JOURNAL OF THE FORESTRY COMMISSION

No. 32 : 1963

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ACKNOWLEDGEMENTS

We are grateful to the Forestry Division, Ministry of Agriculture for Northern Ireland, and to the Editor of *Irish Forestry*, for permission to reproduce the articles "Pinus contorta in Ireland" by R. S. Lamb, and "Lodgepole Pine in Ulster" by K. F. Parkin; to the Power Saw Manufacturers Association of the United States for the article on Power Saw Safety Rules; and to the Ministry of Agriculture's journal *Agriculture* for the article "Built of Wood" by Geoffrey Forrest, and the article "A Home-grown Timber House" by F. W. Holder.

The first three drawings in the Editorial pages are by Head Forester R. J. Jennings; the others come respectively from the magazine *Norwegian Forestry*, Miss Judy Rowe, and Mr. A. W. Coram. The succeeding drawings are all by the authors of their related articles, except for that showing "Two in a Tent," which is drawn from *The Forester*, the magazine of the Northern Ireland Forestry Division.

The first six photographs, showing Danish scenes, are by J. M. B. Brown; the spruce growing in brash was photographed by G. D. Keighley; and the two views of the log cabin are by H. J. Hooper. Valdemars Blankenburgs took the two photos of the Kielder Repair Depot, and Forester R. Bultitude the views of Dartmoor in the snow.

The first two pictures of the Cambio Debarker were provided by Atelje Olsson of Karlskrona, Sweden, and the third by another Swedish firm, Soderhamns Verkstader, of Soderhamn. The picture of the starlings was taken by the *Western Morning News* of Exeter.

EDITORIAL

The Commissioners

The constitution of the Commission is now as follows:

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

The Earl of Radnor, K.G., K.C.V.O., who had been Chairman since 1952, retired on 31st July, 1963. The Earl Waldegrave, who had previously been Deputy Chairman, was then appointed to succeed him.

Mr. Lloyd Owen, C.B.E., who had served as a Commissioner since 1945, and was the first Chairman of the Welsh National Committee, retired during the year, as did Mr. E. Bryan Latham, M.M., who had been a Commissioner for the past six years.

On the 1st August, 1963, Mr. G. E. H. Palmer, Mr. F. Sellers and Colonel J. F. Williams-Wynne took up their appointments as Commissioners.

Honours

In the 1963 Birthday Honours List we were proud to note that Mr. J. A. B. Macdonald and Mr. Eric Lewis, two well-known personalities in the Forestry Commission, had been awarded the O.B.E.

Mr. J. A. B. Macdonald, who is Conservator, South Scotland, joined the Commission in 1922 as a Foreman and has served in all grades up to his present rank. He has contributed work of outstanding value to the Commission, not only in the early development of afforestation and in research, but recently in undertaking the largest planting programme for any one Conservancy in Scotland.

Mr. Eric Lewis, who was a Chief Executive Officer at Headquarters until he retired, had spent 44 years in the public service. During the war he served in the Royal Naval Reserve, reaching the rank of Commander.

In the New Year Honours List for 1963, we were pleased to note that Mr. Frank Best, Conservator, North Wales, had also been awarded the O.B.E. Mr. Best joined the Commission in 1928 as a District Officer. Under his guidance his Conservancy has been developed, as far as Commission land is concerned, into the second largest in England and Wales.

We are also glad to see that Miss Janet Sticks—Higher Executive Officer in the Office of Director, Scotland—has been awarded the M.B.E., after 35 years in the public service.

Our congratulations also go to Mr. Roland Bultitude, Forester at Dartmoor, who was awarded the British Empire Medal. Forester Bultitude joined the Commission in 1946 as a trainee, after service in the R.A.F., and his account of the difficulties he overcame on Dartmoor during the exceptional snowfalls of the 1962-63 winter will be found elsewhere in these pages.

Obituaries

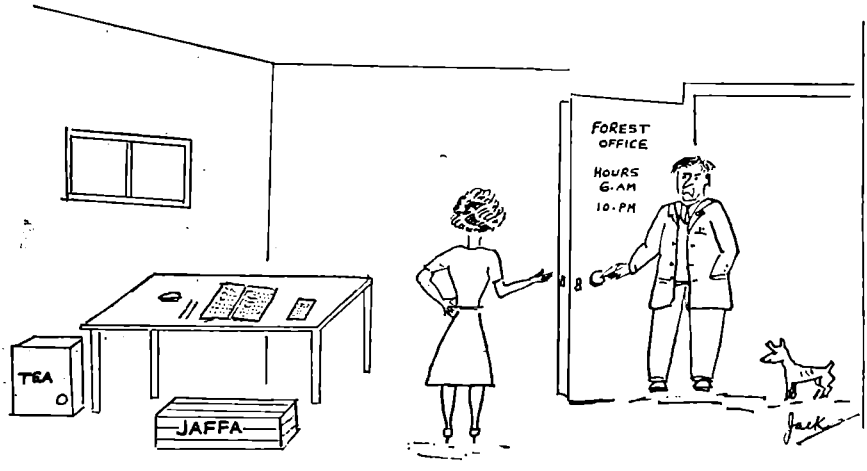
We regret to record the death of Head Forester Harry Bell of Coed y Brenin, North Wales, at the early age of 56. Mr. Bell only recently moved to Coed y Brenin after sixteen years at Dovey.

We are also sorry to record the deaths of Head Forester Lionel Wyatt of Northampton Forest, East England, and W. M. Lawson, Forester at Glenloy, North Scotland, who died at the early age of 40.

Appointments

Mr. J. H. Holroyd, hitherto assistant Private Secretary in the Private Office at the Ministry of Agriculture, was appointed Principal to fill a vacancy in the Establishments Section at Headquarters.

Mr. J. R. Booth, formerly Divisional Land Commissioner for Northumberland in the Ministry of Agriculture, was appointed Conservator, Estates, in the Directorate of Forestry for England, and took up his duties in September.



"I can see you've been re-arranging my office furniture again!" (But see Estacode for official entitlements!)

Promotions and Transfers

We are pleased to report that Mr. John Matthews, Divisional Officer at Alice Holt, has been appointed Professor of Forestry at Aberdeen.

We are also pleased to report the promotions of Mr. Malcolm Shapcott and Mr. George Clarke to Chief Executive Officer rank. Mr. Shapcott is well known to most of the staff, as his duties lie in the Establishment Section at Headquarters. Mr. Clarke was formerly Chief Clerk to the East England Conservancy at Cambridge and is now in charge of Stores Purchasing at Savile Row.

