potash fertilisers at planting, or within a few years afterwards, is restricted to raised and blanket peats, though there are indications that crops on shallow soils over chalky tills may also respond to potash.

Nitrogenous fertilisers are not used at all at planting. This may seem surprising when one considers the enormous responses of agricultural crops, and also the very marked responses in the nurseries of trees, both as seedlings and transplants. There seem to be several reasons for this. Until the advent of effective contact herbicides and selective herbicides the existing plants, especially on grassy sites, overwhelmed the trees and greatly increased weeding costs, so that there is little incentive to boost nutrient supplies in this stage of a crop's life. Also, many conifers suffer from planting check, and seem unable to use added nitrogen, at least in the first two years following planting. If nitrogen is to be used to speed up establishment then the production of plants by different means, with root systems able to exploit the soil more rapidly, may first be necessary.

The rate of phosphorus used at planting is about 20 to 30 lb P/acre, and only on the most phosphate-responsive (or phosphate-fixing) soils has this been appreciably increased. This rate is likely to be used for much future planting, and the total amount in Forestry Commission forests will probably be 3,000 to 5,000 tons of rock phosphate or its equivalent a year.

It is difficult to forecast with any certainty the use of potash on young crops but it is bound to increase with more and more planting on peatland.

Older crops

It may seem strange that work on the use of fertilisers to improve the yield of established crops which are in the thinning stage has only been going on for a few years. This is due partly to the original idea of establishing forests as a primary need, and partly because the problems of establishment seemed so large that all energy was expended on them.

As in agriculture, a wide range of yields are found for a given crop with a mean which falls far below the highest recorded yields. Table 1, for example, shows the distribution of Yield Classes in Commission plantations of the highest-yielding of the commonly planted conifers, namely Sitka spruce, which accounts for over 40% of current Forestry Commission planting. The Yield

Class is defined[2] as the maximum mean annual volume increment; i.e. the maximum value of the quotient $\frac{\text{total volume production}}{\text{age}}$. The classes represent intervals of 20 hoppus feet* in volume to 3 inches top diameter of log.

TABLE 1

SITKA SPRUCE IN FORESTRY COMMISSION PLANTATIONS, AS AT SEPTEMBER, 1967

Yield class	Area, thousand acres	% of total area
<60 (in check)	24	4
60–100	59	11
120–160	400	74
180–220	58	10·5
240–280	2·5	0·5
Total area	543·5	

The small proportion of the three highest Yield Classes, 0·5%, is striking: however the greatest contrast with present-day agricultural practice is brought out when it is realised that all the highest yields have been achieved without any additional fertilisers. It is known that many crops in the lowest Yield Classes, 60 to 100, are associated with soils of low fertility: but it is not known how many of the crops in the range 120 to 160—which comprise three-quarters of the Forestry Commission's area of Sitka spruce—would respond to fertilisers (few have had any so far) or whether the crops in the top Yield Classes are limited by factors which can be remedied. (Even if the situation of the crops in the top Yield Classes could be improved, it may not of course be economic to boost the Yield Class to 300 or over.)

Scottish experiments suggest that Scots and Corsican pines in the pole-stage (i.e. 30 to 50 feet tall) are likely to respond to nitrogen applications, but it is not yet known if these responses will be large enough to justify such treatment.

In Welsh experiments on Sitka spruce, phosphorus is the only major nutrient found to improve the growth of polestage stands of moderate Yield Classes (130 to 180): there have been no responses to N, K, Ca, or Mg in seven factorial trials. Analysis of the foliage has shown that the trees are reasonably supplied with N and K (N$\gg$ 1·7% for 5 trials, 1·5% for two ill-drained sites; K from 0·85 to 1·01%). As in Scotland, Corsican pine seems responsive to N, and Scots pine in England shows responses both to N and P. More detailed results for these trials are given by Binns & Grayson.[3]

There have been few experiments on older crops but there are some suggestions that nitrogen may become increasingly important with age.

Potential use of fertilisers

These results are too few for generalisations to be possible, but it seems that there may be large areas of forest where N and P fertilisation will be effective.

If it is assumed that crops will not be fertilised (other than at establishment) before the first thinning, which is likely to be at 20–25 years, and that the mean rotation is 60 years, the areas of crops coming up for first thinning and entering

* 1 hoppus foot=1.273 cubic feet.

TABLE 2

ACREAGES (IN THOUSANDS) PER YEAR OF FORESTRY COMMISSION CROPS COMING INTO THE THINNING STAGE, AND INTO THE FINAL CROP PHASE

	1971–80		1981–90		1991–2000		2001–10	
	Thinning stage	Final crop	Thinning stage	Final crop	Thinning stage	Final crop	Thinning stage	Final crop
Spruces	24	3	27	10	33*	13	35*	24
Pines	18	5	20	5	15*	5	15*	18
Larches and Douglas fir	10	2	5	3	5*	3	5*	10
Total	52	10	52	18	53	21	55	52

Assuming: Rotation 60 years; first thinning 20 years; final crop phase from ten years before final felling.

* estimated from present planting trends.

TABLE 3

POTENTIAL ANNUAL USE OF N AND P FERTILISERS IN FORESTRY COMMISSION FORESTS, IN TERMS OF UREA AND ROCK PHOSPHATE, TONS

	N as urea				P as rock phosphate			
	1971–80	1981–90	1991–2000	2001–10	1971–80	1981–90	1991–2000	2001–10
At planting	—	—	—	—	5000	5000	5000	5000
Thinning stage, spruces	—	—	—	—	1800	2000	2400	2500
Thinning stage, pines	1200	2500	3400	3200	1300	1400	1200	1200
Final crops	400	750	900	2100	—	—	—	—
Total	1600	3250	4300	5300	8100	8400	8600	8700

the last ten years of the rotation, each year, for ten-year periods can be tabulated (Table 2).

Phosphorus is a slow-acting fertiliser, and the effects of a single application last many years. It is assumed therefore that, following establishment, only one application will be made, probably at the time of the first thinning. In contrast, nitrogen effects last only a few years, and applications at intervals of about seven years, i.e. about five applications in all, are likely for responsive crops.

It is assumed for the purpose of these predictions that half of all pines and spruces will respond to P and that half the pines will respond to N from the thinning stage onwards. It is also assumed that half of the spruce crops will respond to N in the final ten years, i.e. they will be treated once only at the same time as the fifth application on the pines. Practically nothing is known about the responses of larch and Douglas fir, so they have been left out of the calculations.

The rates assumed are 44 lb P and 100 lb N per acre, corresponding to 3 cwt rock phosphate and 2 cwt urea per acre. Using the acreages in Table 2 and the assumptions set out above, the maximum potential use of N and P fertilisers in Forestry Commission forests is set out in Table 3, up to the year 2010.

There are of course a number of uncertainties about the figures. The planting pattern of the 1980s can only be guessed at; it is likely that N will not be used much on Lodgepole pine, but will be used on pole-stage Norway spruce; changes in timber prices, fertilisation costs and rates of return required on capital may radically alter the profitability of fertilising by one method or the other. Many plantations may be felled early, for a variety of reasons. Nothing has been said about potassium, which will be needed on nearly all peat soils at some stage or other, nor have private forests been mentioned, which include nearly 650,000 acres of conifers.

One of the great attractions of fertilisation (at the pole-stage or later) lies in the fact that (once responsive crops are identified) its profitability is less in doubt than that of planting. If more jobs are to be provided in the countryside and in wood-using industries and if at the same time Britain's dependence on imported wood products is to be reduced, then it is likely to be more profitable to boost timber production by fertilisation than by planting the poorest sites.

Summary

In forestry the long interval between investment in fertilisers and any pay-off, particularly for treatment at planting, means that responses have to be large to pay for the interest accrued; this colours all considerations of crop improvement.

Phosphatic fertilisers are still the only ones used widely; potassium gives useful responses only on deep peats and its relative importance will depend on the amount of this site type afforested in the future; nitrogen is only used experimentally at present, though some promising responses suggest wider future use, especially in the last years of the rotation.

Making sweeping assumptions about the responsiveness of different species and the planting pattern of the future, it is estimated that by the end of the century the Forestry Commission will be using, each year, about 9,000 tons of rock phosphate (5,000 at planting) and 5,000 tons of urea (all on established crops).

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SITKA SPRUCE PLANTING AT 9 FT × 9 FT AT JERVAULX FOREST IN 1943

By M. HANAFIN
Forester, North East England Conservancy

The recommended planting distances are getting wider and wider so there may be some interest in reading about a four-acre plot of Sitka spruce planted at 9 ft × 9 ft in 1943. The wood was planted by private owners but now forms part of the Forestry Commission's Jervaulx Forest in the Dales District of Yorkshire.

It has been discovered from enquiries made locally that the Sitka spruce were planted at 9 ft × 9 ft with the intention of interplanting with European larch which either never were planted, or if they were, were removed very early as there are only four European larch remaining on the site. Whatever the origin of the stand, there now remains a very good example of Sitka spruce at 9 ft × 9 ft spacing which has never been treated apart from one-hundred-per-cent brashing.

Contrary to what may be expected the branching habit is very fine but unfortunately the origin of the plants is not known.

The technical details of the stand measured before the growing season of 1968 are as follows:—

Age	*Top Height*	*Yield Class*
25 years	43½ ft	200

With reference to the *Forest Management Tables* the figures per acre should read:—

No. of trees	*Volume to 3 ins. top*	*Average Pole*
825	2,415 h ft	2·8 h ft

The actual figures are:—

No. of trees	*Volume to 3 ins. top*	*Average Pole*
420	2,100 h ft	5 h ft

This illustrates that the 9 ft × 9 ft is not very far behind in standing volume per acre but has lost 700 hoppus feet of first thinning to date. In theory our 9 ft × 9 ft plantation will take another seven years to produce the standing volume that will enable us to remove a first thinning of 700 h ft per acre without losing increment from over-thinning. During this time another 700 h ft per acre thinning will be lost as compared to traditional spacing, but our 9 ft × 9 ft "first" thinning, should be a very profitable one. The average volume per pole should be in the region of 8 h ft and this is the size of pole that can be worked for less cost and sold for more profit than the usual first and second thinnings, which have a struggle to clear any profit.

9 ft × 9 ft spacing may seem a little too wide apart where access for extraction is easy and markets are good for small thinnings. But in bad extraction country with poor small-thinning markets, would it not be more economic to plant wider, and wait a little longer for worthwhile timber, i.e. 700 h ft per acre at an average volume of 8 h ft per pole?

Reduced costs can also be expected in preparing ground, plants, planting, weeding, beating up, no brashing and delayed outlay on expensive roads. One disadvantage of wide spacing I have heard mentioned is quick suppression of vegetation, but that can rarely be a problem with the use of chemicals becoming so prominent.

HELICOPTER SPRAYING TO KILL OVERHEAD COVER AT LAVENHAM FOREST, SUFFOLK

By G. J. SOUTHGATE
Forester, East England

The decision to aerial-spray part of Lavenham Forest to kill overhead cover was made at District level in the Autumn of 1967. It was also decided to carry out the operation by helicopter, as it was thought that the down-draught from the rotor blades would force the spray down through the cover. The object of the exercise was to reduce the high annual expenditure on weeding and cleaning.

The result of this spraying cannot yet be fully assessed, but what information is available may be of interest to anyone faced with a similar problem.

Stanstead Wood was finally selected as being both silviculturally and geographically ideal. The complete isolation of the wood by surrounding farm land that had been harvested, eliminated the possibility of drifting spray damage. The 120 acres comprising Stanstead Wood are split up into 6 compartments, each planted with a mixed conifer crop of Douglas fir, Corsican pine and Western red cedar. Planting had commenced in 1960, and had been continued until 1964. Much of the overhead cover of birch, oak, ash and elm, with thick clumps of hazel coppice, was left during the preparation-of-ground stages. Average height of the conifer crop at time of spraying measured 4–12 feet, while the overhead cover varied between 15–40 feet.

Previous operations of weeding and cleaning had been undertaken annually by hand methods and these had been costly and tedious. Labour cost had been £8–£12 per acre.

Contracts for aerial spraying were eventually signed with Hutsons Sprayers Ltd of Wisbech and their quotation of 63/- per acre, including cost of material, being acceptable. They in turn made arrangements for a helicopter and the firm of Autair was sub-contracted. In due course a representative from Hutsons visited the area to negotiate landing arrangements, and to confirm that spraying would commence as soon as it was ascertained that the growth of the planted trees had ended for the season and hardening off had taken place. This decision was left to the forester's discretion, and on September 11th Hutsons were asked to commence spraying as soon as possible.

Actual spraying: 12th September 1967

At noon the helicopter arrived and an 800-gallon water bowser soon followed, bringing with it all the herbicide. At 3 p.m., after all preparatory work, such as mixing chemical and water, and putting out hydrogen filled marker balloons, had been completed by the three man team from Hutsons, and when the Autair mechanic had checked the helicopter from 'stem to stern', the pilot was ready to start spraying.

The weather was fine but with a fair wind blowing. Spraying finished at 6 p.m. In this time an area of 80 acres had been sprayed with a solution of Trioxone 50 and water, mixed to a strength of 3 pints of chemical in 10 gallons of water, applied at a rate of 10 gallons of mixture per acre.

The method of application was as follows:

The water bowser, into which had been well-mixed 30 gallons of chemical, was stationed a few yards from the selected landing place. The helicopter's 40 gallon capacity tank was then filled. Take-off was immediate. Each run was taken at a speed of 38 m.p.h. and the spray tank was emptied in 1 minute 12 seconds through a 33 ft boom carrying 56 Type D6 nozzles, cone size 45, and operating at a pressure of 56 lb per square inch. On landing after each run, the 40-gallon tank was filled in 15 seconds by means of a delivery hose attached to a high pressure pump on the water bowser. The air mechanic wiped the perspex bubble of the helicopter each time to give the pilot good visibility. At no time was the engine of the helicopter stopped.

The following morning the weather had deteriorated and rain showers forced the helicopter to remain grounded. Eventually the wind and rain stopped and spraying restarted at 12 noon. The remaining 40 acres were completed without difficulty by 3 p.m.

Spraying at all times was carried out across wind and starting on the down-wind side of the area. This enabled the men moving the marker balloons to work upwind, thus avoiding spray drift.

The total acreage sprayed was 120 acres in 6 hours, and this at a cost of £3 3s. per acre is £378. The estimated cost of hand weeding/cleaning over the same area is as follows:

Labour cost at £7·100 per acre=£900. Material, £193. Labour overheads @ 64%=£576. Total cost=£1,669, equivalent to nearly £14 per acre.

What then are the advantages and dis-advantages of spraying overhead cover by helicopter? The two main advantages that come to mind immediately are:

1. The cost per acre is considerably lower than conventional hand methods.
2. It is without doubt very much quicker.

The dis-advantages seem to be:

(1) Spray drift is inevitable, there is always a certain amount even on a still day.
(2) Down-draught from the rotor blades did not force the spray down through the cover
(3) Possible difficulty in finding a suitable landing place and 'work' area.
(4) Could be time-consuming if the weather is not favourable.
(5) Water supply must be within reasonable distance to enable water bowser refilling to be quick and easy.

Inspection Four Weeks Later: 10th October 1967

Inspection after four weeks gave indication that the spraying had so far been 75% successful. Much of the high overhead cover showed signs that the spray had been effective. Also the lower storey of hazel coppice, bramble and woody weeds was looking definitely 'sick'. It only remains now to see if the effect will be permanent, and this became apparent during the next spring.

Conclusions

Experience to date suggests that a helicopter is no more efficient than a fixed wing aircraft, and it is more expensive.

We now know that a pressure of 56 lb per square inch is too high because it produces very fine droplets that are liable to drift.

Finally, the spraying was started when the wind was fairly high. If aerial spraying is to be considered again at Lavenham, I think that under similar conditions, and providing time was on my side, I would postpone spraying operations until the wind dropped. This of course is not a decision that is inevitable, because if the critical time period is running out, then a delay could mean that the spraying would produce a negative result.

Ending note

As we go to press, the use of Trioxone and other 2,4,5T herbicides is currently banned in Commission plantations—*Ed.*

PAPERPOT TECHNIQUE FOR RAISING FOREST TREE SEEDLINGS

By R. B. HERBERT
District Officer, Research

On 10th April, 1969, I attended a reception in London given jointly by The Whalehide Company of Rayleigh, Essex and The Fyba Pot Company of Knottingley, Yorkshire, for the formal introduction to this country of the Japanese Paperpot system for raising 'balled' seedlings for horticultural and forestry purposes.

The people with whom I had discussions during the course of the evening included Mr. David Moseley of The Whalehide Co., Mr. Hall of The Fyba Pot Co., and Mr. K. Peltonen, Marketing manager of the Lannen Sokeri Company of Finland. Mr. Peltonen has already met both Dr. Alan Low in Edinburgh and Mr. Roger Brown of Alice Holt for preliminary introductions to the paperpot system.

Paperpots were originally developed in Japan for the raising of sugar beet seedlings but the system has rapidly found new applications in both horticulture and forestry both in Japan and Finland and, more recently, in the U.S.A., Holland and Denmark.

The paperpot system appears to have advantages over any existing methods of raising container, or 'balled' seedlings in that the individual 'pots' are combined initially in large numbers into single units. The pots, which are hexagonal in section and open ended, are made of specially prepared paper glued together in a 'honeycomb' pattern between two rigid cardboard ends. For transport and storage before use the pot units are folded flat into a pad, 30–38 cms (12–15 inches) long, 5–13 cms (2–5 inches) wide, corresponding to the depth of the pots, and about 3–5 cms (1–2 inches) thick, according to the range of pot sizes available. Each unit opens up like a concertina to expose the honeycomb structure of the cluster of pots extending to 1·3–2 metres (4–6 feet). The principle is not unlike that of the oblong type of paper-chain commonly used for Christmas decorations.

The paper used in the manufacture of the pots contains artificial fibres and chemicals which enable it to resist bacterial action until the plants have formed a firm root ball. Two horticultural types have a life of 3-6 weeks and 5-8 weeks, but for slower growing plants such as forest tree seedlings there are pots with a life of up to two years. The glue holding the individual pots together in the unit is water soluble so that, after a few waterings, the unit becomes a group of closely packed individual containers.

Probably the most suitable size of paperpot for forest tree seedling work is type BH 313 in which the individual pots have a diameter of 3 cms ($1\frac{3}{16}$ inches) and a depth of 13 cms ($5\frac{5}{16}$ inches), and each unit, extending to 1·3 metres (4 feet) when open, contains 700 pots at a density of 1,700 per square metre (1,400 per square yard). The cost of this type is £1 7s. 7d. per 1,000 pots or, approximately $\frac{1}{3}$d per pot. The Finns have been experimenting successfully with Scots pine seedlings in pots of even smaller cross-sectional diameter giving a stocking of 3,000 per square metre (2,500 per square yard).

Trials of the paperpot system in Finland have been carried out at the Government Forestry Board Nursery at Rovaniemi by Simo Halonen, in collaboration with Mr. O. Huuri of the Forest Research Institute. A production line system has been developed in which the pots units are filled after being stretched out on an aluminium filling plate between side boards mounted on a bench. The cardboard ends of the unit are held open by means of metal clips. Seed compost consisting of fertilized peat is fed onto the pot unit from a hopper and after levelling and firming, which can be done by a vibrating machine, the unit is ready for sowing. An efficient machine for this purpose, using pelleted seed, can sow the units with the accuracy of delivering one seed per pot to 95 per cent of the pots and two seeds in the remaining 5 per cent, at a rate of 1,000 pots in 8–10 seconds. An alternative method is to use a perforated plastic template. The seed is finally covered with a layer of sand, also by machine.

The same technique may be employed for pre-sowing the containers for cold storage until the spring. In this case the moisture content of the peat must be between 20–30 per cent. In the Spring the sown units are transferred to unheated plastic greenhouses and watered to initiate germination. The production line for the filling, sowing and storage processes employs a nine man team and their output is of the order of 250,000 pots in an 8-hour day.

At the end of the first growing season, seedlings 15 cm (6 inches) tall of Scots pine can be produced even at Rovaniemi, which is situated close to the Arctic circle, with a growing season confined to the four months from early May to the end of August. Trials are to be undertaken in which the growing season is extended by the use of artificial heat in the early spring, utilizing the additional natural light intensity provided by reflection from the surface of the snow.

Extensive trials in Finland in 1969 are directed towards the production of 9 million seedlings for nursery transplanting or for direct planting in the forest. Mr. Huuri predicts the possibility of raising the entire annual requirement of 80 million pine for Finnish forests, using paperpots and plastic greenhouses on a nursery area no greater than 7½ acres.

With the rapid development of techniques for the intensive raising of economically priced container seedlings there appears to be a very real possibility that the traditional methods of handling bare rooted nursery and planting stock will become obsolescent within a very few years. Container seedlings possess numerous advantages over bare-rooted stock; they can be raised intensively, in an inexpensive greenhouse environment, to plantable size within one growing season; root disturbance on planting is minimized, giving higher survival and reduced growth check; the planting season is not confined to the period of dormancy.

The paperpot system, in particular, is well suited to mechanization, not only for preparation and sowing, but also for subsequent planting. The Finns consider the method to be a considerable advance over other relatively recently introduced techniques, involving containers of peat or other materials, or the Nisula peat belt system.

AERIAL FERTILISATION AT WARK FOREST, NORTHUMBERLAND

By R. E. J. HOWE, *Forester* and
G. B. LITTLE, *Trainee Forester*

The Border Forests contain a substantial area of young plantations which did not receive fertiliser treatment at the time of planting. Over quite large areas growth rate has not been good and deep peats and peat over mineral soil are known to be deficient in phosphate. In 1967 it was decided to select a suitable area for the aerial application of fertiliser. The area chosen was composed of P41 to P52 stands where leader growth was generally poor and Norway spruce particularly rather yellow in colour.

The area selected was visited by Research Branch staff who recommended an application of phosphate at 3 cwt per acre, and over part of the area the addition of potash as muriate of potash at 1½ cwt per acre.

Subsequently a contract was drawn up with Autair Helicopter Services Ltd for the application of this material.

Topography and Situation

Two forest areas were selected for treatment:

(1) The larger block, some 890 acres, situated in the Shepherdshield area of Wark Forest, consists of a shallow valley running west to east, rising from 900 feet above sea level to 1,000 feet above sea level. The valley sides form a series of steps, with severely checked areas on the level peat bogs, and better growth on the scarps.

(2) The smaller area, 110 acres on The Haining, is situated on a gentle south-west-facing slope rising to 1,000 feet above sea level.

Area treated

The age of the crop ranged from P41 to P52; the crop height varied from 2 feet in badly checked areas to 35 feet in the better Sitka spruce plantations.

Some 300 acres of Norway spruce, 576 acres of Sitka spruce and 24 acres of other conifer species making a total of 800 acres, received 3 cwt of phosphate per acre. A further 183 acres of Sitka spruce on very poor conditions received 3 cwt of phosphate, plus 1½ cwt of potash per acre, 37 acres of severe check was treated with an extra dosage making a total of 200 acres.

Landing Sites

Sites were selected by local staff on the guidance provided by the work carried out at Kilmory, West Scotland. Three sites were chosen and prepared, adjacent to forest roads at Bellcrag, Hindley Steel corner and Coldcotes Hill to serve the Shepherdshield area.

One landing site was prepared at The Haining, but proved to be unsuitable due to the wind direction at the time when it was required to use it.

Site preparation consisted of the removal of obstructions e.g. small trees and the laying of extra metalling alongside the road. This metalling proved insufficient to carry loaded lorries at two of the sites.

Equipment

The equipment required for the operation consisted of:

Flags on poles, 15 to 25 feet long.
Protective headgear.
Eight 5-gallon paint tins with handles.
Eight sieves.
Tarpauline sheets for protecting fertiliser.
Sacks for empty polythene bags.

The flags were prepared from white cotton 24 inches × 18 inches.

Sieves were made by removing the top and bottom from five-gallon drums, and wrapping ¼ inch mouse netting over the base. The sieves were allowed to slide into the loading tins to a depth of 3 inches, fixed by attaching brackets to the sides of the sieves, 3 inches from the base. This overlap ensured a minimum of spillage.

Aircraft

The pilot arrived on 6th October, flying a Bell 47 helicopter, fitted with two 2 cwt capacity hoppers situated one at either side. For the first week of the operation progress was very slow due to the excessive load on the spinners. Only three sorties could be flown at a time before the load became too great and the equipment was allowed to cool down. This was rectified eventually by using 35-amp circuit breakers instead of the conventional 25-amp type. The helicopter was limited in its operational capacity by weather conditions, the main adverse conditions experienced being:

Winds above Force 5	— Unable to fly.
Dead calm	— Reduces lifting capacity thereby reducing the carrying load to 3 cwt.
Fog and Mist	— Unable to fly due to the poor visibility.
Rain	— Collects on the Perspex bubble and limits visibility of pilot.
Damp air	— Reduces the air density and consequently reduces the helicopter's safe pay load.

Ideal flying conditions seem to be clear cold days with a steady breeze. Lifting efficiency falls off markedly with increase in elevation and this was appreciable at 1,000 feet.

Storage and Transport

The fertiliser was delivered to, and stored at, Stonehaugh Office, under cover, rather than directly to the loading sites. This was done for two reasons. Firstly, because at the time of delivery it was uncertain as to which landing site would be suitable for use, until a visit by the pilot could be arranged. Secondly, due to the exceptionally high rainfall over that period, a large quantity of fertiliser would have been rendered useless if stored outside. Transport to the loading sites was by Commission lorries daily. Ample time was allowed for loading and haulage every morning as the helicopter did not begin operating until approximately 9.40 a.m. The surplus fertiliser, if any, was stored under tarpaulin sheets overnight.

Loading

The helicopter loading team consisted of eight men with one supervisor; four men were positioned on each side of the helicopter, which landed about two feet from each line of loaders. Immediately on touchdown the loaders emptied their buckets containing ½ cwt of phosphate into the hoppers on their respective sides. As soon as the last one had emptied his bucket on each side, a "thumbs up" sign was given to the pilot signifying the all clear for take off. Loading times ranged from 7 to 13 seconds and averaged 9 to 10 seconds. A simple bonus system made an added incentive to the workers.

The total round-trip time, including loading, ranged from 1½ minutes on the areas nearest the landing site to over 3 minutes. While the helicopter was away fertilising, the loading team had ample time to refill their bucke s from fertiliser dumps positioned each side of the landing site.

Site Marking

Three markers carrying 15 ft to 25 ft poles with white flags were posted along rides and roads where possible along the line of flight (covering a length of ground 29 chains) in the taller thicket stage crops. By moving 10 yards each time it was possible to apply 3 cwt phosphate per acre. In the checked areas where 3 cwt phosphate plus 1½ cwt potash was to be applied per acre, five markers were used for maximum effectiveness, moving 7 yards each flight.

Communications

This was achieved by using radio packsets. Sufficient radios were available to issue to each marker, one to the marking team's supervisor, and one to the loading team supervisor. It was possible to communicate efficiently between the loading-site and the marking area. The markers could be informed of delays, meal-breaks and also be told if they were out of position, by the loading-site supervisor, in conjunction with the pilot. The radio system employed was very helpful and essential to the smooth running of the operation.

Costing

The overall cost of the operations was influenced a great deal by frequent breakdowns during the first few days of the operation, and the excessive rainfall during the whole of the period.

The various costs incurred were:

Hire of helicopter. 1,000 acres @ 46/-	£2,300	0s.	0d.
Fertiliser. 165 tons.	£2,300	0s.	0d.
Labour	£530	0s.	0d.
Labour oncost (25%)	£132	13s.	1d.
Forestry Commission:			
Powered Vehicles and Machinery = £5 7s. 0d. per acre	£87	0s.	0d.
	£5,349	13s.	1d.

Fertiliser costs (1967):

Gafsa Phosphate £12 15s. 0d. per ton. ½ cwt bags.
Gafsa Phosphate and Muriate of Potash 2:1 mixture. £15 per ton. ½ cwt bags.

Difficulties and Suggestions

(1) Adverse weather conditions for the period increased lost time and consequently the cost of the operations.
(2) Considerable time was lost in the early stages of the spreading due to the breakdowns in the spinners.
(3) Great difficulties were found in marking due to the variability in height growth from 2 to 35 feet.
(4) It is important that the landing sites are visited by Autair representative before the sites are prepared.
(5) Landing sites should be selected to give a clear line of take off in at least four directions to allow for wind directions.
(6) Lighter poles necessary for the markers; if helicopter spraying is to be carried out on a large scale in the District it would be advisable to purchase aluminium pruning poles which can be extended to a greater length by bolting them together. These could be stored centrally to serve the whole area together with the equipment. (They sway terribly! *Ed.*)
(7) That spreading should be carried out at a more suitable time of year regarding weather conditions.
(8) Sleepers placed either side of the helicopter landing position are useful for the loaders to stand on, to empty the buckets, as the hoppers were on the high side for the short worker.
(9) The impression was given that the Gafsa phosphate supplied was rather too fine in consistency, and less difficulty would have been experienced with the hopper spinners if the material had been coarser. Further information on the desirable size of grain is required and it is proposed to ask Scottish Agricultural Industries to provide samples if possible for comparison.
(10) Early start of the operation in the morning would have reduced the cost.
(11) Radios are essential for the communication between supervisor, landing site and markers.
(12) Great difficulty was found in marking at Wark due to the height growth being up to 35 feet.

Conclusions

The helicopter proved to be a successful means of applying fertilisers on large areas which are often inaccessible due to the variation in growth.

We have no doubt that our cost could have been reduced if a visit by Autair to the sites had been possible at least three weeks previous to the start of the operations.

It is necessary to select a more suitable time of year to ensure flying is most frequently possible.

We have no doubt that this method of applying fertiliser has a considerable future.

PREPARATIONS FOR TREE PLANTING ON PEATLAND IN NORTHERN IRELAND

By K. F. PARKIN

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Introduction

Government policy in Northern Ireland decrees that afforestation is virtually confined to marginal agricultural areas, much of which lie above the 600 ft contour. In Northern Ireland a high proportion of land above this altitude is covered with a blanket of peat, varying widely in depth but averaging about 4 ft deep. This fact means that much of the 4,000-acre annual programme of new planting carried out nationally is on peat of over 2 ft in depth and the relative importance of the problems associated with this has meant that experimental and research efforts have been concentrated on them for many years.

This paper summarises the current techniques of fertiliser application, ploughing and drainage layout on blanket peat and gives the basic reasoning behind these. At the same time it must be emphasised that techniques are constantly being modified as experimental results throw new light on the many aspects of tree growth on peat, and as new materials and machines are produced to provide more effective ways of tackling problems.

Another important point to be kept in mind when considering the techniques in use in Northern Ireland is the fact that for a variety of reasons it was decided some time ago to concentrate on the growing of pure Sitka spruce on these peat areas. The techniques in use may not always be equally effective if other tree species were employed.

Fertiliser Application

Apart from occasional "pre-draining" of particularly waterlogged areas of blanket bog, or the "chopping" (by rotovator or swipe) of dense heather vegetation cover which might seriously impede ploughing, the broadcast application of fertiliser is the first operation employed in preparation of peatlands for afforestation.

The standard treatment currently employed in our Northern Ireland afforestation is an initial broadcast application of 4 cwt of coarse rock phosphate per acre immediately prior to ploughing. There are indications that a small amount of potash might profitably be applied in certain western peatland areas but this has not yet been accepted as standard practice.

The policy of broadcast application immediately prior to ploughing was generally introduced in 1964 following a number of years of experimental trials.

Previous to this the standard system was hand application of 2 oz of fertiliser to the roots of each tree at the time of planting. In the trials the broadcast application proved so consistently superior to the various alternatives compared with it, that a complete change-over to this practice was introduced. The reasons for the effectiveness of broadcast application are not fully understood but it is probably associated with the rapid development of adventitious roots by the newly-planted Sitka spruce which exploit the entire surface peat in the first few years after planting.

A recognised disadvantage of broadcast application just prior to planting is the loss of fertiliser in the rapid run-off of excess water immediately after ploughing and draining. Experiments are proceeding to ascertain the effectiveness of applying fertiliser some time prior to ploughing thereby using the surface peat and its vegetation as a fertiliser reservoir.

The choice of ground mineral phosphate as the fertiliser to be applied on the normal blanket peat resulted from trials of many phosphates and combinations of fertilisers, trials which consistently failed to produce a more effective and economic alternative.

The "coarse ground" type of mineral phosphate was selected as being more easily broadcast from the type of distributor in use.

Various types of fertiliser distributor have been used over the years but the current and most effective is the "Metsa Viska" mounted on a "Muskeg" low ground-pressure vehicle.

With the introduction of broadcast application of fertiliser the rate was increased to 4 cwt per acre of ground mineral phosphate. Once again this decision was based on comparative trials designed to provide the minimum amount of fertiliser needed to get Sitka spruce through its initial establishment period on typical blanket bog without the need for further treatment.

It is generally accepted that if reasonable yields of Sitka spruce are to be obtained on the extremely infertile conditions of typical Northern Ireland blanket peat then subsequent applications of fertiliser will be required. The frequency, type and amounts of fertiliser to be applied are the subject of intense experimental investigation at present but early indications are that a carefully calculated fertiliser regime is a practical and economic proposition. The plantation layout is designed to facilitate this periodical fertiliser treatment.

Ploughing Techniques

A small amount of afforestation of typical blanket peat had taken place in Northern Ireland prior to the 1939-45 war, but the technique of hand drainage and turf planting employed resulted in poor growth of both Sitka spruce and Lodgepole pine and this discouraged any extensive planting of peatland. The availability of low ground-pressure tractors and special ploughs shortly after the war led to renewed interest in peatland afforestation and from 1950 onwards ploughing has remained the standard ground preparation procedure.

The type of plough used, and the intensity of ploughing employed, have varied a good deal since 1950 as knowledge and experience have increased and it appears likely that there is still a good deal to be learned before a confidently accepted optimum technique will be evolved.

In order to provide a rational basis for decisions on the intensity of ploughing and drainage on typical blanket bog it was necessary to select a hypothetical ideal for tree growth. Careful studies were made of tree rooting and peat changes—both chemical and physical—on existing peatland plantations and on early experimental areas of different drainage intensities. At the same time estimations were carried out of nutrient availability in the peat and the requirements of the trees growing on it. From all these studies it was decided that in order to produce a satisfactory pioneer crop of Sitka spruce on typical blanket bog it was necessary to ensure that the drainage—and hence aeration—of a layer of peat extended to the top 18 inches of the bog.

Further studies suggested that this could be achieved by initial ploughing of an 18 inch deep furrow at 10 to 12 foot intervals plus a main drainage system of a somewhat greater depth to permit rapid run-off of surface water from the plough furrows. It was assumed that the main drainage system would be periodically deepened by machine but that the 18 inch deep plough furrows would have no further treatment.

The assumption that sufficient fertiliser would be applied from time to time, to ensure that a vigorously growing tree crop was maintained to play its part in the water extraction and hence aeration of the peat, was an essential condition of this hypothesis.

Problems were encountered in efficiently achieving the 18 inch deep furrow at 10 to 12 foot intervals and at the same time maintaining a satisfactory basis for a tree planting spacing of 5½ feet by 5½ feet. The Cuthbertson "P" type plough was not capable of providing the necessary furrow under all conditions and although the later "S" type plough had no difficulty in giving the 18 inch furrow, the ridges were rarely suitable for planting on without expensive "stepping" or straightening.

Accordingly, the standard practice accepted for the past eight years has been a combination of alternative "F" type and "P" type Cuthbertson ploughing, the former providing a 24 inch deep furrow every 15 feet and the latter a 12 inch deep double furrow every 15 feet. While this system provided approximately the equivalent drainage intensity to the accepted requirement, it had the disadvantage that the "F" type ridge had to be "stepped" before planting and the fact that two ploughs had to be used over any section of ground; accordingly, it has always been looked upon as a temporary system pending replacement by a more efficient one.

Over the past few years, trials with the Clark Double Throw plough have been carried out under a variety of peat conditions and the general success of this system—which provides the required 18 inch deep furrows at 12 feet centres with acceptable planting ridges on either side—has led to a decision to accept this as the standard system in future.

The Clark Double Throw ploughs are mounted on hydraulically operated frames with double rubber-tyred wheels and are towed by Fordson County Swamp model crawler tractors.

Ploughing and Drainage Layout

During the early years of afforestation of peatlands and the development of ploughing and drainage techniques, efforts were concentrated on finding the most efficient way of establishing tree plantations and little thought was given to the subsequent problems of maintenance and extraction of the timber crop. The short-sightedness of this policy was quickly realised, however, and in the late 1950's a number of discussion meetings were held within the Northern Ireland Forestry Division in order to formulate a peatland plantation layout policy which was most likely to facilitate future forest operations as far as they could be assessed at that time.

This exercise brought to light the need to make a number of very far-reaching and important decisions and yet at the same time emphasised the need for the retention of flexibility in the light of the multiplicity of possibly divergent future developments in techniques and economic policies.

The main factors taken into consideration were as follows:

(1) The well-planned layout of a main drainage system of a peatland area was considered essential. This should be of sufficient intensity to rapidly remove surface water from the plough

furrows and at the same time provide the possibility of a water table sufficiently low to permit root penetration down to 18 inches below the peat surface. The drains must also be capable of mechanical maintenance and deepening where necessary.

(2) In order to facilitate periodical fertiliser treatment of plantations from the ground, an intense system of racking must be provided.

(3) Although the economics of afforestation on infertile peatlands suggests that only limited capital expenditure on roads can be justified, it is appreciated that timber extraction problems on deep peat may be intense and unless extended cableways, hovercraft or other revolutionary means of timber movement are evolved then roadmaking may be inevitable at timber harvesting.

(4) Extraction problems, windthrow risk and marketing, are all factors which influence the decision as to whether a peatland forest plantation will be thinned or not. The current assumption in the Northern Ireland forest planning programme is that thinning will not take place. It is appreciated that this present decision is one that could be influenced by many factors and any plantation layout policy should be sufficiently flexible as to allow for a change to a thinning regime.

(5) Extraction of timber from the stump to the main roadway system—whether as thinnings or final crop—must inevitably be difficult, due to fragility of the peat surface and the obstacles created by ploughing and drainage. Hence an intense rackway system designed to bring timber by the shortest route to the roadways—by low ground-pressure machines or cableways—seems essential.

Based on the above main considerations—plus many other less important ones—the standard plantation layout for peatland afforestation areas in Northern Ireland State forests was evolved. This is summarised below in the normal order of application:

(1) The main drainage system for the whole peatland afforestation area is laid out on the ground in accordance with the considerations mentioned in 1 above. Mechanical maintenance is assumed and access routes are left alongside the drains (see (2) and (3) below).

(2) A maximum roadway system is marked out on the ground and sufficient width (minimum 35 feet) is left to permit eventual road construction—or hovercraft route. Wherever possible the roadway is tied in with the main drainage system.

(3) A network of 35-foot-wide rides is then laid down to form boundaries of compartments which are from 15 to 40 acres in size. As far as possible the rides should be negotiable and should be tied in with the main drainage layout.

(4) Having laid out all the above then the compartments are ploughed, with planting ridges running as near as possible at right angles to the roadways, leaving 15 foot wide racks parallel to the ploughing every 72 feet.

Having completed these preparations then the area is ready for the planting of Sitka spruce at a spacing of 8 feet apart along the plough rides which have been left at 6 feet apart. The planting is left until late in the season (March/April), whenever possible, to avoid a period of dry north-easterly winds which is a frequent feature of the January and February period in Northern Ireland.

Conclusions

Foresters in Northern Ireland are very much aware of the considerable problems associated with the pioneer planting of the inhospitable areas of blanket bog which clothe much of the country's hill land. The progress of older plantations on peat, together with encouraging experimental results, however, indicate beyond reasonable doubt that a tree crop can be produced on these agriculturally unproductive areas. Some doubts still exist as to the economics of the enterprise in pure compound interest returns on investment capital, but as more sophisticated techniques become involved—and research and mechanical trends suggest that this is a probability—then even these doubts may be removed.

It is emphasised once again that the procedures outlined in this paper are strongly influenced by policies and conditions which may be peculiar to Northern Ireland.

A NEW APPROACH TO THE FERTILISING OF PEAT AREAS

By N. DEVERIA

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Land acquired for forestry in Northern Ireland is, through Government policy, that which is unsuitable for agricultural use and it follows, therefore, that most of this land is of the blanket bog type, wet and undrained with usually a sparse vegetation cover of heather and deer-grass. For many years it was considered that it would be sufficient to drain these areas and with the fall in the surface water level the peat would dry out and release its nutrients to trees planted in the upturned turves of the hill draining ploughs. However, the growth of the plants was slow and research into this showed that the nutrient content of the peat, even when dry, was insufficient to meet the demands of the young trees although fertiliser had been applied at the time of planting by placing a small handful into the hole in the turf into which the plant roots were placed.

During this research it was found that the tree root development was unusual in that the roots spread away from the planting hole to a considerable distance often on or just below the ground surface and that the root spread was, in fact, away from the deposit of fertiliser placed with the tree at the time of planting. This discovery promoted interest in the prospect of broadcasting the fertiliser and small pilot schemes were initiated which showed the results promising enough to justify the application of this practice on a full scale.

Early Mechanisation

It was obviously uneconomic to transport the large quantities of fertiliser required in these areas over the very bad ground and to distribute this by hand so it was decided that this work should be mechanised if possible. The ground conditions would not permit the use of normal spreading equipment but a machine was finally evolved which could do this work satisfactorily and the following notes on this might be of interest to others faced with the same problem.

Swamp Model crawler tractors are normally used for pulling the heavy machines to drain these areas but these tractors were too slow in operation to pull the spreader at the speed required to give the very low distribution of fertiliser of 4 cwts to the acre. However, there was also in use in the Forestry Division a special track transporter of Canadian manufacture which was used for the movement of men and material over a large forest area in the west of the province. This was the Bombardier Muskeg Tractor which can travel at speeds of up to 15 miles per hour over very soft bog and carry a payload of up to 30 cwts.

It was decided to use this machine to pull a fertiliser spreader of the conventional type but for working over the soft ground the normal wheels of the spreader were removed and replaced by tracks of similar design to those on the Muskeg. As the tractor had neither hydraulics nor power take-off, the spreader was fitted with a small diesel engine with remote control to the clutch unit from the tractor.

This combination worked moderately well and the Muskeg was able to pull this track spreader over most of the planting area without too much difficulty but the trailer was cumbersome and often became bogged in soft ground which the tractor itself could cross and this caused a great deal of lost time and expense. A further and more serious defect, however, was that because of the high effort required to pull the track spreader the tractor had to operate in a low gear at peak engine revs and this eventually resulted in engine failure and damage to the transmission of the tractor.

Present Methods

In view of the difficulties experienced with the track spreader it was decided that another method of spreading the fertiliser must be adopted which would allow the Muskeg Tractor to work by itself. There was at that time on the market a new type of spinner/broadcaster with a hydrostatic drive and this offered the best possibility of taking a drive from the power unit of the Muskeg to drive the spinner. This was eventually done by fitting a hydraulic pump with a reservoir, control valve, etc., to the Muskeg and taking a drive from the end of the engine crank shaft. Suitable fittings were then secured to the hull of the tractor to carry the spinner/broadcaster and this combination has worked very satisfactorily over the last two seasons.

The fertiliser is carried on special racks fitted over the tracks of the Muskeg with a further load carried in the hopper of the spinner/broadcaster so that 1½ to 2 tons of fertiliser can be carried at one time. The machine can now work much faster than before and although time is lost in having to return to the roadside to collect further loads of fertiliser this is more than made up by the higher speed of operation and the reduction in time lost through bogging.

The fertiliser used for this work is rock phosphate spread at the rate of 4 cwts to the acre and this machine can carry out fertiliser from the roadside to the planting area and distribute it at the rate of 6 tons per day or more if the haul length from the roadside is short. Because of the high repair costs due to the earlier work described above, the operating rate of this Muskeg is higher than one would like, but at the rate quoted above the cost of distributing this fertiliser is approximately 11/- per acre and this is much less than the cost of aerial broadcasting which is the only other method of fertilising ground of this type.

Future Developments

Research suggests that to obtain a forest crop quickly on this type of bog, further applications of fertiliser will be necessary at intervals throughout the life of the crop. Until recently this could only have been done by aerial broadcasting but recent developments in Scandinavia where this fertilising of standing trees is also carried out has led to the development of special fertiliser spreaders incorporating high speed blower fans. These can be driven by any make of tractor with suitable power take-off equipment and can distribute powdered or granular fertilisers over large areas. A machine of this type has recently been purchased by the Forestry Division and has already been used on an experimental scale for broadcasting fertiliser over existing plantations in North Antrim. It is now proposed to marry this air-blast distributor to the Muskeg Tractor and this machine combination should then be capable of carrying out all the fertiliser distributing operations required for this Division from bare mountain to standing forests and to do so efficiently and cheaply in spite of the very difficult conditions.

So far as is known this is the only machine combination of this type in operation in the British Isles and, while forestry is probably the only enterprise where fertilising of such areas on such a scale is required, there may be an application for equipment of this type in certain agricultural applications.

FORESTRY AND LANDSCAPE DESIGN

By P. F. GARTHWAITE, M.A.

Paper presented at the
Institute of Landscape Architects Symposium, June 1969

The Size and Scope of the Problem

It is usually the local impact of forests and woodlands and what is happening in them that attracts attention. It is however necessary to have some idea of the place of forestry in Great Britain to get the problems it generates in proper perspective. Woodlands now occupy only about 8 per cent of the total land surface of Britain, compared with 10 per cent in Denmark, 20 per cent in Belgium, 50 per cent in Sweden and 65 per cent in Japan.

Table 4 below breaks down this woodland area of 4·5 million acres (projected to the end of 1969 from the 1965 census data) into components relevant to this paper. The 3 million acres managed primarily for timber production—the commercial woodlands—occupy no more than 5 per cent of the land area of Great Britain.