Retirements and Departures

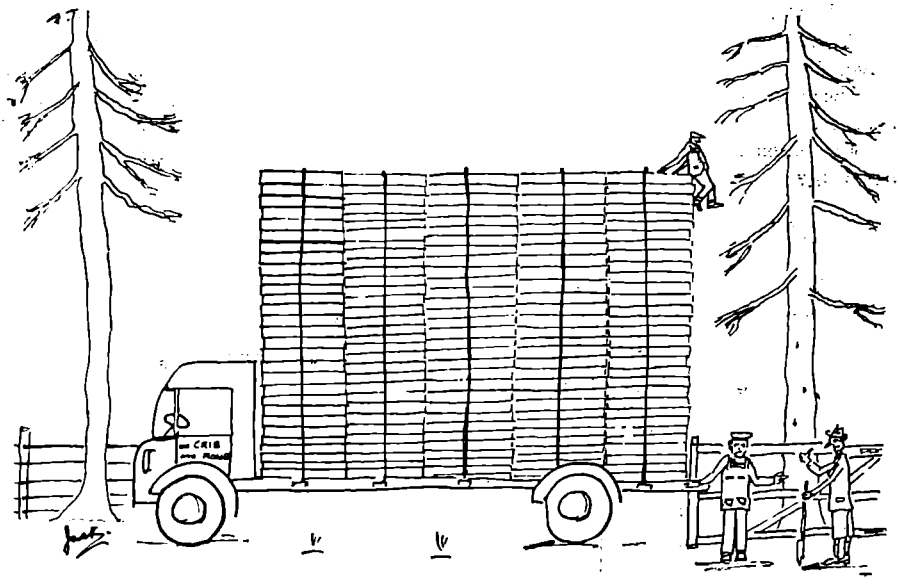
Mr. S. W. Edwards, Conservator in the Office of Director, England, who was the Chief Estates Officer in England, retired during the year.

Mr. Neil Burton, who was a Principal at Headquarters, has finished his agreed spell of duty with us, and has now left for the Ministry of Agriculture.

Mr. W. E. Coggins, O.B.E., a former Principal at Headquarters, has retired; Mr. Coggins spent his last few years of service in the office of Director, England.

Two Chief Executive Officers, Mr. Albert Minter and Mr. Eric Lewis, retired in May, and two Senior Executive Officers, Miss Ann Brooks, M.B.E. and Mr. N. E. W. Mackenzie, also retired during the year.

Head Foresters who retired during the year were Mr. Hugh MacMillen of Kirroughtree Forest, South Scotland, Mr. G. W. Hollis of Bampton Forest, South West England, and Mr. E. T. Jones of Ystwyth Forest, North Wales.



"Unload them again, the Coal Board say they want them *un*peeled!"
(With apologies to the Marketing Section).

The Society of Foresters of Great Britain

Many of our readers will already be members of this Society. For those who are not, we set out its aims and objects, and the cost of membership for the various classes, below.

This Society was formed at Aberdeen in 1925 and adopted its first Constitution at Oxford in 1926. The present Constitution dates from 26th September, 1962.

The objects of the Society shall be *first* to advance, spread and promote all aspects of forestry, especially in Great Britain and Northern Ireland, and *second* to maintain and improve the standards of practice and the professional status of foresters in Great Britain and Northern Ireland. It is intended that the Society shall be representative of the profession.

The objects shall be promoted by the following activities.

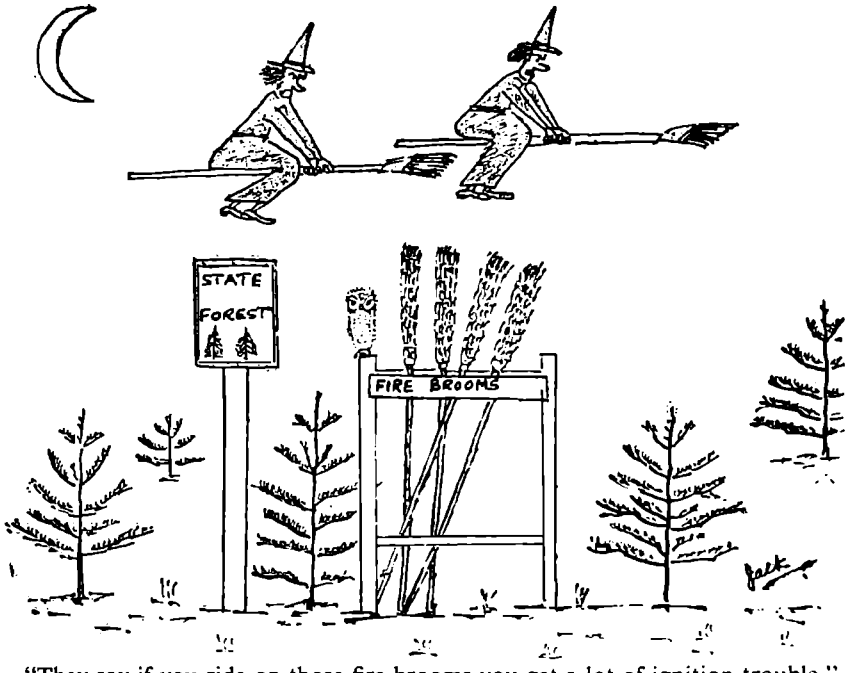
(a) Publishing a Journal.
(b) Holding meetings and conferences.
(c) Organizing excursions within Great Britain or overseas.
(d) Maintaining correspondence with Associations with similar objects.
(e) Representing as a Society the views of the professional forester.
(f) Keeping under continuous review the changing needs of education and research.

(g) Keeping under continuous review the status of the forestry profession and the professional conduct of its members. *Inter alia* it shall be the duty of the Council to maintain a register of those members who wish, and in the opinion of the Council are fit, to be classed as Consultants in the practice of forestry or in any special branch or branches of forestry or allied subjects and to keep such register open for public inspection.

(h) Awarding a medal.

(j) Any other activity consistent with the objects and deemed expedient.

The Society's Journal, called *Forestry*, is published twice a year, in May and November. It provides a means for the publication of the results of practice and research both in the growing of timber and in its utilization, including such basic sciences as forest physiology and ecology, forest soils, wood structure and timber physics, and allied sciences such as forest entomology and forest mycology.



"They say if you ride on those fire brooms you get a lot of ignition trouble."

CLASSES OF MEMBERSHIP

Membership is divided into the following four classes.

Fellows: Subjects of the British Crown fulfilling all four of the following requirements: (1) A degree or diploma in forestry, etc. (2) Ten years as a professional forester in Great Britain or Northern Ireland. (3) A member of the Society for five years. (4) A thesis or published article approved. Annual subscription £6. 6s. 0d.

Associates: Subjects of the British Crown who are either (1) holders of a degree or diploma in forestry, etc., or (2) have made important contributions to forestry, etc., or (3) occupy posts considered by the Council normally held by holders of a university degree in forestry. Annual subscription £4. 4s. 0d. (first four years £2. 2s. 0d.).

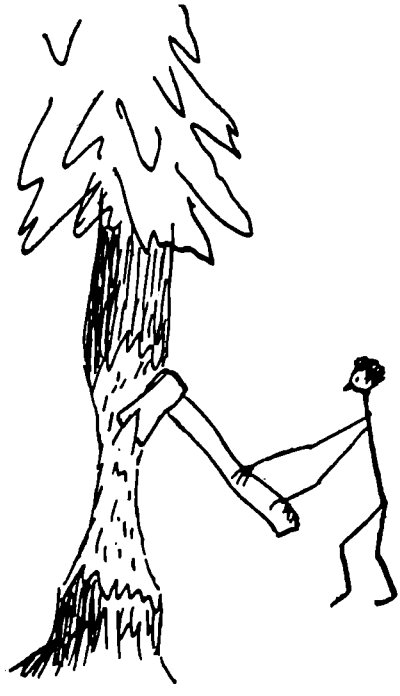
Professional Members: Subjects of the British Crown resident in Great Britain or Northern Ireland, engaged whole time in forestry, not eligible for the above but otherwise suitably qualified. Annual subscription £1. 11s. 6d. (Most Foresters and Assistant Foresters fall into this class).

Affiliated Members: Persons or corporate bodies not eligible for any of the above classes. Annual subscription £4. 4s. 0d.

Annual Registration Fee for Consultants: £5. 5s. 0d.

Further details and application forms may be obtained from the Secretary and Treasurer: Mr. A. A. Cowan, c/o Forestry Commission, Greystone Park, Moffat Road, Dumfries.

In conclusion, under Section 16(2) of the 1958 Finance Act, it is now permissible for Members to show their subscriptions as an allowable expense in their Income Tax returns; this may reduce the real cost of membership to two-thirds of the figures shown above. Thus a Forester who pays income tax at the standard rate may join the Society for a net outlay of little more than £1 a year; for this he receives, besides all the other privileges of membership, two issues of "Forestry", which has a subscription price of £2 a year.



How bright are you? What's going on here?
(For answer see page 209.)

A New Angle on Wood

The covers of most of our Forest Park Guides are the work of a highly skilled wood engraver, Mr. George Mackley, who cuts every detail on the end-grain of a piece of boxwood. He set out the need to judge his working medium carefully in a recent letter, from which the following is an extract:

"Selection of wood is, as I am sure you know, a very difficult business. If the rings are too far apart or the colour too pale, the wood is too soft

area who could organise the necessary machinery to clear the road. The Engineering Branch trucks had had to stop running because of the blockage. Without being in touch by radio, the forester would not have been near his office until 5 p.m. The blockage was cleared by early afternoon. Time saved—probably 10 truck hours.

5. *Message from Lochfire Control to Lochfire Mike—*

"Go to the assistance of Lochfire Mike One who is stuck at . . . ."

Comment. This type of message was relayed four times during the year. A vehicle bogged on the road but with radio, called for assistance, and was mobile within the hour. Without radio, the time in each case would have been at least two hours and could have been very much more as distances to walk to a phone were considerable. On one occasion a vehicle carrying workers was involved. Without speedy assistance, overtime would have had to be paid to the men so delayed.

An Unsolicited Testimonial

"I would like to take this opportunity of thanking you for many happy hours I have spent walking in your forests"

—Extract from a letter enquiring about our Guide to the North Yorkshire Forests.

Contributions to the Journal

The Editorial Committee expresses its thanks to all who have supported the Journal so well this year. The Editor is always on the lookout for fresh contributions.

These can be accepted at any time of the year, but the closing date for each annual issue is the 31st of December. Senior officers will gladly give intending authors whatever encouragement and help is needed.

If possible, articles should be typewritten, in double spacing on one side only of foolscap sheets, but articles in manuscript are not ruled out. A note of the author's rank, official station, and postal address, should be added. Sketches, from which finished drawings can be made, are welcome when they help to bring out points made in the article, and we can also accept a limited number of photos. No payment is normally made for contributions, but reasonable expenses, for example for special photographic prints, can be met.

If for any reason your contribution does not "fit" the Journal, then the Editor will do his best to find some alternative channel for its publication.

Sales of Standing Coniferous Timber from Forestry Commission Areas

The latest available schedule of average prices received from sales of standing coniferous timber in Commission plantations in 1963 is shown below.

This covers a period of twelve months and all sales during that period, whether by private tender or by auction, have been included in arriving at the average prices.

This schedule is printed 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.

FORESTRY COMMISSION

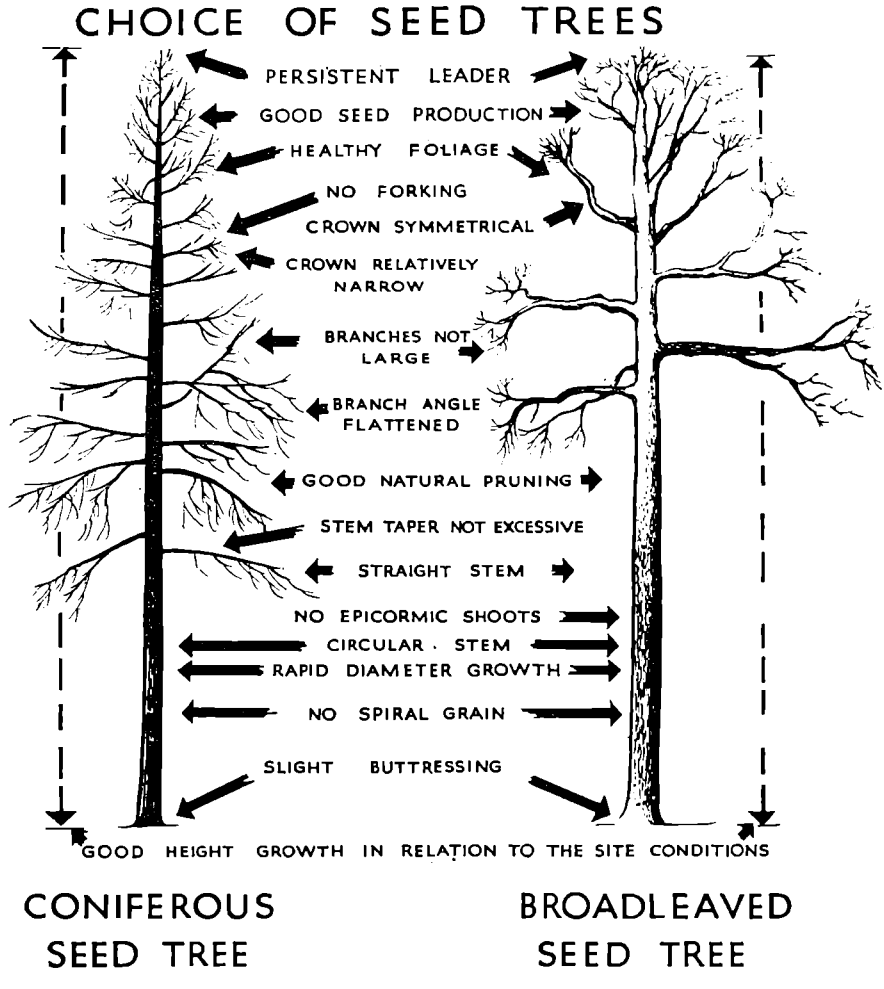
SALES CONTRACTS FOR STANDING TIMBER (CONIFERS) YEAR ENDED 30/9/63.

VOLUMES IN HOPPUS FEET CLASSIFIED BY CONTRACTS TO AVERAGE VOLUME PER TREE

Price Range	*1 h.ft. and under*	*1¼–2 h.ft.*	*2¼–3 h.ft.*	*3¼–4 h.ft.*	*4¼–5 h.ft.*	*5¼–10 h.ft.*	*Over 10 h.ft.*	*Total Volume*
Over 2/–	63	8,157	4,557	170,181	31,559	28,743	210,357	453,617
1/9–1/11¾	6,490	111,527	110,803	81,612	217,140	102,452	204,621	834,645
1/6–1/8¾	13,793	143,385	144,396	181,770	115,467	539,093	142,016	1,279,920
1/3–1/5¾	24,605	256,478	713,677	355,298	222,086	535,210	164,522	2,271,876
1/—1/2¾	53,528	792,346	1,203,060	498,773	272,942	337,825	22,834	3,181,308
Under 1/-	60,618	1,008,805	1,164,875	514,268	161,410	349,828	21,438	3,281,242
Total	159,097	2,320,698	3,320,698	1,801,902	1,020,604	1,893,151	765,788	11,302,608
Av. Price per h.ft.	1/0·1	1/1·2	1/0·9	1/2·6	1/3·9	1/3·7	1/9·2	1/2·5
Av. Price for Year ended 31.3.63	1/1·8	1/1·5	1/1·5	1/3·2	1/3·3	1/4·2	1/9·7	1/2·9
Av. Price for Year ended 30.9.62	1/1·4	1/1·6	1/3·5	1/4·8	1/3·6	1/4·7	1/10·8	1/4·1