TABLE 4

MANAGEMENT, OWNERSHIP AND DISTRIBUTION OF WOODLANDS 1969

Millions of Acres

Country	Managed primarily for timber production			Other Woods			Total Woodland		
	P.W.	F.C.	Total	P.W.	F.C.	Total	P.W.	F.C.	Total
England	0·6	0·6	1·2	1·0	—	1·0	1·6	0·6	2·2
Scotland	0·5	0·9	1·4	0·4	—	0·4	0·9	0·9	1·8
Wales	0·1	0·3	0·4	0·1	—	0·1	0·2	0·3	0·5
Great Britain	1·2	1·8	3·0	1·5	—	1·5	2·7	1·8	4·5

P.W. = Private Woods F.C. = Forestry Commission

The area of 1·5 million acres classified as "other woods" in Table 4 are of great landscape significance. Although not primarily managed for timber production many of them are purposefully maintained as game coverts, nature reserves, amenity woodlands, shelter belts, and wintering ground for stock. They are often broadleaved in character and distributed mainly as small woods and copses in the lowland agricultural belts. They are in manifold ownership (possibly 30,000 different owners) which ensures their continuing diversity; their small size, mainly under 20 acres, makes them unsuitable for some of the methods applicable to large scale forestry enterprises. There is some loss of these woodlands to development of one kind or another, by conversion to agriculture, and through neglect and degeneration, but they are likely to give stability to the landscape for many years to come. The maintenance of some of these woods does however pose a problem which I have attempted to answer later in this paper.

The Forestry Commission itself manages a substantial area in which amenity and conservation are given special emphasis. The 8,500 acres of Ancient and Ornamental woods in the New Forest, oak and mixed broadleaved crops in the Forest of Dean amounting to 5,500 acres, the ancient Caledonian pinewoods of Glen Affric and the Cairngorms, more than 2,000 acres, are examples of areas under special management to perpetuate their particular character for all time. The conservation of flora and fauna of special interest over 100 separate areas varying in size from a fraction of an acre to several hundred acres, are managed under agreements with the Nature Conservancy, County Naturalists Trusts, the Scottish Wildlife Trust, and other bodies. In addition every forest in the Commission has some part of its area managed with special provisions for landscape or conservation based on local assessments. In the great majority of these areas the special aims are not incompatible with the production of timber.

In Great Britain, 28% of both private and Forestry Commission woodlands were broadleaved and 72% coniferous. Broken down by country the figures are: England 46% broadleaved and 54% coniferous; Scotland 8% broadleaved and 92% coniferous; and Wales 16% broadleaved and 84% coniferous. These proportions exclude coppice and scrub. Despite the preponderance of conifers planted since 1950, about one third of the woodlands of Great Britain, and nearly half the woods in England are still of broadleaved species.

TABLE 5

COMPARATIVE SPECIES COMPOSITION BY COUNTRY

Species	England	Scotland	Wales
Pines	22%	38%	10%
Spruces	14%	38%	48%
Larches	11%	12%	15%
Douglas fir	4%	2%	7%
Other Conifers	3%	2%	4%
Total Conifers	54%	92%	84%
Oak	23%	2%	9%
Beech	8%	2%	3%
Other Broadleaved	15%	4%	4%
Total Broadleaved	46%	8%	16%

Table 5 shows the comparative species composition of the three countries in detail. Note that oak is still the predominant species in England as it was at the census in 1947, and the area is approximately as it was then, that is 350,000 acres.

Change in woodland area

The total woodland area in Great Britain has risen by 1½ million acres from 3 million acres in 1920 to the present 4½ million acres, though 2½ million acres have been planted in that time. Much of this has been the restocking of old woodlands which does not add to the gross area and there has been loss to agriculture and to development to offset some of the new planting.

Planting is at present proceeding at the rate of about 95,000 acres per year of which about 57,000 are on new ground and the balance restocking old woodland. Most of the new planting is in Scotland and by the mid 1970s the Commission's programme of afforestation in Scotland alone may be 50,000 acres per year, and the rate of private planting in Scotland is also rising. It is possible therefore that in the next decade a further ¾ million acres of new ground will be planted, mainly in Scotland. The landscape implications are obvious; yet by 1980 forests in the uplands of Great Britain will still only occupy some 17 per cent of the rough grazing land, some of which is of course too high or otherwise unsuitable for forestry.

Timber production

A recent forecast estimates that the current annual production of conifer timber of 2·2 million tons will rise by 1985 to 5·2 million tons, and by the year 2000 to 7·8 million tons. The future trend of hardwood supplies is different. There are still substantial volumes in old broadleaved stands, but the current rate of production from all sources including hedgerows of about 1½ million tons per year cannot be substantially increased without damage to amenity and other interests.

The Changing Landscape Problems of Forestry

Afforestation

Forestry has many faces; the species, the techniques of management and the end products vary with a wide range of geographical and ecological factors. In afforestation of upland grazings it is the change in land use that is significant. Ploughing of familiar moorlands followed by planting brings a dramatic change which even with the best planning takes time to reconcile with the landscape. On the other hand the afforestation of industrial waste ground in the Welsh valleys or the northern coalfield, even though necessarily confined to pioneer species, gives an immediate improvement. Similarly the planting of littoral sand dunes at Culbin, Pembrey or Anglesey immediately enriches and stabilize those regions although the only species that will grow initially are the pines. Shelter belts owing to their relative scale are a welcome addition to the landscape.

Old Woodlands

The restocking of old woodlands presents a quite different series of problems, both technically and scenically. Wartime fellings left many of the woodlands in a state of dereliction with no replanting and only unusable trees left standing. When restocking really started in the early 1950s the forester was faced with formidable problems, especially in the broadleaved woodlands of the south where he had to deal with a tangle of bracken, bramble briar and coppice regrowth. There was consternation if he felled the few remaining trees to help to pay for his costly task, yet they were of little value to grow on with the new crop. A whole series of techniques had to be evolved varying from complete clearance before replanting to establishing the new crop under the dappled shade of birch or other regrowth thinned for the purpose.

Under sustained management such problems will not recur as the owner can plan his felling and restocking on a rational basis spreading it over a long period to ensure continuity and replanting each coupe immediately after felling.

Other operations

Between the establishment of the forest crop and its harvesting there is a period of 50–60 years for conifers and 100–150 for broadleaves during which successive management decisions influence the appearance of each site and of the forest as whole. Roads must be aligned and made, bridges built, huts, sheds, offices and buildings that are as necessary for a forestry enterprise as for farming, designed and sited. Notices are needed (though preferably on a minimal scale) and their wording and siting is as important as their design. All the trouble taken to get the landscape design of the forest itself right can be wasted if the paraphernalia associated with the enterprise are unsightly and of poor design.

Flexibility

In the long period between planting and maturity it is inevitable that objectives will have to be reviewed in the light of technical and social changes and their impact on industrial needs for wood. Much of the oak we see today we owe to the efforts made in the first half of the 19th century to secure adequate reserves of timber for the Navy. The coming of "ironclads" 100 years ago diverted this specialised need to other uses, which have now once more been superseded by new types of markets. The Commission's own principal objective of establishing a reserve of timber for strategic reasons was changed in 1958 to the commercial production of wood for industry. There is therefore in forestry a constant need to adjust to new patterns of management; yet it is seldom practicable to depart fundamentally from the general direction established at planting. If the forester's silvicultural judgement is correct in the species he plants and the way he tends them, advances in the technology of timber utilisation will help to mitigate the errors he makes in predicting the sort of timber that will be needed 50 or 100 years hence.

Natural influences

Running through and sometimes across the forest manager's plans are natural factors—earth, air, fire, water—and ecological influences—plants, animals, insects and fungi. These all affect the forest and shape its structure.

The variations of site and topography on this geologically complex island give rise to different rates of tree growth over quite a limited range of terrain. This can be offset but not eliminated by fertilisers and selection of the right provenance of tree for each region.

Wind is a major factor in British forestry and every year picks out patches in all the upland forests, and periodically causes widespread devastation as in the gales of January 1953 and 1968. Fire can be controlled but never wholly prevented in economic terms, nor can the loss due to animals, insects or fungi. Without drainage trees are more liable to windthrow, and rainfall as much as any other factor influences the choice of species—hence the spruce in the western mountains and pine on the eastern heaths.

Thus the structure and composition of a forest is under continual change from natural causes, sometimes sudden following fire or tempest, sometimes more gradual due to the effects of animals or insects, with normal growth following an uneven rhythm for site, season and species.

The Constraints

In seeking solutions to the problems of landscape design in the planting, management and harvesting of woodlands the forest manager is faced with limitations to his freedom of action. These constraints are silvicultural and economic.

Silviculturally he is limited in his choice of species to those which will grow satisfactorily on the sites he must plant, and he has to carry out certain measures to maintain and protect the trees he has planted. The poorer the site the more restricted he is; for the initial afforestation in extreme site conditions he may well be confined to one species and even this must be of carefully selected provenance. Site amelioration by ploughing, draining, and fertilising will assist the growth of the tree he has chosen but not widen his choice. In restocking these original plantings his choice becomes somewhat larger owing to the shelter of the surrounding forest. On the lower slopes and in the valleys the silvicultural choice widens and here other factors such as yield and future markets can be brought into the decision. On old woodland sites in lowland areas the scope for choice is still further widened by the fertile soil and forest conditions.

After planting the right species it is essential to protect them from competing weed growth, fire and animals. The visible means of fire protection are mown or ploughed firebreaks, grazing strips, belts of relatively fire-resistant species, and the provision of water supplies by damming streams, or artificial tanks if there is no water. Fencing is often necessary against rabbits in the lowlands, sheep in the uplands, and red deer in the Highlands. All these works have an effect on the appearance of the forest.

Economics

This has always been the main constraint on the forester's ability to do all that is desirable to soften the impact of his husbandry. In the early years of the Commission there was continual pressure to get as much planting done as quickly as possible on a tiny budget which left little opportunity for other factors to be considered. Since 1958 when commercial criteria began to be applied to the forestry enterprise as a whole (as distinct from carrying out each operation in the most economical manner) it has become evident that a rate of return of 2 per cent–3 per cent for much of upland forestry, and 5 per cent–6 per cent for lowland areas, is to be expected. The problem today is to achieve these rates of return in face of rising costs and a price for the end product which is based not on the cost of growing it, but on the price for which it can be imported, which has risen only marginally compared with the steep rise in costs in the last decade.

The reaction in forestry has been similar to that in farming; a reduction in labour, an increase in mechanisation and chemical methods, a constant review of the necessity for traditional practices, and the elimination of all but the essential operations for the growing of an increasingly standardised product for known markets. Supported by economists, work study teams, operational research projects, and cost/benefit analyses, a type of forestry is developing in which management is extensive rather than intensive. Under such a regime, fewer plants will be planted per acre, in a pattern allowing the mechanical maintenance of deep drains where necessary; minimum brashing of side branches; line thinning rather than selection thinning, and in some cases no thinning at all before clear felling; fewer roads, with construction delayed till felling is due to take place.

It is perhaps in harvesting methods that the greatest changes may come for it is in the cost of getting the tree from the stump to the mill that there is the greatest need to economise. The present systems involving felling and snedding by power saw followed by extraction to roadside by tractor or winch cable, may soon give way on suitable terrain to various types of combine tree harvesters which fell, debranch and cut a tree into logs ready to transport to the mill. Even more revolutionary methods of getting the cellulose from the forest to the consuming industry are on the drawing boards.

The more sophisticated and expensive the machine the larger the area it must deal with in one place to pay its way, and it is certain that there will be pressure to increase the size of felling areas to enable such machines to be economically employed.

It is unlikely however that in this country such methods will be universally applicable. In the lowlands the relatively small size of the individual forests, and the variety of growing stock on the rich soils, impose a restriction on the use of such developments and traditional methods are likely to persist, modified but not revolutionised by new techniques. The terrain in many of the upland forests may be too steep and rugged to permit the use of some of the more sophisticated machines, and development may be towards improving existing methods—winch and cable—rather than introduction of new ones.

Achieving Practical Results in Forest Landscape Design

The previous section may appear to herald an upheaval in the woods equivalent to the industrial revolution in the peaceful countryside of the last century. But there are safeguards which will prevent the serious damage to the forest landscape which the extreme application of some of these techniques might cause. And there are practical measures which can be taken to maintain the essential qualities of the environment while taking advantage of the latest techniques.

Legislation

Under the Countryside Acts all government departments have a duty "to have regard to the desirability of conserving the natural beauty of the countryside". The natural beauty is defined as including references to the flora and fauna. This has in fact been one of the Commission's published objectives since 1963, and an accepted aim long before that.

The existing forest

Unlike agriculture in which the cropping regime can be changed almost overnight, forestry is not amenable to such drastic change. The direction of management of much of the 3 million acres of existing commercial woodlands cannot be suddenly changed to accommodate entirely new systems. Only at certain stages can fundamental changes be made. The areas under special management in the Commission for landscape or wildlife will not change.

Natural influences

These, which have already been described, will continue to operate and influence the forest irrespective of technological and economic pressures. They create diversity, and in the long term may generate higher values than that of the uniformity which appears to be economically desirable in the short term.

Preliminary planning

Following the teachings of Miss Sylvia Crowe, a great deal of trouble is now taken by the local staff before any new acquisition is planted, to reconcile the outline with the topography, to identify landscape features which should not be obscured by the planting and to align forest boundaries, rides and roads to the best advantage for the landscape. In important places species boundaries are decided from a distant viewpoint so that the change from one species to another, which may give a very different colour or shape, is in harmony with the terrain. Radio sets have been used to talk markers into position when carrying out this type of planning.

For landscape and also for conservation of wildlife, belts and brakes of existing trees or scrub are left even if the components have no economic value. Such reservations make a contribution to the landscape, especially in the upland regions, out of all proportion to the area they occupy.

In the absence of any existing trees in rough grazings about to be planted, birch and rowan soon establish themselves once the area is protected from fire and grazing animals, and can be incorporated into the crop for landscape purposes.

In restocking former broadleaved woodlands groups or scattered belts of the former crop can be retained to break up the new planting. In other areas regrowth of birch or coppice can be used as shelter to retain the woodland habitat and create a transition between the old crop and the new.

Where not to plant

To leave some areas unplanted may be just as important as the species pattern in the planted areas, especially in hilly country. Leaving view points and giving a good clearance on roadsides and a disrupted edge to the plantations are now accepted practice. But experience and economic assessments of site quality now make the forester more selective in his planting within the forest boundary. Bad bogs, rocky knolls and other sites which could be planted, but are only marginally productive at added cost, are now left. Such sites can become important landscape features within the forest, and can be put to good use for other purposes.

Felling

The Commission's felling programme, both deliberate and fortuitous through windblow, is now about 10,000 acres per year. Planning the felling areas to avoid damaging the landscape depends on much the same techniques as planning the planting. In hilly country, where it is most important, it means studying the position from several viewpoints on opposite hillsides, plotting the shape which appears to conform to the land pattern on a map, then fixing on the ground with sufficient scope to adjust the edges while felling is in progress. Felling often gives the opportunity of remedying hard outlines caused by ill-sited rides and species boundaries in the original lay-out. The felling can also open up views and vistas which have been obscured for 40 years, and though the new trees will eventually obscure them once more, felling can be planned so that when this happens a new coupe is felled to expose a similar view. Final adjustments can be made in the boundaries of the coupe to make the most of the view it opens up.

The Management of Broadleaved Stands

Mr. Charles Venables, Chairman of the Royal Forestry Society of England, Wales, and Northern Ireland, and a leading timber merchant, has recently expressed optimism in the future of native British hardwoods, oak, beech, and elm in particular, grown on good sites for the production of high quality timber for which there is an increasing demand and a small but well established export market to U.S.A. and Europe. It was recently estimated that there are about 75 million tons of hardwood timber standing in this country, much of this is of a quality for which there is little demand. There is however every reason to retain stands of good potential and to improve their quality by proper management, oak and beech in particular. In the case of middle-aged stands it is possible to augment the final return by retaining selected groups and interplanting with conifers.

In planting broadleaves establishment costs can be greatly reduced and early returns secured by wide planting in a matrix of conifers suited to the site. Where formerly the practice was to plant up to 4,000 oak or beech to the acre, now the aim is to establish not more than 100 oak or 200 beech to form the final crop. The interplanted conifers are gradually removed to allow full development of the broadleaved species.

The forest manager is also involved in managing broadleaves in those parts of the forest where they have been planted or retained for amenity reasons. These stands are not necessarily on soils capable of producing high quality timber and in such cases the low output can be matched by a low input of resources to give a tempo of management that is financially sound as well as producing good amenity. In filling gaps in such stands it is now possible to use machines for the direct transplanting of saplings from another part of the wood where they are surplus. This avoids the difficult early stages of maintenance and protection, particularly in areas of public access where tree guards are both expensive and unsightly.

Conservation and Forest Protection

The practices of controlling animals that damage trees have undergone as great a change in the past 20 years as techniques of any other branch of forestry. Where formerly it was thought necessary to protect the trees from all risk of damage by all animals all the time, protection is now based on the premise that it is both impracticable and unjustifiable to avoid all damage, and the control of animals must be selective and minimal. This is another example of economics and conservation going hand in hand; the cost of controlling any animal is now such that it can only be contemplated after a very careful appraisal of the value of the damage and the costs of control or protection. The control is in the hands of a few highly skilled men, trained in the ecology of the animals concerned. Wildlife Foresters are in post in each Conservancy of the Forestry Commission to advise their colleagues on forest protection matters, wildlife conservation and the creation of habitats favourable for the increase of species harmless to the forest and neighbours.

Cost of Amenity Work

The cost of the measures that have been described above is relatively small. They all involve modifications of practice rather than fundamental variations. The work is in the time and trouble it takes to think out and plan the ways in which landscape and conservation needs can be given maximum effect with minimum impact on timber production and cost. Most often the "costs" of conserving landscape do not involve direct expenditure but arise as an estimated loss of opportunity of doing something more commercially viable. The retention of some not very good quality broadleaved trees where high yielding conifers could be grown may involve a theoretical sacrifice of up to £5 per acre per annum. There are, however, many variables and alternative courses which can reduce this "charge" without affecting amenity. The fact that in very many cases the needs of both landscape and wildlife conservation can be met simply by doing nothing—by *not* spending money—is in these days a highly meritorious line of action, provided it is not on a scale that will impair the viability of the enterprise as a whole. In many cases the areas most suitable to be left for landscape purposes are those which would be the most costly to afforest or replant.

The scale on which such provisions are made varies with the region and site. In the forest Parks, National Parks, and areas of Outstanding Natural Beauty, greater attention is paid to the landscape aspects. But it is certainly not confined to these designated areas and the working plants for each of the Commission's 400 forests contain prescriptions for the conservation of the landscape in the local context.

Evaluation of Landscape

While the costs to the enterprise of taking these practical steps to secure the assimilation of the forest at all stages into the landscape need not be high, the values they create more than bridge the gap between the returns from forestry and the ruling rate of interest. It is difficult, and probably undesirable, to attempt to evaluate landscape in monetary terms, but it is significant that society is now prepared to pay costs far higher than those ruling for forestry to create and maintain amenity in the context of trees and woodlands. Tree Preservation Orders are costly instruments; and the maintenance costs of purely amenity woodlands, and even for the less sophisticated landscape schemes for screening installations in the countryside, are in a different cost category altogether from those for forestry, even with maximum attention to landscape.

The practical ability to achieve good landscape design and wildlife conservation at a low cost in forestry, while continuing to produce timber indicates that it could be beneficial to the community to incorporate forestry schemes in appropriate landscape and conservation projects, as indeed is done on the continent in communal forests in Switzerland and in regional schemes such as that in the Ruhr in Germany.

Future Trends

Other Uses of Forests

It is certain that the next decade will bring further changes in forestry methods and techniques, and even objectives, to which the forest manager will have to react from both the economic and the aesthetic viewpoints. One change that is already pressing on him is the need to cater for the other uses to which his forests can be put in addition to their primary function of producing timber for industry. The Countryside Acts of 1967 (Scotland) and 1968 give the Forestry Commission powers to provide for tourist, recreational and sporting facilities in their forests, as well as manage trees and woods for amenity. Development of these uses had already been progressing for some years under the limited authority of the Forestry Acts, and there are in the forests now twelve equipped camp sites with a total capacity of 8,000, more than 200 picnic sites, and nearly 100 forest and nature trails totalling 250 miles, with additional way-marked routes for longer distance walkers.

Some forests, notably Grizedale in the Lake District, have developed more sophisticated facilities in an area of outstandingly beautiful scenery, rich flora and fauna, and with many visitors. Observation huts for wildlife study and photography, a wildlife and information centre, tarns where wildfowl have been encouraged to breed, fishing, and stalking are among the provisions in this forest. About 30,000 people are expected to visit the wildlife centre there this year.

Scenic Routes

The Commission has been reluctant to open their 9,000 miles of forest roads to private cars, for many reasons, not least of which is the desire to allow walkers to enjoy the forests free from such traffic. But these roads, built for the extraction of timber, penetrate some of the most beautiful country in Britain, hitherto quite inaccessible to all but the foresters, and before them shepherds or ghillies. Following the success of the "scenic drive" across 13 miles of Allerston Forest in the North Yorks Moors, which has been open for about eight years, other routes are now being considered. Carefully planned, they need not impair the peace of other users, and can give immense pleasure to the old and the very young unable to walk long distances.

Charges for Recreation

Payment is asked, often by means of "honesty boxes", for facilities when it is appropriate to do so. Car parks, camping, wildlife centres, riding, driving and various other activities involve either additional capital expenditure to provide, or money to maintain, and it is right that they should be paid for. Other activities —walking, picnicking, etc do not involve the Commission in significant costs, and moreover any charges would be difficult to collect.

The value of these facilities however goes far beyond the cash return they produce. The forests providing them are in effect fulfilling the same function as will the Country Parks to be set up under the Countryside Acts, but without the cost of establishing and maintaining a specially designated area of country for the purpose. This indirect value more than offsets the additional cost of any modifications to normal working necessary in a forest providing a wide choice of activities. These modifications are not great, but there is justification for added attention to the appearance, retention of broadleaves, the creation of glades and viewpoints, and elimination of techniques which could make the forest less attractive.

Already it is becoming obvious that many of the Commission's more accessible forests are being valued for the quiet enjoyment they give, and it may well be that some, particularly in the south, will come to be managed for recreation as an equal objective with timber production. This emphasises the need in such forests to keep options open and retain features or stands of trees that will be assets in the multiple use that may supplement economic timber production.

Small Woods

At the beginning of this paper reference was made to the 1·5 million acres of woods not actively managed for timber production. Although managed for other purposes many of them are on rich sites capable of growing the best quality broadleaved timber—oak, beech, elm, ash, sycamore—without detracting from their purpose as game coverts, nature reserves, shelter belts etc. The growing of hardwoods could be, in part, transferred to these smaller woods in the most fertile areas. If this were done it would give security to the landscape of which these woods are so vital a part, in a way that no other form of management could do.

The Philosophy of Restraint

In forestry as in all other industries, the application of new techniques is essential for the viability of the enterprise. Unless this is commercially successful none of the ancillary activities associated with it can be introduced. It is now possible however to make dramatic changes in the forest environment by mechanical and chemical means; and there is need for managers at all levels to consider the environmental effects, both short and long term, as well as the economic advantages of the techniques that are becoming available.

Normally it will be possible to achieve a satisfactory compromise by sensible selective use of the means of operating—selective in intensity, timing, and application. There are circumstances however which call for the deliberate rejection over a wide area of the cheapest method in favour of one less damaging or dangerous to other interests. The danger of contamination of water supplies in catchment areas by use of chemicals is an obvious example; but the avoidance of ecological or landscape damage can be of equal importance in particular localities.

Co-operation

The achievement of acceptable standards in landscape design in the broadest sense in forestry depends on co-operation with others concerned with landscape planning and conservation. Consultation at all levels with both official and voluntary bodies is now firmly established in forestry on an informal as well as a formal basis.

Involvement

Much of the success of the efforts of the Commission to provide facilities for recreation, and its more ambitious efforts in practical conservation, is due primarily to the interest and enthusiasm of local people outside the Forestry Staff who have undertaken the planning, supervision or maintenance of activities in which they, not us, are experts. An immense amount of time and trouble has been given by members of voluntary bodies such as naturalists trusts, natural history societies, the Wildfowlers Association, the Scottish Wildlife Trust and other bodies as well as staffs of museums, in helping the Commission to create the facilities I have described.

The continuance of their interest and involvement in the forests will be an assurance that the Commission itself is providing an environment in which such things are possible. Even more important is the influence of the Institute of Landscape Architects whose members can demonstrate to all those who are concerned, officially or unofficially, with the landscape, and to foresters themselves, that forests can be both productive and beautiful.

THE BEGINNINGS OF PROVENANCE STUDIES

Contributed by Roger Lines,
District Officer, Research

12th January, 1924

Dear Dr. Borthwick,

I enclose proposals for the comparative silvicultural study in this country of different races of Douglas fir and Sitka spruce. You will recall that I discussed this with you when you were in Edinburgh and I mentioned it also to *Mr. Robinson. Such a study should year by year add to our knowledge of these species. This study would also give material for a botanical investigation of the races which would be an essential complement to the silvicultural one.

I shall be glad to have your observations on the outlined schemes with any modifications or additions you consider desirable. The immediate requirement is 2 lbs or such amount of seed as is available of each race of the two species together with any information which can be given under heading 1a. If the full

* Later Lord Robinson, Chairman of the Commission.

ranges of the two species are not covered by the seed available this year, I suggest that an effort should be made this autumn to add to the number of different types and origins. I shall endeavour to obtain home seed of known history.

Yours sincerely,
*H. M. STEVEN

Dr. A. W. Borthwick,
Chief Research Officer,
Forestry Commission,
22 Grosvenor Gardens,
London, S.W.1.

Forestry Commission,
22 Grosvenor Gardens,
London S.W.1.

14th January, 1924

Dear Dr. Steven,

Thanks for your letter of the 12th and the accompanying scheme you have worked out for the comparative study of races and types of Douglas fir and Sitka spruce in this country. I think you have made the scope sufficiently wide to cover any details that may subsequently arise and therefore I do not think it requires any modifications or additions in the meantime. I have asked Mr. Honywill to make a note of the seed requirements for this purpose and to let you have such seed as may be suitable immediately on its arrival here.

I agree that we should make a further effort next autumn to obtain as great a variety of types and origins as possible. I think it would be a very useful thing to extend this enquiry to the common Norway spruce. I was very much struck with Cieslar's experiments in Austria. 50% difference in growth and timber production was easily observable on trees from seed of different origins and we are still somewhat uncertain as to the best source from which to obtain Norway spruce seed for growth in this country.

I think we could get seed of various types from Switzerland where Engler also did a considerable amount of work in this direction.

Please let me know if you think this addition would be possible and useful.

Yours sincerely,
A. M. BORTHWICK

Forestry Commission,
22 Grosvenor Gardens,
London, S.W.1.

17th January, 1924

Dear Dr. Steven,

I mentioned your proposed experiment on the comparative study of races and types of Douglas fir and Sitka spruce to Mr. Robinson. He is very interested in the subject and suggested that parallel series of experiments should be carried out by Mr. Guillebaud in England. Accumulating evidence seems to show that types suitable for the north may not be the best in the south.

* Later Professor Steven, Aberdeen University.

As regards the seed you require we have just received a large consignment from Canada and it is possible that the experimental samples we asked for may be in the cases. A look-out is being kept for them and should they have come with this consignment, a supply will be sent to you. The samples of Douglas asked for, for experimental purposes, were to be collected at high and low elevations respectively in the dry and wet belt. For any marked types of Sitka, I fear we would have to go further south than Canada for samples. This we could arrange for next autumn.

I shall be glad to have your views on the desirability of including Norway spruce as a demonstration of the wide range of growth forms which can exist in one and the same species.

As the quantity of seed we asked for is only 1 lb we should only be able to let you have half of that quantity of each origin and it is suggested that one nursery would be sufficient for a start.

Yours sincerely,
A. W. BORTHWICK

Experimental Plan

THE COMPARATIVE STUDY OF RACES AND TYPES OF DOUGLAS FIR AND SITKA SPRUCE IN BRITAIN

It is proposed to utilise fully the opportunity which is presented by the actual or possible availability of seed of different origins whose history is fully known. Such a study includes two aspects, botanical and silvicultural. They are inter-related but the silvicultural one only is considered in what follows as this is the aspect which comes within the scope of my work. The silvicultural study will consist of two stages:—

1. The Nursery Stage.
2. The Plantation Stage.

1. The Nursery Stage

The seed of the different types of each species will be sown in two nurseries differing in soil and climate. The conditions of soil and climate will be defined as accurately as possible.

The following data will be recorded for each race or type:

(*a*) All available information regarding the origin of the seed, the type of mother trees and the soil and climate conditions under which they have grown.

(*b*) Notes on the seed, laboratory germination tests, weight of seed etc.

(*c*) Nursery germination and out-turn.

(*d*) Shoot and root development during successive years in the nursery.

(*e*) Similarly the periods of vegetative activity.

(*f*) The effect of climatic conditions on the plants, e.g. frost, drought, etc.

(*g*) The occurrence and degree of damage from diseases and pests. (This will be referred to appropriate specialists).

(*h*) Any other points of importance.

(*i*) A general summary of the response of the race or type to the nursery conditions.

2. The Plantation Stage

Two or more typical sites, differing in soil and climate, will be selected. The locality conditions will be defined as accurately as possible. The different races and types will be planted both in plots, which can subsequently form increment sample plots and in alternate rows.

Data on the following points will be recorded as available:

(*a*) Species, race identification No., Age of stock, spacing, planting method, etc.

(*b*) Growth statistics from date of formation onwards. (The sample plot method will be used when a suitable age is reached).

(*c*) The effect of climatic conditions on the plants, e.g., frost, snow, etc.

(*d*) The occurrence and extent of damage by pests and diseases (by appropriate specialists).

(*e*) Notes on type of branching, persistence of needles, branches and similar points of silvicultural value.

(*f*) The study of progeny from seed produced by the trees.

(*g*) The study of the timber (by appropriate specialists).

(*h*) Any other points of value.

(*i*) A general summary of the response of the race or type to the conditions of the site.

H. M. STEVEN, 1924.

N.B. Mr. Lines comments: *This would have been a classic of provenance research, had Steven been allowed to carry it out. In fact we had to wait until 1958 for a good provenance collection of Sitka spruce, and we did not sow a comprehensive Douglas fir trial until 1968. Steven's plan, might well have saved the Commission many millions of pounds!*

THE ROAD AHEAD IS SYLVAN-LINED

Reproduced from "Express and Star", Wolverhampton

An operation which will affect the Staffordshire landscape for 100 years or more is being unobtrusively carried through. It might be called sylvan sculpture—modelling the landscape with trees as a sculptor fills in contours with his clay. And it has been brought about by the motor vehicle, that mixed blessing not normally associated with man's oldest friend, the tree.

In 1968 alone the Forestry Commission, as agents for the Ministry of Transport, is planting nearly 50,000 trees alongside the M6 motorway and some of Staffordshire's trunk roads.

Many trees seem as yet little more than twigs poking out of embankments and verges, usually with a drab supporting stake alongside. Eventually, however, they will grow strong enough to break the straps binding them to the stakes. The stakes will then be removed, leaving the trees in grouped shapes varying from Indian file to elaborate scrolls covering an acre or more.

"The whole object is basically to have reasons for the tree grouping", explained Mr. Len Simpson, the tall Scot, who as Forestry Commission district officer, generally supervises the Staffordshire contract.

"Some groups are essential screens for private properties near the roads and others replace ancient trees. But many are to 'beautify'—to give a dash of forest vista to a motorway, or soften the angular contours of bridges and embankments."

For a townsman who likes the countryside and art, this sounds an envious task. But there are problems. Roadside soil is often poor. Some trees need imported soil before they will even begin to bite. Plantings may be sprayed with road filth or winter salt which hampers growth. In some areas damage occurs, both from vandalism and from indiscriminate parking on verges.

Last summer also proved that drought can be a problem. It became critical at the M6 Hilton Park service area, where plantings include rhododendron bushes. Maintenance, too is arduous. The trees have to be nursed, and the forset workers may log more than 15,000 vehicle miles this year alone.

The Commission was, of course, eager to win this new market in succession to local authorities whose own knowledge of trees and planting varied in standard. The contract involves four Staffordshire forests—Cannock Chase, Swynnerton, Kinver and Oakamoor.

Most of the trees have been drawn from seven private nurseries, although the Commission now has a Ministry of Transport stock nursery at Delamere, Cheshire. The trunk road schemes have involved the A5, A449 and A38, with the motorway claiming most of the larger sites (one tree group near Gailey has 6,800 plantings).

Almost forty species have been used, including oak, sycamore, horse chestnut, alder, birch, beech and willow, elm, holly, and thorn to give base thickets as wildlife cover.

On the immediate schedule lies the new Wall by-pass, near Lichfield, and other schemes will involve the Commission until at least 1973.

Photos showing the work in progress appear on our centre pages, Plates 8 and 9.

POINTS OF VIEW

The artist looking at a tree
Admires its form and symmetry
Seeking to fit its lines and shape
Into a landscape he will paint

The timber feller sees the ash
In terms of work or hard-earned cash
How many blows, how hard the stroke
To cut and trim the beech or oak

The merchant wants a log with length
And knot-free stems with girth and strength
To cut veneers from birch and plane
Or sycamore with ripple grain

The tourist needs a spreading crown
When venturing from smoky town
His kettle boils, his tea is made
Beneath a tree with ample shade

The planner-cum-economist
With slide-rule and a lengthy list
Of statistics and formulae
Seeks to computerise each tree

The forester who grows the tree
Needs increment for this we see
Means interest on £. s. d.
Which brings a thriving industry

R. J. JENNINGS

DISCUSSION AND EDUCATION

RESEARCH CONFERENCE—OCTOBER 1967
PAPERS PRESENTED ON THE THEME OF "WHERE ARE WE GOING?"

1.	SEED	Mr. G. M. Buszewicz
2.	NURSERY RESEARCH	Mr. J. R. Aldhous
3.	SPECIES AND PROVENANCE	Mr. R. Lines
4.	IMPROVEMENT OF SITE	Dr. W. O. Binns
5.	REGENERATION	Mr. S. A. Neustein
6.	CLIMATIC ENVIRONMENT	Mr. J. M. B. Brown
7.	TREE BREEDING	Mr. R. Faulkner
8.	PATHOLOGY	Dr. D. H. Phillips
9.	ENTOMOLOGY	Mr. D. Bevan
10.	TIMBER UTILISATION AND DEVELOPMENT	Mr. B. W. Holtam
11.	WORK STUDY	Mr. L. C. Troup
12.	PLANNING AND ECONOMICS	Mr. J. A. Spencer

1. SEED: Buszewicz

I am rather nervous at being the first one to ask you to join me on this journey into the future. One may say however that almost everything begins with a seed and therefore, quite rightly, the seed officer should be the first one to exercise his imagination and vision.

Before starting this journey into the unknown future, let me be allowed to outline the present position, which I think will be helpful when answering this crucial question "Where are we going?".

The potential of a seed is determined by two sets of factors. The first is the genetic complex inherited from the parent plant. The second is a large and complex group of conditions during the development of the seed on the parent plant and its subsequent harvest, provenance testing, storage, transport and, finally, sowing.

The Seed Section is concerned with the second set of factors and is responsible for retaining the highest physical quality from the time of harvesting to the moment of sowing.

In those circumstances the Seed Section is primarily a service section. It was developed and organised from scratch by research people and this is the main reason why it is included in research. Here, however, one should emphasise that this development could not be achieved without the hard work of research and it is obvious that without research this service would have sunk into stagnation.

The Section as it now stands can be proud of its achievements of which the most important contributions are the drastic improvements in seed economy. During the last 10 years the seed usage in F.C. has dropped by 15,000 lb and now 2,500 lb produces the same number of plants as 17,500 lb did 10 years ago. A straightforward calculation reveals that we are now saving over £100,000 each year. This is a considerable sum and approximates to a saving of over £1 per 1,000 plants raised.

The nurseryman can be proud of his share in this achievement but I think it is obvious that this could not have been done without the contribution of the seed section. It is not a coincidence that this sudden drop in seed usage became obvious after 1958 when a new formula for sowing density (based on the effective lb) and the refrigerated seed store were introduced. Is it worth doing research if there are no chances of applying the results?

The question now arises, how much more of the present 2,500 lb, as used today, could be reduced. According to my calculations there is still a scope for another 50% reduction but this will be a difficult task and will require a new approach to our nursery technique. Besides, of course, substantial savings in seed economy the plant production costs are still rather high and call for faster reduction as well.

Here we are moving into the future and as far as I see the problem, the F.C. will have to detach the nursery production from the Conservancies and administrate and organise it as an independent enterprise consisting of 8–10 large nurseries. In this case the area should be reduced by about 50% (from 1,700 acres to about 900). Each nursery should be run by skilled experts and be equipped with modern machinery and greenhouses to allow the plant production time to be shortened. I am convinced that this is not just a Utopia but a hard economical necessity.

Let us move now into the opposite sector, namely tree seed procurement. Here our main aim is to become independent of seed imports. In order to achieve this a big programme was set and nearly 8,000 acres of selected stands were registered and about 200 seed orchards were planted 10 years ago. I heard at the conference that in 10 years we should be able to stop our imports. Since then our seed requirement has decreased by 15,000 lb and, at the moment, in my stock I have only about 8% of seed from our registered sources, which is equivalent to about 3 oz per acre of our registered stands.

Here I am afraid I do not know where we are going but I am sure that we are wasting a lot of money and expensive time. We are learning a hard lesson, that it is not enough to have a lot of beautiful seed sources on paper but there must also be someone managing these stands and collecting sufficient tree seed. As far as I can see the crucial issue here is that the Conservators are not interested in seed collection because it is troublesome and causes some deficit in their accounts. I think that as long as this problem is not solved we will always be importing seed.

As regards the seed research, there is plenty of scope for improvement. Testing to determine the correct viability for some lots of seed continues to be difficult. Further research is required to shed more light on the causes of viable dormancy. Unfortunately we do not have sufficient information on the productivity of more questionable lots in the field.

This problem is also very clearly connected with the concept of germination vigour and this interacts with our long-term storage procedure. As yet we do not have a standard procedure for measuring the germination vigour. Some day, perhaps, the percentage of germination may be replaced by a figure known as the viability index. This could be a combined measurement of germination and vigour.

There is also a strong demand for having a reliable method for quick identification of seed origin and there is little doubt that the ability to do this would, so long as we are dependent on foreign sources, be a valuable safeguard against the great waste of money involved in sowing and planting unsuitable provenances.

2. NURSERY RESEARCH: Aldhous

Before I suggest where we might be going, I would like to say a bit about where we are. In fact we could well be said to be at the end of an era. Quite apart from several staff changes concerned with nursery work in the south, Rothamsted staff recently announced their intention of stopping direct supervision of experiments at the end of 1969.

The last 20 years achievements can be summarised by looking at the cost of Forestry Commission nursery work, excluding overheads:–

Year	Plant Produced (million)	Cash Spent (£000)	Relative Costs per 1,000 plants in terms of 1949 values (%)
1949	83	£518	100
1954	122	£517	54
1959	105	£542	57
1965	99	£371	36

While cost of plants turned out from nurseries is one criterion against which to measure success in nursery work, it would be better to consider the cost of the whole establishment operation—supply of plants + prep. ground and planting + subsequent tending, as the unit and the object to minimise this whole complex of operations. The cheapest nursery plant may not do so well in the forest; conversely, plants raised by intensive (and expensive) nursery techniques may be (and also may have to be) justified by savings in establishment costs. Apart from direct savings, added flexibility in management can be considered a criterion of advance. For example, cold storage has enabled nursery managers to store plants and spread the work of lifting, grading and packing over a longer period.

A third criterion for us is our success as advisors and teachers of techniques. Inspection of correspondence and samples show this to be a continuing and presumably valued service to the field.

Where are we going, then?

At the present time we have three real choices.

1. Do nothing. We can accept the progress made, invest no more in nursery work, disband existing teams and swing all our efforts elsewhere.
2. We can keep up with modern technology. This is, of course, one of the main tasks of Forestry Commission research. To take ideas from forestry overseas or from agriculture and other related fields and apply them to forestry is, and should continue to be, our bread and butter. Unfortunately, we cannot control timing of new developments, and cannot say in advance when, for example, new fertilisers or new herbicides will appear and require exploitation.

If we decide on the role of being able to tackle new developments as they arise, it implies maintaining the skills and experience to experiment in forest nurseries; and as an incidental consequence, of keeping in the position of being able to advise Conservancy staff and to provide instructors for specialist courses.

We have to make the choice between 1 and 2 apropos the continuation of projects started by Rothamsted. By 1969 we must know what we intend to do and how, and who is going to do it.

The most pressing need for improvement in current practice is to increase the reliability of yield from sowing, and survival and growth from transplanting. New fertilisers might help. However, this leads to the third choice—

3. To explore vigorously new techniques by which plants are grown in the greenhouse for part or all of their life. Examples range from tubed seedlings now being used extensively in Canada, to plants in peat sandwiched in polythene or raised in peat or other pots in Scandinavia and Australia. This objective can be subdivided into three lines:
   (*a*) Production of plants in soil, able to be planted out at any time. (Tubed seedlings or ball-rooted stock).
   (*b*) Plants, perhaps in soil or peat or sponge, but raised so that the germination phase of production is optimum and a very high yield of seedlings obtained. In this line it is assumed that plants are fit for the field in the same period as at present.
   (*c*) As for (*b*) but with plants accelerated in growth so that they are consistently ready for field planting in one year.

The economic factors to be taken into account are:

Seed: This is at present the highest single item of seedbed costs. Besides, the value (and cost?) of seed is likely to rise substantially as seed-orchard seed comes into nurseries. We ought to be able to turn virtually every seed into a plant and certainly ought to be dissatisfied with less than 80% yield.

A saving in seed only implies a saving in nursery space and a reduction in number of plants if the margin for error, at present built in to meet most sowing plans, can be reduced.

An improvement to 80% in seedling yield from sowing in F.C. Nurseries at present-day costs would save £8–10,000 per annum. If the value of seed increased, the saving would increase proportionately.

A 10% reduction in seedbed area would save £10,000 per annum at present day costs.

To eliminate the transplant stage altogether would save £250,000 per annum. It would also simplify planning of plant production if one could rely on plants fit for planting one year—or less, after sowing.

The efforts on establishment are as follows:

Altering by one year the date of first thinning is worth £4 N.D.R. at planting. This is a saving if the interval between planting and thinning is reduced, or an additional cost if extended. One year's weeding costs between £3–£6 per acre.

As the number of plants per acre drops—at 8 ft spacing only 680 are required, at £6 per 1000, the cost per acre is just over £4. Thus minor variations in the cost of plants are going to have a small effect on establishment costs. What matters is rapid establishment and quick early growth.

In certain areas the need to plant at all times of the year may be dominant. Our targets should be to find regimes of plant production which meet both the requirements of (i) all the year round planting and (ii) most economic establishment. In my opinion, the intensive methods of work offer the greatest scope for meeting these and should be looked into.

3. SPECIES AND PROVENANCE: Lines

1. Species

This is an appropriate time to look at species in that it is now 11 years since the Exotics Bulletin (No. 30) was prepared. Have we learnt very much in the interval? The main lines of advance are with minor species, for example we now know more about *Eucalyptus*, *Pinus strobus*, *Pinus peuke*, *Tsuga heterophylla* and *Tsuga mertensiana*, to name a few. Our use of the different species has changed: Japanese larch went under a cloud but is still widely used. Scots pine has fallen as the exposure of planting sites has increased and it has to face competition from Corsican pine in the South and Lodgepole pine in the North, but it still represents 7% of species planted in 1966. We have found from bitter experience that Lodgepole pine (21% of the total) has a number of inferior provenances and such great variation that we now have to think of the different major variants almost as distinct species and use them accordingly. Sitka spruce has established its overall dominance (39%) in all those parts of Britain where afforestation is leaping forward and the great question remains as to how far it can be pushed by chemical warfare. Norway spruce, somewhat surprisingly, is still the third most important species (8% in 1966). In relation to Sitka spruce it is generally accepted as being less productive on most soil types and its present use probably reflects a conservative trend. However, there are very few experimental comparisons of the two species which give a statistical estimate of the difference in production. As both show a fair degree of provenance variation (and we have mostly had less-than optimum provenances of Norway spruce) the situation is far from satisfactory. This leads on to the point that nearly all of the older species trials are poor from the point of view of experimental design and though this is partly balanced by their large number it needs a trained (but unbiassed) silviculturist to interpret their results, rather than a statistician. Even the post-1950 trials are somewhat odd from the design point of view in that the major species are barely adequately replicated in large plots whereas the minor species are better replicated in small plots. A great many of these experiments have the species comparisons complicated by mixtures with larch. If we are honest with ourselves we should probably think of our species trials as being largely non-statistical demonstrations backing up what we have discovered from "general experimental experience" including Yield Class Surveys by P. & E. An honourable exception is perhaps the 1958 onwards series of regeneration species trials where the design should enable statistically sound conclusions to be reached. It seems odd that for investigating some questions we demand high statistical precision, while for others we are happy with intelligent guesses.

Looking to the future I suggest that the main gaps which need to be filled are (1) the complex question of which species and fertiliser input give the optimum financial yield on a variety of sites. Frankly, I don't think this can be answered by predictive calculations, though Mr. Wardle has made a courageous attempt to do so for Sitka and Lodgepole comparisons. If one introduces spacing as an additional variable, the complexity becomes so great that one thinks immediately of multivariate analysis as a tool, but the interactions between species, spacing and fertiliser input are likely to be huge and can only be investigated empirically. (2) We may well have to return to species trials when improved genetic stock becomes available. Some species are so responsive to tree improvement methods that the improved cultivars ought to be tested against the best available strains of other species—Hybrid larch and Scots pine may be nearly at this point. (3) Before very long we should consider regeneration species trials on the poor northern peats. At Strathy, for example, in 10 years time we shall have an unique site for investigating whether the initial Lodgepole pine pioneer crop can be succeeded in the second rotation by a more productive species or whether it pays best to run successive pulpwood crops. (4) There are many species and site types which merit a small scale follow-up, e.g. if the Glenbranter *Eucalyptus* trial succeeds, where should the line be drawn? Leyland cypress has clear indications of being a highly productive species on certain Southern sites but what are its limits? Planting on bings is still in its infancy; all indications are that money would be available to re-clothe industrial sites if we could base our prescriptions on certain knowledge.

2. Provenance

I don't propose to say much about provenance since this subject has only recently been examined by the Visiting Group and their Report was generally favourable to the current conduct of provenance work. We have a lot of dead wood still to prune from the older experiments but it would be wrong to give the impression that they involve a big research effort—most are on a care and maintenance basis and the big job is writing Final Reports. In retrospect the older experiments mainly suffered from the disadvantage that far too much emphasis was given to trying out the seed origins readily available commercially, and not enough to discovering the pattern of variation over the whole range of the species. As an example we have dozens of European larch experiments comparing provenances from the Alps with various British origins but no true Sudeten or Polish larch in experiments until 1940. The recent *Tsuga* collection has shown that (at least in the north) the Alaskan provenance from Juneau has a rate of growth much above what I should have predicted from general principles, though its relative position may change after the establishment phase.