AVERAGE PRICES FOR EACH COUNTRY

H.ft.	*England*		*Scotland*		*Wales*		*Great Britain*	
	Volume	*Average Price*	*Volume*	*Average Price*	*Volume*	*Average Price*	*Volume*	*Average Price*
1 and under	67,144	1/1·3	14,117	–/9·5	77,836	–/11·6	159,097	1/1·0
1¼–2	613,458	1/3·8	977,118	–/11·3	730,122	1/1·4	2,320,698	1/1·2
2¼–3	433,239	1/2·3	2,014,608	–/11·6	893,521	1/3·0	3,341,368	1/0·9
3¼–4	215,645	1/3·4	1,029,124	1/2·4	557,143	1/2·8	1,801,902	1/2·6
4¼–5	336,138	1/4·6	307,277	1/1·1	377,189	1/6·0	1,020,604	1/3·9
5¼–10	527,559	1/6·2	595,646	1/0·9	769,946	1/4·2	1,893,151	1/3·7
10 and over	418,873	1/9·7	232,067	1/9·4	114,848	1/7·0	765,788	1/9·2
Total	2,612,046	1/5·0	5,169,957	1/0·8	3,520,605	1/3·3	11,302,608	1/2·5
Year ended 31.3.63	2,609,584	1/5·5	4,856,444	1/1·5	3,593,813	1/3·1	11,059,841	1/2·9
Year ended 30.9.62	3,039,622	1/6·5	4.791,483	1/2·7	3,257,639	1/4·0	11,088,744	1/4·1



Choice of seed trees. A sketch by A. W. Coram, expressing points often made by Professor J. D. Matthews

JOURNAL OF THE FORESTRY COMMISSION
No. 32, 1963

NATIONAL FORESTS AND PARKS

By
G. B. RYLE
Deputy Director General

We live today in a country where each individual can occupy less than one acre of land but of course the ownership of that land is in the hands of a very small number of people indeed. The majority of owners, be they owners of large country estates, small private gardens, factory sites or any type of land, have every right to tell the public to keep out. 'This is my land, my little kingdom you have no right to enter on it'.

So far as the little man's private garden is concerned, the public accepts such a restriction as being fair and reasonable. But the town dweller in particular is finding both more need and better opportunities to get away from his congested cities at weekends and holiday times to breathe clean air and enjoy the green fields, woods and hills. He is inclined to think that the open countryside is his of right to wander over. He does not realize, or often, I am afraid, he does not care, that this countryside is land which is certainly being used by its rightful occupiers for some gainful purpose; that is for the production of food, or for the production of timber, or even for sporting.

The field of corn or turnips is largely recognized even by town-bred holiday-makers as something not to be trampled over, and anyhow ploughed land is not pleasant to walk across. The hayfield or the lush pasture, so long as there are no cattle of possibly male sex too close at hand, is more likely to be considered a fair ground for a game of cricket followed, of course, by a wastepaper chase. If the farmer has been a bit careless in the way he hangs his gates and keeps them shut with pieces of string, why should the picnic be spoiled by troubling to close them? The cows will enjoy a change of diet by moving out on to the highway verges.

But the woodland and the open moorland are obviously the holidaymakers' ideal. The one provides shelter galore for granddad's mid-day snooze, for John and Susy to play the old game of slap and tickle behind the bushes and for little Billy to climb trees and to cut his bow and arrow. The moorlands and the mountains are for the real he-men of both sexes whose degree of enjoyment appears to be measured by the bulkiness of their rucksacks and other impedimenta to comfortable long-distance progress.

The Task of Three Departments

We are faced with a problem indeed on our little over-populated island. We cannot justify leaving our precious soil unused solely for the enjoyment of those who seek health and interest in the countryside. We must produce food, wool and wood within our own shores. If the economy of Britain is to be maintained or improved, we must produce more of these essential raw materials. The idea of multiple land-use is being steadily mooted by many who would solve this problem; but the potentialities of multiple land-use have not yet been studied scientifically. There are perhaps three official bodies who need to collaborate (in an informal manner) in this study because to do so individually, as has been happening hitherto, can produce acrimony but no true answer at all.

The National Parks Commission was set up soon after the last war and has had the duty to designate huge areas of our finest countryside as National Parks for the enjoyment of all of us. It has no stake at all in the ownership of any of the land in these parks. Their ownership, occupation and rural economy remain unaltered in the hands of the farmers or woodland owners who held them before. Neither the Parks Commission nor the administering local authority has any effective *positive* control; they have only certain powers of *negative* control by refusing planning consent for industrial building and other types of undesirable development. If therefore the district is one of rural economic insecurity then nothing is done to improve its lot or to help the plight of its inhabitants. The holiday-making and touring public is encouraged to come to these parks, and as long as they behave themselves the landowners or occupiers, and the farmworkers and the woodmen in their employ, all of whom have their livings to earn out of the soil, generally co-operate bravely in allowing a great deal of access on to their land. They oft-times have to put up with a good deal of careless damage and mess or even devastating fires, for which there is little redress.

Obviously therefore the National Parks Commission must be one party to our study group.

The Forestry Commission is by far the largest landowner in Britain and it is natural that its greatest activities occur in those uplands and wilder stretches of country which are unsuitable for arable food production. In fact its major developments have taken place in just the same types of countryside as those which later became designated as National Parks. Many of the Forestry Commission forests lie within National Parks. Much of the land needed for the Forestry Commission's continued development lies within National Parks.

Now the primary duty of the Forestry Commission is to grow timber as a means of securing a sound national and rural economy and for providing a stable employment in the areas of low-grade or receding agriculture. The National Parks Commission has in its terms of reference that it is to have regard to the needs of agriculture and of forestry within the designated parks: they must not hinder the local rural economy.

Though the Forestry Commission has no statutory obligation to have regard to the needs of the touring public, it has nevertheless taken on this duty in a very large way. So we *should* be able to say that the two Commissions, if in different degree, are largely complementary to one another. If that happy position has not arrived, there is much room for hope that it will do so.

The Forestry Commission then must be the second party to our study group.

The Nature Conservancy, apart from very much more restricted areas of land which it owns or manages for specific protective or conservation purposes, should one day become a department to develop an unbiased and scientific study of land-use problems for the national benefit, taking into proper consideration the measurable economic needs of the country in optimum production from the soil, the less easily measured social requirements for rural employment and the almost imponderable problem of providing interest and enjoyment for the amateur naturalist, hiker, camper or other form of tourist.

I think therefore that the Nature Conservancy should be the third member of our study group.

Dynamic Changes in the Rural Scene

What is wrong today? As a member of the Forestry Commission I am not here to stand up in its defence because it is high time to stop playing the game of attack and defence which has hitherto got us nowhere at all. There has been a habit during the past decade or so for a comparatively small body of folk who

know more about the beauty of the countryside than anyone else to vilify productive forest management and often in doing so to display their ignorance both of forestry and of the real countryside generally. I don't think we need worry about them any more because the ever growing tide of ordinary folk who come to these forests for their interest and for their recreation shows plainly the true trend of public opinion.