In the future there is still much that we don't know about our major species. Lodgepole pine is currently being tested more thoroughly than ever before, using the good collection now in store. The history of L.P. provenance shows the costliness of past errors, amounting to perhaps £1 million with the Lulu Island lots. Sitka spruce deserves a more detailed series of experiments since a small gain in yield would have such wide repercussions. Norway spruce has three current experiments planned or in being and these should suffice. Douglas fir will be covered by the new IUFRO collection. Various minor species (e.g. *Abies grandis*) will have a small series of trials. Exciting new techniques of early testing may help to shorten the selection of the best provenances. I hope to arrange some wind tunnel studies of L.P. in collaboration with Dr. P. G. Jarvis of Aberdeen. Growth chamber and timber testing investigations are envisaged with a number of species, in collaboration with our own Physiologist or University researchers. Equally important is the question of disseminating information about existing provenance trials. The machinery for advising Forest Management on purchase of seed has been improved over the years but could perhaps still be improved further. The question of ensuring that the correct provenance gets onto the correct site is somewhat harder to tackle and in the long run will depend upon a greater knowledge of provenance all the way down the line, and Forest Management can certainly help in this.

4. IMPROVEMENT OF SITE: Binns

My reaction on being asked to speak for ten minutes on "Where are we going?" in site improvement was—COR! I have to cover something like 30 projects in this time and I am speaking, not only for my own subject—tree nutrition—but also for the soil physical work done by my own section, the drainage work being done by Alistair Fraser and George Taylor and, apparently, the herbicides covered by Mr. Brown and Mr. Atterson; in addition to this, of course, Mr. Atterson's northern nutrition work, so I can only hope to give the most sketchy coverage of "Where we are going?".

Now, one of the most important things to determine in any site improvement work is the limit to crop production using those techniques currently available and those which it is hoped will be available in the future, if necessary by simulation. Until we know these things, until we really know what is limiting crop production, and whether, in fact, there is any way of ameliorating this, it is difficult to take rational decisions on site improvement. Therefore the maximum amelioration project which has been mentioned before during this conference, but which has not yet started, is essential if we are to progress very much in our state of knowledge.

In the soil physics work done by my own section, we shall continue to try and work out the place played by the soil moisture and climate on the drier side of the country, turning our attention increasingly to Sitka spruce. A proper link-up of this work with the Northern Silviculturist's studies on bent top + loss of increment is an essential part of our effective attack on the problem.

The drainage work will doubtless continue much along the lines it is a present, with drainage trials of various kinds and sizes in various parts of the country, the objective being to find out, using short cuts if possible, the most economic regimes having definite effects on the soil, which is where, of course, my own section comes in. On cultivation, we have to unscramble the physical-chemical complex of induration and fertility on upland heaths to explain the differing effects of cultivation on tree growth on different sites. This is an extremely difficult project because it's pretty clear that some fairly sophisticated soil physical factors are involved.

On nutrition, we need to establish, in the major climatic regions of the United Kingdom, those combinations of site, species and crop age, which are responsive to fertilisation. In some detail, on the organic soils, most of which will, I am sure, be seeing a considerable use of potassium in the future, but the thing that has to be found out is how far the much greater potential of Sitka spruce compared with Lodgepole pine can be realised on peat by more intensive manurial treatments. On mineral soils I am quite sure that in older crops, pole stage, we are going to see an increasing use of phosphorus and nitrogen. We have already got evidence that phosphorus is beneficial to Sitka spruce and from the North there are some definite responses of Scots pine to nitrogen fertiliser. We have again to identify site factors which are associated with response to these nutrients. For mature crops we have hardly begun and our great task is to see how far the striking results achieved in Scandinavia, particularly with nitrogen fertilisers, can be realised in Britain. Fortunately we have some time in hand here because there will not be large areas of near-mature crops ready for some years. The urgency is clearly with the pole-stage work. In the longer term, we must be looking at the nutrition side of the next rotation. This ties in, or should tie in, quite closely with the regeneration work being done both in North and South, but one thing we hope to find out is if there are any indications of lock-up of nitrogen occurring resulting in decreasing availability of nitrogen, such as has been experienced in the Antipodes. Nitrogen may, in fact, come to take up a considerable amount of our energy when we get on to the second rotation. We shall of course still continue to work on slow grown and checked crops but I do not think there will be a great deal of research done on these sorts of crop.

We shall be concerned with the place of potentially high-yielding species on poor sites, for example paying attention to minor species such as *Abies grandis* which have hardly been looked at in connection with intensive fertilisation. This will also doubtless continue to be an aspect of site amelioration. One thing I haven't mentioned so far is that the work on rapid establishment, using fertilisers and herbicides, will continue, and we shall be further occupied with reducing weeding costs at the same time as boosting growth rates, which can only be done by a combination of fertilisers and herbicides. It is one of the distressing things that happens that if you put fertilisers on, particularly if grasses are present, they appreciate additional nutrition even more than the trees do.

5. REGENERATION: Neustein

Research will continue to concentrate on those problems which have been, or are, markedly influenced by a previous or surrounding crop. Hence it should not primarily concern itself with "afforestation" type problems where only the presence of stumps makes regeneration techniques mechanically difficult.

As yet the Research Branch has done nothing, and currently plans little on the investigation of the effect of trees on the site. However at some future stage basic information may well be required and the complex methodology of this work may make it a suitable field for the Natural Environment Research Council.

Spruce Sites

For surface water and peaty gleys with rotations below 70 yrs., the appropriate regeneration procedures have been established, i.e. no ploughing, phosphate or turf planting required. Slash treatment minimal, "hot" replanting desirable. Sitka spruce is the obvious replacement species, but the role of *Abies grandis* has yet to be determined.

Direct seeding and tube planting, both to cheapen costs and avoid post-planting check, will be investigated—direct seeding also improves our understanding of natural regeneration losses.

No further work is proposed on soil erosion following clear felling on steep open-texture soils in the West until current preliminary trials have yielded some results.

For short term stability large felling areas are safer than small ones, but the effect of crop structure on wind will have to receive further study—in particular, shape of coupe relative to topography.

Larch

Herbicide trials of mist-blown Paraquat have reached a state when an instruction could be issued pending the approval of appropriate gas-masks. Dalapon is now competitive in price and could be similarly used. No new work is required until new materials arrive.

No new underplanting experiments are envisaged until the four major experiments already established provide further guide lines. Light remains the major factor about which we know very little in absolute terms, and a good case for basic research in controlled environment could be made. In my view the complexity and expense involved is not yet justified while empirical and relative approaches still yield worthwhile results.

Pines

The major field for new work. By means of improved site classification and cultivation treatments, the potential for extension of "whitewoods" (and Douglas fir) must be established. Hemlock and Grand fir are demonstrably most promising and the amount of shelter required by these species will be investigated (perforce following immature S.P. crops). With Lodgepole pine the main interest is centred on deep peat sites where experimental material is *very* limited.

Natural regeneration of this species may be desirable if low input extensive forestry turns out to be more economic than the high input demanded by Sitka spruce.

6. CLIMATIC ENVIRONMENT: Brown

Let me say first that this is not an attempt to review the validity of some gloomy forecasts made after the winter of 1963. If my signposts are uncertain in direction and indistinct, this is mainly because it would be nearly true to say that we have only just started on this course. It is just a year since, independently and almost simultaneously, A. I. Fraser and the present writer thought it would be very useful if an intersectional WEATHER GROUP (Forest Meteorology—Climatology Group, to give it the full title) were formed in the Research Division. We recognised the impact of weather phenomena on nearly all phases of forest practice and forest research: we knew that several people in the research stations were collecting climatic data (often in isolation, sometimes even unknown to anyone else) and using these and published data so as better to interpret experiments and observations in the forest. We felt that a small group of those actively engaged in this way, meeting at regular intervals for discussion of general or special problems, would oil the machinery of joint action, where appropriate, provide an indispensable clearing house of information (published or not) and ensure that we make common cause and get our money's worth when expensive new instruments are ordered, or new observatories equipped and manned.

Accordingly a group of nine, including a representative of Silviculturist North, under the chairmanship of A. I. Fraser, met for some valuable exploratory discussion on 24th November, 1966. At our second meeting in early July we were fortunate to have Mr. George Hurst of the Agroclimatological Division at Bracknell (with whom some of us have had previous liaison in the field) to tell us more about the current programme for collecting and summarising climatological data in Britain. Although the last decade has seen the setting up of several new stations in the Scottish Highlands, there are still substantial areas of forest land without effective representation.

Climatic environment is only a part of the whole environment of the forest, the other parts being, in essence, topography, soil, flora and fauna and cultural practices. Three of these are subject to change, and the changes can be influenced by man: topography and climate are not—in the short term. That this is no sound reason for neglect of climatic studies in Britain the following considerations will show.

(1) Although we cannot greatly modify the regional climate (I write *greatly* on purpose, because I am sure that large scale planting on formerly open land, in Thetford Chase for example, has caused important changes in detail) we can do much to mitigate certain adverse effects. We can adjust stand structure, by thinning practice, or the creation of mixtures, to make the trees more wind-firm; more indirectly, drainage to improve root-hold, where studies of wind profiles show special risks of storm damage, will exercise a similar beneficial influence.

Frost damage during the growing season, to which susceptible species are prone in most areas of Britain, is another phenomenon subject to a measure of control—by planting under cover, adjustment of size of clearing or method of ground preparation, or, in the last resort, substitution of a frost-hardy tree. To control this effectively we need to know more about the pattern of frost distribution in the growing season and the tolerance of young trees to frost and to shade.

(2) We are not concerned with climate as such, but with the interaction between climate and forest community. In Britain, unlike most European countries, our future forests are being based mainly on trees from abroad, from regions with climates different from that of any part of Britain, sometimes rather widely different: when we substitute a pure plantation of *Picea sitchensis* or *Pinus contorta* for some heath or bog community (assumed to be in harmony with the climate) in the north: or cut down a stand of broadleaved forest in the south and plant *Pseudotsuga menziesii*, we are only guessing that a state of climatic equilibrium will be restored. Our guesses have sometimes been proved wrong in the

past—many times with Corsican pine, occasionally with the spruces and Douglas fir, sometimes even when native Scots pine has been moved (without special regard to seed source) to new terrain. When this happens disease, or some destructive insect, is a common symptom of incompatibility: thus climatic studies are an integral part of the Forest Entomologist's and Forest Pathologist's work and the Weather Group rightly includes a representative of each.

We are going:

(*a*) to learn a great deal more about the climate of the lands where our principal exotic species occur naturally: without this knowledge we shall sometimes be uncertain about our choice of species and seldom choose the best provenance within that species.

(*b*) to extend, in co-operation with the Meteorological Office, the cover of climatic stations in the upland forest areas, particularly in Scotland. It seems that this can only be done effectively with automatic recording stations and so we have established contact with the three organisations contributing to their development (Plessey; Hydrological Research Unit, Wallingford; Meteorological Office).

(*c*) to enlarge our understanding of the responses of forests to climatic variation within Britain, so that when the development of site classification for forestry goes forward, significant climatic properties will take their place in the scheme.

(*d*) to strengthen then the links (at present partial and sporadic) with the various organisations concerned with the collection of climatic data, research in bioclimatology and certain closely related studies. Ultimately we may need the services of a trained meteorologist (like the Nature Conservancy and Hydrological Research Unit), or of a biologist with practical experience in this kind of work.

(*e*) in accordance with current demands of practical forestry, we are going to make intensive studies (pooling resources and, where appropriate, launching special projects) of particular aspects of the climatic environment—for example the climatic environments of storm-damaged forests, or of regeneration areas. Forest fires are outside our province, but here, too, some liaison to avoid overlapping of effort under head (*b*) seems desirable. Such studies will be on the scale of Topoclimate, Stand Climate, or even Microclimate, where the framework of regional climatic data is insufficient.

7. TREE BREEDING: Faulkner

Seed Stands

The National survey of seed sources was carried out during the period 1950 to 1963 and resulted in the registration of over 7,000 acres of woodlands. For some species the registered acreage was in excess of requirements; many stands were too old or too tall to manage effectively and therefore the opportunity of rationalizing matters was taken during the production of the Register of Seed Sources. In the Register, stands have been placed in categories according to their suitability for management and the estimated seed requirements for the foreseeable future. The revised version of SM 130 gives guidance on management methods. Certain species, notably Lodgepole pine, Norway spruce and Sitka spruce, are still inadequately represented in the Register, and additional areas of coastal Lodgepole pine are urgently required to make good the deficit. The spruces are difficult to manage for seed production and future crops of seed from home sources may best be obtained from special fellings of well formed dominant trees of known good provenance during the seed years. Investigations into the costs of obtaining seed by these methods are in progress.

Plus Trees

Some 3,500 Plus trees have been selected. The current emphasis is on Sitka spruce and Lodgepole pine which are inadequately represented. Once this situation has been remedied, attention will be given to the Silver firs of North West America.

Vegetative Propagation

Experimental work on grafting, rooted cuttings and air-layering has been carried out in earlier year and is continuing. This has shown that large differences exist between trees in their ease of propagation, but it is also clear that well designed propagation facilities which provide good control over temperature, day length and humidity are essential for optimum results. The age and size of the parent tree, position of scionwood or cuttings in the crown, time of collection and condition of the material are all very important factors. Future work will be aimed to provide a fuller understanding of the causes of variation (genetic and physiological) and at the re-designing and re-equipping of obsolete facilities to provide a higher through-put of material. "Mini-grafting", for instance, using smaller rootstocks and scions, if successful, would allow a reduction in the area of glasshouse needs and permit a higher investment in more sophisticated equipment resulting in continuous cropping, as opposed to seasonal cropping, under glass. Techniques will be developed for *Tsuga* and *Abies* species.

Delayed incompatibility between rootstocks and scions is a problem which has bedevilled the Douglas fir seed orchard programme and therefore demands closer scrutiny and investigation. On site grafting, using three- to four-foot rootstocks appears to hold some promise for the future.

Seed Orchards

Over 200 acres have now been established and all Scots pine seed requirements should be met from seed orchards from about 1975 onwards. Close observation of the flowering habits of different clones shows that there is a wide variation between clones for total amounts of flower production and dates of female flower receptivity and pollen shedding. This information will be used for obtaining a better balance of genetic material in the next generation of seed orchards which will be based on progeny-tested material. Computer techniques will be used for designing these orchards.

Flowering

A broader understanding of what causes the initiation of flowering in conifers is still sought and further work into the physiological agencies involved will be pursued following the appointment of extra staff. Heavy flower and seed crops are episodic rather than periodic and treatment such as girdling, fertilizer applications and root pruning only pay handsomely when there is to be a good crop year in any event.

Clonal and Progeny Trials

These now account for a large part of the resources of the Genetics team and over 700 trees are under test, often on four or more sites. Tests are based on rooted cuttings or on open or controlled pollinated material. The performance of the cuttings of progenies are judged after six, ten and fifteen years, and the parents of those which perform well will be regrafted and planted in Phase 2 seed orchards, the first of which will be established in 1967.

Work has begun on developing early-test procedures for spruces and larch by raising seedlings under glass and with some control of heat and day-length. Six-foot tall, second-year Sitka spruce seedlings have been grown and the branching habit and stem form of these will be compared with similar progeny material grown in the forest. If good correlations can be obtained this will provide a rapid means of screening our Plus tree selections.

Hybridization

Little has been done in this field apart from some routine European and Japanese larch crosses. Work is planned for Lodgepole pine and it is hoped that the production of artificial Coastal X Inland hybrids may be feasible on a commercial scale.

Cone Crops and Harvesting

More reliable methods of estimating cone crops are sought and more accurate correction factors are required for predicting the collectable crop from the observed crop data. Investigations are planned for looking into the feasibility of using tree shaking devices which are currently used for harvesting apples, plums, etc.

8. PATHOLOGY: Phillips

Nursery Diseases

For some time past work has been proceeding on Needle blight of *Thuja* (*Didymascella thujina*). So far it has shown that the formulation of cyclo-heximide called Actispray will give complete control of this disease without damage to the plants, and that in much of the country in most years only one spray application is needed. Work on this disease could have been stopped but for three things—(1) more information is needed about the best time to spray if only one application is made, (2) in some seasons on some sites more than one and up to three spray applications seem necessary, and (3) Actispray is being withdrawn from the market.

Future work on Needle blight will therefore look into possible alternatives to Actispray and investigate timing and number of spray applications and their biological background.

Diseases in the Forest

Root and Butt Rots

These are the diseases that cause us the biggest losses, the most serious being *Fomes annosus*, on which most work has been done. As a result of work so far, we have several chemicals that will keep *Fomes* out of stumps when applied immediately or soon after felling. We have some evidence that some are better than others, firstly if treatment is delayed or not very well done, or the stumps are damaged after the treatment, and secondly if *Fomes* is already present in roots of any of the treated stumps. Some of our future work will look into these points and a few experiments already laid down will continue to evaluate the long-term effects of treatment, particularly with the present standard chemical, sodium nitrite. We also plan a certain amount of work with less poisonous alternatives to nitrite for special purposes.

In the field of biological control, *Peniophora gigantea* is already being used to keep *Fomes* out in about 70,000 acres of pure pine, and we are actively looking for a similar fungus for use with Sitka spruce. This work will be continued.

Further work will also be done on eradication of infection, using stump removal techniques, and in the case of pine, we shall continue with experiments to see if *Peniophora gigantea* can usefully hold up the growth of *Fomes* upwards into stumps, from already infested roots, if we inoculate the stump surfaces with it.

The most important root and butt-rot fungi apart from *Fomes annosus* are *Armillaria mellea* and *Polyporus schweinitzii*. Work on these is at an early stage, but we propose to develop work on them. Most of the work so far envisaged is on assessment of losses, species susceptibility, and stump-inhabiting competitive fungi.

Of the parasitic stem diseases, most time is being devoted to Bacterial canker of poplar, but this work is being done almost entirely to put the testing of poplar clones on a sound basis. After three years of fairly intensive work we have gone quite a long way towards the provision of an acceptable test method. Some more work will be needed before we can put the testing on a routine basis, but the back of this work has been broken.

It is partly because of this that we have been able to devote more time to Top dying of Norway spruce, and this disorder will continue to take up a good deal of time. Top dying appears to be a physiological disorder which is very difficult to study by any normal techniques of field experiment. Most work so far done has been by observation of growth patterns in affected and healthy crops, and their correlation with climatic variations, but some supporting biochemical studies are being carried out in the laboratory. We shall continue on these lines until we have enough information to help us in making some field recommendations or to stimulate collaboration with our future physiology section.

The projects so far considered are the most important we have, and although some have been reduced in recent years, they will all be continued and developed in various ways. We have some other smaller projects that may be developed, but the largest future development at present envisaged is a survey of the Northern Research Station area, to help provide a basis for the new station's research programme.

Finally, the following projects may be mentioned very briefly:

Blue Stain in Pine

This is a programme being carried out jointly with F.P.R.L., on whom its size partly depends. At the moment it entails a moderate amount of field work, which is now being much reduced.

Seed Pathology

Some work has been done on this. We would like to do more, and carry the studies out into the nursery to link with work on damping-off.

Crumenula sororia Canker in Pine

Work on this is at a very low level, but is now being developed by the University of Edinburgh.

Dutch Elm Disease

Only routine testing is being done in support of work done by Silviculturist, South.

Drought Crack in Trees

This is a medium-scale project, and deals mainly with the assessment of loss in a small range of tree species.

9. ENTOMOLOGY: Bevan

In order to look ahead we might first look backwards for trends. In the early days of the Commission, Entomologists, like other specialists, were interested in finding out just how a host of organisms, many of which were well known in other countries, would react to British conditions. In that era of quickly expanding afforestation a number of entomological problems soon faced them, and there followed a period which we might term the familiarisation phase. Investigations carried out in those days included those into Oak leaf roller moth, Pine shoot tortrix, Pine sawflies etc., and it is interesting to see how few of them are still subjects of great concern in forestry nowadays. In part this is due to entomologists finding that certain insects were not in fact of great economic importance even in those days, and partly due to the fact that developments in management have changed some species from the naturalist specimen category to the pest one. Some of those species, such as *Hylobius*, were then found to be important and still are. Work of a very high standard was done in those days but not always were the control measures suited to modern conditions. The three or four-year fallow period and the billet-and-spray trap are no longer acceptable to the manager today, nor are they economically "on". *Trypodendron lineatum*, for instance, has been a species long in the British list but not until spruce was felled on a large scale did it become recognised as a serious technical pest. *Hylastes cunicularius*, again, has only reached its full potential with these spruce fellings. Looking ahead for a minute, if *Abies grandis* becomes the latest fashion as it threatens to do, then the so far unimportant species *Adelges picea* could become of importance. If home collection of *Abies* seed became important then *Megastigmus pini* would certainly give us a similar degree of trouble as *M. spermotrophus* does on Douglas fir. So to sum up these points—some of the insect species which we have learnt about in the past can, perhaps, be put firmly in the category of species with little economic importance. Some, on the other hand, could have more than nuisance value if changes in mangement should encourage their multiplication.

There will always be one or two of the smaller type of project which aims to ask one or two specific questions about certain insect species. A current one of this type concerns the small moth *Laspeyresia coniferana* which bores into the bark and bark cambium of certain pine species, and can cause the distortion of their bases. Here we are merely trying to find out what it does, when it does it, and how important is what it does, to the forester.

Since we are firmly looking into the future it would be statistically responsible for us to feel that the probability of a new insect pest arriving on the scene must be fairly high. In 1953 *Bupalus piniarius*, an indigenous insect on this occasion, suddenly showed its paces as a pest. Again in 1957 *Ips cembrae*, this time an introduced beetle, found that E. Scottish larch suited its breeding requirements and infestation followed. *Semasia diniana*, an indigenous moth pest of larch and a very well known Alpine pest, broke out at Cannock Chase in 1964—as far as we know the first time that the insect had ever done such a thing in this country. These sort of events are not surprising, although their impact is possibly greater due to their recency. The larger monocultures in Great Britain date from the early days of the Forestry Commission so that few of them are much over 40 years of age. We have a pretty detailed knowledge of the pests of these earlier years, but are now experiencing for the first time the troubles of middle and older-age. The introduction of insects into our country must have been a very common occurrence throughout history, but successful establishment for any one of them will have been dependent on the existence of a suitable environment for the completion of their life cycles. That earlier introductions of some of the pests of older exotics have not always been followed by establishment, may well have been—even if only in a few cases—due to the lack of a susceptible crop in the right conditions.

I would hope, in five or ten years, that there would be few if any of the present projects in the project register of that date. There could well be, and I hope there will, certain developments from existing projects and I would suggest that two such developments are likely to be (1) an investigation into the susceptibility of a wide range of host plants, developing from the present *Elatobium* project. The first steps in this direction perhaps have already been taken, in that we are currently examining the entomological repercussions of some of the research work involving drainage and fertiliser applications currently carried out by Soils and Silviculture. When the Maximum Amelioration experiment gets off the ground we shall hope to parasitise this one similarly. (2) Investigations into increment loss due to insects using techniques pioneered also in the *Elatobium* project. Here we seem to have got a tool by which we can assess the economic damage caused by insect visitation. If we can develop along these two lines we shall feel that we have successfully left our specialist ivory tower to make a valuable contribution to the ecology of the host species of tree, upon which our insects feed. This path is obviously leading us in a direction similar to that of the team or project approach protagonists.

10. TIMBER UTILISATION AND DEVELOPMENT: Holtam

(1) It has been, and is, accepted by the Forestry Commission, in the field of utilisation research, that our own basic needs as well as those of the private growers, the home timber trade, and the users of home grown wood are, first, to acquire knowledge of the properties of the wood of species grown in Britain, and the nature and extent of the variability and of the inter-relationships of those properties. This knowledge has been considered a necessary basis for sound marketing policy and for determining the suitability of different sorts of wood for present and likely future uses of all kinds, and not only for saw-milling. This knowledge is also necessary for the long term improvement of the properties of the wood that we grow by the better application of genetic and management techniques. That knowledge is an important guide for the silviculturist, the forest manager, the forest geneticist, and others and, last, but by no means least, it is important as a guide to the Commissioners and to private owners in deciding their planting and forest management policies. It is also needed by Forest Products Research Laboratory and by other research organisations, to enable them to answer the many enquiries about the properties of home grown wood that they receive from industrialists who want to decide on suitable specifications, the capacities of their mills and their home grown wood requirements.

(2) The research work on home grown wood at Forest Products Research Laboratory has been under the surveillance of the Home Grown Timber Research Committee on which are represented the Forestry Commission and Forest Products Research Laboratory.

(3) Projects undertaken in the joint programme have generally fallen into four categories:

(*a*) Investigation of general properties of the wood of an individual species. Sitka spruce, Lodgepole pine, Japanese larch and Norway spruce have been examined. Work on Corsican pine and on Scots pine is in progress, and work on Western hemlock is about to start. Work previously done on Douglas fir and on ash has been collated and published.

(*b*) Investigations of a particular property or of a selected group of properties within a single species. Work has been done on the relationship between bark form and wood figure in birch, and on the out-turn of graded sawn timber from low grade logs of Forest of Dean oak; an investigation has been made of the stem crack in Grand fir, and the pulping properties of adult and juvenile wood in Sitka spruce are being examined. A project on the control of blue stain in pine continues.

(*c*) The examination of selected properties within groups of species. Work has been done to determine the compressive strengths of home pit props and a survey has been made of the specific gravity and moisture content of seven major coniferous species. The latter was probably the most thorough exercise of its kind that has been made anywhere in the world. The results of the work on pit props have been published and very summarised results of the work on specific gravity and moisture content have also been published. An attempt has been made to find better ways of preservative treating poles of seven conifer species and abandoned. The possibilities of laminating all home grown softwood species are well proved. Service trials arranged by the Laboratory showed that all home grown softwoods are suitable for cable drum manufacture.

(*d*) Other work including research on development projects. Investigations have shown that sheathing or constructional grade plywood can be made not only from home-grown softwood logs but also from oak logs of lower grade than might be considered suitable for economic sawmilling. One development project between the Commission and a timber merchant resulted from work on the design and construction of a low cost timber drier, itself of timber construction. Work is being done on the effects of laminating two or three layers of wood, compared with work already done on laminating five to seven layers. This seems to be a promising field for further work.

Priorities

(4) The Commission has sought guidance of the Laboratory and of the Technical Sub-Committee of the Home Grown Timber Advisory Committee on priorities of research work. The Technical Sub-Committee of the H.G.T.A.C. put the general programme of research that has been carried out as having first priority, to be followed by work on low grade hardwoods, and work on improved seasoning methods, the latter to be associated with work on the control of blue stain in pine. Forest Products Research Laboratory's advice was to set out in order of precedence the ten most important home grown species. This proved an impossible and unnecessary task and no attempt is being made to do it. In considering priorities we have also asked ourselves what are the major problems that research might help to resolve? And what research is likely to contribute most, at minimum cost and effort, and in the shortest time, to the fulfilment of Commission policy and to the general commercial improvement of forestry in Great Britain?

New Subjects of Major Importance and High Priority

(5) (*a*) The effect of planting distances on the wood properties of Sitka spruce, Lodgepole pine, Japanese larch and Scots pine (Director, Research is having the records examined to see what can be deduced from the files, before asking for work to be done at Forest Products Research Laboratory).

(*b*) The effects of mixtures of species in pulping; for each pulping process currently used and proposed for use, what are the limits to the proportions of species other than spruce which might be used without suffering significant degrade in the commercial value of the resulting pulp? Forest Products Research Laboratory are equipping themselves better, especially in order to be able to do more work on mechanical pulping.

Properties of Home Grown Timber—Order of Priorities

(6) The next species to be examined will be:

(*a*) Western hemlock.

(*b*) *Abies grandis* (in association with limited work on *Abies procera* and on *Abies alba*).

(*c*) Sitka spruce (re-examination of trees which will be ten years older than when first examination was made; the whole population of marketable sized trees to be included).

(*d*) Lodgepole pine. There might be a gap of a few years before a population of sufficient size to yield suitable sample material will exist.

Other Subjects

Sawmilling

(7) F.P.R.L. to continue building up expertise and to be prepared to advise the Commission on the relative merits of different sawmilling set-ups, having regard to likely availability of logs. Mr. Aaron has been given a joint task with Mr. Montague of F.P.R.L. to examine sawmilling problems, for the purpose of considering those which might lend themselves to solution by research.

Sawmill Residues

(8) Continue examination of Chip-N-Saw type of sawmilling, and similar developments, together with possibilities of producing flakes suitable for chipboard instead of sawdust.

Pulping

(9) F.P.R.L. to examine the literature on and feasibility of making dissolving pulp from hardwoods. Pulping properties of species will be examined in the course of work on the properties of home grown timber. Mechanical pulping will be included, especially of species and of mixtures which include those species which are not readily acceptable by pulp mills, such as larches, Douglas fir and hemlock.

Trees of Provenance and Genetic Interest

(10) The Commission will equip itself to do some of the routine assessments in this field.

Other Work to be Continued

(11) The following work which is already in hand will proceed.

(*a*) Preservative treatment by diffusion (boron).
(*b*) Preservative treatment and strength testing of transmission poles—restricted to Scots pine and Japanese larch.
(*c*) Wood properties of trees of genetic and provenance interests.
(*d*) Prevention of blue stain in pine.
(*e*) Seed pallet boxes made from home grown softwoods (examination of boxes in service at Alice Holt seed store).
(*f*) Work will proceed on the mass production of laminated timber using two or three laminae.
(*g*) Work on pruning will be abandoned.

Problems

(12) Some of the main problems that have been encountered and that are likely to be encountered are:–

(*a*) Persuading the home timber trade and the private growers and the Forestry Commission to identify and quantify problems and to assess which problems or which parts of problems lend themselves to solution by research. Coupled with this is the problem of priority of work.
(*b*) There tends to be a general lack of sympathy with the statistical approach to dealing with problems of variability in the biological field at Forest Products Research Laboratory.
(*c*) Because of this, there has been a failure to develop a sampling system within the Laboratory which maintains the representative nature of carefully chosen sample trees or billets which represent a clearly defined population. We shall continue to have to look at this problem which would undoubtedly be eased if F.P.R.L. would employ or would seek the help of a statistician.
(*d*) The home timber trade has acknowledged that it has not always been well equipped to profit from the results of research. One of the biggest problems is how to get the results of research applied with good effect in the shortest possible time.

(13) One important way in which we can use the results of the work obtained from research on the properties of home grown wood is illustrated by the task which Mr. Aldhous has been given in assembling information from research and other sources on *Abies grandis*, *Western hemlock* and *Thuja plicata* in an operational research approach so that top management will have all the information assembled and collated in order to give a management decision about the place of these species in our future forestry programmes. The approach to that task was based on the following line of thought. We have a big stake in spruces and in pines as two major groups. Industries have developed to use these species. Any species whose wood properties, silviculture and management problems, and industrial uses, fit them well to group without creating major problems in marketing with either of these major groups can be used freely on the normal basis of assessment by N.D.R. calculations, in gradually changing (increasing) quantities and in a range of sizes.

Hardwood Feasibility Study

(14) Messrs. Holtam, Wardle and Kennedy have been given the task of assessing the scope and nature of a feasibility study which might be made on the industrial use of low grade hardwoods. Behind this project is the thought that in order to make improved use of the better grades of logs for sawmilling, there is need for a proportional increase in economic uses for wood of all other grades, particularly in pulping, and particularly because the sawn mining timber market which has traditionally used much of the lower grade wood is declining.

11. WORK STUDY: Troup

In ten years we shall be harvesting more than twice as much timber as at present whilst silvicultural programmes may continue unabated. Since labour costs are likely to rise more steeply than machine costs and, since workers are unlikely to be available in significantly greater numbers, the task of Work Study is to stimulate increases in productivity mainly through mechanisation. On the assumption that we have a static labour force, the task is to double productivity over the next decade. Encouraging progress has been made in the evaluation and introduction of various extraction machines and chain-saw snedding promises substantial increases in output per man. Harvesting systems will certainly continue to change and as programmes and terrain justify the introduction of high output equipment so the work will become less labour intensive. Ultimate objectives are timber untouched by hand and the elimination of hard, physical effort: these objectives will be more easily realised on easy terrain. An intermediate solution is the delivery of tree lengths to factories rather than cut-to-size material: in general the more work transferred from forest to factory, the better the overall economies are likely to be: however, the production of chips in the forest is likely to be feasible and paying and, on relatively easy terrain, combine harvesters may find a place (machines which de-branch, top, fell and crosscut).

In silviculture, advance in plough design, planting method and the replacement of hand weeding by chemical or mechanical weeding, promise substantial savings.

12. PLANNING AND ECONOMICS: Spencer

"P. & E." is a branch of Management Services Division, which title indicates its approach to problems.

The type of forward-looking work on which each section is engaged can be illustrated by examples:

(*a*) Working Plans has the task of forest inventory. Data collection is expensive and air survey is being reconsidered, particularly since the development of techniques for measuring tree heights from air photographs.

(*b*) Census would also benefit from improved techniques and economies.

(*c*) Soil survey aims to produce a national soil classification in due course with regional soil guides for the four or five major regions within the next 5 years or so.

(*d*) Mensuration has to cope with "metrication". It is also very much concerned with problems of accurate forecasts of production, with actual production following thinning control fulfilling forecasts based on inventory.

(*e*) Economics and the increasing use of operational research techniques are becoming a fundamental part of management planning and of the solution of forest problems at all levels.

Conservancy Plans are currently being developed.

Objectives are:

(*a*) To create a comprehensive Conservancy planning system as a link in planning and control between Government policy and Headquarters decisions on the one hand and their implementation through forest working plans on the other hand.

(*b*) To facilitate the orderly devolution of authority and responsibility to Conservators by Headquarters while retaining adequate central control.

The Conservancy Plan should thus fill a planning gap, because for some important matters the Conservancy rather than the forest is of necessity the basic planning unit (e.g. housing, mechanical equipment) and because other problems affecting a number of forests in a region can conveniently be resolved in one Conservancy plan rather than in several forest plans.

They should serve:

(*a*) As a basis for programming and hence for budgeting.

(*b*) For the sensible and most profitable allocation of resources between Conservancies (e.g. planting).

(*c*) To identify current problems and enable decisions to be made methodically in full consultation.

(*d*) To consider trends and anticipate future problems.

Thus they must be:

(*a*) Sufficiently informative to enable Headquarters to allocate resources between Conservancies in the best possible manner.

(*b*) Sufficiently comprehensive to enable Headquarters to delegate the sanction of forest working plans to Conservators.

(*c*) Sufficiently specific to govern the preparation of forest working plans by district officers.

It is essential that the Plan should be considered as a dynamic plan written in full consultation with Headquarters. It should be a working document forming an integral part of day to day management.

The consequences for Forest Working Plans if Conservancy Plans are developed successfully would be a considerable simplification and shortening, and they could be sanctioned by Conservators.

The effect on forest research would be on the one hand a greater awareness of particular needs for research with a clearer idea of priorities, and on the other a wider and more purposeful and consistent application of research findings.

TEACHING NOTE ON THE DISTRIBUTION OF TREES IN BRITAIN

By H. L. EDLIN

Introduction

A large number of useful and ornamental trees grow in Britain today; about 80 are common. This note ignores decorative kinds and rarities and deals with 23 that are either common natives or else widely planted in woodlands.

Natural woodlands (Section 1) no longer exist but semi-natural ones (Section 2) survive over small areas in most districts. Four patterns of tending or planting have been superimposed on the natural scheme, thus:

(3) Coppices.

(4) Parkland Planting—mainly for ornament.

(5) Early Timber Plantations, 1575–1919.

(6) Recent Timber Plantations, Post-1919.

Tree distribution studies must therefore take account of history as well as geography. The pattern of land use—as in parks around landowner's mansions—must be considered, besides rural and industrial markets for fencing, firewood, and timber.

The first questions should always be:

(*a*) Semi-natural or planted woodland?

(*b*) If semi-natural, why have these trees survived here?

(*c*) If planted, by whom, why, and when?

1. Natural Woodlands

In prehistoric times most of Britain was covered by natural woodlands. These arose through the spread, around 8,000 B.C., of trees from Europe, after the Ice Ages had ended but before the land-bridge had disappeared. The composition of these woods varied at different climatic periods. At the time when clearances for cultivation began, its broad composition was as follows:

(1*a*) **Oak,** *Quercus robur* and *Quercus petraea,* was ubiquitous over the British Isles, except for the far north of Scotland, but in the northern districts it did not extend far up the hills. Oak woods were however dominant on all the heavier soils of valleys, lowlands, and the south.

(1*b*) **Scots pine,** *Pinus sylvestris,* and (1*c*) **Birch,** *Betula pendula* and *B. pubescens,* throve farther north and higher up the mountains than oak, and grew throughout Britain on more acid, poorer soils, usually typified by heather. Usually in mixture, with occasional stretches of pure pine or pure birch.

(1*d*) **Ash,** *Fraxinus excelsior,* on limestone and other lime-rich formations.

(1*e*) **Alder,** *Alnus glutinosa,* in moist situations—streamsides, lakesides and damp hillsides.

(1*f*) **Willows,** *Salix* genus, various species grew in similar damp places to alder.

(1*g*) **Beech,** *Fagus sylvatica,* confined to the south of England and Wales, not spreading beyond the Midlands. Dominant on chalk and limestone hills, including the Cotswolds, the Chilterns, and all the Downs of the south.

(1*h*) **Hornbeam,** *Carpinus betulus,* confined to the south-east, mainly in Kent, Essex and the Thames valley.

(1*i*) **Yew,** *Taxus baccata,* over most of the British Isles except for northern Scotland and its islands. Locally dominant on chalk and limestone.

(1*j*) **Elms,** *Ulmus,* of various species on good ground in lowlands and valleys as far north as mid-Scotland.

(1*k*) **Hazel,** *Corylus avellana,* a widespread undershrub.

(1*l*) **Juniper,** *Juniperus communis,* forming thickets on acid heathlands in Scotland and also—by strange contrast—on alkaline chalk downs in southern England.

(1*m*) All other native trees were too few in numbers to form clear communities or woodland types. They occurred as individuals or minor groups in the twelve types of forest listed above. Examples are the **limes,** *Tilia,* and the **poplars,** *Populus;* both genera are restricted to England and Wales.

NOTE: Two trees now so well-established that many people consider them native, were not found in natural woodlands. These are **sycamore,** *Acer pseudoplatanus,* and **Sweet chestnut,** *Castanea sativa.*

In natural woodlands all the processes of growth proceed without man's aid. Young trees arise through natural seeding, have their numbers reduced through mutual competition, and die from natural causes. Trees of many ages and sizes are usually present together. Few natural woods were ever static; changes were slowly occurring, throughout their existence, from one phase to another. For example, an ageing wood of oak might slowly change to a younger wood of beech, through colonisation by beech seed and seedlings. Few natural woodlands were ever composed purely of one sort of tree; there was often a dominant kind but it had many associates.

As explained later, no natural woodlands are now available for study. They can only form a basis for theoretical comparison with semi-natural woodlands and man-made plantations.

2. Semi-Natural Woodlands

All the natural woodlands of the British Isles have been altered to greater or less degree by man's interference. The reserves of the Nature Conservancy, established only since 1953, are no exception. Interference has taken many forms, such as:

(i) Deliberate clearance to win timber and firewood, followed by digging or ploughing the land to raise crops.

(ii) Gradual destruction of seedling regrowth by grazing animals, so removing all the forest cover as the older trees died off.

(iii) Burning to improve pastures.

(iv) Harvesting the timber of broadleaved trees on the coppice system, whereby growth is renewed by shoots from cut-over stumps.

(v) Replanting, often with completely new kinds of tree.

Semi-natural woodlands are of high value for study because they represent the nearest available approach to natural ones. Major ones are limited in distribution, but minor areas occur throughout the country. The major ones are either nature reserves or form valuable units of large estates, as timber-producing woods, shelter for stock, or game preserves. Minor ones occupy land of low farming value, because of poor soil or steep slope; such land often forms strips or patches amid better ground.

Following the same general order as that for natural woodlands, their main distribution is:

(2*a*) **Oak** of semi-natural origin is widespread in small woods, growing, for example, in small glens, cloughs, and dingles where poor soil or bad access render farming impossible.

(2*b*) **Scots pine** and (2*c*) **Birch** form large natural woods in two main regions:

- (i) Scottish Highlands
- (ii) Heaths and commons of Southern England, notably in Dorset, Hampshire, Berkshire, Sussex, and Surrey.

(2*d*) Semi-natural woods of **Ash** are found mainly on Carboniferous Limestone in northern England, e.g. Yorkshire, Westmorland, the Peak District of Derbyshire, the Wye Valley, and South Wales.

(2*e*) Semi-natural growth of **Alder** occurs along streamsides everywhere, but is commonly very narrow. Larger woods or *carrs* have been cleared and drained for farming.

(2*f*) Semi-natural **Willow** thickets, though widespread, are usually small; good ground has been put under farming use.

(2*g*) Large semi-natural woodlands of **Beech** persist on the Downs of southern England, the Chilterns, the Cotswolds, and in South Wales.

(2*h*) Semi-natural **Hornbeam** woods are local to the south-east. Examples are Epping Forest in Essex and scattered coppices in Hertfordshire and Kent.

(2*i*) **Yew** woods are local—mainly in valleys of the limestones and chalk downs.

(2*j*) **Wych elm,** *Ulmus glabra*, forms narrow semi-natural woods along glen sides in Scotland and northern England. Other elms are confined to small patches of rough land, or to hedgerows. All good elm land is under the plough.

(2*k*) **Hazel** is local in the north of Britain, woods being common only in Argyll. In the south semi-natural coppices occupy enormous areas on both lime-rich and lime-free soils.

(2*l*) **Juniper** thickets survive on chalk downs in the south, and amid pine-woods of the eastern Highlands, but hardly at all elsewhere.

(2*m*) **Sycamore,** *Acer pseudoplatanus*, an introduced tree, forms small natural woods in many districts with reasonably good soil. These arise through wind-borne seeding from plantation trees.

Semi-natural woodland may have arisen through colonisation of abandoned farmland. This is most frequent in southern England where birch and Scots pine invade heathlands as soon as commons cease to be fully grazed. Oak, ash and sycamore invade similar under-grazed common land on heavier, clay soils.

3. Coppices

In the past there was a major economic harvest of broadleaved timber, poles, firewood, and bark for tanning leather, from *coppices* or *copses*. If broadleaved woodland is felled, the regrowth from the stumps forms smaller stems, far more numerous than the first crop. Cuttings were repeated at varying intervals of years, usually between 7 and 20, according to kind of tree. The system is called *coppicing*, from the Norman French verb *couper*, to cut. Its main markets were rural ones, but pit-props and tan-bark supported town industries.

Much natural woodland was so treated for centuries. The Nature Conservancy has had to accept many coppiced woods—particularly oak in Wales—as the nearest available substitute for the natural forest. Other coppices were purposely planted; the commonest example is the introduced Sweet chestnut (*Castanea sativa*).

(3*a*) **Oak coppice,** nearly all derived from natural woodlands, is the major type throughout the western regions of Britain, and also in Ireland. Frequent from western Inverness-shire, south through Argyll, Galloway, the Lake District, all Wales, Devon and Cornwall. Usually in glens and valleys amid hard rocks. Harvested until recent times (1939–1945 war) for pitprops, fence stakes, firewood, charcoal wood, tanbark. Now has hardly any commercial value, but may be cut for pulpwood, to make cartons for packaging food, etc.

(3*b*) **Birch coppice,** throughout central Highlands of Scotland, locally in hilly districts of England and Wales. Used for firewood and turnery poles; still a small demand. Main value in Scotland is as winter shelter for sheep.

The pine element of birch/pine woods does not coppice.

(3*c*) **Ash** was formerly coppiced locally to provide small, strong poles and firewood.

(3*d*) Many waterside **Alders** have been coppiced for clog-sole timber—or charcoal wood for gunpowder, both markets that are now ended. Some are still coppiced for turnery poles.

(3*e*) **Willow** coppicing takes the form of osier beds, cut over annually for basketry rods. Now rare except in the Sedgemoor district, around Langport in Somerset.

(3*f*) **Beech** was not regularly coppiced, but trees damaged by firewood cutting are common—and picturesque—in south-east England.

(3*g*) **Hornbeam** coppice is confined to Kent, Essex, Hertfordshire and neighbouring counties. Once firewood, now useless.

(3*h*) **Hazel** is the main coppice species of the south. Once valued for hurdle rods, bean rods, pea-sticks, thatching spars, etc., it is now virtually worthless, except as cover for game birds.

(3*i*) **Sweet chestnut** coppice is only frequent in Kent, Surrey, Sussex, Hampshire and Herefordshire. Still profitable and efficiently worked, to yield hop poles and palings for cleft-chestnut fencing.

No other trees are important as coppice, but a few are coppiced incidentally or locally.

Coppice-with-Standards is a variant in which tall "standard" trees—usually oak or ash, are left to grow to full timber size amid a coppice crop. Once important in southern England, now rarely seen.

Most of the larger coppices are undergoing conversion to plantation crops—(see later). Only Sweet chestnut is kept going commercially.

4. Parkland Planting

From Tudor times, around 1500 A.D., to the present day, the owners of large country houses have beautified their surroundings by planting trees in parks. These are the ornamental grounds also called "policies" in Scotland and "demeshes" in Ireland. Ornamental trees often extend onto small woods and shelter belts.

Parkland planting is of exceptional value for instructional purposes because:

(i) Owing to the general distribution of estates and landowners, parks can be found in nearly every district.

(ii) They are always on good land, and their trees have been widely spaced and well tended.

(iii) The variety of trees grown is usually wide, often very wide, and includes native and introduced species valued for both ornament and timber production.

(iv) Access is often easy, since many parks are now owned by local authoritites or public bodies such as the National Trusts.

No attempt will be made to list all the trees likely to be found in parklands. All native kinds occur, and so does every reasonably common and hardy introduction. Most parks include the finer introduced conifers, particularly **Cedars,** *Cedrus,* **Wellingtonias,** *Sequoiadedron,* from California, and the allied **Californian redwood,** *Sequoia.* Among broadleaved trees, **Horse chestnut,** *Aesculus hippocostanum,* **Robinia,** *Robinia pseudacacia,* **Walnut,** *Juglans regia,* and **London Plane,** *Platanus hispanica,* are handsome introductions from overseas.

Parkland planting has no *direct* economic objective; but by providing shelter and scenery it enhances the market value of mansion houses enormously.

5. Early Timber Plantations: 1575–1919

The planting of trees to grow to full size as timber began, on a reasonable scale, in Elizabethan times, (circa 1575 A.D.), and has continued ever since. It was prompted by shortage of wood from vanishing natural forests which could not be made good from the small-stemmed coppices. Landowners devoted their poorer ground to timber growing, and great areas were put under trees during the Enclosure Movement of the 18th century. Timber plantations established by private landowners during the past 400 years can now be found in all districts—*except* those with very fertile soils such as the fenlands of eastern England.

The number of tree species used up to 1919 was limited, the leaders being:

(5*a*) **Oak.** Planted on most estates, but on a large scale only in South and Midlands of England.

(5*b*) **Pine.** Scots pine was planted universally over small areas. It became the major species in Eastern Scotland and over heath lands in south and east England.

(5*c*) **Birch,** the natural associate of pine, has seldom been planted. It infiltrates into woods of all kinds as self-sown seedlings.

(5*d*) **Ash** plantations are local. Mainly in limestone districts of England and Wales.

(5*e*) **Beech** was planted very widely. It is the major tree of the chalkland plantations in southern England, and of limestones in northern England, south-west England (Cotswolds) and South Wales. Also on fertile well-drained lime-free soils generally. Surprisingly, it was widely planted on Scottish estates and around Irish demesnes—always on the best available ground.

(5*e*) **Sycamore** was planted in all parts of the British Isles, always on good ground. Particularly frequent in northern England.

(5*f*) **Norway spruce,** *Picea abies*, used on a growing scale from the mid-eighteenth century. Planted throughout Britain, but commonest in Scotland.

(5*g*) **European larch,** *Larix decidua*, was pioneered in the Scottish Highlands by the Dukes of Atholl about 1775. It was eventually planted on practically every estate in the British Isles.

The seven trees listed above make up the great bulk of "landowners" timber planting up to 1919. All of them were planted in all districts, but some were naturally more prominent in certain areas than others. This pattern dominates the older crops—those now (1970) over fifty years old. As each is felled, the "Rccent" pattern, described in the next section, becomes dominant.

The economic objective of the early plantation was timber for rural and industrial use—poles, fencing, pit props and sawmill timber.

6. Recent Timber Plantations: Post-1919

The advent of Government organisations to carry out and encourage tree planting for timber led to major changes in the planting pattern for tree crops. The Forestry Commission had new ideas for its own woods, and these have been followed, where conditions made them a sound choice, by landowners throughout Britain. Similar trends occur in Ireland.

The current (1970) pattern of timber planting is this:

(6*a*) **Oak** is used only on the most favourable ground in the Midlands and south of England.

(6*b*) **Scots pine.** Widely used over the Eastern half of Britain, but now giving way to the Corsican pine which produces timber more rapidly. Chosen for difficult sites generally, because it tolerates poor soils and harsh climates.

(6*c*) **Corsican pine,** *Pinus nigra* variety *maritima.* Introduced from Corsica and widely planted in the warmer and sunnier districts. The major pine in south and east England; used locally on the east coast of Scotland and in Welsh coastal districts. Fails to thrive in cloudy, rainy, uplands, but resists smoke pollution near towns.

(6*d*) **Lodgepole pine,** *Pinus contorta.* Introduced from Alaska and British Columbia. Planted on a great scale in the cloudy and rainy regions of the north and west. A leading tree in North and West Scotland, Galloway, Wales, and throughout Ireland.

(6*f*) **Beech.** Still considered the best tree for chalk and limestone formations in England and Wales; little used elsewhere.

(6*g*) **Norway spruce.** Widely planted in most districts except the dry south-east. Important in all western region.

(6*h*) **Sitka spruce,** *Picea sitchensis.* Introduced from Alaska and British Columbia. The leading tree for the better ground in the high rainfall districts of the north and west, notably in western Scotland, Wales, and Ireland. Fails in the dry south-east.

(6*i*) **European larch** now rarely planted, because Japanese and hybrid larches grow faster.

(6*j*) **Japanese larch,** *Larix kaempferi,* widely planted in the west, especially Wales, because of rapid early growth. **Hybrid larch,** *Larix eurolepis,* arising through cross-breeding with the European kind, grows even faster and is planted locally where supplies permit.

(6*k*) **Western hemlock,** *Tsuga heterophylla.* Introduced from British Columbia. Now planted throughout Britain as a replacement for slow-growing broadleaved crops.

(6*l*) **Douglas fir,** *Pseudotsuga menziesii.* Planted in all districts over small areas of really good land.

(6*m*) **Cricket-bat willow,** *Salix alba,* variety *coerulea,* is planted at wide spacings in eastern England, on fertile riverside land.

(6*n*) **Poplars,** species and hybrids of the genus *Populus,* are grown on similar sites, also at wide spacings, mainly for match-making timber.

This Recent Timber Plantation pattern is the main feature of all the younger crops—those now (1970) under fifty years old.

These can be seen in all the national forests, both in Great Britain and Ireland, and on all the progressive private estates. The economic objective is raw material for sawmills, mines, paper mills and factories making chipboard and similar modern wood-based materials.

TABLE 6

DISTRIBUTION OF TWENTY-THREE COMMON TREES AND UNDERSHRUBS IN FOUR HISTORICAL TYPES OF WOODLAND

NOTES: Parkland planting is omitted; such planting includes all the trees shown, though only in small numbers, as specimen trees.

Entries in brackets indicate impossible situations.

Class of Woodland	Natural (Prehistoric) and Semi-Natural Woodlands	Coppices, Mediaeval	Early Timber Plantations, 1575–1919	Recent Timber Plantations, Post 1919
	Native timber trees—found throughout Britain			
Oak	Common, ubiquitous	Common, ubiquitous	Common	Few
Scots Pine	Common, northerly, south-easterly	Does not coppice	Common, ubiquitous	Common
Birch	Common, ubiquitous	Occasional	None	None
Ash	Local, limestones	Occasional, limestones	Occasional, limestones	Few
Alder	Local, streamsides	Usually coppiced	None	None
Willows	Local, streamsides	Local, osier beds	Few	Few*
Poplars	Local, streamsides	None	None	Few
	Native timber trees—limited distribution			
Beech	South-east only	Few	Common, ubiquitous	Common, South
Hornbeam	South-east only	Common in South-east	None	None
Yew	Ubiquitous minor	None	None	None
Elms	Local, minor	None	Hedgerows	None

* Mainly Cricket-bat willows.

Class of Woodland	Natural (Prehistoric) and Semi-Natural Woodland	Coppices, Mediaeval	Early Timber Plantations, 1575–1919	Recent Timber Plantations, Post 1919
		Native Undershrubs		
Hazel	Ubiquitous	Very common, especially south	Not a timber tree	Not timber
Juniper	Local	(Does not coppice)	Not timber	Not timber
		Introduced Broadleaved Trees		
Sycamore	(None)	Few	Common	Few
Sweet Chestnut	(None)	Local, South-east	Few	None
		Introduced Conifers—Common before 1919		
Norway Spruce	(None)	(Does not coppice)	Common	Common
European larch	(None)	(Does not coppice)	Common	Local
		Introduced Conifers—Not common before 1919		
Corsican pine	(None)	(Does not coppice)	None	Common, South and East England
Lodgepole pine	(None)	(Does not coppice)	None	Common, North and West Britain, also Ireland
Sitka Spruce	(None)	(Does not coppice)	None	Very common in North and West Britain, Ireland
Japanese Larch Hybrid Larch	(None)	(Does not coppice)	Few	Common, especially Wales
Western hemlock	(None)	(Does not copppice)	None	Local, old broadleaved woods
Douglas fir	(None)	(Does not coppice)	Few	Local, better ground

NIGHT VOYAGE

"I must down to the seas again, to the lonely sea and the sky"

John Masefield.

When shadows fall in fading light
I sometimes sit beneath a tree
And let my mind's eye watch the night
Indulging in wild reverie.

Then when the wind blows through the wood
To rustle birch and poplar leaves
I hear the sound of breaking waves
And my ship sails to distant seas

The church clock strikes up in the tower
Eight bells a slow and measured peal
I must turn to and take a trick
At binnacle and steering wheel

The night jar whirring in the fern
To serenade the summer moon
Is now the hum of dynamo
Away down in the engine room

A woodcock croaking overhead
Or squeaking bat that flutters past
Must be the chafing of the ropes
And wires against the radio mast

A roaring bull across the field
Is siren warning us of fog
And hark! I hear a barking seal
Or is it but a farmers' dog?

The cattle drinking in the brook
Is water lapping on the hull
And bubbling curlew on the heath
Is changed to cry of herring gull

With darkening clouds a storm blows up
On my bare face I sense the rain
A barn owl hoots . . . the pilots' launch
'Stand by' . . . I'm back in port-again.

R. J. JENNINGS

FOREST PROTECTION

GREEN SPACES AND AIR POLLUTION

By A. RAAD, M.Sc.

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The European Conference on air pollution held in 1964 in Strasbourg under the auspices of the Council for Europe pointed to the great importance of green spaces in the town for the regulation of the town climate and for the purification of air. In 1889, long before air pollution in our towns formed a serious problem, the Viennese city builder Camillo Sitte called the town avenues and parks "the lungs of the town". Did he only think of absorption of carbonic acid and yield of oxygen in the vegetable world, thanks to which man could breathe more freely, or was this man far ahead of his time? He already computed that in a town impossibly large green areas should be available to keep the oxygen-carbonic acid relation in balance.

In population agglomerations such big amounts of oxygen are consumed by the breathing of man and animal and by all the processes of combustion of industry, heating and traffic, while corresponding volumes of carbonic acid are yielded, that green places in a town, of whatever extent, cannot maintain this balance. The total botanic life on earth does provide for the oxygen-carbonic acid balance in the atmosphere but in a limited area this is not possible. The overall supply of oxygen is such that it cannot be appreciably reduced by a concentrated consumption of many millions of people with their breathing and all their processes of combustion. Some rough figures for Great Britain may elucidate this.

A 1,090-yard-high air body above these islands, with an area of 97,600 square miles, contains 65 milliard tons of oxygen. The 52 million inhabitants consume for their breathing 18 million tons annually and domestic animals and cattle 80 million tons. If the consumption of coal and oil is about 200 million tons the consequent consumption of oxygen is 600 million tons, giving an estimated total oxygen consumption of 700 million tons.

Six per cent of the country's surface is covered with wood, thirty per cent with arable land and forty-nine per cent with meadows. If we calculate the production of oxygen moderately, at 500 tons per square mile per annum, for these green areas the output is 100 million tons. So a shortage of oxygen of 600 million tons is less than one per cent of the supply available. Even if this shortage should not be directly supplemented by wind movements in the atmosphere it would not be noticeable because the oxygen content is still higher than on a hill 600 feet high, on account of the air-pressure reduction there.

So, compared with an oxygen supply of 65 milliard tons, a green space in a town of 7,500 acres together with 7,500 acres of private green area with a production of 30,000 tons of oxygen, does not play an important part. Nevertheless the words "the lungs of the town", which have become generally accepted, should still be used because the urban green spaces play such an important role in the quality of the air to be breathed: a field other than that of oxygen economy.

Pollution of Town Air

In our towns the air is strongly polluted by industry, domestic heating and traffic. This pollution varies according to place and time, in which order of importance they will be discussed.

The amount of dust and soot brought into the air by industry is beyond imagination. For example, in West Germany a dust ejection rate has been computed of two million tons a year, more than half of it in the Ruhr district. There 1,700 stations are engaged in measuring dust settling. They found average deposition of two to four tons a year with maximum values of 20 tons, which is 4·5 lb per square metre. This figure becomes even more clear when compared with a normal dose of granular fertiliser of 0·2 lb and of compost of 4·4–8·8 lb per square metre.

New York has an average dust deposition of three tons per 2·5 acres annually and London one ton. The factory chimneys of the American steel centres each year bring six million tons of coal dust into the air. In a city of one million inhabitants 10,000 tons of rubber dust annually come into the air through the wear of car tyres.

In the total dust content of the air we distinguish three fractions:

nuclei of 0·001–0·2 micron.
fine dust of 0·5–10 micron.
coarse dust bigger than 10 micron.

The nuclei are only subject to the Brown molecular movement and not gravity, so that they do not sink to the ground. They are not deposited in the lungs when man breathes, but breathed out for the greater part. The fine dust can penetrate as far as the alveoli of the lungs. The bigger particles are detained by the mucous membranes of nose and throat. Man uses for breathing 432 cubic feet of air each day and in case of physical exertion two to ten times as much, so that even a slight pollution causes big amounts of harmful matter to penetrate into the human body. The following figures have been measured:

nuclei	147,000	per c.c. in big cities
	34,000	per c.c. in small towns
	9,500	per c.c. in the country areas
dust	940	per c.c. over the ocean
	270	per c.c. in big towns
	7–10	per c.c. in country areas

These figures may vary widely according to methods of measuring and circumstances of place and time; their value is only of comparative importance. Without experimenting every townsman knows that white snow soon acquires a grey top layer and that on cars standing still for some days one can write in the dust on the lacquer.

Gases

The figures indicating the volume of gases brought into the air by industry, domestic heating and traffic are as alarming as those about solid and liquid substances. In West Europe there is an annual consumption of 550 million tons of solid fuel and 280 million tons of oil products containing respectively 1% and 2–5% sulphur. Their combustion results in three million tons of smoke and 20 million tons of sulphur dioxide. Motor transport consumes 45 million tons of petrol yielding 20,000,000 tons of poisonous gases. In burning coal and fuel oil 0·85% is oxidized to sulphur dioxide on an average. For West Germany the production of sulphur dioxide was computed at 400 tons per second. In the Ruhr district there are industries bringing along 500 tons of sulphur dioxide daily into the atmosphere. In Holland the annual production of sulphur dioxide is 700,000 tons and in 1970 this will be 900,000 tons. Even in the case of natural gas on a large scale, which contains hardly any sulphur, 700,000–800,000 tons of sulphur dioxide will be brought into the atmosphere in 1980. The poisonous gases include sulphur dioxide, ammonium hydroxide, fluorhydric acid, chlorine, hydrochloric acid and carbon dioxide, while the exhaust gases of motor vehicles cause a pollution of carbon monoxide, ethylene, 3·4 benzpyrene, lead chloride and lead bromide. These last two substances are formed through the additions made to petrol to increase the octane number. Ozone and peroxyacetylnitrate (P.A.N.) are the most important components of photochemical air pollution. It is caused amongst other things by incompletely burned motor car and exhaust gases, converted in the atmosphere under the influence of sunlight and in the presence of nitrous vapours as catalytic agents into P.A.N. and ozone. These substances may cause serious damage to crops even in minimal concentrations. In 1960 the damage to horticulture in the U.S.A. created by this form of air pollution was estimated at 26 milliard dollars.

Radio-Active Air Pollution

Owing to the technical development of the atom an increasing radio-active air pollution should be taken into account. Accidents in reactors cannot be deemed absolutely excluded. Reactors hardly allow radio-active matter to escape as particles when normally operated. Slight amounts of volatile radio-activity do escape, however, principally of the rare gas character. Some atom species of radio-active rare gases break down again into radio-active auxiliary products, mostly of a non-volatile character. Solid and liquid radio-active particles may behave, dependent on size, compactness, form and condition of surface, as air pollution through dust. The volatile radio-activities only undergo the Brown movement and are not subject to gravity. They must be absorbed, however, into dust particles and then follow the ways of these particles.

In 1957 a medium reactor accident occurred in Windscale. On that occasion 22,000 Curie radiojodium came into the atmosphere. The infection could penetrate into the human organism via the food-chain: meadow-grass—cow—milk. In an area of 193 square miles strict restrictions were necessary for the cattle industry and more than 250,000 gallons of milk were destroyed. Traces of this ejection of radiojodium could be measured all over Europe.

A result of the various kinds of air pollution over industrial and urban agglomerations is a clearly perceptible haziness of the sky, toning down sun and light, making the sky less blue and obstructing a great part of the ultra-violet rays. In many big towns we know that there is less sunshine and more fog than in the surrounding country. Such strong centres of air pollution encourage the formation of mist under certain atmospheric conditions, in which the poisonous gases—sometimes also in certain combinations that are even more harmful to the health of man owing to the separate components—dissolve in the mistdrops and attain even higher concentrations in them when the fog is persistent. So some very serious fog catastrophes could happen. In the Maasdal in 1930, in Donora in 1948 and in London in 1952 air pollution caused more than 4,000 fatal casualties.

The influence of a "normal" degree of air pollution—as present in all big towns—on the health of man is not so conspicuous, but an adverse effect has been found by medical men for all forms of air pollution. Everywhere measures are being taken to fight the evil at the source of dirt. These problems are not considered here. In spite of precautionary measures taken there will remain a considerable air pollution but I am only concerned here with air pollution and green spaces.

The Influence of Air Pollution on Vegetation

Harmful actions of air pollution can be more clearly shown with regard to vegetation than in respect of man and animals. Under normal conditions in big towns, where the influence on the health of man is still little noticeable damage to vegetation can be clearly seen already.

In the year 70 Plinius wrote already in his "Histora naturalis" about the damage by smoke. He reports that vegetation was dying away in the vicinity of smelting works. From this we learn that harmful air pollution for vegetation is already as old as the production of metal from ores and minerals. Metals are mostly found as sulphides so that sulphur dioxide was liberated in the smelting works.

In 1895 and 1905 the Agricultural University at Wageningen, Holland found much damage caused to horticultural industries by factory smoke which resulted in a petition of 22 horticultural industries to the Ministry of Agriculture for an indemity against damage caused by fluorhydric acid to lettuce, endive, potatoes, pears and red beets. Horticulture around industrial areas of the large towns in western Holland suffers considerable damage rather frequently nowadays to crop production, to such a degree that certain cultivations have had to be transferred to other areas. In the U.S.A. and in Europe many cases are known of thousands of acres of conifers dying away as a result of pollution by industrial gases.

The adverse effect of exhaust gases of motor cars is illustrated in the following example. In several squares in Paris there are wonderful paulownia trees. Flowering was normal until 1927 and then decreased through the falling off of unopened buds. In 1940 flowering had practically come to an end. Between 1940 and 1947, however, when there was little motor traffic on account of the war, the trees were flowering beautifully again. After 1947 flowering was reduced to zero again within a few years. These phenomena are attributed to the action of carbon monoxide and ethylene which laboratory tests have proved caused unopened buds to drop. The same substances are obviously also responsible for the bad state of health of the trees, notably limes and maples, on many Paris boulevards. The plane trees alone show no signs of dying away and make a very sound impression just as they do in London.

These examples of the adverse effect of polluted air on botanic life makes one think about the possible influence of such poisons on the total biological community, in which we consider ourselves to be the most important species. Having discovered considerable damage to the vegetable world the concentrations responsible have been determined for all kinds of crops. For example, lichens found everywhere on trunks die with sulphur dioxide concentrations of 0·035 p.p.m. (particles per million c.c. per cubic metre). Algae and lichens are most sensitive, which is understandable in view of their physiology as epiphytic plants.

In large parts of West Europe the lichen flora has suffered due to the loss of the most sensitive species; hardly any lichens are to be found in and around large towns. This absence clearly demarcates the area infected. A certain gladiolus variety shows damage with a fluorhydric acid concentration of 0·0001 p.p.m., beans, petunia and *Poa annua* with a biochemical pollution of 0·01 p.p.m., tomatoes with an ethylene pollution of 0·1 p.p.m.

So botanic life suffers severely from air pollution. Because people are worried now about the health of man owing to the increasing air pollution, interest has been focussed on this problem in the last few years and research into the influence on plants has developed. If people had been as sensitive as plants the fight with air pollution would have started half a century ago.

The Influence of the Vegetable World on Air Pollution

Though vegetation itself, as a matter of fact, is damaged by air pollution, the plant may also exercise a not unimportant influence for the better on air purity. Air naturally contains less dust, smoke, bacteria and waste gases in the green places because of the absence there of chimneys and traffic. Measurements taken in the Champs de Mars in Paris showed a much purer air there than in the surrounding urban area.

Near the main railway station at Frankfurt-am-Main 18,000 dust nuclei were measured per air unit; in the Rothschild park of 10 acres this was 1,000–3,000. In streets planted with trees 3,000 dust particles were measured against 10,000 to 12,000 in streets without trees in the same urban area. The more the town is intersected by green spaces and avenues the greater are the clean parts in the town and the lower the town average of air pollution.

All plants, especially trees and shrubs, have the ability of filtering considerable amounts of dust in solid and liquid form from the air, particularly the finer particles of the dust, including the tar and oily products. Leaves and twigs retain dust particles owing to the adhesive properties of their very fine hairs, and through electrostatic charging particles cling to the leaves. The bigger particles are washed down by rain-showers to the earth; the particles more strongly attached to the leaves generally remain there the whole season, hampering the assimilation function of the leaves. They fall to the ground with the leaf in autumn and remain there harmless.

The absorption of dust is dependent upon the position of the leaf and the nature of the leaf surface. *Robinia* absorbs little, while *Populus alba* and *P. nigra*, *Betula*, *Tilia* and *Ulmus* absorb very much dust. Particles smaller than 40 micron stick even to leaves in a vertical position with a relatively smooth surface till the rain washes them down. Bigger and heavier particles cling to rougher leaves held in a more horizontal position or fall to the ground through gravity due to the relative calm among the trees.

Horizontal pavements and vertical walls of buildings encourage frequent air vortices which cause the dust to whirl up constantly so that man may inhale it again. Trees and shrubs break this whirling completely so that dust once settled remains on the ground without danger and it may penetrate into the ground layers during rain. An even, close-cropped lawn retains almost completely dust settled on it. The absorption of dust by trees may be very great. Two acres of lime trees may retain 372 lb of dust per day and 42 tons per season. For a spruce wood this is 30 tons and beech wood 68 tons. It stands to reason that those edges of clumps of trees exposed to the source of infection absorb most of it. A plantation 30 yards deep gives an almost complete interception of dust; but 100 to 300 yards of depth is preferred.

Conifers would be most valuable for the filtration of dust both in summer and winter but their evergreen nature causes them to be less resistant to the pollution on the surface of the leaf. After some years the pores become clogged in such a way that the leaf can no longer assimilate and breathe and then the tree will die away. Deciduous trees are to be preferred in the most exposed sites with conifers as the second line of defence.

The cleaning action of plants for air pollution through gas is considerably less than for dust. The pores can indeed absorb part of the sulphur dioxide from the air and detain this. Sulphur content in plants grown in air polluted with sulphur dioxide was measured at a level twice to three times as large as with plants grown in clean air, but a strong pollution is definitely not completely intercepted.

In consequence of too high a sulphur dioxide concentration the leaf itself also dies. In a large leaf sulphur dioxide can be better spread, it is true, and neutralized as anion in a certain degree to sulphates and further to organic sulphides with the cations absorbed from the ground (potassium, calcium, magnesium). So the better the state of health of the tree the more it feels at home in the place. The better the state of nourishment of the soil the better the neutralization, the less damage to the leaf and the more sulphur dioxide can be absorbed. So with the help of good soil and fertilizers if necessary, and the choice of naturally resistant trees, the greatest possible effect can be reached for sound growth and for the possibly useful actions the tree has to accomplish.

Although the activities of trees, as far as the interception of poisonous gases from the air is concerned, must not be exaggerated the following examples are nevertheless striking. A factory in Germany ejected gas containing sulphur dioxide and dust containing lead. At a distance of 100 yards from the factory against the slope was a beech wood 100 yards deep in which 1·7 p.p.m. sulphur dioxide was measured. Beyond the beech wood there was an undamaged spruce wood. After the beech wood had been removed the spruce wood died in a short time.

In a wood acting as a screen between the industrial area of Rotterdam and a block of houses alternate rows of alders and larches were planted on that edge facing an oil refinery. The alder is unaffected while the outer rows of larch are strongly affected by sulphur dioxide. The less exposed rows fare better and after 20 yards from the wood's edge the effect has practically disappeared. In the same area it was found that young beeches alternately planted with young alders, both 20–28 inches high, died. The following year when the alders had grown up to 60 inches the beeches replaced in between them grew fairly well.

It appears that a very light screen of a few rows of still young trees may give an important and early protection. It should not be assumed that this useful action consists of the complete interception, or reduction to harmless values, of the poisonous gas. The protecting influence in these cases must consist in the action of the plantation to mix the gases and the air in such a way that the poisons are diluted to harmless concentrations. This is the most important action of clumps of trees.

In the Ruhr district it was found that in a wood strongly exposed to air filled with sulphur dioxide the content in the tops of the trees was 40% less than that above the wood. The latter only allows partial penetration and guides the greater part over the wood. To carry out this function properly it is necessary that the wood should not to be a closed block of trees of the same height. In such cases the current of air is guided almost unhindered over it to come down again behind the wood. The ideal type of wood to fight against air pollution in flat areas is a rather open wood, or parkland, where the current of air can penetrate between the tops of varying height and through and over the undergrowth of shrubs and herbs. This should be followed by an open field and after that a further cluster of trees.

In the tops and the underwood the strongest wind is reduced to velocities of 4 yards per second, thanks to which a great part of the pollution will either sink to the ground through gravity or adhere to leaves and branches. The pollution through gas remains in the air, however, but is fully mixed with it by all obstacles in the wood so that there is everywhere a lowest possible concentration. The same action occurs over the tops of varying heights. Thanks to this so much turbulence is caused that mixing is also complete. The density degree of the plantation from 0·4 to 0·6 probably offers the best results.

The present style of the layout of big parks in the towns, with considerable wooded parts intersected by playing fields and other open ground, satisfies fairly well the design desirable for best possible action against air pollution.

Very resistant kinds of trees must be planted on the most exposed places and the resistance of poplar, alder, willow, oak and plane trees is good. In the second line of defence *Pinus nigra austriaca* shows itself to be fairly resistant. Opinions about the resistance of the various kinds of trees differ strongly, because they may react quite differently to the various gases or combinations of them while many crops seem to be injured more by a high concentration of poison during a short period than by a low concentration during the whole year.

As radio-active fall-out is tied to dust it is evident that the great action of woodland on dust filtration applies in the same way for the filtering of radio-active particles.

In the years of the great atom tests twice to four times as high a radio-activity could be measured on trees on the weatherside than on the leeside. A lawn on a plain open to the windward side had a radio-activity five times as high as a similar lawn in the lee of a woodland. In November, 1958, when radio-activity was high, one measured on the weather side of a woodland a radio-activity 32 times as high as that on the lee side. At the same time it was found in south Germany that a district with many green spaces had only 56% of the radio-activity of a strongly exposed place in the same town.

Tests with radio iodine, one of the auxiliary products of radio-active gases, have shown that this substance is strongly absorbed from the atmosphere by trees; guided via the pores, and probably also via the cuticle to the inner part of the plant, it is stored harmless to man and loses quickly its harmful action. Protection by trees cannot replace technical protection. But a decrease in the supply of radio-active matter of about 30 to 50% caused by a wood, may contribute in certain cases to the maintenance of human health and life.

Some of the influences exerted by the green spaces in towns still play a role on the air movements in and over towns and so on the substances carried along by this moving body of air. This situation only holds good for towns with a strongly continental climate where in summer, during prolonged high pressure periods, there are high temperatures during absolute calms.

The dead material of roofs, walls and streets is heated most and produces a rising air-current that must be supplemented from cooler green spaces and from the edge of the town along the ground. The cool and clear air from large green spaces moves under the hot and "dirty" air. Air flowing from the edge of the town should not be obstructed by contiguous buildings. Green spaces reaching from the edge of the town to the centre facilitate the flow of this pure air. Wind velocities of some yards per second will, however, fully dominate these weak air currents. Narrow, bare streets may increase wind velocities so that the air is strongly loaded with dust and on street corners strong whirlings may be caused. Trees and shrubs break these whirlings so that the dust is intercepted and can settle.

Town Planning Aspects

From 1327 already town planning measures are known with regard to air pollution. After the fire in Munich it was prescribed, when reconstructing the city, that industries causing reek and noise were to be assembled in separate alleys as the Farbergasse, Ledergasse and Schafflergasse. In some towns in the U.S.A. "unpleasant" industries were concentrated in certain quarters of the town in former times. The great English scientist John Evelyn suggested in 1661 the transfer of all industries using coal to an area downstream from Greenwich, while on the weather side of London areas of aromatic trees, shrubs and herbs were to be planted.

From the foregoing considerations some town planning recommendations can be developed:—

(1) industrial and housing areas should be apart;

(2) industrial areas should be located down-wind from housing and recreation areas;

(3) industrial areas should be separated from the housing areas by wide, green belts;

(4) an alternation of high, medium and low buildings to promote turbulence should be developed, although it should be borne in mind that they should not be directly connected, because chimneys of low buildings cause nuisance to upper storeys of high domestic buildings. Tall housing developments should not be located to the leeward of areas producing

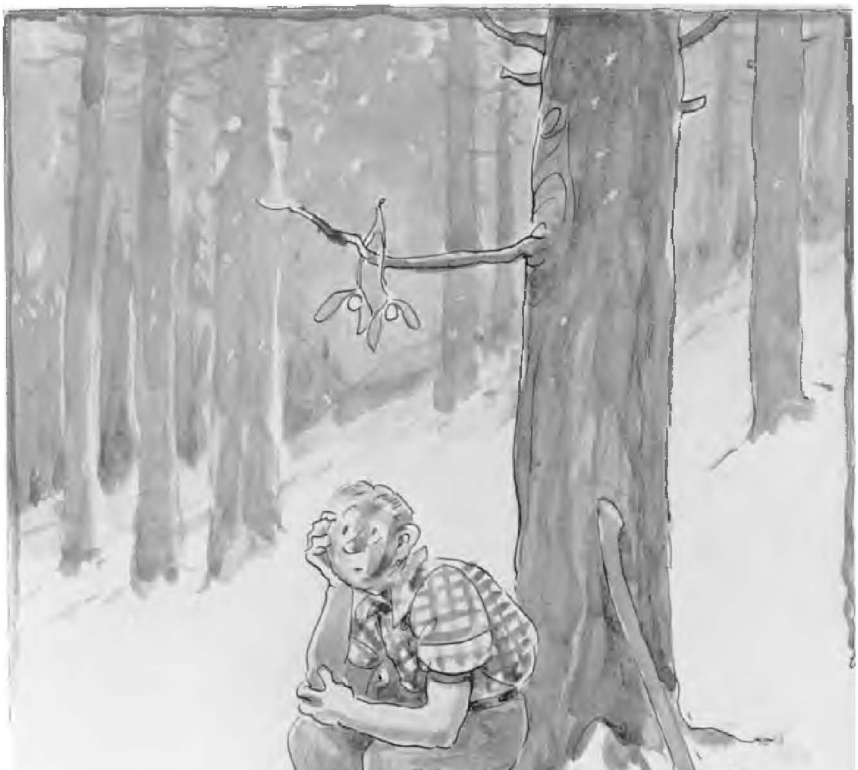


PLATE 1. Forest Workers' Christmas.

PLATE 2. Charcoal burners in the Forest of Dean, about 1920.

PLATE 3. A lumberjill of the Womens' Timber Corps, the Forestry Section of the Womens' Land Army that worked in our woods from 1939 to 1945, in regulation uniform. Power saws and safety helmets were both unknown, but excellent work was done, even though the stump above recalls the work of beavers!

PLATE 4. Newton Forest Nursery near Elgin in Morayshire, about 1925. No machinery, all spade work. Boards, as today, were filled by hand, though fashions, at right of picture, were then more practical. Each man illustrates a particular step in the job:—stamping firm, smoothing soil, earthing up, lifting a board and cutting a new trench.

PLATE 5. Tree planting gang on the Norfolk Brecklands of Thetford Forest, also about 1925. A well-drilled gang has been "frozen" in nine different planting positions by a photographer making a long exposure. Wages were 24/- per week.

PLATE 6. The Commission's oldest plantation of Douglas firs at Eggesford Forest in Devon, planted on 8th December, 1919. Taken about thirteen years later, during a visit by Commissioners. Lord Robinson, Senior Technical Officer from 1919 to 1932 and Chairman from 1932 to 1952, stands fourth from left. Others include (standing) E. C. Kibble (foreman), Lord Courthope, Major Sir William Strang Steel, Bt., Sir William Ling Taylor, who served from 1919 to 1949 (a former Director General), Mr. W. R. Smith, Mr. A. G. Herbert (the Commission's Secretary from 1919 to 1946), Sir Alexander Rodger and Sir Hugh Murray. Seated are: Mr. F. S. Scott (Divisional Officer), Mr. D. R. Grenfell, Sir Francis Acland and Mr. W. D. Russell (District Officer).

PLATE 7. The commemorative plaque, bearing the names of Lord Clinton and Sir Hugh Murray, Commissioners, C. O. Hanson (Divisional Officer), and Tom Brown, Forester. In the picture: Sir Francis Acland, author of the 'Acland Report', 1917, and Sir Hugh Murray himself.

PLATE 8. Motorway planting beside the M1 in the English Midlands. Establishing a plantation, using small trees, to screen an embankment.

PLATE 9. Larger trees, requiring staking, are planted along a cutting. Besides improving scenery, both these measures will lessen wind pressure on cars and vans, leading to safer steering at motorway speeds.

PLATE 10. Today's tree-planters at Loch Goil Forest, Dunbartonshire, West Scotland.

PLATE 11. Modern tree feller, with power saw, safety helmet, fungicide can, and brush for treating stumps against *Fomes* butt rot attack.

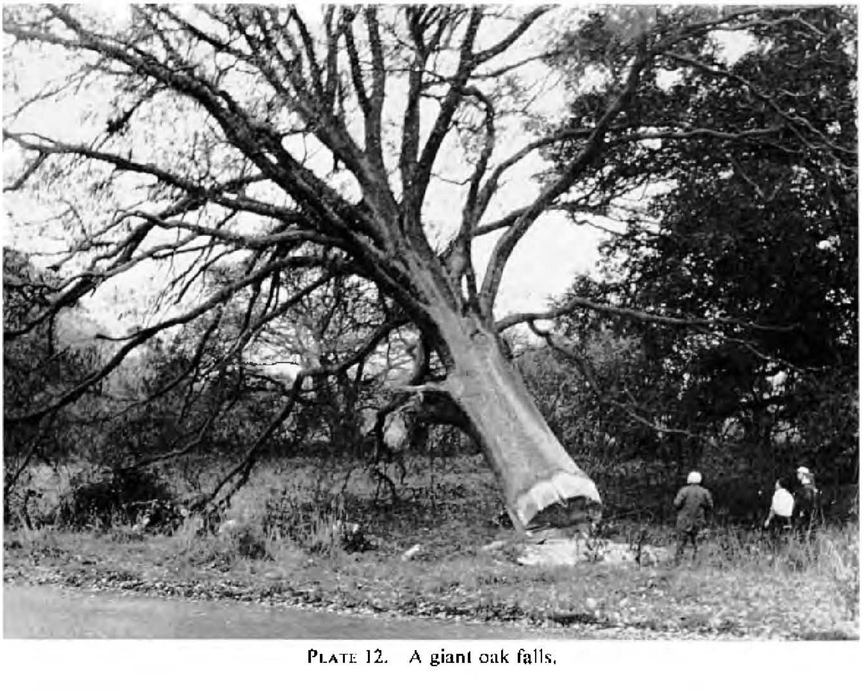


PLATE 12. A giant oak falls.

PLATE 13. Midday lunch-break. Tree-planters in Glen Righ Forest, North Scotland, gaze across Loch Leven to Glencoe Forest in West Scotland. Glencoe and its guardian peaks lie beyond.

PLATE 14. Passenger cable car used to transport logs downhill at Marhofen, in the Austrian Tirol.

PLATE 15. A bulldozer excavating the road-bed for a new forest road along the steep Greensand slopes of Monkton Wyld Wood, in Charmouth Forest, Dorset.

ATE 16. The huge butt of a Californian redwood, *Sequoia sempervirens*, is cut by a great bandsaw in a Devon sawmill.

ATE 17. Basket willows, or osiers, growing near Langport, on Sedgemoor in Somerset. Cultivated fertile, well-drained peat, the willow rods are harvested by annual coppicing for several seasons.

PLATE 18. Early days in Work Study.

industrial gases, as in such cases, at a height of about 90 feet, a much higher concentration of pollution is found than nearer the ground;

(5) housing areas should be laid out intersected by green spaces;

(6) the urban green spaces should not be laid out too much in separate parts but assembled in big complexes. Local parks should be kept so small that as many green spaces as possible can be concentrated in parks in larger units.

(7) sports grounds should be laid out in connection with the space for passive recreation to obtain the largest possible green spaces; this will give air available for sports and games with their strongly increased breathing;

(8) children's playgrounds should definitely not be laid out along streets heavy with traffic but in the green spaces;

(9) all streets should be planted with at least one row of trees and if possible with wider green patches.

(10) the green spaces should penetrate uninterruptedly from the edge of the town to the centre and should be connected with each other radially. The pedestrian traffic should follow the same pattern;

(11) large thoroughfares should be diverted round the town centre;

(12) crowded roads should be as much as possible without cross roads and "green waves" on thoroughfares should allow the traffic to flow as smoothly as possible, without producing exceptionally many exhaust gases through the alternation of stationary periods with acceleration;

(13) along the thoroughfares plantation should be on a large scale of such an open character that the air can penetrate into the plantation and is not forced to go over it;

(14) in the building regulations of all towns provisions should be inserted for maintenance and laying out of green spaces on private building grounds; this has been done in an excellent way in the Paris town planning regulations.

The large cities are the centres of the world whence strength and wisdom should come to guide mankind. The green spaces should give man the surroundings in which to live, to work, to breathe, to be healthy; to be man.

SNOW STORM IN DELAMERE FOREST

By W. A. BOLLARD

Forester, North West England

Delamere Forest and its immediate vicinity of mid-Cheshire suffered a remarkable fall of snow on 5th February, 1968 and I feel that it should be put on record.

I was working in the nursery at the time and snow began to fall at 3 p.m. in large flakes but thinly. For some time, the ground remained uncovered but gradually became white and at 4.30 p.m. we all left for home, cutting tracks with our vehicle tyres through the thin snow cover.

I live in a house on the edge of the forest with large mature Scots pine, oak and birch all round and acres of forty-year-old Corsican pine and more mature Scots pine within half a mile.

At frequent intervals during the evening, I went to the door and always the snow was falling thickly but very gently as there was no wind at all. At 7.30 p.m., I decided to shake a six-foot-tall cypress tree which was twenty yards from the door and whose leader was already touching the ground through the weight of snow upon it. I had to wear wellingtons as the snow was already nine inches deep. At 8.30 p.m., I was again at my door and there were further developments as the snow fell as fast, as thickly and as gently as before. Now and again, through the deathly stillness, there would be a crack like rifle-fire, often a riving noise and then, after a pause, there would be a dull thud as the snow shed from an overloaded branch hit the ground. These noises continued throughout the night. By the following morning at day-break the snow had just stopped and no less than 18 inches had fallen. As my son and I cleared the drive to the road with shovels, a branch in an old Scots pine cracked above our heads showering more snow down.

After clearing the drive, my son and I proceeded up the public road, which passes through the wood adjacent to my house, and cleared it of all fallen branches—no small task as the snow was deep, clinging and very wet, making the job heavy and uncomfortable.

Returning home, I changed my wet clothes before forcing my van, suitably weighted with sacks of soil, onto the main road and proceeded four miles to the main block of Delamere Forest.

For the rest of the day, all men were fully occupied clearing limbs and branches off the main roads, which unfortunately are all more or less bordered by a very old mixed amenity belt where fairly extensive snow-break occurred. Not only had the public roads, almost all reduced to single tracks by fallen boughs, to be cleared, but also the telephone lines which often had branches hanging upon the wires. Later all the forest roads had also to be cleared of fallen branches.

Only later was it possible to appreciate the extent of the damage. Throughout the Forest, oak and birch had branches ripped out of their tops or were bowed over by the weight of snow so far that, even a year later, the trees had not returned to normal and in fact, probably never will. The pines, which are the main species in this forest, had suffered very severely—many having branches snapped off, either falling to the ground or hanging, so that the following August I was asked by a public visitor why the trees were dying at the top. Others were bowed over permanently and others snapped off at some weakness at various heights from the ground.

Certain areas of the forest where the snowfall was heaviest had so many mutilated trees that it was necessary to fell and remove them. Elsewhere the scars of this snowfall will remain for many years to come. The extremely severe damage suffered by the birch is if anything, beneficial, as it has relieved the adjacent trees.

Some time after this remarkable fall of snow at Delamere, I was reading the Forestry Commission Journal No. 17, April 1938, when I came across an article called *Snow Storm in the New Forest* by D. W. Young. As I read it, I could almost visualize that storm he described as being the same that happened at Delamere, as the snowfall (18 inches), conditions and resultant damage were almost identical.

I would like to conclude by repeating word for word Mr. Young's final paragraph.

"It is to be feared there is nothing to be learned from the experience. If the temperature had been a few degrees higher it would have been sleet and would not have lain. If it had been a little colder the snow would not have clung as it did, and had there been any wind the snow would not have been allowed to accumulate in any case. One can only be thankful that such a combination of meteorological circumstances can occur only occasionally".

APPRECIATING NATURE

"Go forth, under the open sky, and list to Nature's teachings".
William Cullen Bryant

I hear men say that woods of spruce and pine
Are silent dull and colourless, so drear
That you may walk beneath their shade in spring
Yet see no living creature move, nor hear
The arpeggios of linnet, warbler, thrush
From hazel twig or top of blackthorn bush.
But reader, come with me for I can show
You fascinating things where fir trees grow.

Look closely at that old decaying stump,
A pile of dry spruce needles throbs and heaves
Where black and red wood ants have made their home,
And laid a million eggs amongst the leaves.
When heavy human footfall sounds the alarm,
And warns them that their queen may suffer harm,
Their habitat they instantly defend,
Ejecting acid from their hinder end.

Those shreads of bark, that heap of woody chips
Beneath the old dead spruce beside the ditch,
Hewn from the dried out limbs and hollow bole,
By yaffle seeking grubs and nesting hole.
His mocking laugh, the drumming of his bill
Rings through the wood like some pneumatic drill,
In undulating flight he's often seen
A flash of gaudy red and shimmering green.

Suspended on a limb above your head
And swaying in the breeze, there hangs a nest
Of lichens, wool, and feathers woven close
By master craftsman, who, with golden crest
And olive plumage, hunts each fissured ridge
Of wood and bark, for spider, insect, midge.
His voice a tinkling trill you've often heard
Exceeding loud for Europe's smallest bird.

No colour in these woods? What of the glint
Of setting sun on pine bark, or the tint
In rhododendron of the deepest dye
Against the glory of the morning sky,
The copper larches and the glaucous hue
Of sombre Sitka spruce, the yellow and blue
Of great tit's plumage, or the coal-black crow,
The shell of pigeons' egg as white as snow.

Each tuft of grass, each tree, each branch and shoot
Holds or conceals some tiny living brute,
Some insect that was hatched and given birth
A minute creature of this complex earth.
Thus you may see that far from being dull
Coniferous woods are singularly full
Of interesting things not in the book,
You'll find them if you're curious and look.

R. J. JENNINGS

Notes: The yaffle is the Green Woodpecker, while Europe's smallest bird is of course the goldcrest. *Ed.*

WILD LIFE

BIRD LIFE OF THE BORDER FORESTS

By W. L. McCAVISH

Chief Forester, North East England

1. THE BIRTH OF A FOREST

As far back as the year 1925, when Britain was sadly depleted of its reserves of timber by World War I, Sir Roy Robinson, later chairman of The Forestry Commission, stood upon the heights of Bolts Law, situated upon the area that is now known as Chirdon Forest. He remarked, "This would make ideal planting ground, and could become one of the largest forests in England. That is if we can acquire the land for the planting of trees."

Little did we think that those words would come true, and that many, myself included, may never have set foot in the North Tyne valley to become one of so many Foresters who are able to say, "I was one of those who helped in the creation of what is now the largest man-made Forest in Europe."

It was in the autumn of 1937 that I received instructions to proceed to Tarset to take over the duties of Forester upon Chirdon Beat, which was then a newly acquired area, where planting was to commence the following year.

I set off from a forest in Yorkshire with a feeling of pride in my heart at the thoughts that I was at last to be in sole charge as Forester, my first with the Forestry Commission. I was met by the then District Officer of Division I, Northumberland and Durham, Mr. G. L. Batters.

It can be visualised how sparsely populated the district was, when I say that it took most of the day to find a place where I could be accomodated.

I then had to purchase a bicycle to enable me to get to the area upon which most of my work was to take place. This meant proceeding up the narrow road that led to the Bower Farm, a noted place in history with connections with Bowery Charlton, of the Border raider days. At the time of my arrival, the area to be planted was still being farmed, and carried a stock of sheep and store cattle. From the Bower Farm onwards lay a cart track, which made its way up to Hopehouse, a lonely farm about five miles off the beaten track. After travelling for about three miles, I noticed a rather high ridge and made my way towards its summit. Little did I know that I was standing upon the same height where stood the future Chairman of The Forestry Commission in 1925.

It was an awesome sight, not lacking in beauty. As far as the eye could see in all directions, there stretched open moorland of blue moor grass, with patches of ling heather peeping through, just managing to survive against the heavy grazing of the animals feeding upon the area.

Many depressions were veritable quagmires where one feared to tread. In the early days we termed such areas as unplantable, as little was known of mechanical means of cultivation, to prepare ground for planting, and all drainage was carried out by hand. These areas were left unplanted, until mechanical means of draining came into being years later.

It may give the reader a little more insight into the wildness and remoteness of some of these areas to note some of the names upon the map, such as: Bellcrag Flow, Drowning Flow, Deadwater Fell, Kielder Waste, and many other such names. In later years, many tractors were to become hopelessly bogged down until they were practically out of sight, while trying to drain them.

On the other hand there were large outcrops of rock which stood out like sentinels here and there throughout the area, many named after some noted man of the Border regions, such as Jock's Pike, Sandy's Pike, Ellis Crag, Muckle John's Crag, Harry's Pike, and many others. Many crags gave me an idea of the birds which had, or did inhabit the particular spot, such as Merlin Crags, Ravenshill, Hawkstone Pike, Ravens Crags, Many names such as these are quite common in this Border area, and these confirm a certain wildness to its character.

2. BIRDS OF THE OPEN MOORLAND

In this particular era, the game shooting was really at its best, and I can well remember the many coveys of red grouse which rose in the air upon one's approach, or their continuous calling, which sounded as if they resented any presence but their own, and kept telling you to "Go back". It was quite normal in those days for the shooting tenant and his party to bag in the region of 150 brace of grouse in one outing, and indeed they expected that quantity or looked upon the shoot as deteriorating.