Anyhow the Forestry Commission came into being only about forty years ago and since then, mostly since 1948, it has created over 1¼ million acres of forest. This is all baby forest and most of it is on land which was not previously cropped with trees. So it has wrought very big changes in the country scene. They are mostly changes which have not yet matured, though in many places the artificiality of the young plantations is already giving place to the grandeur of real forests. We are already being criticized in advance because these big stretches of rather even-aged forest will shortly fall ripe for the axe and we shall see enormous areas equally suddenly laid waste to the bare soil. That of course is complete rubbish. No forester worth his salt, except in time of war or some such emergency, would be so ignorant as to slaughter a forest like that. The aim, the Commission's declared policy, is that once a forest has been created it shall be kept flourishing in perpetuity. Supposing, as would commonly be the case, our trees take say 70 years to reach maturity, we should only fell one seventieth each year and that would usually be in scattered areas. Thus our forests will steadily move from being rather even-aged to mixed-aged, with clearings, thickets, middle-aged and mature groups presenting a far more diverse scene than obtains today. This diversity of scene too will be accompanied by a diversity of ecological habitats attractive alike to a much wider range of animal and plant communities. Among the plant communities, natural or artificial, I would include trees. Here will be scope for less monoculture and the introduction of greater variety, even if for reasons of economic supply and demand the bulk of the crop is confined to a few main species.

Forests and People

What is the Forestry Commission's policy as regards the use of these forests by the public? In the first place when we acquire land we frequently have to accept certain restrictions, for example where the previous owner wishes to reserve the sporting rights or where these rights are leased to someone else. Secondly we insist that a very important consideration must be to those local people who earn their living in and near the forest. It is our duty to be good employers of labour, to employ people who dwell in the locality and to see that our own tenants are housed as well as may be. A very large proportion of our upland forests in particular have been built up in districts where agriculture has fallen sadly into the doldrums, where there was steady de-population or rural under-employment. We can look with very justifiable pride at these areas: the working country population has increased: there has been re-housing and there is virility where once there was a creeping paralysis. Then thirdly we seek to encourage the holidaymaker, tourist, hiker and naturalist. Restrictions are limited mainly to the fire danger periods. Our forests sooner or later have to be roaded: mostly narrow roads of native stone or gravel and on these we like to see walkers. The surface and gradients do not always prove attractive to cyclists. But we want these forests to be peaceful places away from the noise and smell of the motor car or motor cycle. So, with some exceptions, our forest roads are not open for motor traffic other, of course, than for the lumbering timber wagons and access to our neighbouring farms and smallholdings. But of course we must provide more and more parking places so that motorists also can enjoy the forests near to the public highways and whence the more energetic passengers can scatter on foot to the hinterlands.

In some of our forests—the Forest Parks which were instituted long before the National Parks Commission was even thought of—we have gone further and provided very carefully laid-out camping and caravanning places and I am quite confident that we shall have to expand these facilities as time goes on.

But of course it would be quite wrong to assume that forests on the grand scale, which we shall not see in their maturity for a good many years yet, will meet all the requirements of the travellers of today or tomorrow. Open hills, fells and mountains are important for many of us: we must protect them on a big scale as part of our native heritage of unspoiled countryside. What I want to stress is that as forestry in the uplands and other territories is necessary for Britain's future economy and for keeping a people in sound employment away from the towns, we must not decry it merely because it brings a change to the rural scene. If the country is to be a healthy country it must be a productive country. Derelict scrub woods, a receding and deteriorating agriculture may have a passing wild beauty for the holiday traveller, but they spell national poverty and political shame.

For that reason I stress that National Forests and National Parks must work hand in hand together to keep the best scenic districts of Britain healthy: available alike for people to live and work in and for people to come to for their leisure days. We must not be afraid of change.

A Welsh Example

As a young man it was my responsibility to plan and administer, amongst other areas, a large block of land in West Wales. It was a poor country which the Forestry Commission steadily bought piecemeal from a number of bankrupt large landowners and from innumerable aging small hill farmers. It is impossible not to look back with pride at this property today. The worst of the old dwellings have been pulled down and are now lost deep in the new forest. The better of them have been modernized and with the more fertile fields have been kept as small holdings for our skilled woodmen. The several little hamlets have been enlarged with new dwellings for woodmen and their families. There is a new school and a new police station. There is a daily bus service where there used to be only one each week. It is today a range of hills and valleys pulsating with life whereas when I first knew it it was decaying. I hope to see it made into yet another Forest Park, because then in addition to its production of about 500 cubic feet of timber during each daylight hour (that is two good lorry loads) it will give an immeasurable amount of enjoyment and interest to a large number of visitors.

BRITAIN'S FORESTS IN 1970

PAPER PRESENTED TO A STUDY CONFERENCE ON THE COUNTRYSIDE IN 1970 AT FISHMONGERS' HALL, LONDON, E.C.4 4th–5th NOVEMBER, 1963

Of all the major land-using industries in our island, perhaps the developments of the State-owned forests are the ones most easy to forecast and while the picture of the privately owned woods must be painted with a somewhat broader brush, the whole scene, including the impact upon rural employment and economy, can be depicted with a tolerable degree of accuracy.

The Forestry Commission came into being only in 1920 so that, with the exception of the old Crown woods—the New Forest, the Forest of Dean and several smaller forests which rose to commercial prominence at the time when Britain needed to increase her supplies of oak for naval armament purposes—the State forests in 1970 will all be of less than 50 years growth. Even the Crown woods had been heavily denuded during the two world wars so they too contain a high ratio of recent replantings.

Today forests and woods comprise some 7·2% of the surface area of Britain, thus:—

Private woods	2,700,000 acres
Forestry Commission	1,500,000 ,,
Total	4,200,000 ,,

It is noteworthy that though the private woods and the old Crown woods contain large areas which are poorly stocked or otherwise of low productivity, less than 12% of the whole woodland area is both in bad condition and lacking any definite plans for future effective management.

The mere seven years remaining until 1970 will not see all the poorer woods brought round to a condition of full productivity but progress in this direction is likely to be of the order of 30,000 acres each year.

Meanwhile, in accordance with the Government decision of 24th July, 1963, it is anticipated that the Forestry Commission's forest will expand by about a further 45,000 acres a year. Most of the contemporary private effort is likely to remain confined to the restoration of the old woods but a concurrent expansion by additional private planting of 3,000 acres a year would be a reasonable assumption. On the other hand, some private woodland areas will undoubtedly be acquired by the Forestry Commission.

Thus, by 1970 we may expect our forests to have expanded to some 4,500,000 acres.

A softwood forest begins to become revenue-producing at about the age of 20 years when thinning operations commence. But the early thinnings are small in size, limited in market outlets, and can be difficult to handle in bulk so that financial returns are low. It is not till the age of say 30 to 35 years that the major intermediate revenues begin to accrue and, of course, not till the end of the crop rotation, which may be anywhere between 50 and 80 years, that the final profit and loss could be ascertained.

In hardwood forests the delay is very much greater: profitable thinnings may not arise till the fiftieth year or later and the rotation length may be between 80 and 150 years.

While an ideal distribution should give an approximately equal area of woods in each age-class, it is interesting to calculate that, owing to our very recent entry into the timber production field, the actual spread in 1970 is likely to be as shown below.