The black grouse, or blackcock as they are sometimes termed, though the latter name applies to the male bird only, were abundant. The female bears the title of grey hen, why, I do not know, as she is more of a brown colour in keeping with her surroundings, and most difficult to find when sitting upon the nest. Flocks of up to fifty in number were seen flying from one point to another, or roosting in the scrub birch and alder which flanked the Chirdon Burn, and I have seen as many as twenty-five birds sitting upon the garden wall of the Bower House, looking very much like the scene one sees at a shooting gallery upon a fair ground. These birds at least livened up the day, for apart from the postman, or once-weekly visit of the travelling grocer, they were the only visitors that my wife saw.

These birds were at that particular time classed as vermin on account of the damage they wrought to the young buds of newly-planted trees. They paid particular attention to the Scots pine, and it was mainly due to this damage, and the presence of a great number of rabbits, that I received permission to carry a shotgun to reduce their numbers.

I can well remember my first shot at a blackcock, which can be a very difficult bird to bring down, and also a wary one. Like the crow family they tended to have one of their number on look-out duty, to give warning of one's approach. It so happened that while playing football I injured the cartilage of my knee, and this as far as I was aware had healed up. It was one evening that I had crawled up unawares to the blackcock, and took my first shot at one upon its lekking ground, as they always visit these areas at this season, and not being a Class A marksman, I wounded it. It was what one would term a runner and so I also started running. I was fast catching up with the bird when off went the cartilage of my knee once more, so that I myself was rolling in agony on the ground, accompanied by a blackcock in similar state.

He succumbed to his injury, while I had to get the cartilage back in its right position. This I did, and bore a great deal of sympathy for the unfortunate bird. To any onlooker this would have seemed a rather humorous situation and I was so glad that no-one had seen me.

The lekking time for these birds is in early May, and is a sight worth rising at daybreak to see in its full glory, the babbling noise of the male birds as they form into a circle, hold sham fights, and display their tail feathers in an effort to attract the females, who sit in the centre watching and choosing the mate they desire for that occasion.

The golden plover is indeed a strikingly pretty bird, and unlike the lapwing, prefers the remoter parts of the moors. They were to be seen flying in groups of about six at a time, and again did not flock together so much as the lapwing, or "peeswip" as they are known locally.

It was a happy experience to be out early upon a spring morning, listening to its high drawn out "peep", a plaintive and melancholy note, which seemed, at least to my mind, as if it was telling me that only it and I were present in the vast remoteness all around us.

I have only seen one hawfinch in the Border Forests and I considered myself lucky to see it one morning near Allery Bank Farm, sitting upon a hawthorn tree and feeding upon the haws in the month of November. Occasionally a bevy of partridge were seen, but these birds preferred the lower-lying arable land of the valley down which flowed the North Tyne river.

Merlins were to be found upon most rocky outcrops, generally in an inaccessible place, and were fairly common.

Their sharp "chat" call gave them away but to see these birds in flight, or after their prey, made one wonder with admiration, at the speed that they struck at their prey, often an unwary grouse.

Peregrine falcons were also present, though not in great numbers, and tended to stick to their favourite haunts around Whickhope Linns, Christianbury Crags, Ellis Crags, and Chattlehope Spout, where they could be seen quite often.

These birds were used quite a lot in olden days, mainly before the days of the shot-gun, for a form of sport called falconry.

Snipe were often flushed from some rushy marshlands such as previously described and in the evenings, especially when the mating season arrived, the drumming of their wings in the air sounded very ghostly to anyone not acquainted with the noise. What a bird to shoot! He certainly tests the marksman, as upon being flushed, he goes off skimming ground level on a sharp zig-zag course.

The curlew was very common in the 1930's, and arrived regularly from the mud flats of the river estuaries every year as regular as clockwork, and always gave the signal that spring was in the air. At this particular time the eggs, as large as hen eggs, were often collected, being considered quite a delicacy to eat. Curlews were often shot for their food value when upon the mud flats. I always termed this bird "The Watchman of the Moors", and have many a time sat and watched this bird's antics.

When he gave forth his high metallic alarm call, diving towards the earth, then soaring up again once more to give his alarm call, you could be quite sure that some intruder was encroaching upon his domains. Very often he has pointed out to me the whereabouts of a slinking fox which had passed me by unnoticed. The musical trill which he gives forth upon descending to earth, is a pleasant note to the listener's ear. They remained upon the moors for most of the spring and summer months, returning to the river estuaries in the autumn, as most of the birds which inhabit mud flats do.

As the autumn days approached, it was a common sight to behold skeins of geese flying overhead, upon their way from the Northumberland coast to the Solway Firth, or vice versa. Their honking as they winged their way across the dark grey skies tended to sound very melancholy, and was a sign, that if flying northwards warmer weather was in the offing, or if flying southwards, adverse weather was approaching. This was the local shepherd's version, and very often he was correct, or was it pure co-incidence?

There were three varieties which could be seen, always with the old leader to the fore, flying in the characteristic V formation. The varieties were, the barnacle, pinkfoot, and greylag geese.

It so happened that one windy day about six greylag descended upon a small plot of land which carried a crop of oats ready for harvesting. The farmer's daughter rushed down to ask me to fire a shot or two to scare them away.

The war had been going on for a year and meat was beginning to be in short supply. The temptation was too great, and I aimed at the largest bird, which fell dead.

I bundled it over my shoulder and carried it home to the great rejoicing of my wife, who plucked and stuffed it and placed it in the oven on a Sunday morning. The time came for it to be carved up for what was to be a marvellous meal. Alas! I could not even get a fork into it let alone carve it, and the goose was buried in the Bower garden in a very unceremonious way. I was later told that I should have buried it for a week before eating, and it would have then been quite tender. I never had the heart, or chance again to prove these words and came to the conclusion that the goose I shot had been flying backwards and forwards to the Solway Firth since the 18th century!

It was upon one of these autumn mornings that a mechanical bird flew down the Chirdon Burn, in the shape of an aeroplane, barely flying at a height of 200 feet. Only when overhead did I notice the black crosses on the under side of the wings, a reminder to us that Herr Hitler was even keeping an eye upon the Border Forests. We were later informed that the plane had been shot down over Berwick.

At that time the buzzard was fairly common upon the moors, and could be seen quite often, recognisable by their habit of soaring high in the sky and wheeling in circles with light showing between their primary wing feathers.

Their eyesight must have been exceedingly good to discern their prey from such a height.

It was rather noticeable at that particular time that the jay was absent from these parts of the Tyne area, though I had seen them in the Wark area, around Nunwick and Chipchase estates.

Skylarks, and meadow pipits were nesting in great numbers upon all blue moor grass areas, and one had to be careful that you did not step upon their nests. In travelling over the more remote and higher reaches of the Forest, I occasionally came upon the twite, or mountain linnet as it is sometimes called. It resembles the little hedge sparrow, but has a yellow beak.

Both the sparrow hawk and kestrel were to be seen. The kestrel was always more common in the moorland areas, on account of its love of mice and voles which tended to come into the newly-planted areas on account of the heavier growth of vegetation which appeared.

The sparrow hawk was sometimes seen skudding along where there were any patches of scrub woodland about, hunting for small birds.

In the 1930's only a few short-eared owls were to be seen, and could not be called common by any means.

There were many crags throughout the Forest where the ravens could be seen regularly each year, and very often their deep croaking call, which was quite a musical sound, could be heard before the bird was actually seen. I have seen as many as five ravens flying together, presumably a family group, the young ones having just taken to the wing.

As the available food supply is the main factor which rules what variety of bird is in the area, so the presence of sheep, and other grazing animals, had attracted fairly large numbers of carrion crows, or "corbies" as they are known locally. These birds are indeed the scavengers of the bird world, and clear up most of the dead carcases left lying about. I have actually seen these birds pecking out the eyes of newly-born lambs, and ailing sheep, while they were alive. No wonder that farmers, gamekeepers, and most sportsmen hate this bird. Very often during the spring when nights are beginning to lengthen out we would have organised corbie shoots, visiting all the outlying and remote plantations.

Our plan of action, was to draw lots out of a cap for the position we were to take up our stand in the wood, and great rejoicing could be heard coming from the men who drew a position whereby the carrion crows had to fly into the wood against the wind, as this they nearly always do.

Just before dusk began to settle in you could hear in the distance that raucus call "caw caw" and one was instantly on the alert, and word passed down the line, "Here they come". Afterwards the wood would be alive with reports of shotguns going off and the thud of falling bodies could be heard hitting the ground, with each thud one knew another corbie had met his doom.

Often a winged bird would be attached by its leg to a length of string, secured by a peg inserted into the ground. Its calls attracted the other corbies into the wood.

This reminds me of one incident which took place one evening in a wood called Fiddlers Plantation, so named because it was planted in the shape of a Fiddle, and stands upon the hillside near Stewart Shields, in the Rede Valley. I had brought down a corbie shortly before dusk set in. It was fluttering upon the ground wounded. I was in the act of starting out to collect it when I heard a shout from one of the men who was positioned next to me. I just stood where I was, as I thought he was warning me not to go out into the open, in case incoming corbies should see me.

Imagine my surprise, when ten minutes later a pack of hounds in full cry passed within three yards of where I stood.

I learned later from my companion higher up the line, that he had shouted to draw my attention to the fox which was slinking past me, and had I turned at the time I could nearly have touched him.

But as is the case with many of God's wild creatures, the carrion crow has its good points also in that it helps to keep our countryside clear of any dead carcases, and indeed can do a good job of work in ridding animals of ticks which are attached to their bodies, and like the starling, can be seen perched quite often upon the back of a sheep, or a cow, busily picking them off. The animals seem quite pleased to allow them to do so, as indeed would I if I had been infested with them.

In the summer months, the whinchats, wheatears, stonechats, paid us regular visits, while in the winter months the fieldfares, redwings, and one-year-old starlings, used to frequent the moorland areas.

This then was the bird life that frequented the open moorland in the early days of the Forest. My next chapter deals with the birds most common in the lower reaches of the valley in the 1930's, and two or three years later.

3. BIRDS OF THE LOW-LYING FARMLANDS

The valley of the North Tyne, in the regions of the Border Forest, could not be regarded normally as heavily cultivated, with the exception of the reaches within the Tarset to Bellingham area, but with the War in its second year, more land was being cultivated than usual. This tended to bring in a large number of lapwings.

They seem to prefer meadow or ploughed fields, and large flocks appeared in the spring to make their nest, if nest you could call it, as it only seemed to be a scratch in the ground. This bird could be classed as a jerry nest-builder.

Into this hollow she laid her eggs, never more than four, on account of their being rather pointed at one end, making four eggs the perfect number to sit upon.

In fact many birds from the mudflats of river estuaries have their eggs of this shape, and most of them do not make elaborate nests. The eggs are so shaped so as they do not roll out of the nest, as they would do if they were of a round shape.

At this particular time the eggs of the lapwing were highly sought after for their food value, and brought a good price on the markets.

Little wonder that they frightened many a person who was not accustomed to their habit of swooping down at one's head when approaching their nest, with their cry of "peewit" accompanying their dive bombing act.

I well remember the cries of a young town evacuee who wandered onto their domain, and was caught up in a swooping mass of these birds.

They extended their territory as far up the valley as Kielder, but not in as many numbers, as they preferred the more arable land.

Both redshanks, and greenshanks favoured the meadows around the Greystead area, and their high pitched "peep" "peep", gave them away, they are so named because of their red and green legs.

Rooks, and jackdaws, I term lowland birds, as they generally have their rookeries in low lying blocks of plantations, surrounded by agricultural land.

Preferring to be in close proximity to the habitat of man, they habitually return to the same area to nest each year. Sometimes the young rooks were shot to prevent their numbers from becoming too numerous; they make delicious pies.

The following birds were of course present, as they are in most areas, but were not what one could call in abundance. Tits, robins, wrens, house sparrows, hedge sparrows, thrush, blackbird, and the chaffinch being most commonly seen.

The willow wren flitted among the willows that fringed the waterside, whilst the wood pigeon kept mainly to the lower reaches of the valley where the arable land was its larder.

Visitors, or migratory birds, arrived in the area in late April or early May. These comprised the redstart, chiff-chaff, spotted flycatcher, martin, swift, swallow, cuckoo, and grasshopper warbler.

Occasionally reed buntings were seen, but not a very great number of migratory birds were seen other than those mentioned.

Winter migrants were the redwings, fieldfares, a few crossbills, and wax-wings. The crossbills either came from north Scotland, or Norway, the Norwegian species being slightly different in size.

Magpies were also present, but these kept mainly to the regions below Tarset, and never did I notice one up in the Kielder area at this time of which I am writing.

Not that many worried, for like the jay, which was also in the lower reaches of the valley, their love of eggs, of all descriptions, can be a great nuisance to farmer, sportsman, and ornithologist alike.

They will also take young fledglings. Both these birds have a most devilish chuckle of a call, as if glorifying in robbing any small bird's nest, and in my opinion, need to be carefully controlled, so that we will always have an acceptable number in our midst.

Sparrow hawks were present in quite considerable numbers, and tended to scud along at barely tree top height, and I have watched one of these birds swoop as if from nowhere, to pick a blue tit from the branch it was perched on, without halting in its flight, and start plucking the poor thing while it was still alive. No wonder that this bird has almost disappeared from the scene, as one held a certain distaste for it and its cruel ways, so it was shot on sight by most game keepers. Today it is a protected bird.

Most creatures were created to provide food for the more stronger species, and this is as life must go on.

There were a few kestrel hawks, which fed mainly upon mice, and voles. Though a moorland bird they could also be seen in the regions of the farmland.

I had only heard of one pair of red-backed shrikes being in the Forest area up to 1941. This bird also has a cruel nature, and from its habit of impaling its prey upon a hawthorn bush until it is considered ripe for eating, is also know as the Butcher Bird.

It will impale moths, bees, beetles, mice, and small birds, though it is known to have caught birds of the size of a thrush. It catches its prey mainly by pouncing upon them while they are feeding upon the ground, or perched upon the branch of a tree.

Sometimes it chases its prey, keeping it from getting into any thick cover, until the bird becomes exhausted, and alights upon the ground or perches upon a branch. Then the shrike will attack its prey.

I was asked to keep the whereabouts of this bird to myself, as it is so rare in these parts, and we felt that to publicise its position would be detrimental to the bird itself.

Around Kielder Castle, The Birks at Tarset, and other estates surrounding the Forest, one could find the greater-spotted woodpecker, and on only rare occasions would you see the lesser-spotted variety. There were no green woodpeckers to be seen in the Forest area at this time.

The meadows were full of skylarks, and pipits, as were also the moorlands, and what nicer sight could meet the eye than to watch the lark soar up into the sky and give forth his trilling song as he descends to earth. This always reminds me of the cockney boy's first glimpse of the Skylark. Turning to his companion he remarked, "Cor mate! that sparra up there can't get down and he ain't arf hollerin!"

Corncrakes were constantly heard in the hayfields, and cornfields, at this time. The crake's call is practically as if he were saying his own name, and he could be definitely termed the ventriloquist of the bird world, for I have had great difficulty in placing his whereabouts, as first he would be heard in one area, then in a totally different position the next.

How pleasant it was in those days to watch the ploughman, with his pair of horses, ploughing the fields in spring, the clanging of the plough chains, the ploughman's orders to his horses, he in turn being followed furrow by furrow, by gulls, rooks, jackdaws, pigeons, and starlings, all waiting for the worms, and grubs, which appeared in the newly turned-up furrows.

The world moved around at a slower pace in those days, even though the rigours of war surrounded us all, and our wartime duties as Home Guards, and Air Raid Wardens, tended to keep us busy.

4. BIRDS OF RIVER, LAKE AND STREAM

My main interest in these birds, lay in the fact that ever since boyhood, from the age of nine years old, my father, who was always keen on nature, and the sport of angling, took me with him and taught me the art of casting the fly. This brought me into contact with many birds that frequent these areas, and my advice to any person interested in birds of the waterways is to take up angling, for if you don't catch fish, there is always something of interest occurring at the waterside.

Just picture the rippling of the stream as it flows on its journey to the sea. To laze upon the bank, awaiting for the "rise" to take place, listening to the birdsong which, on a summer's morning or evening, can make one's mind drift into a separate world.

The sandpiper can suddenly appear, and he in turn becomes very agitated in his behaviour if you are in the vicinity of the nest, giving forth that high shrill piping note to show he resents your intrusion. They always appeared in early spring to the North Tyne, and their nests were nearly always in a tuft of grass, or rushes on some sandy bank. Rather a sensible bird as regards his selection of site, as it was always well above high flood mark. To find this nest it is best to watch the parent birds, as they always give you an insight as to its position by their increasing agitation as you draw near the nest. When the young fledglings hatch out they can immediately run away if disturbed, very similar to the young of the plover family.

Another common bird in these parts is the dipper. The bird always facinates me, and many a time I have put down my rod to watch his antics. They could truly learn the poacher how to catch fish, and always they sit upon some favourite stone which stands above the water line, it in turn being covered with their droppings. Their habit of bobbing up and down would truly fit in with the Jive and Pop music age, as to watch them reminds me of my own teenage family, who seem to bob up and down in similar rhythm when dancing in these modern days. One moment the dipper can be standing upon his favourite stone, and next he can plop into the water in a flash. I have watched him do some very fine underwater swimming, to appear upon the surface holding a nice juicy minnow in his beak.

These birds catch mainly minnows or small fry and could not be classed as a serious menace to the fishing potentialities of the river, though too many of them about, could lessen the food supply of the fish. They nest mainly under waterfalls and bridges, the nest is constructed mainly of moss, and bracken, and is similar to that of the wren, though much larger.

The oyster-catcher, or "Sailor Bird" as he is sometimes called, due to his black and white plumage with brilliant orange beak, also frequented this area, preferring the gravel beds in the reaches between Mounces Hall and Bellingham. The nest, if nest is the right word for it, is a shallow scraping in the gravel in which the eggs are laid, very similar in shape and colour to the pebbles in the vicinity. It is very hard to find this nest, and the bird is very apt to disregard the dangers of flood waters, as I have seen many of their nests washed away.

The grey wagtail is the most common of this group; next in line is the pied variety; the yellow wagtail was comparatively rare.

The pied variety seems to prefer building its nest in old walls and buildings, and seems to like being near human habitation. They often appear upon the garden lawns, and are mainly seen upon the water side in May, when the hatches of mayfly are upon the water.

The other two species preferred to keep to the river-side, their nests mainly built under any overhanging bank, or rock. They are rather interesting to watch as they flutter up in the air to catch the passing fly.

Goosanders regularly visited the Tyne river and its tributaries, and even in the early period of the Border Forests, they were known to nest in the trunk of an old hollow alder which grew upon the banks of the Kielder Burn. Regularly the parent birds raised their family with little or no interference, as the area was sparsely populated.

They raised four or sometimes six young each year, and could be seen backing down-stream all together in the autumn, the parent birds looking so proud of themselves as if saying to each and everyone: "Mission accomplished!"

The main breed of duck upon the rivers were the mallard; their nests were to be found in the reeds at the side of the river. Teal and widgeon were not so plentiful but could be seen occasionally upon the small lakes and ponds which they seem to prefer.

I can well remember taking a walk up the Chirdon Burn, to the region of Hopehouse, a flourishing hill farm in the early 1940's, and seeing for the first time the Seven Linns, a series of waterfalls which in flood-water were, and still are, a beautiful sight.

Remote was a word which hardly described these falls, and as I sat watching the water cascading down, I noticed a black bird with what I then imagined was a white collar. Upon returning down stream I met a neighbouring shepherd, and I remarked how unusual it was to see a blackbird in such a remote place, wearing a white collar as if he had joined the ministry. I admit he looked at me with an air of disdain, and said, "Laddie, that's no blackbird, I dinna ken what its name is, but its a kind o' its ain".

At this time I had purchased a pair of small binoculars (a Forester's salary was comparatively smaller in those days), and time and again I visited the same area, very often meeting up with this bird, which I had come to know as the ring ousel. This bird is extremely shy, and tries to scurry away unnoticed.

I was to see quite a few of these birds in the future years, but my first glimpse of the ring ousel always seemed to be the most thrilling.

One bird which I felt sure I would see in the Tyne regions of the Forest proved to be absent, and I have not seen one in this area, that is the kingfisher.

I wonder why? I have seen this bird upon most rivers but he certainly is not in the upper reaches of the North Tyne, beyond Bellingham.

Herons were frequently seen upon all types of waters, standing like sentinels in the shallows, to all-of-a-sudden dart their head under water to bring up a fish. I have read that a certain oily secretion from their legs attracts the fish to them. This I feel is the case, because if you stand still in the water near a shoal of minnows, they will certainly come nibbling at one's toes. On the other hand it may be because of the slight disturbance to the gravel, thereby stirring up some under water feed.

Occasionally you would see a cormorant in the Tarset area, but in those days that I am writing of, any such bird would be shot on sight, as the Tyne was a noted salmon and sea trout river, apart from also being an exceptionally good trout fishing river.

The cormorant can devour an enormous amount of fish in a very short time, and I have seen one of these birds with a trout weighing a pound, half-way down its gullet when the bird was shot.

Alas! Pollution was to put an end to the migratory fish ascending the Tyne in any numbers. It is very interesting to know that the Chinese use the cormorant to catch fish for them. This is achieved by placing a metal ring around the bird's throat, so that it cannot swallow the fish. Cormorants are trained to retrieve the fish to their trainer.

One must visit the Farne Islands to get a good view of these birds, and any other sea birds for that matter. This is a bird sanctuary off the north-east coast, and to get to the islands you must go to the picturesque little fishing port called Seahouses, where boat trips to the islands are catered for. For the bird lover, this is a trip worth while, if at any time you should be in the Border area.

In the evenings during the summer months, it is a grand sight to see the swallows, sand martins, and that flying mammal the bat, flying backwards and forwards after the flies that abound above the waters at this time of day. The bat has his own radar system by which he can locate his catch, and many a time have I hooked this creature, when drying my fly in the air prior to casting. Swallows will also take the artificial fly, so anglers beware, as they are very difficult to unhook without losing a lot of tackle, and must cause pain to those involved, not least the nature lover.

The dabchick, or little grebe, was very rare in the rivers, but was mentioned as being upon the Catcleugh Reservoir by a naturalist of some repute, named Robert Craigs, who resided at Byrness in the Rede valley. I was unfortunate in that I never had the privilege of meeting him, as I moved to the house next door a year after his death, but read many of his notes upon the birds of the Rede valley.

The waterhen could be seen upon the rivers, especially where rushes and bushes fringed the waters edge; but they prefer lakes, and ponds, as do the coots.

At this time I had read of the pied flycatcher, a visitor to these islands of ours, but had never seen one in this area of the Border, but therein lies another story which will be unfolded in due course.

This bird loves to be near rivers and streams, and also prefers hardwood trees, to conifers, this may have accounted for its absence, as there were very few hardwood trees in this locality at this period.

In fact I believe that it was the scanty cover of trees up the valley at this time, that prevented the migratory birds from getting up to the Forest area, as this left them open to attack from predatory birds, in trying to make their passage up the valley.

I must mention one very interesting place I was told to visit, and at the same time I was warned not to venture too near the water's edge for my own safety, as many a horse and sheep had disappeared below the slimy peat which surrounded this moorland lough.

Only the local inhabitants who knew the area well could pick out the safer ground to walk upon.

It stood upon the hilltop three miles south-east of the Bower, and was upon Pundershaw Farm, which had been newly acquired by the Forestry Commission, and was due to be planted in the early forties. This lough was known as Cairnglastenhope Lough to the locals, but its correct name as shown upon the map was Blackaburn Lough.

It was upon an early morning in the beginning of April, that I set off to see this lough. It was certainly the most lonely and desolate looking lough I had seen for a long time, and gave one the feeling that down you would go at one false step, into the quagmire that surrounded its shores.

The day was very cold, and showers of sleet were blowing into the side of my face, so that I was glad to wrap my scarf around my head for protection against the cold. Even in April we can experience cold weather and snow in these border areas. I stamped my feet upon the ground to keep warm, and the ground all about me shook just like a newly-set jelly.

I could quite understand why I was warned not to penetrate too near the waters edge, and made sure I took the advice given me.

My main reason for visiting the lough was to see the black-headed gulls which nested in their hundreds in the rushy areas at the north end of the lough, and were wheeling overhead making a most awful screeching noise, as if quarreling among themselves. There, in the rushes, their nests lay thick upon the ground, mainly at the northern end of the lough.

I gave up any idea of getting near the nests, and had visions that I too might join the horses and sheep that had disappeared below the slimy mass. Many of the local people visited this lough to gather the eggs of the gulls, which if obtained freshly laid were excellent for baking purposes, but had a very fishy taste if eaten boiled.

They used to have long-handled nets to scoop the eggs up out of the nests, presumably pickling them afterwards, for use later on. Even so the gulls kept coming every year in great numbers.

It was upon this lough that I saw coots, waterhens, mallard, teal, widgeon, shoveller ducks, and wild geese upon the waters. The geese alight mainly in rough windy weather, mainly for a breather before carrying on with their journey.

Greater black-backed gulls naturally visited the lough, mainly attracted by the thought of a good meal of eggs, or young black-headed gulls. Of course I did not see all these birds upon the same day. This never occurs, but I made many visits until quite suddenly I was informed that I was to take charge of Hamsterley Forest, in the county of Durham.

I said goodbye to all my friends, with a certain amount of regret, as the North Tyne people are always so very homely, and go out of their way to make a stranger feel at home. My wife did not regret moving, as she was going back to the area of her birth.

As I took my last look around I thought this is goodbye for ever, but fate was to lead me back.

5. RETURN TO THE BORDER FOREST

I would like to deviate away from the Border area for a brief spell, as at Hamsterley Forest I found it totally different, in that the main bird population was of the insectivorous varieties.

Meeting a local naturalist one day, brought me in contact for the first time with a bird I had not seen before. He informed me it was rare in those regions. So we set off one sunny morning towards Barnard Castle. After creeping up a very pretty little glade, down which ran a stream overgrown with oak, and beech, we halted, and he pointed out the area to watch.

The sun had disappeared behind a cloud for a brief spell, and suddenly burst forth once more in all its glory, it was then I saw it, a white front, black back, with a white bar down its wing, looking very much like a man in evening dress.

It was the male pied flycatcher, whose habit is to perch upon a certain branch, then flit into the air to catch a fly, then alight back upon the same branch.

The female was not far off, though she, poor dear, was not so striking to look at, being a browny colour upon the back, but very delicate looking for all that. It is best to watch for this bird upon a sunny day, as he does not seem to like showing himself in dull weather.

So I was introduced to the pied flycatchers, and thought that there were some spots in the Hamsterley Forest with similar habitats.

This started off "Operation Nest Box", and I erected twelve boxes, seven of which contained pied flycatchers the following year. All boxes were erected near the water side, about six feet above the bank. In all 200 boxes were erected, and to this day I am pleased to say they are still tended carefully, though some of course will have been renewed, or increased in number.

Another incident of interest that occurred at this Forest, took place one winter's night. While my wife and I were sitting peacefully in the lounge, I heard a noise upstairs. I crept gingerly up towards the bedroom, with thoughts of a break in, so torch in hand, and poker in the other I opened the door, and shone the light around the room, until the beam came to rest upon the head of the bed. There two big green eyes shone back at me, and I began to think of all my ancestors who had passed on, who may have come back to visit me, but it turned out to be a young tawny owl sitting upon the head of the bed, having entered out of the cold, through the slightly open window.

My stay at Hamsterley lasted for seven years, and once more in 1948 I was on the move. Back once more to the Border Forest, to become Forester in charge of Whickhope Beat, much to the sorrow of my wife, who had to say good-bye to all her relatives once more, and remain faithful to her wandering husband.

It is easy to say seven years have passed, but a lot of changes can take place in this space of time, as was indeed the case. Many pre-thicket stage plantations were now ready for brashing, that is the lower branches had died back, and were ready to be sawn off up to a height of six feet, so as to allow access into the plantations prior to thinning. This in turn allowed the bird population to penetrate more easily into the plantations, so that I visualised a big change had taken place since I was last in these parts. This was the case, and one could definitely say the situation at this time was the halfway mark.

There were still large tracts of land in the high reaches of the Forest still to plant, and larger planting programmes were taking place now that the war had ended, which meant that many areas were covered by plantations of a very young age. These provided more rough vegetation, which again meant more voles etc., and it was not surprising that the short-eared owl had taken over, and was the predominant bird of prey upon the moors at this time. The short-eared owl is unique in that it can regulate the size of family to rear, according to the food supply available. This meant a rapid increase in numbers, and I have seen as many as fifteen of these birds hunting during the daytime upon the Hopehouse Moors.

I can well remember ringing a nest full of young owlets, and it was quite amusing to see that they were all of varying sizes, the elder being coated in a very thick downy coat, while the youngest owlet was as bald as a coot, and less than half the size of his elder brother, or sister.

I was grateful to have the help of a keeper to ring these birds, as the parent birds were swooping down nearly to head height, and then soaring up into the air making a clapping noise with their wings, as if to try and frighten us away, and I am sure had I been alone they would have struck at my head.

Kestrels were also on the increase, as again the voles and mice were the attraction. Their marvellous ability to remain stationary in the air, while keeping a watchful eye upon the ground for their prey, would put any helicopter to shame. I always look upon this bird as being the dragonfly of the bird world.

The merlins were still in evidence, but not as numerous as in the 1930's, and like the peregrine falcon, which was now a very rare sight, they kept to the higher crags where planting had not yet taken place. One incident which took place in 1950, will always remain in my memory, as I personally witnessed the visit of a golden eagle to the crags in the Cranecleugh area of Whickhope Beat. This bird had decided to make a temporary home upon the Christianbury Crags. I happened to see this bird soaring in the sky, and thought it to be a buzzard afar off, but upon its approach I could see that it was much too large and was definitely a golden eagle. Reports began to come in of a high death rate among the lambs in this area, and the farmer was beginning to become alarmed at the presence of a large bird he had seen, this I knew was the eagle. So I went one evening and lay down in the ling, and sure enough the bird appeared not far off. It swooped down and picked up a newly born lamb in its talons, soared up into the air, and when it had gained a good height dropped the lamb, which was naturally killed by the fall. So I just waited and watched when down came the eagle, and again took the lamb in its talons, it was quite a while before it was airborne, and reminded me of an aeroplane taking off. It then made off in the direction of the crags. It stayed for three weeks in this vicinity, then disappeared. Whether it was shot, or just moved on of its own accord, I could never find out, but who could suffer the loss of so many lambs? I was glad it had moved on before it suffered a worse fate, that is if it had not already done so.

To me it seemed to have a wing-span of six feet, and was definitely about three feet long. I may never see this bird again in the Forest area, so thought it worthy of space, in case at some future date one may return.

Other birds which now frequented the higher elevations of the Forest, were the redwings, or northern thrush, and I can well remember one autumn day while out with my District Officer upon inspection, seeing a huge flock of birds alight about a quarter of a mile away. It entered our heads that it may be a flock of redwings, as autumn is their time of arrival, so we crept over drains and bog until we came within real seeing distance of them, and imagine our surprise when they turned out to be a flock of yearling starlings, which do not change to their adult colour until the following year.

Another unusual incident took place in 1949 when, while walking up the Whickhope Burn, the keeper of that area came upon an unusual bird lying exhausted by the side of the Burn. I had seen this bird many times before upon the Farne Islands, and recognised it as the razorbill, which is a sea bird which likes to be in the vicinity of the habitat of the guillemots, and is very similar in appearance, except that it has an unusual beak which is very thick, and similar in formation to the beak of the puffin, but longer. How this bird came to be in this area remained a mystery, as it was entirely out of its environment, but after a rest it regained enough strength to fly away. I often wondered what became of it, and came to the conclusion that it was making for the Solway Firth, but heavy winds must have forced it down at this spot through exhaustion.

Many birds I have seen in the early days had even at this time begun to disappear from the scene, and had dwindled down to a much lower population. These birds were the golden plover, which now had a very restricted area to move around in, and was to be seen only upon the few remaining unplanted areas of the uplands. The lapwings were now solely to be seen in the lowlands of the valley bordering the North Tyne River, and kept strictly to the agricultural areas. Gone were the huge flocks of black game, and only small groups of up to fifteen to twenty birds still hung on, upon certain lekking grounds.

There were still a fair number of red grouse about, as many of the areas planted were in the younger stages, and due to drainage, had dried out the land, which seemed to suit them at this time. The sudden lack of sheep tended to allow the ling heather to once more gain a hold. Of course grouse love the areas where heather abounds, but one great drawback was now quite evident, namely that the systematic burning of the heather could not take place in the planted areas, and to have good grouse moors the sportsman or keeper knows that strip burning has to be carefully carried out, because if the heather regains maturity it becomes too high in growth and hard in texture for the birds to feed upon. Therefore it is best to have heather of various ages upon the grouse moor. The pickings upon the young heather is highly sought after by the grouse, whilst one must be careful to leave areas of older heather for the grouse to nest in, and as a place where young birds can have a safe refuge from their many predators.

One story I must relate, which occurred to a gentleman not too well informed about the methods of tending the grouse population. Previous to his travelling through one of these areas, the keeper had been around and scattered grit upon certain areas. The grit was white in colour, and from a distance looked very much like snow.

He arrived back down from the higher reaches in the middle of our British summer time, and swore, much to our amusement, that it had been snowing upon the hill tops. He did not know that the grit was placed at different points for the benefit of the grouse, as most birds have to have grit of some kind to allow them to digest their food.

Alas, curlews were very few and far between and gone was the time when they could be seen upon any portion of the hillside. The meadows in the valley were the only domain left to them, as most of the moors left unplanted were heather moors, and with the exception of such areas as Clintburn, and Hopehouse moors, few were to be seen.

The days of the curlew being upon the open moors were almost over. So also had the raven been affected in that many of its rough craggy areas had now become obscured by trees and they were forced to seek other havens. Some areas are still occupied by these birds but it would be unfair to disclose the only remaining nesting places left to them, as some keepers think that they do a lot of harm to their rearing of birds upon the moor, in that they take the eggs from the game birds' nests.

This may be the case but I feel that a certain control level needs to be kept, and this in my opinion is a keeper's duty to keep the balance of vermin at its correct level. But heaven forbid that all birds and animals should be wantonly destroyed, for in many cases they do a lot of good as well as having their adverse effect upon other animals and birds of the wild.

The sparrow hawk is fast losing ground, and is not seen so often as in earlier years. One very striking thing is the complete absence of the jay in the Border Forest areas, also the magpie is to be seen no further up the Tyne valley than Tarset. Not that their presence in any large numbers would be desirable, as like the jay, they need carefully controlling, if smaller birds are to survive.

So the picture is changing, and even the ring ousel is having difficulty in holding its ground, as from 1945 onwards, tractors and ploughs appeared upon the scene to prepare the ground for planting, and speed up the growth of the Border Forest.

AWARDS OF THE BALFOUR-BROWNE DEER TROPHIES FOR 1968 AND 1969

The 1968 trophy was presented to Mr. Springthorpe by Mr. Kenneth Whitehead in the Deer Museum at Cannock Chase on Thursday, 16th January, 1969. Kenneth Whitehead, the well-known stalker, writer and authority on deer, is a Vice-president of the British Deer Society.

The Trophy, which is a silver replica of the bronze *The Challenge* by Vincent Balfour-Browne, the famous Scottish deer artist and sculptor, was presented to the Forestry Commission by Miss Balfour-Browne, in memory of her late brother, for annual award to a person who has done exceptional work in promoting the proper conservation and control of deer.

The award on this occasion came to England for the first time. Previous recipients have been Kenn MacArthur of Dumfries in 1964, then K. W. Clark and W. N. Gibson, both of the Forestry Commission's South Scotland Conservancy, and last year Finlay Macrae, one of the Commission's District Officers in North Scotland Conservancy.

Gerald Springthorpe started work with the Commission as a tractor driver at Cannock Chase in April 1953, after completing his service in the Army. His great interest in wildlife soon led to him being given additional duties as a warrener, and his performance and keenness in this field were such that when the Forestry Commission introduced selective control of deer in 1956, he was chosen as the first of their employees to be trained in this technique. Having been trained himself he then took, and has continued to take, a leading part in the training of others. The Deer Museum was started for this purpose and all the exhibits in it have been collected and set up by him. Some were displayed in the House of Commons library during the debates which led to the passing of the Deer Act in 1963. As soon as selective control had been effectively established among the deer on the Chase, his duties were further enlarged and he was given responsibility for the general supervision of deer control throughout all the Commission's woods and forests in the Midlands. In 1967 he was promoted to the newly established grade of Head Stalker.

The work of a Head Stalker is extremely varied and goes far beyond the mere shooting of surplus deer and the prevention of damage to trees and crops. It involves good relations and co-operation with neighbours, promoting the interest and support of the public in the proper conservation of deer, preventing poaching, meeting requests for expert assistance and advice of all kinds (including recently the problem of keeping deer off the M1 motorway where it passes through Sherwood Forest), helping with research, putting on exhibits at Agricultural Shows and the Game Fair and providing facilities for people to watch and photograph deer, and for sportsmen to stalk them under supervision. During the winter of 1967/8, very serious and difficult problems arose from the outbreak of foot and mouth disease in the Midlands. There has been a growing concern in recent years with the number of deer being killed on the roads of the Chase by motor vehicles and the general disturbance of the deer by increasing pressure of visitors.

Gerald Springthorpe is married with two young children. In addition to his absorbing interest in all aspects of natural history his hobbies are carving deer antlers and making articles from deer skins. He is also a keen photographer.

The Forestry Commission started planting on Cannock Chase in 1921 and the forest now extends to about 6½ thousand acres (over ten square miles). Fallow deer have been wild in the area since Norman times. The shelter provided by the new plantations allowed their numbers to increase and control became necessary to reduce damage.

Cannock was the first Commission forest to introduce selective control with a rifle. The object is to keep numbers within the limits of what the ground can support in winter, and in doing so, to establish a well balanced herd in which the different sexes and age classes are maintained in the correct proportions, and from which injured and/or sick animals are humanely eliminated.

This was also the first forest at which a system of stalking by daily permits was introduced. It was at a meeting at Cannock of the Deer Group of the Mammal Society that the decision was taken to form the British Deer Society. The first regional organisation of that Society—its Midland Branch—was also inaugurated at Cannock and uses the Deer Museum as its regular meeting place.

Mr. Peter F. Garthwaite, until his recent retirement the Forestry Commission's Conservator in charge of Forest Management, was awarded the Balfour-Browne Deer Trophy for 1969 in recognition of his achievements over many years in the proper management and conservation of deer in Great Britain. The Commission's reputation for its enlightened approach to control and protection measures for wildlife is largely due to Peter Garthwaite's efforts in this post and it is particularly fitting that he should be awarded the Trophy in European Conservation Year.

The presentation of the Trophy to Mr. Garthwaite was made by The Earl of Lonsdale—first President of the British Deer Society—at the Society's Symposium held in the Edward Lewis Theatre in the Middlesex Hospital Medical School, London, on February 28th, 1970.

In selecting the winner of the Trophy the Forestry Commission is assisted by the Chairman of the British Deer Society and the Chairman of the Scottish Committee of the British Deer Society. This Selection Committee of three announced that in choosing Mr. Garthwaite they had no doubts that he richly deserved this honour, not only for promoting the interests of the proper management of deer in the Commission's forests, but also for his valuable contribution to the work which had led to the passing of the Deer Act 1963. This Act prescribes close seasons, prohibits shooting after dark or snaring deer, and defines the unsuitable weapons which may not be used. It became known as "The Deer's Charter" because it was designed to end cruel and indiscriminate shooting in England and Wales, and its passing was a landmark in humane control. It was also in 1963 that Mr. Garthwaite was given special responsibilities for wildlife management in the Commission, and in 1965 he became Conservator in charge of the Commission's Forest Management Division.

Mr. Garthwaite's interest in forest wildlife—from insects to deer—goes back many years for, during his time with the Burma Forest Service from 1931 to 1948, he served for several years as an entomologist and also had special responsibilities for game management. At this time he collaborated with B. E. Smithies on a well-known reference book *Birds of Burma*.

During the War Mr. Garthwaite served throughout with the Royal Engineers in India and Burma and attained the rank of Lieutenant-Colonel. On Burma's declaration of independence in 1948 he joined the Forestry Commission and served in its North East England Conservancy until 1954; thereafter he filled many important posts with distinction up to the time of his retirement last month. Yorkshire-born Peter Garthwaite has only nominally 'retired' to his home near Godalming, as he has now commenced yet another career as an independent consultant in forestry and wildlife conservation.

ACCESS AND SPORT

By P. F. GARTHWAITE
Conservator, Headquarters

Paper presented to the Society of Foresters Jubilee Conference at Reading University, 4th January, 1969

The Present

Powers

The Countryside Acts of 1967 (Scotland) and 1968 (England and Wales) give the Forestry Commission power to provide for tourist, recreational, and sporting facilities not only in the seven Forest Parks and the New Forest, but on any land placed at their disposal. The Acts also give powers for the Commission to acquire land for these purposes. Legality has thus been given to developments that have been going on for some years, but recently with gathering momentum under the general pressures on the countryside that gave rise to the Acts.

Constraints

The powers are permissive, not mandatory, and are subject to various constraints. The most important of these is the financial one; money for such development comes from the Forestry Fund allocated by the Treasury; moreover development on Forestry Commission land is not eligible for the 75% grant available to local authorities and private individuals for approved schemes under the Countryside Acts.

Further constraints may exist under the terms of the conveyance, feu charter, or lease under which the land is held; others are accepted in reservations contracted at time of acquisition, in the lease of sporting rights, or by reason of the status of the land, e.g. as a nature reserve or site of special scientific importance.

A further point which must be considered is the legal liability of the Commission for injury, loss or damage to those to whom access is permitted for recreation or sport.

Despite this rather formidable list of constraints it has been possible even before the Countryside Acts made it "legitimate", for the Commission to provide a very wide range of facilities. In the Forest Parks access to beautiful country, forested and open, has been allowed since the first Park was designated in 1935. But the main developments have been in the past five years. These have however been sporadic, in response to local enthusiasm and initiative, and local pressures, rather than an ordered progression to a master plan.

Facilities

There are now ten camp sites equipped with the essentials, with a capacity of 8,000 persons, a number of unequipped sites for scouts, guides, and adventure groups, and the unenclosed areas in the New Forest, where camping is permitted.

200 picnic places have been made, some equipped with rough tables and benches, and more than 5 million people are estimated to have used these and sites of their own choosing during day visits to forests last year.

The encouragement of access has led to the desire of many visitors to be guided and instructed in this new environment; at the same time the forest staff felt the need to canalise their activities for their own and the forests' safety. Thus arose signposted routes, guided forest walks and trails, and nature trails, many of them supported by descriptive leaflets and maps. There are now 65 such forest walks and trails, totalling 190 miles, plus a further 100 miles of way-marked routes.

The interest generated by these trails stimulated the formation of a number of forest museums or wildlife centres where the forest scene can be presented indoors. The centre at Grizedale attracted 15,000 visitors last year, paying, through an "honesty box", 1/- and 6d. entry fee for adults and children. Others have been established at Kielder and Cannock Chase.

Widespread provision has been made for horse-riding and pony trekking, controlled by permit; for training of the adventure type, and also military training of a non-destructive nature. Wildlife photography is becoming increasingly popular, and at some forests special hides and high seats have been built for which a charge is made. More multiple high seats, on the Grizedale "tree-tops" pattern, are being erected.

It has not been the practice to open Commission roads to private motor cars. The only "scenic road" is the 13-mile Forest Drive through Allerston Forest in Yorkshire, linking the Vale of Pickering with the Derwent valley over forest roads. This is very popular.

Sport

The traditional sports of hunting, shooting and fishing have occupied a casual place in the Commission's management in the past. They have been neither deliberately obstructed nor actively encouraged. Foxhunting does however relieve the Forestry Commission of an increasingly onerous responsibility for controlling foxes in the interests of our farming neighbours. In the upland areas where hunts do not operate the cost to the Commission of fox control is of the order of £70,000 per year.

In the past few years there has been a gradual move towards a more flexible approach in procedures for letting and reletting shooting and fishing rights. Woodland deer stalking by daily permit has been developed to enable 300–400 people each year to have the opportunity of a stalk. Co-operation is being sought, from the Wildfowlers Association of Great Britain and Ireland, and other organisations, to improve habitats for game. There is currently a joint research project with Eley Game Advisory Station to investigate the possibilities of introducing and holding pheasants in one of the solid spruce forests in the Borders. The problems of shooting in such an environment, and the modifications in normal forest management patterns to make this worthwhile, are to be investigated.

Other sports and pastimes not involving wildlife which are sporadically or periodically practiced are motor rallying, orienteering, archery, swimming and canoeing.

Damage

The affect on the forest of access on this increasing scale has so far been small. The main impact has been on the administration—in providing the facilities described above, and being available at week-ends, throughout the holiday period, to guide and help visitors. The possibility of extensive fire damage was feared, but so far these fears have been groundless. In fact those regularly using the forest are becoming an insurance against damage by others.

The Next Ten Years

Anyone who sees the latest film in "Our National Heritage" series called "People + Leisure = ?" will not need any further evidence to convince him of the vital urgency of providing more facilities for access to the countryside as a whole, and of planning to avoid the destruction of the countryside in the process. All the trends are in the same direction; more population, more cars, longer schooling, earlier retirement, longer expectation of life, higher earnings, shorter working hours, and quicker means of access to the countryside to spend the leisure thus generated.

As farming becomes more intensive, coasts more crowded, and waterways more congested, pressure on the lowland woods and on the upland forests will increase. Planners, from preliminary studies, see many advantages in this, owing to the absorptive ability and concealing capacity of planted areas.

To meet this advancing avalanche of demand, some rapid positive planning must be carried out in the next few years. Decisions will have to be made on the strategy of development; where resources should be deployed to have the greatest impact with least harm to the forest and other interests, co-ordination of plans with those of local authorities; design and layout of structures, administration and control of camp sites and the best means of obtaining payment for all facilities, further development of the less formal features in the recreational repertoire—picnic sites, forest walks and trails. All of this planning needs screening to avoid the clashing of incompatible activities, which implies a degree of zoning.

It is in this context in particular that shooting will need to be looked at, but I think it is only at the extremes that it will come into conflict with access. It is obviously not possible to reconcile a high degree of encouraged access with an intensive pheasant shoot for which a rent of £1–£2 per acre is accepted. But there are many intermediate conditions where *some* shooting, perhaps on a daily permit system, can take place without conflicting with *some* access, e.g. a defined nature trail opened for a specified period.