BRITAIN'S FORESTS IN 1970

Thousands of Acres

Age: yrs.	*Private*	*Forestry Commission*	*Total*
	I. SOFTWOODS		
Uneven	40	10	50
61 or more	100	20	120
41 – 60	120	130	250
21 – 40	140	430	570
– 20	400	1,050	1,550
Total	900	1,640	2,540
	II. HARDWOODS		
Uneven	350	10	360
121 or more	60	10	70
81 – 20	80	10	90
61 – 80	70	5	75
41 – 60	45	10	55
21 – 40	20	30	50
– 20	100	80	180
Total	725	155	880
	III. COPPICE AND OTHER		
Uneven	1,045	65	1,110
	IV. TOTAL FOREST AREA		
All classes	2,670	1,860	4,530

Thus in the softwoods there are likely to be some 1,800,000 acres still in the juvenile, unprofitable age groups, 400,000 acres becoming marginal in intermediate yields and only 240,000 acres providing a larger bulk of thinnings of better size and of crops approaching maturity. Furthermore, the expansion by new plantations will still be continuing. The stock-in-trade is growing all the time but the majority of it even in 1970 will be very immature.

In the hardwoods the situation is less accurately predictable because the large acreage of old crops will, unless market conditions undergo an unexpected change, still contain big volumes of those second grade logs which are today in minimal demand by any branch of the wood-using industries: scenically pleasant to many, but economically very poor.

Production

The out-turn of merchantable wood products from our forests is likely to rise during the present decade 1960/70 from 85,000,000 to well over 100,000,000 cubic feet (Hoppus) and will be consumed increasingly in large up-to-date factories rather than in the small country mills and workshops. The home production of fabricated boards and of paper pulp is already expanding rapidly and is likely to continue to do so. By 1980 a far greater rate of increase in merchantable production will have taken place.

Access to the Forests

The rapidly expanding *area* (though not yet the *proportion*) of Forestry Commission woodlands which are growing out of the young plantation or the dense thicket stage into what the public considers as real forests, means that there is an ever increasing pressure to use these places for recreation. Thousands of acres of "dull" countryside, not to mention areas which had been disfigured by bygone industrial action, have been converted into rather magnificent forests, while the face of much of our upland moor and mountain scenery is being quite radically altered. Degenerating sheep husbandry (degenerating alike economically and in its effect on the ecology) is giving place to forest and incidentally providing three to ten times more local employment. A generation of country lovers has arisen which no longer damns this change merely because it seems different or alien: it seeks entry to these forests for healthy recreation and for study.

The Forestry Commission already manages seven Forest Parks wherein camping, caravanning and exploration facilities are well known. "Camping nights" rose from 171,000 in 1956 to 395,000 in 1962. It allows ample access on foot in a majority of other forests. But the need increases and it is the intention before 1970 to create several more Forest Parks, to increase access elsewhere, to provide way-marked hiking and trekking routes, nature trails and, for the less active folk, more picnic places, wayside halts at viewpoints. (Unfortunately also more litter bins will have to be provided for those who are too irresponsible to take their tins, bottles and papers home). It is the intention to keep nearly all forests roads closed to public motor traffic: Britain will have an increasing need for open spaces free from the noise and smell of cars and motor-bikes.

Arrangements will be continued to maintain nature reserves in conjunction with the Nature Conservancy and the County Naturalists' Trusts.

In this broad work of conserving (as distinct from merely preserving) the countryside to provide local wealth and employment, and to provide added recreational facilities, there will essentially be a need for a more positive collaboration with the National Parks Commission and the Local Authorities.

The Next Generation

Because the Forestry Commission has created large blocks of single-age, single-species forest they are occasionally criticised for their intention (which it has never stated) always to continue to manage their woods in like manner. We are told that the mono-specific forest will lead to calamitous soil deterioration and that the one-age forest will invite other disasters, and both will lack the beauty and the productivity of the mixed-age and mixed-species forest. While these critics have indulged in grand hyperbole, the dangers of such a policy, under certain circumstances of species and site, are well recognized by all foresters.

The creation of a forest on bare land which has been under low grade grazing for generations, incurs rigours of soil and climate which are extremely limiting to young trees and confines selection to a very small number of hardy species. But the regeneration of that forest a life-span later will operate under entirely different conditions. The time for this second step will be arising only to a very small degree by 1970, but the Commission's research and field officers are already busy on the problems. There is no doubt at all that as our first generation forests become ripe for regeneration so will they steadily become far more mixed as to age distribution, and in many places also as to species.

F.A.O. SILVICULTURAL STUDY TOUR

14th-23rd May, 1963

By

P. F. GARTHWAITE

Divisional Officer, Office of Director, England

Places Visited

Four days were spent in the Forest of Dean, Tintern, and Mynydd Ddu Forest in Wales, and two days at Thetford Forest in East Anglia. The Commonwealth Forestry Institute at Oxford was briefly visited en route to Cambridge, and two days were spent in Cambridge preparing and discussing the final report. Optional tours were arranged after the close to the Forestry Commission Research Station at Alice Holt Lodge, and to the National Pinetum at Bedgebury in Kent. Three wood-using factories were visited. This itinerary proved to be very satisfactory for illustrating the theme of the tour and gave a good cross-section of Forestry Commission activities—old woodland in a National Park, hill afforestation, dry heath afforestation and major production arising therefrom.

Participants

There were 18 participants from 11 European countries including 3 from the United Kingdom. Apart from these 3 and one of the officers from the Republic of Ireland none had been in the United Kingdom before. Out of the whole party, 5 were from the Headquarters of their services (i.e. on staff work as opposed to field duties), 4 were in Research, 4 were engaged in professional or training duties, and 5 had territorial responsibilities. This gave a very satisfactory distribution of professional experience.

Theme of the Tour

The subject "selection of species for forests in their productive role as a source of raw material for industry" enabled full play to be given to the role of forest economics in guiding the decisions on the question to which the subject gives rise:—

Should a given site be planted or not?
Which species should be planted?
Should uneconomic crops be replaced, and if so, when?
When and how should mature crops be replaced?

The economic probing of these questions and the method used by the Forestry Commission (net discounted revenue at 3½%) was well taken and understood by the Scandinavian members of the party, but not so immediately acceptable to the central Europeans with their long tradition of high capital growing stock with a low rate of interest and financial considerations generally being subordinated to silviculture.

This attitude of rather shocked horror that foresters should have to set themselves such a revolutionary target as a rate of interest as well as a fully stocked forest, gradually gave way to one of understanding as the tour progressed, and the history leading up to the present situation was carefully explained to them. At the end it was evident that even the Swiss, despite their traditionally "biological" attitude to forestry, realised that this commercial outlook was the correct one for foresters to adopt here, and all were impressed by its results, and by the expert way in which the economic information was obtained and applied.

Ecological Aspects

To add to their fears that forest principles were being sacrificed on the altar of commerce, the first reaction of all participants, including those from the Republic of Ireland and Northern Ireland, but excepting those from Norway and Sweden, to the afforestation seen was that more use should have been made of broadleaves "for soil improvement and protection". This opinion was severely shaken, but not I think finally dispelled, by the soil scientist at Thetford who explained that 1,000 years under a broadleaved crop made no difference to the soil structure or humus content there, and that an understorey of broadleaves *might*, in the critical water relationships there, be harmful in depriving the pines of moisture! Also by Dr. Phillips of Alice Holt Lodge when he explained that a mixture of oak made the pines more, not less, susceptible to *Fomes*.

It was explained that all Forest Officers in Great Britain had graduated on Central European practice, were aware of the classical examples of the dire results attributed to monoculture, knew the attention now being paid in Europe to diversification of growing stock and were watching and noting conditions in our own plantations as they became forests; but that so far the conditions in this country and the silvicultural practices adopted did not indicate the need for such mixtures for *soil improvement and protection*, though mixtures were frequently planted for other reasons (e.g. amenity, nursing effect, early financial returns). At the end of the tour, the Swiss Professor admitted to me privately that he *did* know of some perfectly healthy pure stands of Norway spruce in his country!

ROYAL SCOTTISH FORESTRY SOCIETY 66th ANNUAL EXCURSION: THE BORDERS

By

I. MACKENZIE

Forester, West Scotland

Melrose was chosen as the base of operations for this year's excursion, and on 6th May a large party from all parts of the country assembled at the Waverley Castle Hotel.

Much depended on the weather for the success of the extensive programme of visits to private estate and Forestry Commission plantations in the four days to follow, but unfortunately the sun did not often shine. Enthusiasm was not dampened however in spite of cold and squally days.

Visits had been arranged to Wells, Minto, Mertoun, Monteviot and Eildon Estates, and a description of these follows. There was much of interest to see, and some of the detail has had to be curtailed or omitted.

As an introduction to the programme, Dr. H. H. Corner of the East College of Agriculture gave an after-dinner talk on Land Usage in the Borders, with particular emphasis on the Tweed basin embracing Peebles-shire, Selkirk, Roxburghshire and Berwickshire, an approximate total land area of 1,000,000 acres. Of this area 300,000 acres is at present arable land, 600,000 acres hill grazing and the remainder under forest.

Dr. Corner traced the history of the area from the Roman era through changing periods of prosperity due to improvements in methods of management and cultivation, and the introduction of sheep which led to the opening of trade in wool with the continent. Throughout this time the forest was retained largely as a source of fuel, shelter and cover for game until the Industrial Revolution when the bulk of growing timber was removed.

The picture now is of an area of rich agricultural land ideally situated to supply the store markets of Durham and York to the South, and to benefit from the grain-growing districts of Lothian and Fife to the North. The average farm is large and generally carried 800 breeding ewes and fat cattle. The upland grazings support one sheep per acre and the average return from this land is £4. 10s. per acre. Forestry plays an increasingly important role particularly in the form of shelter belts. A lively discussion followed the talk and took the line that the hill grazings could be more economically used under forest. The general conclusion was that this was indeed the case, but that it must be a process of gradual integration.

Wells Estate

On Tuesday morning party B travelled by bus to Wells Estate through delightful countryside patterned by rich pastures and shelter belts many of which were of oak and beech. The estate extends to 4,000 acres of which 336 acres is dedicated woodland. The woods lie in Rule Water on the eastern slopes of Rubers Law at an elevation of 300-1,000 ft. Rainfall is 32 ins. and the soil a heavy clay with peat overlying in parts. Timber production is given priority over sport and amenity, and the woods are enthusiastically managed by Mr. H. Usher who conducted the party.

C. 6. Of particular interest here is an area of Scots pine regeneration known as the Seedlings. 16 acres of this is Scots pine 90-130 years old last thinned in 1951 when 283 trees were removed, yielding 4,830 h.ft. Thinning was long delayed, and this is evident from the number of wolf trees and whips still standing. There is an under-storey of naturally regenerated seedlings which are to be retained, but if this method of restocking is to be pursued successfully there must be a gradual opening of the canopy now. The parent trees are not of good form but this may be due to the delay in thinning and a selective thinning would now remove these poorer specimens and aid regeneration which is suppressed at present.

C. 9. 2·6 acres of this compartment carries a crop of Japanese larch planted in 1909 and not thinned until 1938, receiving further treatment in '49, '52 and finally a light thinning in 1956. The average top height of the crop is now about 60 ft. and many whips still remain. Various suggestions were offered for future operations, clear felling and replanting being an economically sound policy. The trees are now putting on girth, and the crowns are spreading so it would seem to be a pity not to retain the best trees and underplant. There has been slight windblow at one end of the plot but the position is a fairly sheltered one, and thinning light and often would not be too great a risk.

In a nearby stand of Scots pine planted in 1908 thinning was again much delayed but the crop is now responding to treatment and will in time make a good stand.

C. 3 & 4. Meadsgrove and Dykes Glen, 35 acres in all, are hardwood areas, the main species being oak, beech and elm. In the former are a number of old Scots pine, four of which have been selected as plus trees.

The policy now should be to remove the poorer of the oak and beech stems and underplant. Natural regeneration of oak is appearing in parts and this could be encouraged.

Minto Estate

From Wells the party carried on to Minto where they were met by the woods manager, Mr. Brierton.

The woodlands are situated in the valley of the Teviot, 6 miles N.E. of Hawick at elevations ranging from 300–800 ft. 623 acres are dedicated and of

this area 495 acres are stocked with a range of age classes 1–200. The remaining 128 acres are yet to be planted. 170 acres in the thinning stage and 70 acres are mature or overmature.

C. 9. The first stand visited was planted in 1788 to pure Scots pine and underplanted with beech soon after. Following windblow in 1962 it was noted that the pine was butt-rotted and it was decided to fell most of the trees, retaining seed trees throughout the area and to carry out selective felling of beech. This has now been carried out and the intention is to net the area, and scarify when a good seed year occurs. It does not seem to be other than a "wait and see" policy and one cannot know now what the final crop will be. The canopy is very open now and weed growth will be heavy, resulting in deterioration in soil conditions. The site is obviously capable of growing good hardwoods, and it would seem to be best to underplant now.

Bordering this mature stand is ½ acre of Douglas fir planted in 1910 and thinned only once prior to this year. The intention is to retain this plot and create stability by a series of light thinnings. The trees are of good form and amongst them are two plus trees. It is doubtful if they can be kept on their feet for a fairly heavy thinning is marked on the windward side in the mature Scots pine and beech.

C. 6. Here the party saw the results of a neglected drain system in Sitka spruce. Drains had been neglected and the stand underthinned. Successive windblow occurred following the clear felling of an adjacent stand and is gradually extending. Drains are now being cleared and light thinnings carried out.

Doubts were expressed about the advisability of replanting Sitka spruce on the area which is a shallow peat over heavy clay, but this could safely be done after ploughing if only on a short rotation, say 30 years.

Also in this compartment the party inspected a stand planted in 1894 to Scots pine and larch, the volume at present being 3,150 Hoppus feet per acre. The larch is reputed to be Hybrid but recent identification favours Japanese. The stand has had little thinning in its life but is now being opened out gradually, and will make good.

A neighbouring stand of Scots pine planted in 1894 similarly lacked treatment of any sort until 1939. In 1936 the stand was seen unthinned by a Royal Scottish Forestry Society excursion who considered it beyond recovery. Following thinning in 1959 and 1963 the stand shows great improvement now and the intention is to continue with frequent thinnings. An interesting feature of Scots pine in this stand is the lack of heartwood but it has not affected its value on the market. At least it shows vigour of growth.

The general impression of the woods as a whole was of a considerable problem being tackled vigorously.