Sport such as woodland deer stalking and duck flighting on well-sited ponds, which take place in the dawn or dusk periods and can be supervised, are still possible in forests subject to very heavy daytime access. A group of the standing committee of "The Countryside in 1970" conference is currently examining the problem of reconciling sport with access, and I have no doubt that, such is the demand for both, a *modus operandi* will evolve which will establish a new pattern or series of patterns, for the continued enjoyment of sport even in those forests where some access is accepted.

With fishing there is little conflict. The current trend is to let waters to clubs or associations so that the widest possible spread is given to those enjoying this popular pastime.

It seems inevitable that the Commission's present practice of not allowing private motoring inside forests will have to be relaxed in the next decade. The example of the scenic routes which have been opened in some of the forests in Northern Ireland shows that this can be done without detriment to the forest or other users, and with a large gain in revenue. There is a car-bound public very willing to pay for such facilities. The Commission now has over 9,000 miles of forest roads penetrating some of the most beautiful scenery in the British Isles, much of it completely inaccessible to all but shepherds or stalkers till the trees were planted and the roads made. Roads are a resource which have been a high cost to forestry, but which, sensibly exploited, can bring a return from the scenery they open up to the "motoring-for-pleasure" public.

Finally it is my personal hope that the Commission, in developing its estate for recreation as well as timber production, will recognise two things. First the need for diversity of treatment, secondly the needs of the individual as well as the mass.

People come to our forests in the first place because they are permitted to do so; they repeat their visit because they find a different atmosphere and environment in the woods and a new range of interests. Let us also maintain this diversity internally, and try to match the facilities we provide to the character of the area, and standardise only on quality.

And let us keep some forests without any public facilities—no car parks, no picnic sites, camp sites, lay-bys or lavatories, where seekers after solitude, be they nearby residents or visitors, can find refreshment of mind. Though such people may be a minority, they are a vital component of our society.

MANAGEMENT FOR CONSERVATION

By P. F. GARTHWAITE

Conservator, Headquarters

Paper presented to the Forestry Section of the British Association, Exeter September, 1969

The science of forestry is changing and developing so rapidly that in discussing the practical measures that can be taken to conserve wildlife in forests, it is necessary to review some of the changes that have occurred in the techniques of forest management in the past few years. This paper will therefore cover some ground very familiar to many foresters, while pointing out some of the principles of conservation which will be equally familiar to conservationists. It is however only by a complete synthesis of the two sciences that *continuing* success will be achieved in face of economic and materialistic pressures.

The Forest Estate

There are today in Great Britain three million acres of woodland managed primarily for timber production, about half of which are the "new" forests planted on rough grazings in the uplands in the past fifty years on land that has been bare of trees for 400–500 years or even longer. These new forests are expanding at the rate of 60,000 acres per year.

One and a half million acres of old woodland areas are under management for timber, involving a gradual change in the character of many of them.

In addition to these three million acres of "forestry", there are one and a half million acres of woodlands managed for other purposes—game coverts, amenity woods, shelter for livestock, nature reserves, public open spaces—or with no specific management. They are mainly small woods and copses, well distributed throughout the agricultural lowlands and in the steep valleys of the uplands. They are composed mainly of deciduous species and owing to their small size and poor shape many of them are unsuited for the type of management and techniques necessary for the success of a purely forestry enterprise.

The future of these small woods, many of them on land of high fertility, and capable of growing quality hardwoods as well as sustaining a rich woodland flora and fauna, is a matter of great concern not only for wildlife but also for the landscape to which they contribute so greatly.

Special Areas and Rarities

The woodlands of Great Britain contain many special habitats for plants, insects, mammals and birds which are of such national importance that they are protected by designation as National Nature Reserves or Sites of Special Scientific Importance. In addition local woodland Nature Reserves are owned and managed by such bodies as the Royal Society for Protection of Birds, County Naturalists Trusts, and the National Trust. Where such sites occur on Forestry Commission land they are given the status of a Nature Reserve and managed by agreement with the Nature Conservancy, County Trust or other body. Under the Countryside Act 1968 similar agreements can now be made in respect of woodland in private ownership being worked to an approved forestry plan under the Dedication Scheme. There is also consultation via the Planning Authority where there is a declared conservation interest in new areas acquired by the Forestry Commission or, if in private ownership, proposed for working to an Approved Plan.

Thus woodland sites of known scientific importance, and similar sites on bare ground proposed for afforestation are adequately cared for under statutory procedures. Although they include some substantial areas, such as the 7,000 acres of Ancient and Ornamental Woods of the New Forest and 2,000 acres of the Caledonian Pinewoods of Glen Affric and the Cairngorms, in total they amount to a very small proportion of the three million acres under timber management. I want now to explore the ways in which this great area of forest can contribute to the conservation of wildlife as well as fulfilling its primary function. It is not only the rarities that need conservation; the maintenance, creation, and management of habitats to increase the distribution and numbers of a wide variety of common species is an equally important objective. Moreover conservation of wildlife needs to be tackled on a broad front, with *every* forest incorporating in its management the principles of conservation, so that they are universally applied, not just reserved for the Reserves.

Different types of forestry

The distinction between *afforestation*, mainly of bare moorland, but including such special areas as sand-dunes and industrial waste; and *replanting* of former woodland, mainly deciduous, is of significance in mangement for conservation.

In both cases, to comply with economic necessity the main species planted will be conifers. But whereas in the former, the trees will form a richer habitat than the annually burnt-over rough grazings of the previous regime, in the latter the native hardwoods are replaced by species supporting a less luxuriant complex of wildlife.

In afforestation, measures can be taken to improve the habitat still further; in restocking old woodland planning is directed to maintain as much of the previous habitat as is compatible with economic working.

Afforestation

Although much of the upland afforestation is carried out on land that is devoid of tree growth, there are often relics of native species that have survived the moor burning regime of pastoral agriculture, in ghylls and ravines and wet flushes. These should always be retained in the forest scheme and extended where possible to run up into the main planting.

Enclosure from grazing, and the drainage of upland peats and the shelter of the young trees bring a great increase in plant, insect and animal life, which may last for ten to twelve years, until the herb and shrub layer have been suppressed. But the forest will be permanently enriched if some of the worst bogs, which modern machinery can now drain, but which will grow trees of only very low potential, are left to act as reservoirs, within the forest, of typical bog plants and insects. Similarly where it was formerly the practice to plant even the most uninviting rocky knolls and outcrops, rising costs and poor results from such areas now persuade the forester to leave them unplanted to remain as islands of the former habitat within the growing forest. Future extraction difficulties also make it unwise to plant to the bottom of steep ravines, thus leaving the stream to form its own habitat without excessive shade from planted trees.

As the forest forms thicket, the needs of fire protection demand a constant and well distributed supply of water. This can best be achieved by a series of small dams on perennial streams, creating little ponds and pools. Where conditions do not permit this, small water holes are cheaply made by explosives. These soon become the haunt of water-dependent species of plants, insects and animals, which can be actively encouraged in various ways.

As the forest develops into the pole and thinning stage, the natural diversity of different rates of growth of different species and varying sites is increased by patches of windblow. The light let in by the thinning on the forest floor permits the regeneration of a variety of species including trees from seed brought by birds.

Thus in the pinewoods in Allerston Forest in the North Yorkshire Moors a rich understorey of oak, birch, rowan, thorn and other species has developed under the thinned stands.

These large new upland forests have provided conditions suitable for a great natural expansion of roe deer and also for species which were becoming rare such as the pine marten, polecat, wild cat among the mammals; and birds such as the siskin and redpoll and the crested tit. The botanist, the entomologist, the mycologist and indeed every student of natural history can find corresponding ecological events in these new forests which will more than balance the spread of trees onto the open moorland habitats.

This is especially so when these largely unplanned developments are supplemented by positive measures. In the Forestry Commission's plantations there are now many thousands of bird-nesting boxes, recorded and maintained by Natural History Societies and school groups. In co-operation with the Wildfowlers Association of Great Britain and Ireland, large areas of water have been created as wildfowl refuges and breeding areas. Thus at Grizedale Forest in the Lake District, the greylag goose has been re-established as a breeding species after 200 years.

The felling phase gives opportunities for altering the structure to favour wildlife. In the Forestry Commission the felling programme is now 10,000 acres per year; by the year 2000 it will have risen to about 50,000 acres each year. The size of felling coupes vary with the crop, the terrain, and the extraction techniques and equipment, but these holes in the canopy let in the sunlight, give diversity, and extra "edge" length, all of which favour wildlife. The aim of sustained forest management is to work towards a steady annual programme of felling and restocking in each forest or group of forests, so that there will always be a gradation of age classes. This gives a wide range of habitat even when the tree species are restricted by limiting site conditions.

Modern timber harvesting and extraction equipment often involves widening forest roads at the time of felling. The verges become colonised by native herbs and shrubs, as do temporary timber stacking sites along the road. Deliberate introductions of willow and birch on roadsides can be made to accelerate the creation of a favourable roadside habitat.

Thus these new forests which started so uniformly and which were seen with some dismay by naturalists, develop under normal forest management, with sensible intervention to favour wildlife, into habitats able to sustain a rich and varied flora and fauna.

Replanting Old Woodlands

In the old woodland areas the situation at the start is quite different. Most are in the more fertile lowlands and for the past 100 years or more have been growing broadleaved trees—oak, beech, ash—many with an understorey of hazel, hornbeam or chestnut, and providing good conditions for wildlife. The regrowth of scrub and mixed regeneration after wartime fellings of the timber trees maintained these conditions.

In the early 1950's when a start was made to restock these woods, a large number of broadleaves were used, either pure or in mixture with conifers. The Forestry Commission alone planted 30 million oak and 70 million beech between 1950 and 1965; and private owners continued to use these species in regenerating their woods. Gradually however rising costs and diminishing markets for existing timber of the principal hardwood species, particularly the smaller sizes, have restricted the use of broadleaves. Where they are now planted, they are widely spaced in a matrix of conifers to form the final crop trees only, in a stand that will be an evergreen/deciduous mixture for most of its life. In 1950 the Forestry Commission used four and a half million oak and six and a half million beech plants in its planting programme; in 1968 use of these species had dwindled to sixty thousand oak and half a million beech, and this is the sort of level that is likely to continue. Nevertheless the preliminary figures from the 1965 census of woodlands show that the total area under oak high forest in England still stands at about 350,000 acres, and has not materially diminished since the 1947 census.

After initial failure, particularly on heavy clay soils, with methods involving mechanical clearance of scrub in old woodland areas, a system was evolved of thinning out the hazel, birch or other regrowth and establishing the new crop under shelter of this. This preserved the site and gave frost protection. The overhead cover was gradually removed over ten to twelve years, and the poles were sold for turnery and stakes. The reduction of this market, coupled with rising costs of felling and extraction, has forced the forester to reconsider this technique. After various modifications involving the use of herbicides the latest development is to kill the scrub by chemical means in the summer before planting, so that it provides a gradually diminishing shelter of moribund stems for the new crop to grow through, without further intervention by the forester. The financial savings of this method are substantial. The effect on wildlife has yet to be assessed; it is certainly less drastic than mechanical clearance, and leaves much of the herb layer untouched; the dead stems of the scrub provide breeding sites for insects and some nesting sites for birds; the derelict appearance of leafless scrub may be the worst result. Much depends on the scale on which this method is used in any one locality.

It is clear however that chemical methods of control of plant species interfering with the growth of the tree crop at any stage will continue; it is in this context that wildlife conservation in old woodland areas must be viewed. The Forestry Commission has drawn up for its staff a code of practice setting out stringent precautions in the use of all chemicals, particularly when sprayed from the air. Special arrangements are in force in or near all Nature Reserves and other designated sites. Nevertheless the forester is now armed with a powerful weapon for changing the environment more rapidly and drastically than ever before. There is always a temptation to use such weapons because they are to hand, and to destroy more than is strictly necessary. Used sensibly, selectively, and minimally the forest habitat will not suffer—indeed herbicides are now so used in many nature reserves as a tool of management. It is the ill-directed and indiscriminate use of chemicals that is harmful.

The knowledge that herbicides will be used gives added urgency and importance to thoughtful planning for conservation in old woodland areas, especially as few broadleaves will be planted in the new crop. Groups or clumps of young or middle-aged oak can be left to grow on with the new crop without detriment to it; broadleaves that become established on the edges and corners of compartments can be left. In some places patches and brakes of scrub and rough grass can be retained. The wider spacing of planted stock now adopted for economic reasons on fertile old woodland sites—8 ft × 6 ft or the equivalent to give 800–900 plants per acre—allows a herb layer to develop between the rows of trees without harm. Some old dead trees can be left, and the cost of "tidying" the forest floor before planting is now so prohibitive that planting is done through the residual lop and top and brushwood of the previous crop. This preserves the soil and gives many special sites as it gradually weathers.

In the later stages from thicket to timber size the tree crops replanted in old woodland areas will only differ from those in the upland areas on a broad climatic basis. In general however the lowland forests are smaller in size, and although now being planted mainly to conifers, are so interspersed with existing broadleaved woods, belts and copses that on a regional basis the new conifer crops have had little effect on wildlife. Indeed the shelter provided by the young conifer plantations may help to maintain bird populations.

Providing therefore that sensible plans are made for conservation, and that modern techniques are used with discretion, I do not think that there will be any serious long term loss of wildlife in the old woodland areas now being regenerated to meet modern industrial needs of wood.

Forest Protection

So far in this paper I have dealt with the encouragement of wildlife in forests and woodlands. Some of the habitats so created will be colonised by species which damage the trees—rabbits, hares, deer, grey squirrels—or neighbours' interests—foxes, pigeons, carrion crows. The days have long passed when it was considered necessary to take action all the time against all individuals of all species that at any time damaged trees. The ecological approach to damage prevention and control of animals has now been adopted throughout the Forestry Commission. Trees and neighbours' interests must still be protected, but control is selective and minimal, and carried out only when and where damage occurs. This type of approach is now an economic necessity as much as it is desirable for wildlife conservation.

Its application needs a different type of man from some of the warreners and trappers of the past; a man with a broad training in ecology, and an ability to observe, record and understand animal behaviour. The Forestry Commission has never lacked skilled field naturalists among its staff at all levels and it has been possible to recruit from them a cadre of men responsible not only for protecting the trees from damage but for planning the conservation of wildlife in the context of efficient forest management. Their work is supported by an active research programme into better methods of preventing damage, and they are in constant liaison with local officers of the Nature Conservancy and with the County Naturalists' Trusts, Wildfowlers Association of Great Britain and

Ireland, the British Deer Society and other bodies of which many of them are members.

Sporting Leases

Woodlands have been used for hunting game from time immemorial, and today the sporting value of some lowland pheasant coverts exceeds the timber value. With sensible safeguards, shooting for sport can contribute to wildlife conservation; the habitat most suitable for pheasants is also suitable for many other birds and insects. Many woods now famous for their fauna and flora were planted or maintained as game preserves.

The Forestry Commission leases many of its woodlands for shooting, but provides special conditions to protect badgers and otters from destruction, and also rarities such as pine martens and polecats. The modern gamekeeper has a much less ruthless attitude to predators—many of which are now legally protected—than his predecessors, but it is only the landlord who can enforce on his employees or sporting tenants a responsible attitude to wildlife conservation.

Most of the woodland deer stalking in the Forestry Commission is let on a daily permit system, the visitor being accompanied by the Commission's Wildlife Forester or Ranger responsible for the proper conduct of the stalk according to a strict set of rules.

Adaptation and Introductions

Many of the new forests in the upland areas provide a vacant niche for wildlife which can be filled only by colonisation, adaptation, or introduction. The roe deer is a good example of the ability of a species to colonise a new habitat, though it is surprising that the large forests in Wales of apparently suitable type have not yet been reached. The stone curlew is one of the creatures that has successfully adapted itself to a forest environment when its native brecks in East Anglia were planted. It flourishes in the broad rides, in forest nurseries, timber dumps and other pieces of bare ground within the forest. Other bird species are also adapting themselves to this new forest habitat which is not surprising in view of the woodland origins of most of our native species.

But there remains a vacant niche in these big spruce and pine woods of the uplands which Bruce Campbell has suggested should be filled by carefully screened introductions. "Possible candidates" are the European race of the crested tit to the southern pinewoods; the great black, middle-spotted and greyheaded woodpeckers; and the goshawk. There is also the desire among sportsmen to spread the capercailzie and blackgame into new areas and to introduce the Reeves pheasant as a sporting inhabitant of the wet spruce forests.

Cost

Finally, what is the cost of the measures advocated? It is made up of three elements; overheads, being the time of the staff; cash expenditure on materials and labour for the positive works to promote better habitats; and the charges labelled by the economist as "loss of opportunity". This last is the theoretical sacrifice of timber yield in for instance retaining an area of scrub for wildlife instead of planting with an economic crop.

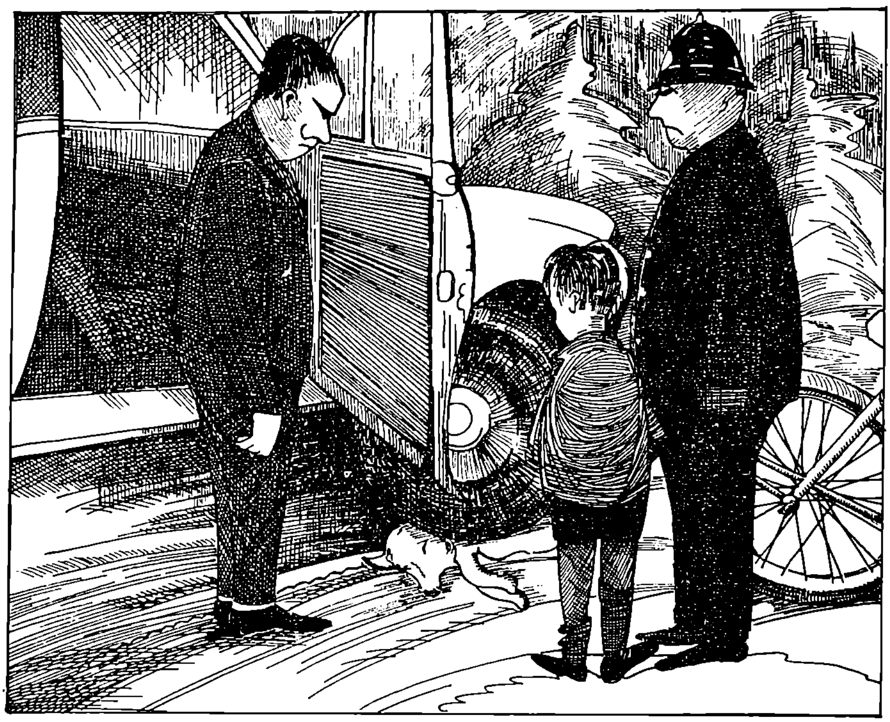
These costs are difficult to isolate; there are many counter-entries in the balance sheet for conservation measures which directly benefit the forest; and the social benefit to the community as a whole of conserving the native wildlife of this country is impossible to evaluate. But the total costs are certainly not great and do not affect the viability of the forest enterprise as a whole. I am sure that the future generations for whom these forests are being created will derive greater benefit from forests managed to conserve wildlife as well as to produce timber, than from the slightly greater yield of wood which might result from a negative attitude to conservation.

SHEPHERDS ON WHEELS

By R. J. JENNINGS
Chief Forester, South Wales

"But ca' them out to park or hill,
An' let them wander at their will:
So may his flock increase and grow
To scores o' lambs and packs o' woo'!"
Robert Burns

The police constable dragged the carcase of a dead ewe to the road verge as the car with a bent bumper and shattered headlamp drove off down the hill towards the village of Parkend. Then casually kicking pieces of broken glass into the gutter he took out his note book and turned to me.



Dead as mutton

"These sheep in the Forest of Dean are no ordinary sheep", he said. "Look how they run and jump . . . more like flamin' mountain goats . . . racin' sheep I call 'em . . . this one would have gone faster than one or two that I've backed at Chepstow races."

He made an entry in his notebook and spoke audibly to himself: "Blue cross on rump, no ear marks and half starved . . . looks like one of Tommy Crane's to me . . . not enough fat on its ribs to grease a pair of scissors."

The small crowd began to break up and the constable spoke to the remaining spectator a school boy of some thirteen years who was straightening the handlebars of his bicycle. "Not hurt are you sonnie? . . . no . . . well all the same I'd best take your name and address."

Scenes of this description are a frequent occurrence in the Forest of Dean where several thousand sheep roam the public roads and unfenced areas of these ancient woods. Born and bred in the shelter of the old oaks they are owned by the villagers, colliers, quarrymen, woodmen, lorry drivers, retired labourers and others.

With little more than an armful of hay in the wintriest of weather, most of these hardy creatures survive and rear their lambs on the short grass that they snatch from the dusty road verges or the brambles that grow in the open forest. Most of their lives are spent wandering from one side of the highway to the other, or scavenging in the streets and several villages in the forest, scratching a living and dodging the heavy traffic that rumbles through this built-up area. Most of them are cross-bred Cluns and Welsh ewes, wily hungry animals whose owners are known locally as "sheep badgers". Shepherds who watch their flocks from the driving seat of a van or the saddle of a bicycle.

The stranger to the forest may well ask what these creatures are doing at large on the public roads in such numbers and wonder what problems they bring in their wake.

A thousand years ago the Forest of Dean was a Royal hunting forest where all grazing was strictly reserved for the King's deer. Savagely enforced forest laws excluded all domestic animals from the woods save those of a privileged few.

Over the centuries however these laws have been gradually relaxed and today there exists in the forest a body of men who choose to call themselves "Commoners" and who regard this custom of grazing sheep, that is known locally as "commoning", as a "right". But legal experts and authorities have pointed out that by the most ancient forest law sheep are specifically excluded from grazing in a forest. Be that as it may, the fact remains that sheep have been run on the unenclosed areas of the Forest of Dean for as long as living memory can recall and with no rent or rates to pay for the grazing, and income tax extremely difficult if not impossible to assess or collect. The running or keeping of sheep on other people's property is a profitable hobby for a hundred or so inhabitants in the locality.

These several thousand grimy woolly animals, now regarded by visitors as a picturesque addition to the questionable scenery peculiar to the Forest, bring with them certain risks, inconveniences, problems and dangers.

Of the hundred or more owners who turn out their sheep on the forest very few own or rent any land at all. Most flocks consist of thirty or forty animals and by local tradition and mutual agreement each owner runs his animals on a particular part of the open forest. For obvious reasons as near as is possible to his home.

Some owners mark their animals with red, blue or black raddle. Others do not. The sheep flock together and can usually be found grazing in or around the same area.

One or two of the 'badgers' "bell" an old ewe, and in foggy autumn weather when visibility amongst the trees is poor an active dog will quickly rouse up the ewes and the bell will guide the owner to his flock.

The sheep of the various owners do not generally mix together intimately and if for any reason they are brought together by accident the animals are easily separated as soon as a dog is put behind them.

Strangers to the district express amazement that the sheep who appear to belong to no one in particular can be so easily found. It should be borne in mind that as most of the owners are in regular employment during the day it is only at weekends that they have time to inspect their animals.

However, with certain notable exceptions there is an air of general comradery amongst the shepherds and it is in their own interests that they assist each other, by bush telegraph, to locate or collect strayed or missing ewes or send word to a neighbouring owner concerning an animal that may suffer death or injury on the roads. Most owners easily recognise each other's sheep and the majority of them belong to their own society which is called The Dean Forest Commoners Association.

At first sight, the fact that sheep are being reared with a minimum amount of food and attention seems a worthy enterprise. As the owners themselves rightly claim, the sheep grazing on the road verges keep the grass closely cropped, thus saving a considerable sum of money that must otherwise come out of rates. Furthermore the grass that they consume would otherwise grow rank coarse and untidy, and as the trees under which the animals graze in the unenclosed forest are too large to be damaged by browsing no harm whatsoever can follow. This of course is a matter of opinion.

Some 11,000 acres, which is rather more than a half of the forest, is unenclosed, and here, where the sheep graze, hardly a flower of any interest or beauty is to be seen.

Were it not for the close cropping of every speck of green vegetation in the wood, the whole of this area might well be a mass of colour. Primroses, violets, anemones and all the other flora of a normal forest would thrive and spread. As things are however the bluebell seems to be the only flower that has not been eliminated by grazing. During nine years in post as Head Forester I did not find one specimen of the commonest of orchids in more than ten thousand acres of the unenclosed woods. In a National Forest Park this seems to me to be nothing less than a tragedy from the point of view of a botanist or naturalist.

Again it must be remembered that the sheep owners have virtually no land of their own and what few acres they rent or possess will certainly not accommodate several thousand sheep. During the past ten years there have been three serious outbreaks of foot and mouth disease in the forest amongst sheep, pigs and cattle. As soon as a case of the disease is confirmed, the authorities issue an order which makes it an offence to allow any stock to remain at large, and ordering all sheep owners to remove their animals from the open forest. This of course brings about an impossible situation, as the 'badgers' have hardly any land to remove their sheep to, and on their own they are quite unable to comply with the order. No farmer can be expected to allow suspect animals to be brought on to his land. Yet it is a punishable offence to allow them to remain at large and in these circumstances the risks of the disease being spread cannot be over-emphasised.

Another aspect that requires some examination is that of cruelty. Sheep that are at large over a vast area and not inspected daily frequently get into difficulty. I have seen ewes dead in the woods after being caught up and injured by barbed wire. Many animals get hit by vehicles on the very busy public roads. Sometimes they are killed outright. On other occasions they leap into the cover badly injured, to fall into a ditch with broken limbs or ribs and to die a lingering death from starvation or through haemorrhage.

Sometimes sheep get stranded on quarry faces and have to be rescued by the police. Occasionally they fall and are killed. At other times they lie injured and are discovered at the weekend alive with maggots. What these creatures suffer is best left to the imagination.

Traffic through the forest is heavy and the cyclist and motorist have to be constantly on the alert. Sheep that are lying in the grass verge have a habit of strolling suddenly across the highway and many accidents occur during the year.

Keen gardeners are not at all happy with the situation.

The keen gardeners and householders are not at all happy with the situation. When grass is short sheep will break through any weak-spot in the best of fences and many a prize cabbage in the Forest of Dean has made a dinner for a sheep instead of winning a certificate for its grower.

Tradesmen too are apt to leave gates open and it is not unusual to see a dozen sheep standing patiently by a row of houses on the day that dustbins are due to be collected, awaiting an opportunity to rout amongst the garbage cans that they know so well contain crusts of bread, potato peelings and other delicacies, before the arrival of the Council vans.

In midsummer the sheep seek out shady spots and wherever these occur near housing estates the objectionable fouling of paths and garden gateways must be seen to be believed. Complaints are often made to the local authorities on grounds of public health.

The fences around the plantations of young trees that are to be seen in the Forest of Dean are almost entirely for the exclusion of sheep and it costs the taxpayer many thousands of pounds annually to keep these creatures out of the woods.

The Crown Foresters are constantly on the alert, watching for stray sheep that appear mysteriously inside the fences and enclosed plantations in spring when grass in the open forest is scarce. Young trees are easily ruined by browsing, and unless the sheep owner has a sound reason and explanation as to why his animals are trespassing, the woodmen remove the animals to a wooden enclosure where they are impounded. They are released to the owner only after payment of ten shillings per head. Speaking from experience I can say that chasing, catching and collecting agile sheep amongst thorn, bracken and bramble is an exhausting business, though it may be good for the figure.

Every August, sales are held at Coleford and Littledean and several thousand lambs leave the dusty forest for Wales and other upland parts of the country. Then for six months the roads are fairly clear until the lambs arrive again the following spring.

In 1958 the Government published a White Paper in which it was recognised that straying sheep in the Forest of Dean were creating serious problems. Several recommendations were made to remedy the situation but as yet Parliament appears to have had insufficient time to deal with it.

With the opening of the Severn Bridge, traffic through the Forest of Dean will, it is expected, be trebled in three years. Most of the inhabitants of the area are waiting to see whether the agile sheep and their crafty owners can continue to survive with so many more fast-moving vehicles, or whether the casualty rate amongst them will be so high that the 'badgers' will abandon their so-called commoning, having realised at last that the tyre marks of the cars and lorries combustion engine have written . . . FINIS . . . after so many years, to the profitable hobby of the "SHEPHERDS ON WHEELS".

GRIZEDALE FOREST HANDICRAFTS

By A. GALLOWAY
North West England

As far back as 1959 Mr. M. Orrom, District Officer, surveyed the wasted deer skins at Grizedale and considered that these might form the basis of a cottage industry, an idea that came from H. A. Fooks.

For various reasons there was constant change amongst the forestry workers in those days, shortage of money being one of them. A cottage industry might remedy this perhaps, and provide a new interest for the wives who were living rather isolated and somewhat narrow lives, though admittedly in exquisite surroundings.

Accordingly Mr. J. Chard, Conservator, asked Arthur Galloway to recruit interested people to join an Adult Education Class. In October 1961 a class of eighteen was formed and met once a week in the Parish Room, Satterthwaite, to be taught the rudiments of leatherwork by Miss W. Armer. Tools and thread were purchased through Miss Armer, Mr. Orrom arranged for leather offcuts to be bought from the Kendal "K" shoe factory, and one or two skins which were cured at Grizedale were made available to the class. It was interesting and leisurely.

Then one day Mr. Shields, Technical Officer, Saddlery, Rural Industries Bureau, Wimbledon, paid us a visit. He conferred with Mr. Chard, Mr. Orrom, Miss Armer and with the people who felt attracted to the ideas of a cottage industry. Shortly afterwards Mr. Shields came again, this time bringing second-hand tools and clamps and, best of all, creating enthusiasm and talking about markets. The Forestry Commission made a loan of £50 which paid for the shoe leather and the tools from Mr. Shields. Later the members of the Group paid for these as they required them.

In October 1962 Miss Armer took a class for the second time and by November it was clear that six people desired to form a Group, Doreen Winstanley, Phyllis Moss, David Hawkes, Jenny Askew, Arthur and Betty Galloway. Mr. Orrom asked Arthur if he would do any necessary book-keeping and he agreed.

Under Miss Armer's instruction Doreen Winstanley made attractive flower brooches, David Hawkes, a delightful Dorothy bag and the other four struggled with purses and mocassins. By January 1963 these six members had left the class and were producing small articles in their own homes. The cottage industry was *a fait accompli.* Growing pains were to follow and a year later they keynote was discouragement and apathy.

The first modest output of purses, flowers, key-rings and scarf-rings were sold in the Deer Museum at Grizedale and soon this became known to Mr. Harper at Hawkshead who became our first wholesale customer. This was felt by the Group to be a step forward and really quite a milestone.

To find designs suitable to our materials has never been easy, but invariably the best sellers have been items that were simple both in design and in the making. The key-rings of today are only a little smaller than the original pattern produced by Phyllis Moss and the same applies to the scarf-rings first made by Doreen Winstanley.

When handbags were made, the simple flat shoulder bags topped the sales.

It became evident that we must find suppliers for split-rings, brooch-pins, zips, press-studs and other sundries that were required constantly. Mr. Shields was most helpful in obtaining for us, and selling to us, some of these items and later in giving us names and addresses of wholesalers. He impressed upon us the need to pay all our bills within one month of receiving goods. Arthur ordered, and members paid for, their goods as they needed them. Leather offcuts came from Connolly Bros., Persian skiver from the Light Leather Co. Soon Mr. Shields felt that acetate boxes would assist the presentation of the deerskin flower brooches and he ordered 200 of these from John Dickinson. The Rural Industries Bureau settled this account.

At this time the deerskins were in short supply, particularly the summer roe which was used for most of the articles. But the flowers were made from scraps; the boxes stood empty; we needed no other incentive to fill the lot! Meanwhile the money to repay the R.I.B. was raised by the members.

Early in 1963 it became clear that the Secretary must have money to pay the bills promptly. Members suggested, and Mr. Orrom agreed, that a levy of one penny in the shilling be deducted from individual earnings until each member had loaned £5 to the Group.

On 22nd April, 1963 the first Annual General Meeting was held at Hill Top. Mr. and Mrs. Orrom and five members attended. It was reported that the following articles had been sold:

Key-rings	309
Scarf-rings	24
Purses	16
Mocassins	4 pairs
Jewel Cases	6

The six members were now producing more than they could sell and one of Mr. Orrom's friends agreed to show samples of flower brooches to his customers, but no orders resulted. Mr. Orrom then supplied a list of addresses to which Arthur wrote, enclosing samples of the brooches. Again no orders followed! Unfortunately the enthusiasm was such that a further 200 boxes were ordered and paid for and by March 1964 each box held a flower.

Sales were almost at a halt and the Group felt discouraged and slightly apathetic.

A few items were sold at the newly opened Camp Site at Grizedale and Jean Taylforth asked Doreen Winstanley for some purses suitable for scout campers to wear on their belts. Doreen made a few, and this purse continues to sell extremely well.

An acccount was opened with the Midland Bank, Ulverston, on 11th July, 1964, under the name of Grizedale Forest Handicrafts. Three specimen signatures were lodged at the Bank, P. Moss, D. Winstanley and A. Galloway.

The deerskin work was being noticed in the gift shops and the owners of other gift shops began to find their way to Hill Top and to give orders.

Exhibits were staged by Mr. Shields at the Game Fair in Oxfordshire, Mr. Anderson, R.I.B. Organiser for Lancashire, set up a display at the Royal Lancs. Show at Blackpool and Mr. Garthwaite showed the work of the Group at Savile Row. Some retail sales were thus made and £13 10s. 4d. was added to the loans kitty. This was fortuitous and enabled tissue paper, stationery, postages, bank charges and cheque books to be paid for without using the money from the members' loans.

For the Game Fair, David Hawkes had made a very attractive shoulder bag and in October Phyllis Moss made an 8 inch gusset hand bag, patterns of which were distributed, and soon handbag production began in earnest.

The third A.G.M. took place at Hill Top on 26th October, 1965. Mr. Orrom, Mr. Grant, Mr. Shields, Mr. Anderson and nine members were present. During the year June Webb and Peter Townsend had left and five members had joined the Group, Margaret Gosden, Jean Wood, Teddy Taylforth, Brian Dean and Mary Hawkes.

Acquaintance with H.M. Customs and Excise Officer was reported. Apparently everything hinged on whether mocassins be classed as "wearing apparel"!

Members felt that Arthur should be paid an honorarium for his work but he declined to be paid for his voluntary task.

Mention must be made of the deerskins which were cured originally by John Corfield at Grizedale. This was time-consuming and not wholly satisfactory so small quantities were salted and then sent to the Tannery at Millom. Between 1962 and 1963 a bundle of summer roe skins was lost in transit so another tannery was sought and found in Scotland. The skins were cured cheaply but were too hard for the work. Mr. Shields' help was sought and finally the skins were accepted by the National Leathersellers College, London, where they are sent still. The summer roe were in very short supply always, whilst the winter roe skins tended to be in excess of the needs of the Group. In 1965 however Holker Hall agreed for their fallow skins to be collected by the Forestry Commission. These beautifully marked skins more than compensated for the shortage of summer roe and they were used to make spectacular bags. In May 1965 the deerskins were moved from Grizedale to Hill Top so to be more easily accessible to members. The deerskins are the basis of the industry and the work of skinning and salting, packing and dispatching goes on throughout the year unnoticed until the heavy sacking-covered bundles are delivered and the skins are sorted and priced. A room has been cleared to house the skins, leather and the acetate boxes and to hold the finished articles as they are handed in.

The fallow skins gave added incentive to the bag makers and at Christmas, 1965, twenty assorted bags were sold. (These appear on the list of sales for 1966).

The sales for 1964 were noticeably higher:

Key-rings	434
Scarf-rings	396
Purses	399
Mocassins	322 pairs
Flowers	73
Dorothy Bags	12
Shoulder Bag	1

12 months—April 1964 to March 1965	£448 11s. 0d.
6 months—April 1965 to Sept. 1965	£358 12s. 6d.

The year 1966 was memorable for a number of displays of the products of the cottage industry.

At the Deer Museum, Grizedale, displays were seen by the Chairman and Forestry Commissioners, the Duke of Edinburgh and by six M.P's. who were visiting the Forest.

In May, Teddy Taylforth and Arthur Galloway manned a stall in the grounds of John Ruskin School, Coniston, and handed the profit of £5 2s. 0d. from the afternoon sales to the Swimming Pool Fund.

Mr. Orrom expressed the wish for a permanent display of deerskin work in the Deer Museum, Grizedale.

The year was marked also by an increase in the variety and number of bags produced. Betty Galloway introduced the 10-inch shoulder bag which was followed by Teddy Taylforth's 8-inch shoulder bag, an immediate success and still the bag with the highest sales. A 10-inch gussetted handbag was added by Phyllis Moss to her 8-inch variety, but this was discontinued the following year. Brian Dean made a somewhat complicated round gusseted shoulder bag, much sought after, but it was discontinued as the amount of work involved in the making made it uneconomic. Teddy and Phyllis Taylforth made three turnlock handbags but the leather available was unsuited to the design, which was withdrawn.

Group membership had increased to thirteen by the time the A.G.M. of 1966 was held at Hill Top on 13th December. Phyllis Taylforth, who had been working splendidly with her husband for some months, joined the Group during December. Mr. and Mrs. Orrom, Mr. Anderson and friend and twelve members were present at this meeting.

A large order from the Swan Hotel, Newby Bridge, had been fulfilled for Easter and a number of orders had been received for Easter 1967 so these were divided equally between members, who were each given a list of things to be made during the winter months.

It was noted that the prices of materials and postage had risen and the wholesale price of every bag was increased by 2/6 to offset this. Customers raised no objections because 6d was taken off the wholesale prices of key rings and zip purses.

During the year a few members thought they would like to make bags of a higher calibre. Mr. Shields agreed to come up to Grizedale to give further instruction, but this was not possible as he succumbed to several spells of illness.

In August the Group agreed to pay £2 10s. 0d. per year for the salt used on the skins at Grizedale.

For the first time, two prospective customers could not be accepted, as small follow-up orders were being received from the established customers and it was felt inexpedient to take orders that could not be executed promptly.

1967 seemed rather a quiet and uneventful year but a glance at the sales will show that the Group was working steadily. Sales reached their highest level of £1,046 10s. 10d.

It was pleasing to note that our highest sales, £241 8s. 4d., were made at the Camp Shop, Grizedale.

The total sales for the year were as follows:

Key-rings	505
Scarf-rings	158
Purses	1,005
Mocassins	207 pairs
Flowers	270
Bags	221
Zip Pulls	44

The 1967 A.G.M. was held at Hill Top on 6th October. Mr. Grant attended and Mr. and Mrs. Fletcher met the Group as a whole for the first time, 12 members being present.

In April Betty Galloway made a short recording which was broadcast on Woman's Hour and in June she had talked to a group of Womens Institute Produce Group members about the cottage industry. At the A.G.M. it was felt that this talk might form the basis of a short history of the Deerskin Industry which Betty Galloway agreed to write.

During May, Major-General S. H. M. Battye, C.B., M.A., called at Hill Top. The Major is the Director of the Council for Small Industries in Rural Areas (formerly R.I.B.) and upon being shown some bags he commented upon the high standard of sewing.

The sum of £4 11s. 7d. was given to the Satterthwaite Church Fund, this being profit from goods sold on the Deerskin stall during the July Garden Fete.

Mr. Anderson called to give his good wishes to the Group before leaving for a new post in Scotland. Mr. H. Shaw, his successor, paid a brief visit to Hill Top in July.

A stall was set up at the W.I. Country Fair held in September at Grizedale and the profit of £13 1s. 1d. was given to the Rusland and Satterthwaite W.I.

The decision to pay Arthur 5% of all wholesale sales was proposed and accepted unanimously.

The 1968 A.G.M. was held at Hill Top on 11th October. Mr. Fletcher and six members attended.

During the year Ann Threlkeld and Norman Howgate had joined the Group, but five members had left leaving ten. The five were Doris and Mary Smith, Jean Wood, Phyllis Taylforth and Doreen Winstanley. Doreen was one of the original members who in November 1968 sailed with her family to Australia. We promised to send her all future A.G.M. reports as a means of keeping in touch and we wish her well in her new way of life.

Much constructive discussion occured during this Meeting. Ideas for new "lines" were exchanged and exhibits supporting them were produced. Small changes were made in the prices of five types of purses, and key rings, now joined neatly and speedily with a rivet and no longer sewn, were reduced by 6d. to 2/6 wholesale. The 10 inch shoulderbag would be shortened by 2½ inches and the same price charged. Teddy Taylforth had made eight 10 inch bags—both sides of winter roe—during the year, and Betty Galloway showed a similar bag with a gusset which adds to the strength and capacity of the bag. Customers' reactions have been favourable and these bags would use the winter roe skins which were plentiful.

Total sales from October 1967 to September 1968 were:

Key-rings	613
Scarf-rings	310
Purses	950
Zip pulls	217
Flowers	327
Mocassins	138 pairs
Insoles	8 pairs
Bags	161

Members who had left the Group had had the whole of their loans returned.

Betty Galloway expressed concern that the money available from members' loans would be depleted in time by unrecoverable expenses. Bank charges and cheque books; invoice books; carbon and typing paper; tissue paper and string; petrol to collect a longstanding debt; payments for replacing skin on two bags and one pair of mocassins; postages—these had been such expenses during 1968 and they had been met out of the profits from the odd retail sales at Hill Top. These sales were unpredictable and Arthur and Betty Galloway were not keen to continue them.

As an alternative to raising money in this way, Betty Galloway asked if Phyllis Moss and Jean Taylforth would sell the deerskin products in the Post Office and in the Camp Shop on a percentage basis. They agreed readily to take goods on a sale or return basis and for the cottage industry to have 40% of the retail profit. In return they would have the first choice of all items made.

This then is the story of a dream come true. In its small way it is a success story; a few people setting out simply and hesitantly to make things good enough to sell to the public. This they achieved but their success continues because they strive constantly to uphold and to improve standards. To produce attractive handsewn work using traditional tools and elemental materials is in itself a fair accomplishment and fulfillment indeed.

THE DROVERS HIGHWAY

In Crychan Forest's hanging mists
There is a track that turns and twists
By rocky outcrop, stone and cairn
Through peat bog, heather, grass and fern
It runs from Towy's fertile farms
'cross Eppynt to *The Drovers' Arms*
Where horsemen brought Welsh cattle down,
Beef on the hoof for London Town.

That trade has gone full many a day
No drovers ride their old highway
And all the hill from foot to brow
Is changing face and colour now
For where black cattle trod the land
A million forest trees now stand
Though Army lorries, tanks and guns
Still travel where the old road runs.

Sometimes at night when all is still
I see a light up on the hill
Then my imagination turns
To well-worn tracks amongst the ferns
And troops manoeuvring in the rain
Are phantom forms on horse again
Who drive ghost cattle that I see
Back through the roads of history.

R. J. JENNINGS

HARVESTING AND UTILISATION

STUDIES ON LIGHT, FRAME-STEERING TRACTORS

By A. WHAYMAN

It is now generally accepted that:

(1) A wheeled vehicle has a lower first cost and lower operating cost than a similar tracked vehicle.

(2) A 4 × 4 vehicle (i.e. four wheel-drive) has a better performance than a 4 × 2 (or two wheel-drive) vehicle.

(3) An articulated vehicle has greater flexibility than a rigid frame vehicle with conventional steering, particularly over difficult terrain.

In North America, comparatively large four wheel-drive articulated tractors have been developed for timber working, both as "forwarders" and "skidders" mostly in clear felling operations. These tractors are from 60–70 horse power and upwards, and have not as yet been widely used in Great Britain, where thinning at present predominates. When a smaller and lighter type of articulated tractor, the Holder A20, fitted with a rear-mounted winch, was seen working in Norway, it attracted considerable attention in view of its likely application for the extraction of thinnings, where, as in other parts of the world, a substitute for the horse was being sought.

In 1966 a machine was purchased, modifications were made to the tractor and equipment and studies were carried out to develop an appropriate logging system and to provide preliminary performance and cost data. The results are no doubt applicable to other similar light-frame steering tractors.

Description of Tractor and Equipment

Tractor

HOLDER A20
(Made in West Germany for agricultural and horticultural use).

Engine
20 h.p. twin cylinder, air cooled, 4 stroke Diesel, 1005 cc.

Transmission
Fluid flywheel. 4 wheel-drive via 2 differentials.
8 Forward gears—0.37 m.p.h.—12.2 m.p.h.
4 Reverse gears—1.00 m.p.h.—4.42 m.p.h.
Hydraulically operated differential locks on both front and rear axles.

Steering
Hydraulically assisted.

Tyres
7.50 × 20 (7.50 × 18)

Length
9 ft.

Width
3 ft 4 ins.

Ground clearance
1 ft 3 ins.

Weight
1 ton 3 cwt.

Winch

VINJE JUNIOR

Chain-driven from power take-off.

A single-drum winch in which the axle of the drum is parallel to the length of the tractor. The winch rope passes through a block attached to the turret which is mounted above the skid pan at a height low enough to prevent the tractor tipping over, and yet high enough to allow the winched in load to be clear of the ground.

Rope

50 yards $6 \times 19 \times \frac{3}{8}$ inch diameter.

Speed

150 yards per minute.

Load

Approximately 2 tons.

Weight

2 cwt.

Other Equipment

"SKARPSKO" tyre chain (set of 4).

Norwegian sliding choker chains with "keyhole" adjusters

Wedge eye socket (fixed on end of rope).

Running hook ($2\frac{1}{2}$ tons).

Modifications to Tractor and Equipment

Tractor

Modifications were required to convert what was an agricultural tractor into a machine suitable for forest operations.

Safety cab

A safety cab was designed, fitted and tested by the National Institute of Agricultural Engineering; it passed the Institute's stringent requirements.

Guards

Guards were fitted to the radiator and also to the underneath of the tractor. The guard plates at front and rear protected the differentials, the brake and clutch controls and the sprocket driving the winch. Valve guards for the wheels were essential.

Weights

Weights were added to the front wheels (this can also be done by water ballast).

Winch

Clutch and brake controls were extended to enable them to be operated from the driver's seat.

Brake stop

A stop was fitted to the brake release to prevent the rope and drum from over-running when the rope was pulled off the drum, or the load was released.

The butt plate was strengthened and extended to cover part of the rear wheels.

Methods

In thinning it was found necessary to lay out "racks" for the tractor to move through the wood. The tractor is able to move between trees 5 feet apart, but for ease of operation "racks" are required.

Racks

10 feet wide and 33 to 44 yards apart. They should be as straight as possible with no side slope. Slope of rack should not exceed 40%.

Felling

Felling must be directed in a herringbone fashion so that the trees lie at an angle of 30° to 60° to the line of the rack. If trees are felled parallel to, or at right angles to, the rack, extraction is difficult and time is wasted manoeuvring the trees into a suitable position.

Piling

It is not necessary for the fellers to assemble complete loads for the tractor because the winch is used to collect the trees into a load. However, at the time of felling, the fellers should pull "tips" or "butts" together wherever possible to reduce hitching time, especially where the trees are under two hoppus feet. The fellers should be instructed to pull either "butts" or "tips" in the direction of extraction, a mixture of "butts" and "tips" should be avoided.

Chokering or Hitching-up

The driver is usually responsible for his own chokering in thinnings where hauls are relatively long and the density of trees relatively low. But in clear felling, or where hauls are short, there is a case for a chokerman to speed up terminal times by using a second set of chokers. When the driver has positioned the tractor, he pulls out the rope to the furthest tree, fixes the cable to it by means of the sliding hook and wedge eye-socket, then he chokers the remainder of the trees on his way back to the tractor using the sliding chokers attached to the rope. Normally there are five chokers which may accommodate one or more trees depending on their size. Sharp angles in the line of the rope must be avoided as must the positioning of chokers too far back on the tree. It is easier to disentangle the chokers at the landing if more than one tree can be carried in each choker. It was found better to use choker chains with a "keyhole" adjuster whereby the length of each choker could be adjusted, rather than to use wire chokers of a fixed length.

Winching in and Movement out

The driver winches the load up to the back plate, then drives out to the landing. If "tips" are extracted first, a bigger load can usually be carried (as less weight has to be lifted) but the butts are liable to spread out and may jam when going round obstacles. However, an extra advantage of tip-first extraction is that all pulpwood lengths lie together and this aids subsequent conversion at the landing.

The controls of the winch are so arranged that the driver can, without dismounting, drop his load, move the tractor forward independently of the load and then winch the load back to the tractor. This enables soft areas or steep banks to be traversed.

Stacking and Conversion

A great deal of time is often spent stacking and sorting at the landing; if the tractor is fitted with a log roller it can assist with this work, or if there is ample room loads can be spread out.

If, however, conversion can be married to the extraction then up to 25% of cyclic time can be saved. A grid placed at the landing on which the load is deposited, and on which the timber is converted as it arrives, eliminates the need for any stacking prior to conversion.

Provisional Times for Extraction of Early Thinnings (Using Holder Tractor (Pole Lengths))

Job specification

Trees felled in herringbone fashion towards rack.
Trees debranched and cut off at 2½ to 3 inches top diameter.
Butts or tips moved together by fellers.
Racks 10 feet wide at intervals of 33 yards.

Ground condition

Slopes not over 21%.
Stumps or boulders under 12 inches high.
Drains not more than 18 inches deep.
Up to 12 inches peat on stony clay.
Easy access from rack to road or ride.
One-man operation.
Loads deposited on grid.

Allowances

Personal needs and rest	22%
Other work	11%
Contingencies ..	4%

STANDARD MINUTES PER HOPPUS FOOT

Average Extraction Distance Yards	Average load in hoppus feet		
	15	20	25
50	0·75	0·66	0·61
100	0·86	0·74	0·67
200	1·08	0·90	0·80
300	1·30	1·06	0·93
400	1·51	1·22	1·06

The standard times are based on a *limited* number of studies but give useful early guidance.

1 hoppus foot = 1·273 cubic feet

Comparative Extraction Costs Horse Tushing and Holder A20 Tractor

Studies indicated that under the given conditions cost savings of 20–30 per cent may be expected when horse extraction of pole lengths is replaced by extraction with the Holder.

Comments and Conclusions

The Holder A20 tractor, an example of light, frame-steering tractors, is easy to drive and handles well. The safety cab, which will soon become a legal requirement in Britain, gives the operator confidence in handling the machine and protection in case of accident. An over-exuberant driver can over-drive and over-load this small tractor; this leads, inevitably, to mechanical troubles.

We have not yet gathered enough experience to state with confidence the period over which machines of this type should be depreciated, but present indications suggest between three and five years.

Wheel chains are imperative. They prevent wheel spin and the formation of ruts, and uphill performance, particularly, is enhanced.

Directional felling and proper rack layout are essential for the efficient use of the machine.

The correct team balance for extraction and subsequent cross-cutting minimises costs.

These light machines promise to make a useful contribution to productivity in earlier thinnings, but the larger, frame-steering tractors are more appropriate to clear felling or late, heavy thinnings.

A CHEAP AND USEFUL TIMBER SCRIBE

By R. J. JENNINGS
Chief Forester, North Wales

Everyone engaged in the tariffing of plantations or the measurement and conversion of coniferous timber will require a scribe. The diagram opposite illustrates how such an article can be easily made from a worn out weeding hook. After removing the wooden hook handle fix the steel blade firmly in an engineers vice and saw off at point *A*.

With a blowlamp or oxyacetylene burner apply heat at point *B* and straighten the bend.

Apply heat at point *C* and when red hot hammer over the tip to form a *U* to a desirable angle. This is the cutting edge of the scribe.

When cool replace the wooden handle and ferrule and re-sharpen the original edge, with a file.

Foresters who require to number hardwood butts will need a smaller scribe. But the article that is described above will serve a useful purpose in marking-off lengths of pulp or pitwood. It may also save a considerable sum of money on the issue of folding scribes to forest workers, scribes which they often break and more frequently mislay.

NOTES ON TERMS USED IN THE PULP, PAPER AND BOARD INDUSTRIES

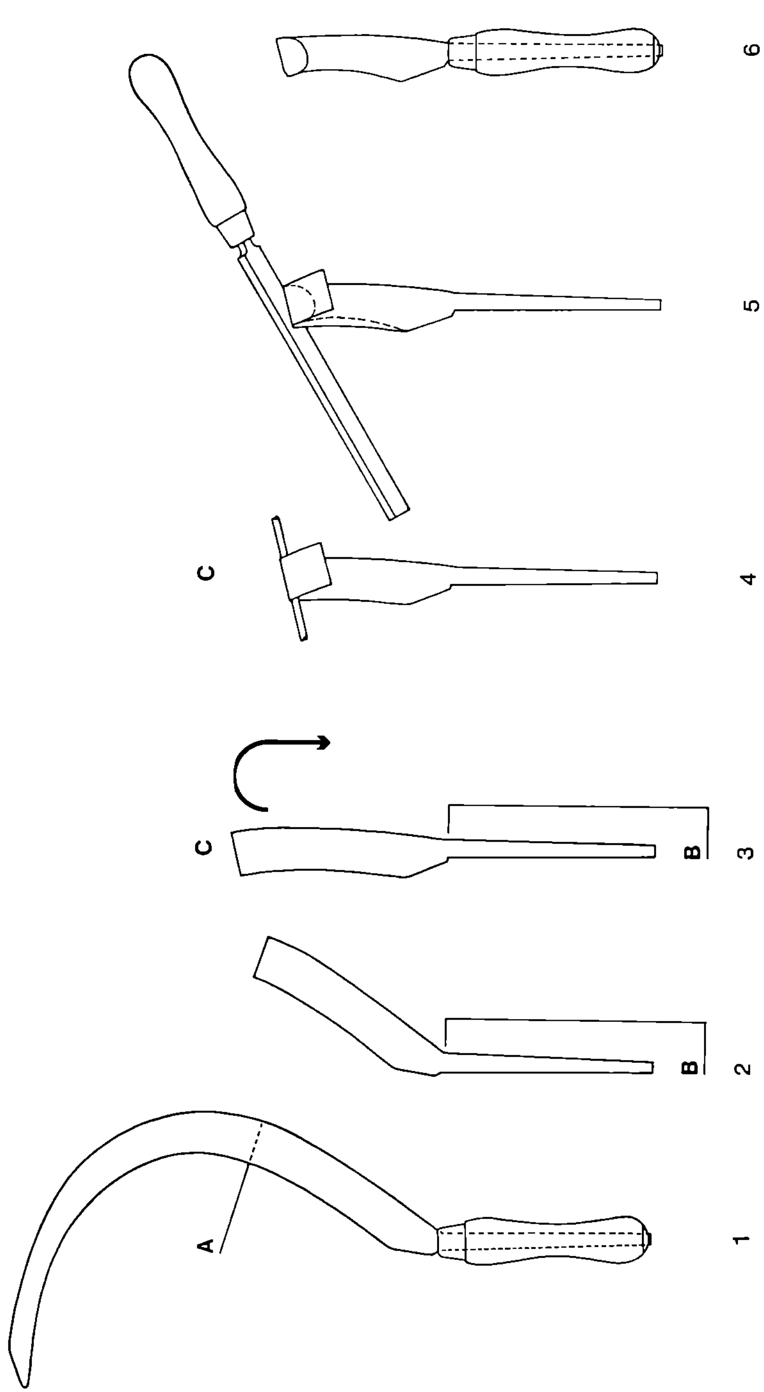
By E. G. RICHARDS
Conservator, East Scotland

These notes have been written in response to a request for a simple definition of some of the terms used in the pulp, paper and board industry which may be expected to have increasing usage in home forestry circles.

The Main Divisions of the Industry

The Pulp Industry

Strictly speaking the pulp industry is concerned with the manufacture of pulp for sale or transfer to paper and paper product manufacturers or the rayon



Stages in making a timber scribe from an old weeding hook.

industry. The term *pulp industry* is sometimes loosely used in Britain by foresters to cover the whole field of pulp, paper and board manufacture.

The Paper Industry

The paper industry is concerned with the manufacture of paper from pulp. This pulp may either have been purchased from a pulp mill, or else made in a pulp mill attached to the same paper mill.

The Board Industry

This term is applied to three quite separate industries:

(i) When paper exceeds a certain substance (generally 250 grammes per square metre) it is called *board* by the paper industry. In everyday language board of this type is often called *cardboard*. The board industry in this sense is part of the paper industry as in "The British Paper and Board Manufacturers' Association".

(ii) Quite distinct is the manufacture of what are variously called *wall-boards*, or *fibre building boards*. These are sheet materials usually at least $\frac{1}{8}$ inch in thickness (sometimes $\frac{1}{10}$ inch) finding a wide use in building and are familiar to the do-it-yourself householder. The denser types of board are known as *hardboard* and the less dense but usually thicker ($\frac{1}{4}$ inch and up) boards as *insulation board*. These boards are made in integrated mills, i.e. where the pulp is made in the same factory as the board.

(iii) The third type of board, made not from pulp but from chips of wood glued together, is called *chipboard*. In Britain the correct term is *wood chipboard* but the internationally used term is *particle board*. Wood chipboard or particle board is a sheet material generally at least $\frac{1}{4}$ inch in thickness and more commonly $\frac{3}{4}$ inch thick.

Chipboard is used for furniture manufacture when it is normally covered with a veneer or laminated plastic face. It is now finding increased use in the building industry for flooring and partitioning, even, when suitably composed, for load-bearing.

Chipboard, however, in the paper industry's language means a type of cardboard made from waste paper (it is for this reason that the makers of the wood-based chipboard (particle board) in Britain have adopted the term "*wood* chipboard").

Types of Pulping Processes

Mechanical Pulping Processes

There are two processes. In the *groundwood* process, round billets of bark-free wood are pressed against large grindstones which grind the wood down into fibres or bundles of fibres. In the *refiner groundwood* or *disc refiner* process, the wood is first chipped and the chips are then ground between contra-rotating serrated steel discs.

Chemical Pulping Processes

The wood is first chipped and then treated with chemicals to dissolve the lignin which binds the cellulose fibres together. The fibres so obtained can be easily separated without the need for further mechanical treatment. For *Dissolving Pulp* the chemical treatment is carried still further and the cellulose is later re-constituted as rayon fibres or cellophane sheets.

Semi-Chemical Pulping Processes

Chips of wood are first treated with chemicals but this part of the process is not carried so far as in a "pure chemical" pulpmill. Mechanical treatment follows the chemical treatment to complete the separation of the fibres.

Types of Pulp

Mechanical pulps give a high yield of the original wood substance since only a little is lost (as fine particles) during grinding or refining. Chemical pulps may yield only 40%–50% of the original wood substance since part of the original wood substance is dissolved out by the chemical action. Semi-chemical pulps give a yield somewhere between the mechanical and chemical pulps.

Many variations of the basic pulping processes are used, each giving a somewhat different type of pulp. But it is necessary only to distinguish between a few main types of pulp. The terms used are largely self-explanatory so long as one remembers that they describe the processes used to make the pulp rather than the properties of the pulp itself.

A few common examples may be helpful.

Mechanical Woodpulp

Pulp obtained from wood by entirely mechanical means (e.g. the action of a grindstone).

Sulphate Pulp

Chemical pulp derived from wood or other vegetable material by digestion with a liquor consisting essentially of a mixture of caustic soda and sodium sulphate and possibly of other sulphur compounds.

Kraft Pulp

Sulphate pulp made from softwoods by the sulphate process.

Sulphite Pulp

Chemical pulp derived from wood or other vegetable material by digestion with a bisulphite liquor.

Semi-chemical Pulp

Pulp made by a semi-chemical process.

Pulp may be further described by the addition of the word *bleached* or *unbleached* to denote whether or not the pulp has been bleached to a high degree of whiteness.

Two expressions which are commonly met with describe the degree of wetness of the pulp, rather than the process by which the pulp was made.

Slush Pulp

In the great majority of pulp-making processes the wood fibres are conveyed in water from one part of the process to the other. Towards the end of the process when the pulp is fully prepared but still contains a lot of water it is called *slush pulp.* If the pulp mill is attached to a paper mill the pulp is normally pumped in slush form to the paper-making machinery. If the pulp is to be sold, most of the water is removed and the pulp pressed into sheets for transport; at the receiving mill the sheets are broken down in an aqueous medium to give again *slush pulp.*

Air-dry Pulp

Pulp with a moisture content approximately in equilibrium with the surrounding atmosphere is said to be air-dry. When the daily or annual capacity of a pulp mill is given as so many tons of pulp it can usually be taken as meaning "tons of air-dry pulp".

SALES CONTRACTS FOR STANDING CONIFEROUS TIMBER FROM FORESTRY COMMISSION AREAS, MARCH 1969

The March 1969 schedule of average prices per hoppus foot received by the Forestry Commission from sales of standing coniferous timber appears opposite. It covers six months and all sales during that period, whether by private negotiation, by tender or by auction, have been included in arriving at the average prices.

This schedule is published for general information only. The average prices shown for each of the various size categories cover a wide range of species, localities and conditions and must not be regarded as either the maximum or minimum value of standing timber in that category.

Sales of Scottish windblow material have been excluded for the whole of the period 1st October, 1968 to 31st March, 1969. When comparisons are made with previous years, an allowance should be made in both the Scottish and Great Britain averages for the fact that the distribution of species/size classes in standing sales made in F.Y.68 was different from the normal pattern, because the quantities marketed were reduced on account of the priorities given to clearance of windblown timber.

SOME CHIPS FROM THE OLD BLOCK

By R. J. JENNINGS

Chief Forester, North Wales

"The proper study of mankind is man"

Pope:—Essay on Man

While I was clearing out a cupboard recently I came upon a photograph of a group of woodmen that I worked with many years ago. There were eight of us sitting on a big oak log and I remembered the occasion quite well. We had been felling some trees around the churchyard and the picture had been taken by the vicar. Behind us were neatly ranked heaps of cordwood and in the foreground were our axes driven into a stump beside two cross-cut saws. It must have been posed just after a meal-break because a fire was burning and our tin billycans in which we brewed tea hung on a forked stick stretched over the flames.

AVERAGE PRICE FOR EACH COUNTRY

Period 1st October, 1968—31st March, 1969

Contributed by Marketing Division, Headquarters

Average Volume per tree in hoppus feet	ENGLAND			SCOTLAND*			WALES			GREAT BRITAIN		
	Volume h.ft	Total Price	Average Price per h.ft	Volume h.ft	Total Price	Average Price per h.ft	Volume h.ft	Total Price	Average Price per h.ft	Volume h.ft	Total Price	Average Price per h.ft
		£	s. d.		£	s. d.		£	s. d.		£	s. d.
Up to 1½	47,922	1,702	8·5	37,882	931	5·9	106,696	7,159	1 4·1	192,500	9,792	1 0·2
Over 1½ and up to 2½	407,743	24,689	1 2·5	122,757	4,529	8·9	460,423	31,991	1 4·7	990,923	61,218	1 2·8
Over 2½ and up to 3½	510,067	35,643	1 4·8	313,024	15,971	1 0·2	279,475	22,802	1 7·6	1,102,566	74,416	1 4·2
Over 3½ and up to 4½	207,494	15,103	1 5·5	100,542	4,955	11·8	351,496	30,372	1 8·7	659,532	50,430	1 6·4
Over 4½ and up to 5½	229,814	19,722	1 8·6	184,448	8,526	11·1	304,255	27,609	1 9·8	718,517	55,857	1 6·7
Over 5½ and up to 6½	199,567	16,728	1 8·1	170,852	11,870	1 4·0	169,553	16,819	1 11·8	539,972	45,417	1 8·2
Over 6½ and up to 7½	71,486	5,452	1 6·3	1,561	54	8·3	20,355	2,056	2 0·2	93,402	7,562	1 7·4
Over 7½ and up to 10½	427,581	43,930	2 0·7	504,994	36,006	1 5·1	48,285	4,759	1 11·7	980,860	84,695	1 8·7
Over 10½	113,756	13,573	2 4·6	214,395	19,849	1 10·2	61,227	7,468	2 5·3	389,378	40,890	2 1·2
TOTAL	2,215,430	176,551	1 7·1	1,650,455	102,691	1 2·9	1,801,765	151,035	1 8·1	5,667,650	430,277	1 6·2

Footnote: * Sales of windblown material made in period 1st October 1968 to 31st March 1969 have not been included.

Felling some trees around the churchyard.

We were a wild looking bunch; with rolled up sleeves and arms tightly folded. The older members of the outfit appeared to have put on a most determined and savage expression; the younger folk, including me, were clenching our fists and pressing out our biceps with the backs of our hands to make the best picture of what muscle we possessed.

As I studied the photo for a few moments memories of these woodmen came back to me and I began to compare them with the workers of today.

Alf was a thickset character with square shoulders and short bowed legs. He had a smallholding and was, I think, one of the hardest working men I have known. With a round, ruddy face and his arms hanging loosely at his sides he looked as though he might have stepped straight out of an anthropological exhibition in the British Museum. Ginger hair sprouted out of the open neck of his shirt like the frayed edges of a coconut mat in a forester's office. When concentrating on a job, such as fitting a gate hook, or boring a post hole with an auger, his tongue would project from his mouth progressively in inches and then move slowly from one side of his thick lips to the other. This had earned him the nickname of 'Strawberry'.

No one seemed to have a good word for Alf. "Watch him," was all that his colleagues would say. In time I found out that Alf's weakness was that he was apt to claim as his own anything that he saw lying around. He was well known locally as a 'Magpie'. If he was sent fencing he would never be allowed in the store shed on his own or all kinds of things would be missing. The staples that he needed for the fence had to be counted out or he would require more every day.

I once set several dozen snares and caught surprisingly few rabbits. I made a few enquiries and discovered that Alf did a round of them every night. Early one morning I caught him at it and when challenged he just laughed it off . . . "Ooh ah" he said . . . "I might 'ave 'ad one or two . . . no good letting rabbits stay in there all night . . . the cats or foxes 'll 'ave 'em . . . Up in the mornin's the game."

Then there was Alec who had worked in the woods as a boy and after service in the navy came back into forestry.

Although he lived nearer than anyone to the woods, Alec, who came to work on a cycle, was seldom on time. He would creep in behind the smoke of a browst fire through the bushes after we had started, and after watching points for a few minutes would merge in amongst the rest of us with a bill hook in his hand taking care to keep out of sight of the foreman until he was actually on the job.

He played this game, though, once too often. One morning the foreman went out earlier than usual and stationed himself in a concealed spot close to Alecs' house ready to pounce on him when he ought to have been at work. Coming along late as usual, Alec spotted trouble and dismounting rapidly went to earth and made himself scarce by crouching down behind a stationary milk lorry that was parked in the road. However, the vehicle moved off and to the amusement of the villagers left Alec squatting in the middle of the road like an Indian snake charmer.

Following this episode Alec was sent to the nursery where he was given the job of sounding the siren every morning at starting time. This cramped his style somewhat in the matter of bad timekeeping because the siren was just outside the boss's house. Alec had to be punctual or the whole neighbourhood knew about it as they set their clocks by our time. It was great fun to watch Alec in the morning. Sometimes the boys at the nursery would deliberately block up the gateway to delay him. He would come whirling round the corner of the yard several seconds before starting time, then leaping off his bike he would hurl it into the shed and with a groan and a windy gasp fling himself at the handle of the siren and do his utmost to get a weak toot out of it before he could be accused of being late.

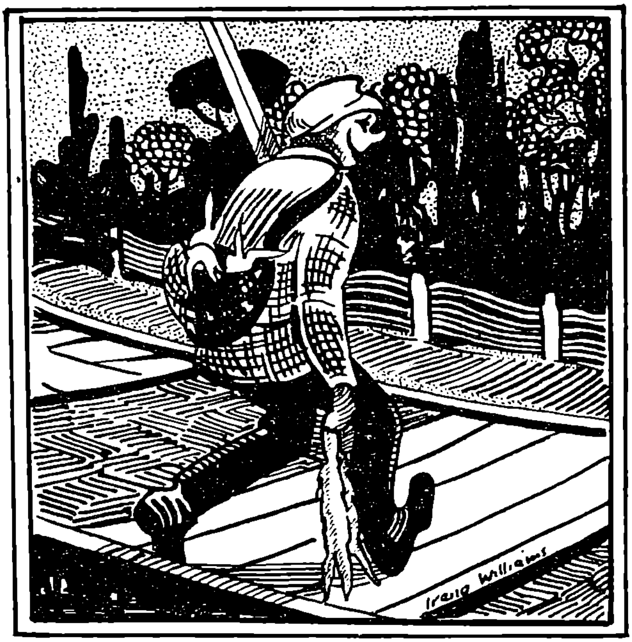
Alec was proud of his time in the Navy and kept up his sea-going jargon. He would never speak of the floor or the ground, it was always the deck. He drove nails into the bulkhead not the wall. We stowed spades and hoes in the locker or the hold. Even the lining-out shelters were "made fast" or "taken adrift". His nickname, which he loved, was of course 'Captain,' and to create atmosphere he bought a blue yachting cap from the Army and Navy Stores with a hard shiny peak.

Bill the foreman was a supreme judge of human nature and could be relied upon to get done what was necessary by what might be looked upon as a mild form of blackmail. Call it what you like . . . it worked. He made a point of getting to know as much as he could about every worker's business and the more scandal and gossip that the information contained the better he liked to hear about it.

Thus if one of the younger married men dropped a bundle of firewood inside the gate of a widow in the village, Bill would wait for a wet day when everyone was sheltering from the weather and then with a knowing wink at one or other of his cronies he would say nonchalantly to his victim . . . "I hear you're setting up a firewood business Jim," or . . . "I reckon 'as it's a pity as some of you young chaps don't take a leaf out of Jim's book and do a bit of charitable work for people on a pension as can't manage" . . . etc. . . . This ribbing would be taken up and developed by others who were in the know and would be a subject for discussion at other village tea tables. Most of the workers were scared to argue with Bill; he once told me . . . "I've got summat on all of 'em if they did but know it!" Bill knew who owed the grocer or who had not paid their rates, and by exploiting this knowledge to the full he got a lot more work out of the men than a good many of them realised.

There was really no harm done and it was one way of keeping this very crafty collection of individuals on their toes.

Willy, a round-shouldered, snivelling individual, was the rabbit-catcher and was heartily disliked by the woodmen. He caught newts and reptiles for dissecting at Universities and biology classes and was known as "Froggy".



Doing a bit of rabbiting along the railway.

In his spare time, which to all of us seemed fairly plentiful, Willy was a part-time keeper to a sporting tenant. The woodmen said that Willy spent most of his time doing a bit of rabbiting along the railway, and rearing and feeding pheasants. He had a free and easy existence and this made the hardworking men very jealous. He always had a couple of half-starved cowed dogs lurking at his heels and the men said that when Willy knew the boss was about he would give the dogs a kick or a clout to make them howl 'pen and ink' and then after the lapse of a few seconds fire a shot into the bushes which would give the impression that having put up a rabbit the dogs had chased it for a short distance until Willy had shot it!

Joe, a weaselly little man, had once been an estate carpenter. He did not use heavy tools and I recall was in the gang to burn up the browst and make hedge stakes from the hazel coppice. Joe's hobby was making walking sticks and you seldom saw him without one. After lunch, before resuming work whilst the other men were studying form, discussing football or the iniquitous piecework rates he would rise to his feet, knock out his pipe and vanish into the shadowy undergrowth.

After poking around amid the spindle trees, ash regeneration and old man's beard he would return shortly afterwards, more often than not covered in burdock seeds with a spot of blood on the tip of his nose or the lobe of his ear, armed to the teeth with ash crooks, holly branches or some weavers beam that he had cut in the coverts.

Then in his spare time he would whittle away at the rough knots and callouses with a knife and in no time at all he would have fashioned a shapely stick with a smooth knob or handle that fitted pleasantly into the hand with a comfortable

Burning up browst and cutting hedge stakes.

grip. "There's plenty of sticks about the wood," he said . . . "if you've an eye for them, but fewer now grow along the lanes and side roads."

"I used to cut some good ones on my way to work at one time" he told me "but they're not so easy to come by nowadays . . . these mechanical hedge trimmers spoil them . . . the tops get chopped off and they grow forked" . . . "years ago" he went on . . . "when I spotted one that I liked I'd cut around the bark with my knife and decorate it with grooves like 'oney-suckle growing . . . or a snake twirling up round the handle . . . then when it healed over I'd cut it and take it 'ome to shape it up."

"At one time" he said . . . "I'd a master collection in my shed . . . holly . . . hornbeam . . . crab . . . hazel . . . ash crooks and blackthorn thumb sticks . . . I once made one out of ivy . . . but I kept 'em too long and they got the worms in 'em." "Course" . . . he continued . . . "they weren't all straight to start with . . . but I just hang 'em up with a bit of a weight on 'em in the right place or maybe nail 'em to the wall of the shed and they dry out straight enough. Them factory-made sticks be no use . . . they steam 'em to get 'em straight or to bend the 'andle . . . but that's no good . . . get 'em wet or leave 'em in the wet and they go out of line . . . I uses a bit of copper tube for a ferrule, and a 'orse shoe nail in the bottom so it won't wear short too quick."

Asked whether he sold his finished article, he shook his head telling me that he made them for the pleasure that it gave him. "I've entered a few for competitions at the shows at different times" he told me "and I've given a few as prizes for old whist drives, but it's the missus as finds 'omes for 'em . . . she gives 'em away to our visitors if they takes a fancy to 'em." "The best I ever 'ad, though; he reminisced . . . "was one I cut out of a gorse bush . . . now that was a beauty . . . I peeled it and varnished it when it was dry and all the little lines and holes showed up . . . it got everybody guessin' . . . some of 'em said it were a foreign wood . . . I won myself many a pint with it but one night I left it in the corner down at the local and it walked itself off."

"Lots of folk reckon as the proper time to cut a walking stick is in the winter when the sap is down" Joe once told me . . . but he said he didn't agree with that. "Best time to cut it is when you see it" he maintained . . . "might not be there when you goes by again, eh?"

George was another hard-working, lean, sinewy figure. Tough and weather-beaten he had the largest hands that I have ever seen on a human being. "Like a shoulder of mutton with five pork sausages stuck around the edge" one of his mates was once heard to say. His nickname was 'Hungryguts' for he seemed to be continuously eating. I suppose modern psychologists would have called him a 'loner'. He wanted to work on his own, he lived on his own and wished to be quite independent of others. He brought a huge tin of food to work, with him every day. A cottage loaf, hunks of cheese and slices of fat bacon that sparkled with salt crystals. Long lean rashers, home-cured with a hard yellow rind, some of them eighteen inches long. He would grill this bacon on a fork as he sat by the fire at meal times and the rest of the workers would catch the dripping as it ran into the flames.

One of Bill's tricks was to try to distract George's attention and when he was off his guard he would give the toasting fork a sharp knock so that the bacon would fall into the fire.

We all liked to hear George's flow of language when his streaky lengths were frizzling in the ashes. He used to grill cheese on a fire shovel, kippers or herrings sometimes for a change. George was a noisy eater and reminded me of an old foxhound with a bone. He would find himself a quiet spot away from the other men where he could gnaw and grind away without having to talk or be disturbed, giving the impression that he was afraid that someone would snatch his food away.

One day I recall George sitting on a path between two other men, about to begin eating, when he accused one or other of them of kicking his tea can, which stood steaming away beside him. Both denied touching it and as George was about to move off on his own the can suddenly tipped over and upset the contents. It was then seen that by a curious coincidence a mole had chosen to heave a heap of soil out of the earth immediately beneath the spot where George had placed his can, which caused a great laugh all round.

Tom was the gardening expert of the party, and given an opportunity he would lecture us on the troubles that ensued from using too much artificial manure which he confidently stated "Was the root of all evil."

With his back to the fire he would pat his spacious stomach in a fatherly way and then, after blowing his cheeks out and complaining of heartburn, he would unbuckle the wide leather belt which hung round his waist, by a couple of notches, and then allow his corduroys to drop three inches or so to relieve and ease the internal pressure. Tom lived close to Alec and criticised his neighbour's slap-happy way of gardening.

"You know for a bloke who calls hisself a countryman I reckon old Alec's a pretty poor sort of gardener" he would say . . . then after a dyspeptic . . . "Baaaahh" . . . he would continue . . . "he called over to me a night or two ago . . .Tom . . . he says . . . I'm going to give my land a heavy dose of lime this autumn, . . . soon as I've lifted me dahlia tubers and me taters . . . reckon as it'll do it good." "Wallop it on Alec . . . I says . . . can't do any 'arm . . . it'll be the fust heavy dose of anything that you've ever put on it."

Tom would shake his head dismally . . . "trouble with Alec is 'e's too mean to give it a decent dressin' of anything" . . . "basic slag and rainwater is Alec's idea of 'eavy fertilising . . . I saw 'im in the spring makin' an onion bed, . . .Five long rows he sowed altogether and there wasn't enough muck under there to line a thrush's nest."

"Ah . . . but 'e won a fust for cucumbers at the show though didn't he" would say Bill . . . coming to Alec's rescue and to make another argument.

"So 'e might" would say Tom . . . narrowing his eyes and nodding his head . . . "but only with outside jerkins from the frame . . . 'e never 'ad no inside one's or tomatoes at all! . . . 'ad white fly in that tuppeny green house . . . place was sniving with 'em. I gave 'im a tin of Cymag as we use for gassin' rabbits . . . it's powerful stuff. Put a teaspoonful on the damp floor of the green house I told 'im, and in the morning when you open up you'll see all they flies laid out on the floor."

"What 'appened then?" enquired Bill, who already knew the story. "Huh" said Tom . . . "he laid 'em out alright . . . tomatoes cucumbers and all . . . used too much . . . poisoned the air . . . killed everything in the green house . . . fruit . . . blossom . . . the lot . . . all went soft and yellow. As usual you see he wouldn't be told . . . used 'alf the tin . . . 'cos I suppose 'ee didn't have to buy it . . . Ah . . . 'e's a poor gardener."

Yes, these were some of the men that I worked with in the woods. Every one of them a different character and all of them possessing some special skill or craft at which they were better than their colleagues.

What did I learn from them? A good many things. Useful hints of a practical nature that they had learned the hard way. All the artful dodges that working men get up to if not closely supervised. Crafty ways of scamping work if the piecework rate is too low. How to do a job thoroughly. How to do a job badly but to look as though it has been done properly. How to pull the wool over the boss's eyes if he is not up to his job. Dozens of excuses for being late for work and almost as many for being absent.

Most important of all how much work a man could turn out in a day on most operations. In short, all the things that a good forester ought to know that can only be learned in the school of experience.

FOREST UTILISATION

By W. H. B. FORBES

Reproduced by kind permission from "The Forester," December, 1967

In Northern Ireland we are planting many thousands of acres of Sitka spruce. Are we really convinced that this is the correct species? It is a dark sombre foreboding tree and its sole use is for the production of wood.

Would not the use of Silver Birch be a much more attractive proposition? This tree is not only a native of this country but it grows well on our bogs and is an attractive amenity tree which is something very important these days; it can be grown to produce timber, but, what is really important is that it can be used for the production of a very potent birch wine. Just imagine thousands of acres of Silver birch trees being tapped by foresters who would be content with their lot. Worries about promotions, etc., would be forgotten in the manufacture of this very pleasant drink.

Imagine the increase in tourism which would result from the production of such a wine. A new gimmick for the Forest Parks—birch wine on tap.

Before the revolution in Russia, birch sap wine was a very popular drink amongst the peasants. However, silviculture was a word unknown to them and the continuous tapping caused the death of thousands of acres of young birch trees.

With correct tapping, and taking off only one gallon of sap per year, the tree can be used for many years to produce the sap which forms the basis of birch wine. The main precaution to observe is that young birch trees under nine inches in diameter should not be tapped.

The method of tapping is to drill a hole into the bole of the tree at an angle of 60 degrees below the horizontal, in other words, the hole is facing downwards. Into this hole insert a cork, or plug of some type, with a hole drilled through the centre. The depth of the hole in the tree should only be sufficient to hold the plug in place. Into the plug insert a piece of glass tubing to which has been added a length of small diameter rubber hose or plastic tubing and connect it to a suitable glass container placed on the ground. In early March when the sap is rising a free flow will occur and a gallon of sap can be quite easily collected. Once a gallon has been tapped off, remove the tapping plug and insert another wooden plug so that the same point can be used next year. Our tree surgeon could advise us on the proper technique of this operation.

When drilling the tree to insert the tapping plug, care must be taken not to go into the heartwood as it is only on the outer edge that the sap flows freely.

Preparation of the wine

Having obtained the basic ingredient—1 gallon of birch sap—the following ingredients are also required: 2 lemons, 1 sweet orange, 1 lb of raisins, 3 lb of white sugar, 1 Seville orange, yeast and yeast nutrient.

Peel the oranges and lemons, discarding all pith, and boil the peel in the sap for 20 minutes. Add enough water to bring back the volume to one gallon and pour into a suitable container containing the sugar and chopped raisins. This container can be a plastic bucket of some sort. Plastic dustbins are provided with covers and these prove ideal for this operation. Stir until the sugar is dissolved and when the mixture has cooled to about 70°F add the fruit juice and yeast. Cover the container and keep in a warm place until fermentation has quietened. When fermentation has quietened down, strain into a 1 gallon fermenting glass jar and fit an air trap. These containers can be purchased in Northern Ireland at a well-known home brew store in Belfast. Leave the mixture for about six months, then siphon off and bottle. Strong bottles should be used and the corks tied down. The bottles should then be stored on their sides for at least another six months before sampling.

The resulting brew should give great happiness to the manufacturer and would put to better use the birch trees in Northern Ireland. What an acceptable project for the Working Plans Section to prepare a location map of birch in Northern Ireland and its future management.

Perhaps someone can come up with a suggestion for a brew made from the tapping of Sitka spruce trees.

"The Forester" Editor's note:

The following are two recipes for Spruce Beer:—

Essence of Spruce—½ pt.
Pimento and Ginger (bruised) 5 oz. each
Hops—½ lb.
Water—3 galls.

Boil the whole for 10 minutes then add 12 lb of moist sugar and 11 galls. of warm water; mix well and when lukewarm add 1 pt of yeast. After 24 hours fermentation place in bottles.

Sugar—1 lb.
Essence of Spruce—½ oz.
Boiling water—1 gall.

Mix thoroughly and when nearly cold. Add one-half wine glass of yeast. Bottle next day.

Neither writer gives any recipe for the production of Spruce essence but an old American book gives the following:—

Deodorized Alcohol—500 parts
Proof Spirits—400 parts
Oil of Spruce—50 parts
Carbonated Magnesium—50 parts
Colour with Caramel

This may be the Essence of Spruce referred to by other writers—if so, it would appear to be a remarkably potent mixture. Here again no recipe is given for the production of Oil of Spruce.

The spruce referred to in the first two recipes is Norway Spruce. In the American one it could be presumably any species. This would surely be a field for experimentation. If tapping of spruce trees is involved it could be explained to irate timber merchants that woodpeckers had taken up residence in Northern Ireland, or, alternatively, that the holes represent experiments being carried out by our Research Officer in the reduction of timber weight.

It is interesting to note that great minds run in similar channels as Christmas approaches. Readers who receive *Entopath News* will have read an article on beer making which puts forward similar economic reasons for indulging in this pastime.

WOOD AND THE HOMEMAKER

By FOREST PRODUCTS LABORATORY, U.S. FOREST SERVICE

Reproduced by kind permission of the United States Department of Agriculture

Let me take you on an imaginary abbreviated day of a homemaker, and on the way, point out some of the subtle services that wood or wood products perform for her and thus aid her with her daily work and add to the enjoyment of her daily activities.

First let us consider that our average homemaker has a house built of wood, for it's a fact that every 9 out of 10 American homes are made of wood construction. Our homemaker is pleased with her house because it performs so well for her. Consider that each 1 inch of wood in its construction is equal to 12 inches of concrete in insulation value—in the summer months wood insulates against the heat of the flaming sun; in the winter wood retains the warmth generated from within her home, and shuts out the icy wrath of those arctic winds.

In her home construction are many materials that appear to be made from something other than wood, but wood products can be used in such a multitude of ways that only a Sherlock Holmes could detect them. For example the shingles may be the composition type referred to as an asphalt shingle but, like many of the wood products of today that appear to be made of other basic raw materials, the asphalt shingle actually contains more wood fibre than does the conventional wood shingle.

Yes, traditionally, the American homemaker prefers her home made from wood, even to the interior with beautiful wood floors, and natural wood panelling and trim.

When she bounces out of bed, little does she realise that the sheets on her bed were woven with a dogwood shuttle and the picker sticks that throw the shuttles back and forth in the loom are just one of the hundreds of specialized wood products created by the U.S. Forest Products Laboratory. She might then put on a rayon robe which was produced from wood cellulose. Even her nylon hose could be made with the aid of furfural, a chemical that can be derived from wood. On her feet, her shoes will probably contain wood fibre insoles and most likely wooden heels.

After her morning coffee, which is another product of the tree, our homemaker has some time to do a little primping by fussing with her hair, maybe even using a little spray, which by the way, contains galactin, a product extracted from the larch tree. She will remove the remnants of the face cream she applied the evening before with a facial tissue made of softly buffed wood fibre, and maybe retouch her fingernails with liquid nailpolish based from wood.

Back to the kitchen, she prepares the morning orange juice which comes from the orange tree and is packaged and frozen in a wood fibre can; she then removes the strips of hickory-cured bacon from their cellophane wrapper, also made from wood, and the eggs from the moulded wood-pulp container; the butter too, has been protected with a special greaseproof paper made from wood.

In setting the table she places wood-fibre paper napkins at each place. As a convenience, she uses absorbent paper towels, from wood, to wipe up any spills from the linoleum floor which contains, as a component, wood flour.

With breakfast over and the family off to school or work, it is a good time to have that second cup of coffee with a wee bit of cream from a wood paperboard milk container. Then a cigarette made of tobacco cured by a wood burning furnace, filter tip made of wood cellulose and activated wood charcoal, and a simulated cork tip made of paper. To light her cigarette, our homemaker uses a paper match, match and cover both made from wood.

We could help our imaginary homemaker get over the chore of washing the breakfast dishes as soon as possible by mentioning that she could use a modern sponge made of wood cellulose to do this job.

The water from the taps is pure and clean, thanks to the Forest Service National Forest where the water originated; proving again that wood plays many roles in our daily lives.

Maybe the next thing to be accomplished is the morning baking where she will use a wood spoon to blend the ingredients, a wood rolling pin to skillfully make that tender flaky pie crust and, of course, she will use vanillin for the flavouring. Vanillin is a wood product derived from lignin residue accumulated in the pulping process, and is used by practically all manufacturers of ice cream, candy, and baked goods. Our homemaker will be working on a modern counter top of laminated paper plastic. Modern homemakers, in the most part, have had their "fling" with metal kitchens, and are swinging back to wood for kitchen cabinets. Each individual piece of wood has a beauty, warmth, and a grain pattern all its own. Being a normal homemaker, our homemaker likes things that retain their individuality; so, she prefers, and has, a wood kitchen.

Her wood kitchen also has a hidden safety factor, wood does not conduct electricity—an ever important factor with small children often playing in the kitchen and a multitude of electrical appliances on every counter.

After completing her morning chores, she must leave to do the weekly shopping. The car she drives has tyres reinforced with wood-based rayon cords and rubber from the rubber tree, or synthetic rubber made from ethyl alcohol, a product of wood hydrolysis. The interior of the car contains moulded fibre door inserts, and plastics based from wood are predominant on the instrument panel.

On her way to the supermarket, she may stop to have the oil in the car checked and if a quart of oil is needed, undoubtedly it will come from the new type of can made from a paper product. Even the frames of her sunglasses, protecting her eyes, are made from a wood product.

Around 90 per cent of the items she purchases at the supermarket are packaged in wood products. Many of the items are actually wood products—tissue paper, toothpicks, clothes pins, napkins, towels, and of course, many other items on a list that could seemingly go on forever.

Our homemaker pays her bill with paper money, or writes out a check using a pen made of wood-based plastic. She exchanges her money for trading stamps, and of course, all of her goods are packaged in kraft paper bags; all of these products coming from our omnipotent friend—the tree.

One of the highlights of any homemaker's day is a cookout with food prepared on a charcoal grill using a charcoal of hardwood along with green hickory chips to add flavour to the sausage she is cooking. No doubt the sausages are enclosed in wood cellulose casings. The salad is prepared in a wooden bowl and tossed with a wood spoon and fork.

She loves the cookout, and can thoroughly enjoy it because there's little mess; most of the items can be thrown away. Items like paper plates, paper cups, napkins, tablecloth, wood forks and spoons, are purchased at little expense and can be discarded after the cookout, eliminating the chore of washing dishes.

In the evening our homemaker relaxes by the fireside, capturing the warmth of a birchwood fire, listening to soothing music from her hi-fi, enclosed in a finely crafted wooden cabinet. The recording she hears is made of wood-based plastic. Or, her fancy may be listening to the radio or watching TV, and not to press a point, they're both probably operating on electrical circuits printed on a special paper laminated plastic based from wood. We have watched only a few segments from our homemaker's busy day, since her days are rather long but you can be assured that in one way or another a wood product will have had a prominent place in all of her activities.

Now our homemaker retires for a good night's rest, or should we say "saw some logs," and as she dozes off, she's probably not thinking of the part wood has played in her day; but if you were to ask her she'd say that wood is truly a homemaker "Every Board Foot a Homemaker".

FOREST AUDIT

In a wooden forest office
Three yards long by ten foot nine
Sit two senior civil servants
Checking paylists line by line.

Errors here are soon detected
Details must conform with Code
H.Q. staff with red ink ball-points
Auditors from Priestley Road.

Ledgers stacked upon the table
A. 100's, S. 3 a's
Tally sheets compared for piece rates
Overtime and holidays.

Eyebrows raised, a pointed question
To the forester in charge . . .
"This cash balance . . . TEN AND SEVENPENCE
Don't you think it rather large?"

Forester explains his actions
"Had a fire on Saturday
Ate my lunch at half past five and
Lloyds Bank is twelve miles away."

Scrutinising Produce Records
Posts and pitprops, stakes unpeeled
"Let us take a random sample
We must go into the field."

So they don their rubber knee-boots
Drink a hasty cup of tea
And proceed in Green Land Rover
To Compartment forty-three.

There with scribe and timber crayon
Counts begin on numerous piles
Stacked along the rides and roadlines
Stretching over twenty miles.

Volume up on pulp and lagging
Down on rustics, props and stakes
Hoppus feet on stock deficient
"Please explain these strange mistakes."

Forester describes position
"Ganger Buggins has ill health
Gyppos steal my props for firewood
I can't catch them by myself!"

"Schoolboys heave stakes in the river
Tourists take poles at weekends
Pinch my larches for their arches
Nearly drive me round the bend."

Auditors are sympathetic
Reconversion puts things right
Buggins trusted, books adjusted
Everyone sleeps well at night.

R. J. JENNINGS

MISCELLANEOUS

A REMINISCENCE FROM GEORGE B. RYLE FORMERLY DEPUTY DIRECTOR GENERAL

1. EAST ENGLAND

When I joined the Forestry Commission on a Friday, 13th October 1924, I reported to Divisional Officer A. P. Long, who occupied a two-roomed office in Rothsay Road, Bedford. He and I shared one room. As there was only one desk and one chair, I did my work standing at a map-press. The other room was shared by the Chief Clerk, Childs, who died a few years ago, and a typist, Miss Finch.

The Division stretched from Ampthill in the South to Allerston in the North and included also Hazelborough, Brackley, Salcey, Swaffham (including Didlington) and Selby. Clipstone (now part of Sherwood) came in very shortly afterwards and Laughton about the same time. I remember Laughton well because we were in sore difficulty about housing Forester Tribe who had, I believe, seven children and Laughton had a large old house in the middle of the area. Several of the young Tribes became Foresters.

Thetford Chase was not included in this Division I. It was run from London as Sir William Taylor's special responsibility. Though he was then spending most of his time as Acquisition Officer for England and Wales, he also had time to run his Division 5 which comprised Rendlesham, Chiddingfold, Bramshill, Thetford Chase, Bedgebury, Alice Holt and Woolmer (now War Department property).

From Bedford, Long was permitted to visit his nearby forests in a car, but for Selby and Allerston we had to travel by train to the nearest town and then hire push bicycles to get to the forests! I was small fry and had to use push bike normally. Bedford to Brackley was a pleasant run!

2. OTHER CONSERVANCIES

As regards the other Divisions, as they were then called, my earliest reference is the 1925 *F.C. Journal.*

Division I.	As above.
Division II.	North Wales. D. W. Young was there in 1924/5 but was replaced by O. J. Sangar, probably in 1925 on the former's promotion to D/S Dean.
Divisions III and IV	had been combined in 1922 under the Geddes Axe and thereafter comprised South Wales and South West England with its Divisional Officer, C. O. Hanson in Exeter.
Division V.	Was the London Division as above. A. L. Felton followed Taylor who became full-time Acquisition Officer.
New Forest	Was just on point of transfer from Leese to L. S. Osmaston, cousin of our man now in North Wales and father of the Oxford lecturer. He is still alive in his late/middle 90's and lives near Canterbury.
Forest of Dean	Was on the point of being transferred from Osmaston to D. W. Young.

Then at H.Q. we had Robinson as the Technical Commissioner and Big Chief, W. H. Guillebaud as Research Officer and Fraser Story as Publications Officer. Lord Lovat was Chairman. Every day at 4 p.m. the telephones rang as a summons for the Secretary (Herbert) and all the professional staff to gather in the room of Lovat's secretary, Miss Ingram, for tea and biscuits. This was a nice habit which should have been perpetuated on a delegated system!

The Assistant Commissionership for England and Wales had just been taken over by H. A. Pritchard from Sir Hugh Murray, who became a Commissioner. Pritchard had a great love for Thetford.

My own sojourn in that Bedford Division was short-lived. After my probationary year (one year in those days) I was soon transferred to H.Q. as Working Plans Officer and remained there for a couple of years. I was however retransferred to Long's Division in 1928. The office had then moved from Bedford to Santon Downham and the boundaries of the new Division were, I believe, very much the same as East England Conservancy is today, but including also Notts and Derbyshire. However, my second stay under Long was of only a couple of months' duration. Having had Bridge House re-decorated, got fitted carpets and curtains made for it and having rashly embarked upon matrimony (without the Assistant Commissioner's consent), I was suddenly moved to Tintern to take charge of the South Wales District. From then until 1948 I was a Welshman and naturally lost contact with East Anglia.

When I came back to Santon Downham in 1928 there was another District Officer stationed in Nottinghamshire by name of D. C. D. Ryder. He also left the F.C. quite early having had "Pritchard trouble" about taking all his leave on Saturday mornings to enable him to play Rugby for Blackheath!

Memory is fickle but I think most of the above is correct.

G. B. RYLE
2nd March, 1965.

WITH NATURE IN THE MONTH OF MAY

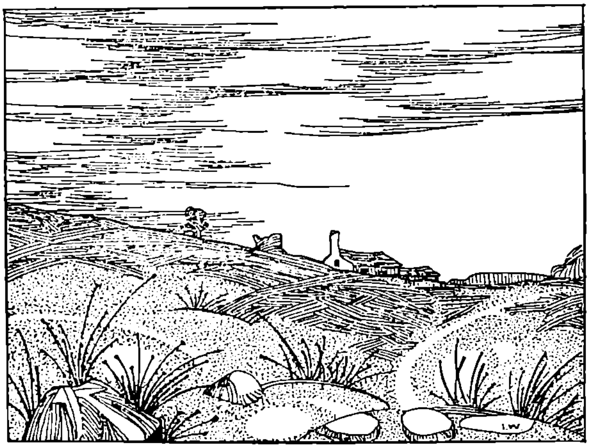
By R. J. JENNINGS
Chief Forester, South Wales

"Far on the forest-skirts where non pursue."
Matthew Arnold: The Scholar Gipsy.

Anyone wishing to spend an interesting day amongst trees could do no better than come to Wales, for it is a land of woods and forests. Travel where you may and you will see trees. Oaks in the valleys of Caernarvonshire, ash in the rocky ravines of Merioneth; rowan and hawthorn in the hills of Cardigan and Montgomery. Even the loneliest old farmhouse on the wild Denbigh moors has a gnarled sycamore standing like a sentry at the side of the barn.

As a small boy I was fascinated by woods and thickets where dry twigs crackled underfoot, and I had an irrisistible urge to explore the mysterious silence of the dark spruce plantations, the dense hazel coppices with the magic perfume of fresh green growth where bees and insects hummed. But best of all I liked searching for birds nests in the brambles and leafy bushes on the edges of the wood, where tree creepers might be seen scuttling around the rough fissured bark of the old oaks like feathered mice, and a startled squirrel would bounce out of the undergrowth to make a frenzied dash up the ivy-covered trunk of an ancient beech, and where on rare occasions wild orchids were to be found.

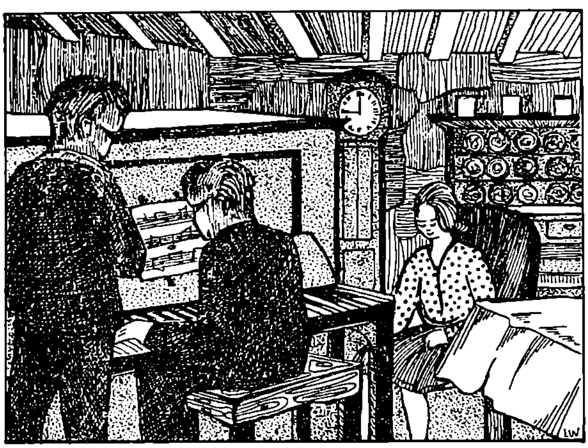
Now, forty years later I still live and work in the woods, and today with a fine clear sky and the woolly cumulus clouds sailing over the top of Mynydd Eppynt like giant cauliflowers I set off to walk the boundary of a block of plantations forming part of Crychan forest in Breconshire where spruce and pine trees grow.



A moorland waste.

Climbing over a stile by the side of a derelict farmhouse I begin the long trek around the fence to inspect the condition of the wire netting between the woods and adjoining moorland waste. An old corner post is sited a few yards from the abandoned kitchen garden and after thirty years an apple tree which grows there still bears blossom.

Beneath the gaping window of the dairy is a flowering currant and as I admire the delicate pink blooms I visualise the scene here many years ago when clumps of daffodils grew beside the front door, white geese and ducks pattered busily about the farmyard and the round iron cauldron that now lies cracked and half-buried by the wall of the pigsty hung on a hook and chain above a glowing peat fire that smouldered slowly in the black barred grate.Through the window might be heard the strains of music and voices practicing penillion singing.



Practising penillion singing.

Swallows and house martins flying in a wide arc between the barn and the back of the house would pause occasionally to swerve up to their nests in the eaves.

But there are no martins here today for the roof of the house has long since collapsed and the chimney stack is the home of a colony of jackdaws that rise with raucous cries of alarm, startled by the unusual clatter of my nailed shoes as I stumble over a heap of broken glass and shattered slates. A brisk walk of a few hundred yards from the farmhouse and I am stepping through tufts of rushes, blue moor grass and heather on the mountain.

There is not much wild life to be seen on the exposed eastern boundary of the wood. A wheatear skims silently over the hillside and perches on a heap of grey shale. Here the bird is camouflaged and almost invisible amongst the boulders except for the gay conspicuous white flash beneath its tail. In the distance though I can hear the harsh 'kok . . . kok' of a raven and the bewitching bubbling cry of the curlew.

Pausing for a moment at the top of the bank, I see a hole in the fence and in the soft ground the hoof prints and marks of trespassing sheep. There is wool on the rough spruce twigs and I follow the tracks into the wood, scratching my face on the branches as I go, for spruce is a prickly tree to face in its youth. Stepping quietly out of the plantation on to a ride, I look to my right and there grazing on the lush green sward are eight sheep and five lambs.

How fat and well they look! I notice that they have no coloured raddle or pitch mark on their flanks or rumps and this indicated that they have probably been running wild in the woods all through the winter. Sheep cannot be allowed to graze in the young woods as they damage the leading shoots of the newly-planted trees; and of course no farmer would wish his animals to remain in coniferous plantations as the needles that fall from the pines collect in the wool which lowers the value of the fleeces.

The moment that the creatures see my movements they are off into the woods like deer. No wonder either! Here they have plenty to eat and live a fine life away from the rest of the flock. They have no inclination to rejoin their companions to be harried by sheep dogs. As they disappear into the wood I see the wool hanging from their backs in great tufts and gouts as though they had escaped from the grip of the shearers when half-shorn.

But there are risks in this care-free existence, for foxes are numerous in the hills and a newly-born lamb is easily taken, particularly if it is one of twins. However, foxes are cunning creatures and hesitate to kill on their own doorstep. Though their own litter may be reared in the wood they seem to sense that they attract less attention to themselves if they go further afield for their dinner.

The ride in which I am now standing is of some historical interest for it runs along the course of the old Welsh Drovers' Highway. At one time it was a busy thoroughfare from Carmarthen to Hereford. It was used by the cattle men of a century ago to drive their beasts across country on foot to London to the Smithfield market.

Although the herdsmen and drovers have not passed this way for more than a hundred years, the deep green colour of the grass is still visible, marking out the track where the bullocks trod. The last time I walked this way I picked up a small iron half-moon shoe, bored with holes, which a knowledgeable farmer told me was one of the type used and fitted by the blacksmiths to the hoofs of the oxen before they were driven off the mountain tracks on to the hard roads.

Climbing over the fence to leave the wood I notice that in one place the galvanised wire is quite shiny some eighteen inches above ground level, and a closer look shows brown hairs attached to the nearby heather twigs. This is where a fox has a run through the wood and his constant journeys squeezing through the wire have resulted in his fine coat polishing the metal.

By midday I have travelled more than half-way around the area and after choosing a comfortable spot in the sheltered side of a bank I eat my lunch on the highest point of the hill. Below me facing west I can see the River Irfon curling its way through Llanwrtyd Wells towards the Wye near Builth and in the further distance the rocky road twisting and turning over the Cambrian mountains where Breconshire, Cardiganshire and Carmarthenshire meet and the River Towy rises—a land of mist and cloud which must surely be one of the most desolate and silent spots in Wales.

Everything around me now is perfectly still and quiet except for the sad mewing cry of a buzzard soaring across the valley on outstretched wings, and close at hand the occasional "tic . . . tic" and sweet little trill of a small bird. In a moment or two it puts in an appearance. It is a robin, though I am unable to distinguish its sex, for despite popular belief both cock and hen have red breasts and identical plumage.

Robins are quick to locate human beings and make friends and whenever you halt for a few moments in the woods you will have one for company. As one old poacher once said to me of the village constable . . . "You can't keep out of his sight for long . . . might as well try and hide from a robin."

My visitor surveys me from the twig of a birch tree, and with his head cocked inquisitively on one side and his black beady eyes shining, he stands motionless like a red-coated guardsman on duty at Whitehall. Then uttering a few liquid notes and with a flirt of wings the bird swoops to the ground to pick up a crumb of cake that lies on the earth beside me. As he darts back to his observation post the words of W. H. Davies, the Welsh poet, come to my mind . . .

"Yes I will spend the livelong day,
With nature in the month of May,
And sit beneath the trees and share
My bread with birds whose homes are there."

As I resume my journey again along the northern boundary, I catch sight of a tiny inert bundle of brown-and-white fur lying on the ground. Picking it up I see that it is the corpse of one of our smallest mammals, the common shrew. This animal, whose whole body from head to tail measures less than four inches, lives on insects, woodlice and minute snails. They are continuously on the hunt for they consume three times their own weight of food daily and should they fail to eat they will die of starvation in a matter of a few hours.

It is not often that we see dead creatures in the woods or fields. Although many come to grief on the roads, most wild animals die a natural death. We seldom see them where they lie because, like human beings,when they feel unwell or feeble through age, injury or disease they have an instinctive desire to be quiet, so they steal away from their fellows to lie down peacefully and rest; and when they finally grow drowsy and fall into their last deep sleep it is usually in a remote corner of the woods where the grass, wild flowers and falling leaves conceal them.

I am now travelling downhill where the woods rub shoulders with cultivated farmland, and as I cross the stone footbridge near the grey stone farmhouse of Nant Garw I see several roots of primroses growing on the bank. The primrose is a woodland plant and where I am now walking was probably at one time part of an ancient forest.

This is a country of high rainfall indicated by the prevalence of moss and lichens. Every post and stake is capped with a dainty wig of delicate greeny yellow threads. A pretty sight against the deep glaucous colour of the sombre spruce.

An hour or so later I am nearing home, having walked right around the perimeter of the plantations.

So ends my journey. It has been pleasant in the woods and I haven't seen a human being or heard a man-made sound. My day with nature in the month of May has been spent with the wild creatures and a robin for company.

The grey stone farmhouse of Nant Garw.

THE BASIC PRECAUTIONS FOR MOUNTAIN SAFETY

The following precautions have been approved by the British Mountaineering Council and the Central Council of Physical Recreation.

1. Wear BOOTS (NOT shoes), either nailed or fitted with rubber mountaineering soles (Commando, Vibram, etc.).

2. Have plenty of warm clothing, especially wind- and rain-proof outer garments (jacket or anorak WITH HOOD, and over-trousers). Never wear jeans: when wet and subjected to a cold wind they are liable to cause "exposure" (hypothermia)—a dangerous and often fatal condition which can occur AT ANY TIME OF THE YEAR, EVEN IN SUMMER.

3. Carry map and compass, AND KNOW HOW TO USE THEM. Also take watch, whistle, torch, small first-aid kit, and one or two spare long-sleeved pullovers.

4. Have a reserve supply of food in case of emergency (chocolate, mint cake, biscuits, glucose tablets). A hot drink in a vacuum flask is strongly recommended.

5. Plan walks carefully. Do not overestimate your physical ability. Study routes and allow enough time to be back well before dark. This is especially important when daylight hours are limited.

6. Check weather forecasts. Keep a constant look-out for changes. On high ground, mist and rain can close in with alarming speed.

7. Do not hesitate to turn back or cut a walk short if the weather deteriorates, or if the route is too much for you or for one of your companions. "Pressing on" is folly, not pluck, and it can have disastrous results. STAY TOGETHER AS A GROUP AND ACCEPT ALL DECISIONS BY THE GROUP LEADER.

8. ALWAYS LEAVE WORD WHERE YOU ARE GOING, AND WHEN YOU EXPECT TO BE BACK. Tell someone at the place where you are staying,

or leave a note on the seat of your car. A search party has little hope of finding you if no-one knows where you went. Remember to report your return.

9. Keep to your planned route as far as possible. If for some reason you cannot return to base and have to spend the night in other accommodation, TELEPHONE EITHER THE POLICE, OR THE PLACE WHERE YOU ARE STAYING AND EXPLAIN WHAT HAS HAPPENED. Failure to do this PROMPTLY may result in search parties spending many wasted hours (and risking their lives) looking for you.

10. KNOW WHAT TO DO IN AN EMERGENCY (e.g., accident, illness, or being overtaken by bad weather or darkness). FIND OUT by reading the booklet *Safety on Mountains*, published by the Central Council of Physical Recreation, and the Mountain Rescue handbook, published by the Mountain Rescue Committee. Both are obtainable from most climbers' shops.

11. NEVER VENTURE ON TO SNOW AND ICE until you have FIRST learned the special techniques for dealing with them, and how to use rope, ice-axe, and crampons.

12. Always remember that on British hills BAD weather is NORMAL and good weather the exception. In other words, meeting bad weather is never "bad luck"—it is merely good luck when it is fine. So play safe by being fully prepared with proper clothing and equipment. It's YOUR life!

LINES TO HONOUR A FIFTY YEAR ACHIEVEMENT BY THE FORESTRY COMMISSION

By D. L. SHAW
Forester, North Wales

HAIL!

Achievement, with a purpose born of need—
To restore this Nation's gravely drained resource;
A haunt of kings, a fount of British might
Depleted by the need to counter force.
A fifty-year creation restocks our ancient land
Fulfilling, in broad splendour, much of Britain's wide demand.

HAIL!

Five decade's growth invests the ancient hills
Uplifts serrated form o'er lonely moor.
Clothes rugged slopes and shelves of fissured rock
Spreads, sighing, to the vacant farmhouse door.
And cradling, in tender, close embrace
The lowland hamlet, quaint with pristine grace.

HAIL!

Take pride in these our forests, secure them well;
Their creation spans the flow of fifty years.
Endeavour, trial and study stamp their course
From seedling growth to ripening forest tiers.
Take pride! Within these confines is narration—
Of man's dedicated service to his nation!

HAIL!
Two hundred seasons can chronicle this feat!
And fifty springs have come and gone, awakening the bud,
Renewing Nature's cycle with never failing pulse.
Long summer days have fled on sunshine's lustrous flood.
The guise of autumn tints revive a splendour all too brief
And winters frost-clad pageant recalls woodlands veiled in grief.

HAIL!
Prospects of visual charm enhance the dwindling rural scene
—From Dunnet, in Caithness, to Land's End's blustery shore
From Preseli's lonely fastness to Aldewood in the east
Our forests straddle landscapes alleged as infecund before.
A heritage for ageless youth!—and those as yet unborn,
Ah! amber-littered forest aisles—your crown is proudly worn!

HAIL!
Let us respect, and not neglect, those men who laid foundations.
Long pioneer days of trial endured with patient skill
Out of the seed the forest grew—replete with tales and legends
Of men of courage, patience too, who practised on the hill.
Many praise, are with us yet—and for those who are departed
What greater tribute—these our woods—which they so zealously started?

HAIL!
Then let us celebrate these fifty years of function;
Distinguish proud achievement in this year of Jubilee.
And observe we are united, for in honour and esteem—
A Prince of Wales will be proclaimed with Royal Pageantry!
Grow on then noble trees, grow on—your spell has never fled
Lead on proud forest service—the century lies ahead!

CENTENARY OF THE CUTTY SARK

By EDWARD CROWLEY
Lloyd's Register of Shipping

'Whene'er to drink you are inclin'd,
Or cutty-sarks run in your mind,
Think, ye may buy the joys o'er dear,
Remember Tam o'Shanter's mare.'

Robert Burns

With the witch Nannie in hot pursuit, Tam just made it over a running brook (witches can't cross running water) but his horse was somewhat mutilated in the process and left its tail in Nannie's outstretched hand. Burns' strictures on the perils of drink and the cutty sark (or short chemise) may savour of cost-benefit analysis, but his poem provided the name for one of the world's most famous clipper ships and the figure of Nannie clutching the remains of the unfortunate animal's tail was the figurehead which adorned the underside of the bowsprit.

The Cutty Sark, now on permanent display at Greenwich, was a splendid example of the composite-built sailing ship—a tall, beautifully rigged clipper with 32,000 square feet of canvas which enabled her to log 17 knots when 'cracking it on' with a fair breeze.

Yet she was, if not an unlucky ship, certainly an unfortunate one in some respects. Built for the China tea trade and designed to work the trade winds and to round the Cape of Good Hope, she was rendered obsolescent for her destined calling even before she was launched on November 22nd 1869. The Suez Canal was opened a few days earlier and this event provided the new-fangled steamships with a much shorter route to the Far East, so that by 1877 almost the whole of the China tea trade was carried by steamships.

For her builders, Scott and Linton of Dumbarton, who had previously built nothing bigger than a schooner, her construction spelled financial disaster. On a voyage in 1880, the death of a coloured seaman at the hands of the chief mate, led to the latter's appearance at the Central Criminal Court on a charge of murder and to the suicide of the Cutty Sark's master, Captain J. S. Wallace.

Nevertheless, the Cutty Sark is unique among the great tea clippers in having survived into modern times. She is a relic of an era of great competition for a specialised cargo which led to considerable risks being taken commercially by owners and at sea by tough, hard-driving captains.

In the heyday of the clippers the annual race from China with the first teas of the season was a sporting event for anyone connected with shipping and huge sums were wagered on favourite ships. Apart from the top prices obtained for the cargo, the winning owner stood to collect a small fortune in stake money, while his skipper consolidated his professional reputation for all time. Captain John Willis, a Scottish shipowner with offices in Leadenhall Street and a member of Lloyd's Register Committee, never had any luck with his ships in the race from China and was determined to build a clipper which would outclass even the Thermopylae, which in 1868 made a record-breaking maiden voyage to Melbourne.

The man Willis chose as his designer was Hercules Linton, son of a Lloyd's Register surveyor and a naval architect and shipbuilder of great ability. Linton had formed a partnership with William Dundas Scott-Moncrief who was a civil engineer and who, amongst other things, invented a mechanically propelled tramcar powered by compressed air. They set up as Scott and Linton, building ships at Dumbarton, and soon established a reputation for turning out fast and beautiful vessels. Willis calculated that the young partnership might be prepared to quote him a favourable price for the chance to show what they could do with a large ship. He was right in this and the agreed price of £16,150 for the Cutty Sark (or about £17 per ton) proved to be the undoing of the small firm. They ran out of ready cash before she was completed and called in Denny Brothers to finish her. The partners never recovered from this setback and went into voluntary liquidation in 1870.

Was 'Old White Hat' Willis so pleased with the price he negotiated and the prospect of glory in the City as the owner of a winning tea clipper that he failed to note the significance of the impending opening of the Suez Canal?

One thing was certain, he had a good ship for his money. The Cutty Sark was surveyed by Lloyd's Register and placed in the 16 A1 class. The survey report noted that she was built with teak decks and with keel, stem and stern post also of teak. Her outside planking was of rock elm and teak and the inside planking was of red pine. As a composite ship she had beams of bulb and angle iron. Her scantlings were heavier than her rival of almost identical size, the

Thermopylae, and the relative strength of the two ships is often debated. However, the Cutty Sark is still with us, whereas the Thermopylae lies fathoms down off the coast of Portugal.

The Cutty Sark performed best under a strong breeze and with a real 'driver' as captain. Her maiden voyage to Shanghai was plagued by lack of suitable winds and her captain, George Moodie, was not the one to get the best out of her. Passing the Downs on 15th February 1870 it was not until the 1st March that Moodie was able to set his sky-sail and royal stay-sails on picking up the first of the North East trades. After lying becalmed on the line he eventually picked up the South East trades but soon ran into flat calm. Moodie wrote in his log, 'Calm! Calm! Calm! Sea like a mirror.' She reached Shanghai 104 days out on 31st May and after unloading started taking on new teas at £3 10s. 0d. per 50 cubic feet. She was the first tea clipper away from Shanghai in 1870, crossing the Woosung bar on 25th June and entering the Thames on 13th October. It was the best passage from Shanghai made that year and although Captain Moodie and John Willis were disappointed with the actual time of 110 days they were satisfied that they had a vessel which could beat the Thermopylae or any other ship in the China trade.

From the 18th to the 24th October the Cutty Sark underwent the first of many annual surveys by Lloyd's Register and in Green's Upper Dock and East India Docks her yellow metal sheathing was repaired. Samuel Presions, the Lloyd's Register surveyor, recommended retention of class 16 A1.

It was not until 1872 that the Cutty Sark was able to match her speed against the Thermopylae. The two ships loaded together at Shanghai and sailed from Woosung on the same day, the 18th June. Sailing south down the China coast, round the north coast of Borneo and through the Sunda Strait between Java and Sumatra, the two ships kept fairly close and the Cutty Sark made several sightings of the Thermopylae. But once out into the Indian ocean the Cutty Sark picked up the strong trade winds and forged ahead. By 7th August she was off South Africa and 400 miles ahead of the Thermopylae. Here her luck deserted her. On the 13th and 14th Moodie encountered a tremendous sea with the wind from the west which developed into a hard gale with howling squalls. On the following day a heavy sea broke under the stern and tore the rudder from the eye bolts. Captain Moodie tried a spar over the stern but was unable to steer the ship with it. The owner's brother, Robert Willis, who was on board, pressed Moodie to make for the nearest South African port but Moodie declared for a jury rudder. A spare 70 ft spar was cut into three parts and fitted. This took a week and while the Cutty Sark was hove to, the Thermopylae made the most of the prevailing strong winds and passed round the Cape.

Nevertheless the Cutty Sark made the Thames by the 18th October in 54 days from the Cape, an extremely good performance with her jury, and this brought her time from Shanghai to 122 days. In the arguments which ensued the captain of the Thermopylae insisted he was ahead at the time the Cutty Sark's rudder was lost but on being challenged he refused to yield his log book for inspection and it was generally conceded that the Cutty Sark would have beaten the Thermopylae but for the mishap.

Lloyd's Register carried out a survey of the damage at Green's Lower Dock and South West India Dock between the 29th October and 20th November and the Society's surveyor, Henry T. Tyrrell, noted, 'Repairs: Now done on account of loss of rudder. Placed in dock for examination. Rudder renewed. Main piece with English oak. All new pintles fitted and one brace on stern posts. New iron flange and revolving hoop fitted to rudder head and steering gear refitted and made good. New head rails and timber on port side.' Tyrrell recommended retention of the 16 A1 class. The Cutty Sark continued in the China tea trade, though in 1875 her creditable 108 day passage from Shanghai lost some of its lustre alongside the 42 days taken by the steamship Glenartney via the Suez Canal. By 1877 the clippers could no longer operate profitably in the once lucrative tea trade. It was in 1877 that the Cutty Sark nearly came to grief in the great November gale of that year. She left London for Sydney on the 3rd November and encountered a strong South West wind, thick rain and a falling barometer in the Channel. In company with many sail and steam ships she ran back to the Downs and sheltered there. As hurricane-strength winds developed, cables parted and many of the 60 ships at anchor started drifting. At night, blue lights, flares and rockets were to be seen in every direction and a large steam ship was on the Shingles, firing guns and burning distress flares. Five ships went ashore in Pegwell Bay, a large barque sank off Broadstairs and another was stranded on the Goodwins. Margate was full of dismasted coasters. Amid the turmoil the Cutty Sark's cable parted too and she fouled a brig on her port bow and then hit another vessel with her starboard side. Tugs eventually took her in tow and got her to East India Dock where Lloyd's Register surveyor J. W. Scullard carried out a damage survey. Extensive repairs were carried out and a diver went down to look below the waterline. 'Sir', he reported in writing, 'I have examined the Bottom of the ship Cutty Sark and all that I could find the matter with her, there was a few sheets of Copper off amidships on the Port Side of the Bilge which I have replaced and now that the ship is all right.—R. Arnold, Diver.'

The salvage tugs were awarded £3,000 and in the wake of the gale lawsuits were scattered around like autumn leaves. John Willis, owner of the Cutty Sark, was sued for damage by the owners of a ship damaged by collision during the gale but the case against him was dismissed through lack of evidence. It is said that, during the gale, the Cutty Sark's carpenter found a piece of the name board of a vessel lying on the deck of the Cutty Sark, where her bulwarks had been stove in, and thoughtfully slid the evidence overboard. If he did, it saved Willis a lot of money.

The Cutty Sark won her greatest fame as an Australian wool clipper under Captain Richard Woodget in the 1880's. Taking over command in 1885 Woodget took the Cutty Sark from East India Dock to Port Jackson in 77 days. On his return trip from Sydney to the Channel he took 67 days, beating his rival the Thermopylae by 12 days. The Cutty Sark had proved her right to be considered the fastest ship in the wool trade, which in the eighties meant the fastest ship in the world.

In 1895 the twenty-six year old ship docked at London with a record cargo of 5,304 bales of Australian wool putting her two inches below the Plimsoll line and Captain Woodget learned that she was to be sold to J. A. Ferreira & Co., a Portuguese firm. Her last voyage in the wool trade had taken 84 days.

After a condition survey at Amos's Dry Dock due to the new ownership and change of name to Ferreira, Lloyd's Register surveyor W. Morrison recommended retention of the 13 A1 class she had been given in 1888. Her new master was Sebasteos dos Santos Pereira. One of the signs of the times was the appearance of a letter, in connection with the survey, which was done on a typewriter.

As the Ferreira, the Cutty Sark sailed the world for another 25 eventful years after which she was acquired by another Portuguese firm and renamed Maria do Amparo. In 1916 she was dismasted in a gale off the Cape of Good Hope. Finally the late Captain Wilfred Downman bought her from the Portuguese in 1922 and had her towed to Falmouth where she was used as a full-rigged training ship. In 1954 she came to her present resting place at Greenwich. Though she ended her commercial career under the Portuguese flag her crew always referred to her as 'El Pequina Camisola'—the little chemise.

MIKE SMITES: TRIPS THAT PASS OUT OF SIGHT

From British Columbia Lumberman, 1923, and reproduced by kind permission of that journal.

Actual letters from the files of a firm concerned with big timber in the Sitka spruce/Douglas fir backwoods.

Letters from Messrs. Horne & Bevan, Bonds & Investments, 306 Wall Street, New York, to Michael Cassidy, Timber Cruiser, North Vancouver, B.C. Dated January 3rd, 1921.

Dear Sir,

Your name has been given to us by Mr. Macdonald, of Vancouver, who is now in New York, as a reliable and competent woodsman with a good knowledge of standing timber.

In partnership with the firm of Long & Short, Wholesale Dry Goods, 2835 Yates Street, Victoria, B.C. we own 14 timber licences on the West Coast of Vancouver Island, towards the north end.

Some Boston clients of ours are now in Victoria and wish to make an examination of this property with a view of purchasing same. Are you in a position to make this journey with them and show them the timber? If so will you kindly get in touch with Messrs. Long & Short as soon as possible, enclosing this letter when you write. We have mailed them a check sufficient to cover our half of your expenses and salary. The cruiser's report which we enclose has the number of the licences on it.

Yours truly,

HORNE & BEVAN

From Mike Cassidy to Long & Short, Victoria, B.C. Dated January 10th, 1921.

Dear Sirs,

I got this letter in my male this morning. what are you going to do about it. myself i think that anyboddy wood make a trip to the west coaste this time of year should get his been examined for konk but if your people can stand it i guess i can.

Yr obt servant

M Cassidy crooser.

P.S. What wages do you figure on paying.

From Long & Short, Victoria, B.C. to Mike Cassidy. Dated January 11th, 1921.

Dear Sir,

We are in receipt of yours of yesterday's date enclosing letters from Messrs. Horne & Bevan, of New York, and we beg to thank you for your prompt attention to this matter.

As we have only recently transferred our business from Toronto to this city, we have had little or no opportunity of acquiring an insight into the lumbering industry, and we therefore propose to leave all the arrangements for this trip with you; in the matter of wages we are also—within reasonable limits—in your hands; we presume you will require current logger's wages; we are informed these are higher than in Eastern Canada and run from $4.00 to $5.00 a day.

The senior partner of our firm proposes to accompany the party, and, as it is the first time any of them have made a trip of this nature, they all anticipate a most enjoyable time under your capable guidance.

They propose taking several rifles and plenty of ammunition and hope that you will be able to put them in the way of getting a few moose, caribou, etc. How long will your preparations take?

Yours truly,
LONG & SHORT

From Mike Cassidy to Long & Short, Victoria, B.C. Dated January 13th, 1921.

Dear Sirs,

Yours to hand and I beg to state that it dont take me no time at all to get reddy, my other sox is dry and I can pull any time you say. You got off rong about wages I aint no current logger and I dont work for currant loggers wages neether. My pay for croosing is from 20 to 25 dollars a day but things is quite now and there is going to be a lot of time lost traveling and wating on botes so I will do this job for 15 bones a day. my time starts when I roll my blankets rite here and stops when I get home again provided you have settled up. if you aint it still goes on. You tell them other birds leeve them rifels where they are at now. I got one gun and thats the only gun going into the woods this trip. We better meet at nanaimo get our grub there and pick up the steamer at alberni. I seen the south end of the island plenty times alreddy and wont loose anny sleep if i never see it again. We can hire a gas bote off them indians in nootka.

Yrs. respeckfully
Mike Cassidy. crooser.

P.S. You dont need to write anny more letters about this job. send me a wire and lets go.

From Long & Short, Victoria, B.C. to Mike Cassidy. Dated January 15th, 1921.

Dear Sir,

We are in receipt of yours of the 13th inst. and must state that we are somewhat taken aback at the salary you ask for this work.

Probably you do not understand that we do not expect you to do any measuring of trees or counting how many thousands of trees there are on an acre, which we believe to be the regular work of cruisers. We merely want a reliable man to take care of our party, act as guide and cook, see that they have a dry place to sleep at night and show them all the best collections of trees on the 14 claims.

Our good friends in New York have remitted us the sum of $62.50 to which we are adding a like amount, this would surely be enough to defray the cost of your wages, travelling expenses, launch hire, etc., and leave enough to provide sustenance for the whole party.

Hoping for a favourable reply and that we can come to terms in the matter of your wages.

Yours truly,
LONG & SHORT

From Mike Cassidy to Long & Short, Victoria, B.C. Dated January 16th, 1921.

Dear sirs. mister say what the hell kind of a dam fool you think I am. why dont you tell me before you only got 130 bucks to make this trip on. dont you know them claims is scattered round all over the place. some of them 4 miles inland. dont you know you got to hire a launsh on strate time and unless them indians up there is different to anny siwashes i ever see in b.c. theyl soak you from 20 to 25 bones a day and more than that if your pardner akts as crazy as you rite. dont you know you libel to get wether bound for too three weeks and camp on the beech wating on the bote. do you spose i figger on setting on that steemer and watch you and your cheechako tillikums being seasick all over everything for the good of my helth. my helth is rotten the ways things are and travelling along with a bunch of cheep tinhorns like you wont make it any better neither. when you get half way throogh the trip you wont have money enuff lef to buy a pair of leggings for a humming bird let alone what you call providing sustenance at 4 to 5 a bottle. I tell you what you do if you want a cheep man to flunkey for you. I see a band of them harey bohunks going up to the camp this morning. them fellows look like they might be currant loggers. you go hire one of them. you dont hand me anny of these trusty guide jobs. I done it before in the peece river country. and i tell you sum more mister man. I red that report i got from New York and i know just what kind of a kultus muskeg country you got up there with 70 per sent hemlock ballance ruff cedar suitable for shingle logs and you got to cut down a 6 foot cedar to get a cupple of armsfulls of dry wood out of the top and no dry place to pitsh a fly neether, and you got three four dam fools standing round telling you the way to lite a fire when its raning to beat hell and how they done up in the north woods that time. and then you got to get up the middle of the night to look for bears that aint ther atall or rub there stummacks or sumthing bekos they dont know when theve eeten enuff cold beans. you tell me mister man what you rekkon you going to do with them three beech claims. them ones with the fine open vew of the sun set and the north end of jappen. you better forget about the timber bisness and get sum of your friends to take care of you if you got anny that aint as krazy as you are. i been in this country over 30 years and met lots of different kinds of fools, but i rekkon you are the most kultus i ever see. I dident aim to rite a long letter like this, but the more i rote the madder i got.

Mike Cassidy crooser.

P.S. you may go to hell.

From Mike Cassidy to Horne & Bevan, New York. January 17th, 1921.

Dear sirs,

i rote them fellows in Victoria the way you said to they rite me back too letters mostly bunk. i got no use for them birds and i dont like your job so i gess we wont do bisness. you owe me ten bones. i rote a bunsh of letters and went to town twise to look up bloo printz so you better send it along pronto. i dont beleeve youre much better than that bunch of pi faced theeves down in victoria.

Mike Cassidy crooser.

P.S. I told that victoria outfit they can go to hell.

P.S. 2. since I rote this i got wird to go out and do a cupple of quarters on the chilliwak line so you dont need to bother about that ten spot and you may go to hell too.

ORIENTEERING

By HERBERT L. EDLIN

Publications Officer

Orienteering, an outdoor sport that combines cross-country running with map-reading, gained a mention in the Commission's *Annual Report* for 1967-69, and increasing use is being made of our forests for this exciting new activity. Introduced from Scandinavia as recently as 1965, orienteering remains a mystery to many who are familiar with conventional athletics. So a few notes to explain how it is done may help foresters whose ground is used for competitions.

Briefly, orienteering is a cross-country race against time, in which the competitors must find check-points with the aid of map and compass. This sounds simple but calls for much advance organisation. The British Orienteering Federation, which arranges the use of Commission woods, has now developed this to a high degree.

First, an organiser chooses a stretch of country that will tax the runners' speed and ability. This normally includes some woodland, so that the course markers, called *control points*, can be hidden. It also ensures that runners cannot see each other over much of the course.

Basic maps, on a scale of 1:20,000 (roughly 2½ inches to the mile) are then obtained from the Ordnance Survey, which has given special permission for their amendment and duplication. One major step is to alter the main direction from true North to the local magnetic north, to save competitors making continual calculations when they use their compasses. The next step is to re-survey the ground and add new features—such as forest rides, that are not yet shown on Ordnance Survey maps. Older features may need alteration too—a gravel road may have been tarred, a railway abandoned, or an old farmstead may now be a ruin. The corrected map is then printed by a cheap lithographic process, the cost being recovered by entrance fees and the sale of spare maps to competitors, at about 1/- per copy. Obviously the map cannot be disclosed to competitors in advance, so approved course planners arrange it all under bonds of secrecy. The National Grid is not used; there is no time to work out grid references at the speed of the race.

On the day of the contest, competitors, who usually enter as teams, assemble at the starting points and register. Each receives a number, and when his number is called a runner moves forward to the *Pre-start* point. Here he receives for the first time his copy of the map and a brief list of the control points he must find. He still does not know the course he must take. He next goes forward to the *Start* point.

At one-minute intervals, a starter blows a whistle and each man in turn crosses the *Start* line and sprints a hundred yards to the *Map-marking point:* Here he sees a master copy of the same map as he holds, but with the course marked on it. As quickly as he can, he copies this on to his own map as a series of straight lines linking numbered, circled dots.

Suppose the first dot, or control point, lies due east of the map-marking point, then all a man need do is follow his compass-bearing due east, for the estimated distance, to hit it. His special orienteering compass enables him to follow an arrow pointing just the right way.

Sounds easy, and so it is on flat ground with no undergrowth. But in young plantations you can get there quicker by dodging along open rides. Of course this will take you off your compass bearing, and only smart map reading will enable you to find this control point from a fresh direction.

But maybe a steep hill may stand in your way. Which is quicker, over the top on the shortest line or round the bluff with no climbing? An orienteer must make spot decisions and stick to them. Every second counts.

Arrived near the control—or where he thinks it is, the runner must next find it. It is a large square object, boldly marked diagonally in red and white, hanging from a bush or post. You can't see it from all directions, and the only clue you are given is something like: "Beside the wall" or "On the bridge". Once you've spotted it, you rush to it and mark your course-card with a pricker bearing an index letter, such as "A", to prove you've been there.

Then on to the next control point, along your next compass bearing, or your preferred roundabout route.

As competitors of different running speeds and map-reading ability start in random order, there is bound to be much overtaking, and here the fun comes in. Should I follow X, who seems sure of his course, though it looks odd to me? Or forget him and go my own way? Make up your mind quick, or he'll have run out of sight! Anyway, you're not allowed to "tag".

During an hour's hard running over six or seven miles there are constant shifts of order, some gaining, others dropping behind. Eventually everyone heads for the finishing line, usually on open ground, and there are neck-and-neck contests between close competitors going all out to gain the last few seconds of time.

As everyone's starting time has been recorded, their running time is quickly ascertained. But the winner cannot be declared until the last starter has got home, or at least not until *this* last man's "time-out" is seen to exceed that of the best man already "home".

With a big field of runners—say 120 started at one-minute intervals over two hours, the contest can extend over most of the day—needing an hour for assembly, two hours for starts, an hour's good running time and another hour during which the last, half-lost stragglers find their way back to the base.

This may sound tedious but in fact there is excitement throughout, especially at the finishing point where fresh times are being recorded and displayed on the results board, at frequent intervals. Also, it is possible to run as many as four contests simultaneously. For example, Junior Men, Junior Women, Senior Men and Senior Women may start in groups of four and then take separate courses of different lengths, all ending at the same spot.

An alternative arrangement is the team relay race, in which the first runners in each team make a massed start for the first "leg" of the contest. The second and third men then set out, as in a normal relay, as soon as their predecessors get "home", so there is soon a succession of exciting starts and finishes at the base. Relay contestants are given maps already marked with their course, and it is essential that these marked maps are kept secret until the actual instant of start. Routes must be decided in the immediate action of the race, not throught out ahead.

Since all relay teams—and there may be fifty in a big race, start simultaneously, the winner is known as soon as the last runner of each team comes in.

An Actual Meeting

The following notes on the 1970 Jan Kjellström International contest may show what is involved.

Around ten o'clock on a cold dry March morning some 500 competitors, plus another 100 officials and supporters, assembled at a Worksop school on the fringe of Sherwood Forest. They had come from points as far afield as Oslo, Stockholm, Dublin, Exeter, Bangor and Dundee, by car, coach, boat and plane. Around 300 cars rolled up, so the big car park was essential.

After changing into running kit, registering for entry, receiving running numbers and final instructions, the competitors trotted to the starting point. Each group of starters was called, in turn, by loud hailer to the actual starting line and issued at the very last minute with maps and details of control points. At the blow of a whistle four starters sprinted to the map-marking point and crouched on the ground to mark the maps for their different courses. Then they stood up, took compass bearings, and set off in four different directions according to their prescribed routes.

For the next three hours the Commission's plantations of Corsican pine, and the National Trust's parklands around Clumber House, were filled with picturesque figures in gaily-coloured track suits, all haring madly along different courses on what they trusted were the best routes to a dozen control points—the farthest three miles out.

Then back towards the finish, clocking-in at further hidden control points on the way, till the last woodland point was cleared and the runner emerged on to open fields. Then flat out across the grass for an uphill quarter-mile to the finishing point, marked by a flag on the hilltop, with an excited crowd of spectators watching out for winning times.

That evening there was a social get-together of all competitors, from six countries, in a local club, at which prizes were handed out for the various events. Next morning everyone re-assembled at a completely fresh course which had been kept secret until the day before so that nobody could do any advance prospecting.

This was the relay event, and was held five miles south of Matlock at Alderwasley Hall, a National Trust property that provided open parkland for the start and the finish, and also car parks. The main course however ran through Shiningcliff Wood, part of the Commissions' Matlock Forest, adjacent. This is a notably nasty piece of ground, falling 500 feet from the hilltop to the River Derwent, with natural crag and scree, old quarries and tips of waste stone, all overgrown with bracken and brambles, plus tall trees surviving from private ownership days, coppice, and recent conifer and beech plantations. Its advantage was that, within a triangle having sides only one mile long, it was possible to conceal thirteen control points, with exacting courses running up hill and down dale between each, more or less out of sight of each other.

On the three "legs" of the relay each competitor had to visit his control points in a different sequence to his team-mates on the other two legs. This cut down "follow-my-leader" tactics. Teams were also classed by ability, so that junior ones had fair chances of winning the less exacting events.

Overall, honours went to the Scandinavians, with a Norwegian team winning the senior relay contest, and Swedes scoring high in both men's and women's individual events. Scottish runners came next; English competition was not taken very seriously.

Who goes orienteering? The age limits are roughly sixteen to sixty, with a natural concentration at the younger end. Universities field strong teams, and so do the Royal Marines as an adjunct to Commando training. There is no professionalism, nor opportunity for any. The sport, still little known, is likely to grow, particularly if it is taken up by physical training colleges, or if the Army realises, as the Marines have done, its values for map reading and personal initiative in rough country, combined with top physical fitness.

Though I attended this meeting simply as a supporter—of a Scottish University team incidentally—I inevitably speculated on its impact on forest management. No adverse effects were apparent. Today the sport is run by the very responsible British Orienteering Federation to which all serious clubs are affiliated. It is keen to maintain a good impression because it wants to be invited back, after a suitable lapse of time, to woods it has used previously. The advance marking of the course only involves two or three people reconnoitring the ground with the assistance of the local Forester, who will naturally indicate areas or features to avoid. The contest lasts only for a few hours and is not repeated over the same land for several months. The only structures needed are tents for the officials, and these are removed as soon as the race is over. Litter is scrupulously tidied up.

Extra fire risk can be discounted because orienteers would be the last people to endanger the cover that is essential to their sport. They can't smoke whilst running, and if a fire did occur, there is a strong force of organised, able-bodied young men on the spot to tackle it.

Obviously nobody would want to let a few hundred runners go charging through a game covert in the nesting season, but apart from that, disturbance to wild life is slight, because it is so temporary.

Casualties, fortunately few, are looked after by a competent first-aid squad. If any runner fails to return a search party is sent out, and as each runner carries a whistle a lost or injured man is soon found.

Altogether orienteering is an activity that deserves full encouragement in our woods. Do the competitors gain any knowledge of the Commission's aims and objects as they chase headlong through the trees? I'm sure they do, since I found my son, through his running week-ends, was rapidly getting to know more about our forests than I did myself.

NATURE'S CAMOUFLAGE

'He made their glowing colours
He made their tiny wings.'
Hymns—Ancient and Modern.

Close to the earth crouched in its form
A brown hare lies concealed
His tawny coat now merging with
Ploughed furrows in the field.

Nearby a brooding pheasant sits
Tight in the grass and sedge
Her mottled plumage faintly marked
Like dried leaves in the hedge.

The plovers' eggs lie on the ground
With pebbles, well disguised
Thus mingling with the soil and
Safe from predatory eyes.

A hungry pike lurks in the reeds
Eclipsed in tones of green
And rainbow trout with speckled scales
Swims through the weed unseen.

With dappled pelt the fallow fawn
Lies in a forest glade.
Quite still and inconspicuous
In varying light and shade.

Disguise by background camouflage
Appears to be the theme
That countless birds and beasts employ
In Nature's colour scheme.

R. J. JENNINGS

FORESTRY COMMISSION STAFF

At 1st January, 1970

Note: It has not been possible to show the stations of individual officers in Conservancies. The list should not be read as a Seniority list; it has been compiled from returns submitted by various offices to Establishment Branch.

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Bowman, P.
Brain, J. S.
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Clarke, H. F.
Cox, D. J.
Deal, W.
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Gunter, A. T. G.
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Lewis, C. J.
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Skinner, F. C.
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Stott, W. S.
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Westacott, W. D.
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FORESTER

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CLERK OF WORKS: Court, T. J. (T.W.G.III).

SUPERINTENDENT OF WORKS: Lang, A. S. (T.W.G.III).

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Walker, I.
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Wood I. E.
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MacLeod, J.
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MacRae, H.
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Morris, H. D.
Newsom, G. B.
Officer, A. W.
Patience, J. J.
Pemberton, F.
Reid, G. W. M.
Scott, J.
Scott, M. P.
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Smith, D. R.
Sutherland, F. W. S.
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Tear, D.
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Denholm, J.
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McCreadie, F.
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MacKay, J. W.
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MacLure, A. R.
Pargeter, J.

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SUPERINTENDENT OF WORKS:	McConnachie, J.; Stewart, A. R.
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Miller, J. W. B.
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Anderson, M.
Biggar, A. W.
Christie, J. H.
Davidson, A. L.
Main-Ellen, R.
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Grigor, E.
Guild, J.
Hepburn, N. R.
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Marchant, R. E.
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Reid, J. G. M.
Seaton, J. A.
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Bousfield, N.
Fraser, R.
Yeats, D.

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SUPERINTENDENT OF WORKS: Clark, J. D. (T.W.G.III); Logan, G. M. (T.W.G.III); Rae, M. F. (T.W.G.III); Ross, P. F. (T.W.G.III).

SENIOR CLERK OF WORKS: Raisborough, R. (T.W.G.III).

CLERK OF WORKS: McIntosh, A. F. (T.W.G.III).

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Murray, W.
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SUPERINTENDENT OF WORKS: Currie, J. J. (T.W.G.III).

SENIOR CLERK OF WORKS: McClory, J. (T.W.G.II).

CLERK OF WORKS: Hay, W. (T.W.G.III).

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