Mertoun Estate

Open day was held at Mertoun on Wednesday, 8th May, and in the forenoon the party walked through the parks, visiting various stands of hardwoods and shelter belts. The estate extends to 22,000 acres and the main interest is agriculture, game and sport with forestry playing a very minor part in the economy of the estate.

During the walk some outstanding specimen trees were seen

Douglas fir	Ht.	130 ft.	33	BHQG	
Oak	,,	130 ft.	37½	,,	
Abies nobilis	,,	132 ft.	51	,,	Vol. 443 H.ft.

It is uncommon for the forester to see Scots pine and Sitka spruce brashed

at 7 years of age, and there were many puzzled enquiries about the reason for this. A case of the need for cover for pheasants having priority.

A show and demonstration of Work Study tool development and a selection of proven tools was held in the marquee following the Annual General Meeting.

The party returned by way of Scott's viewpoint from which a magnificent scene stretched forth of river, hill and woodland.

Monteviot Estate

This, the largest of the estates visited covers an area of 35,000 acres and approximately 3,000 acres of this is dedicated woodland at elevation of 200–900 ft. Soils are mainly derived from Old Red Sandstone. Rainfall is low varying from 25 inches to approximately 30 inches on the hills.

The woodlands comprise three main blocks and scattered shelter strips and blocks, the predominating species being Scots pine.

Several stands of conifers and hardwoods were seen during the morning and all had considerable amenity and commercial value. Underplanting was in progress in most of the older hardwood stands with a view to perpetuating their amenity value and also to improve cover for game. Gradual removal of selected trees was found to cause no great degree of damage to the understorey and the general appearance of the woods was maintained. Hares caused considerable damage in many of the young hardwoods and control was effected by trappers. No extra fencing is used.

A shelter strip of hardwood and over-mature conifer was considered to be ripe for underplanting, this best being done by the removal of the conifers first then opening up of the lee side of the strip and underplanting with beech.

After lunch at the sawmill and a demonstration of the Hiab Hoist the party travelled by Landrover to Birkenside Plantation consisting of 250 acres at an elevation of 600–700 ft. and providing shelter for the surrounding agricultural land. At this level a lot of snow damage in young Scots pine was observed.

The party inspected a block of Scots pine planted in 1933 and now in check. The vegetation is *Calluna* and *Vaccinium*, and the soil a heavy clay. Extensive draining was tried in an attempt to get the trees away but this would not have a great effect. Lack of nitrogen is probably the reason, and with present methods the ground would have been ploughed before planting. There are signs that the trees are beginning to make headway now and they could be left for a period yet.

Norway spruce adjoining this on similar ground, planted in 1930, is in severe check and the area covered with rank heather. There is no hope for it and the solution would be plough and replant with Scots pine or Lodgepole pine.

In the same area but at a slightly lower elevation, a 9 acre block of Sitka spruce planted in 1925, adjoining Scots pine of similar age, is being progressively blown. Windblow probably commenced following felling below the Sitka spruce and the problem here is whether or not to restock with Sitka spruce. There are still a few trees standing on the fringe of the blow and considering the much greater volume produced by the Sitka spruce, compared with the Scots pine of similar age, it would be worth it even if windblow did occur again at a similar period.

Eildon Estate

On Friday morning the party assembles at Eildon for the final visit of the excursion.

A magnificent avenue of Birch opened the way to woodlands of great beauty,

where the hand of the forester was everywhere in evidence. The older woods are mainly of Scots pine and beech and the Scots pine carried an understorey of beech planted between 1909 and 1920 on the advice of Sir Wm. Schlich, with the aim of improving soil conditions, retaining moisture in a low rainfall area and prolonging the life of the overstorey.

In addition to normal thinnings in pure coniferous stands, selection thinnings have been carried out in the Scots pine and beech overstoreys and the resultant gaps planted with a variety of conifers and hardwoods. Wherever natural regeneration occurs it is encouraged.

Above C. 3A, at an elevation of 900 ft. approximately, is an extensive area of land with dense gorse which could produce timber. There is no evidence of exposure on the fringe trees of the stand below or on the few isolated trees above. Here it was interesting to note the conflict of sport and forestry, for although it was accepted that the gorse could be eradicated by burning followed by chemical treatment, it was explained that the area gave good cover for foxes.

In C. 4B where some of the Scots pine overstorey was being thinned, many of the trees were butt rotted. Light thinning was also in progress in the beech understorey to favour the better stems.

The party dispersed from Eildon Hall after refreshment.

TREE PLANTING ON THE ISLAND OF LEWIS

By

I. A. D. GRANT

District Officer, North Scotland

The problem of establishing trees on the Island of Lewis has been studied for many years and it is generally agreed that the practice of normal economic forestry on the island is not possible even with the modern techniques now in use on the mainland. During the last thirty years, the Forestry Commission has carried out several surveys over large parts of Lewis and the area of land classified as plantable was negligible; for example, over an area of 5,000 acres in the Parish of Lochs there were found only 340 acres of plantable land in fourteen separate lots, and in Stornoway Parish there were 130 acres of suitable land over 4,300 acres.

The reasons for this are two-fold. First, mineral soils are only found over a small percentage of the land area and these soils cannot be spared from agriculture. Most of the island is covered with blanket peat of very poor quality and often of considerable depth overlying the parent rock, Lewisian gneiss. The second major factor which is adverse to tree growth is the severe exposure. Even on the east coast, the area of woodland at Lews Castle shows the effect of blast for a considerable distance inwards from the margins. This woodland, the largest in Lewis, extends to about 90 acres and is sited on an area of sandstone and basalt.

Since 1930, the Forestry Commission have participated in three planting schemes on Lewis.

1. Lewis Experimental Plots

The idea of these plots came from the late Mr. T. B. Macaulay of Montreal who proposed in 1930 that the Forestry Commission should plant and maintain at his expense about 20 acres of shelter belts with the object of providing shelter and of encouraging crofters to plant other shelter belts. In 1932, blocks of 10 acres and 6 acres were planted at Balallan, Lochs parish and Valtos, Uig Parish

respectively, and the main species used were Sitka spruce and Mountain pine. Moderate growth was obtained until 1941 when the Balallan plot was destroyed by fire, and Mr. Macaulay abandoned the project. In 1945/46, the Balallan plot was replanted using mainly *Pinus contorta* and Sitka spruce, the Forestry Commission having taken over the plots on a new lease. By 1963, the average height of the crop at Balallan was 11 feet and the trees had formed thicket over a large part of the area.

The Valtos plot has grown much more slowly, the trees having suffered considerably from exposure and also because the ground was not wholly suited to the main species, Sitka spruce. After the war, the plot was refenced excluding two acres which had failed and the plants were manured. Subsequent growth has been steady but very slow and the average height of the trees is now about five feet, although in one sheltered corner a few trees are over twenty feet high.

2. Shelter Planting Advisory Scheme

This was started as a pilot scheme in 1952 under the auspices of the Ross and Cromarty Planning Committee. The scheme was an attempt to stimulate interest in tree growing generally and to show that, given a reasonable chance, trees could be grown on crofts to provide shelter and amenity. The scheme was limited to individuals who wished to grow shelter for their houses, steadings on their own land where no common rights were involved. Following advertisements in the press, applicants were visited by a Forestry Commission officer who discussed the proposals and advised on fencing, preparation of ground, how and where to plant, and the numbers and species of plants required. The crofter obtained free advice but all other expenses were met by him. The principal species advised were Sitka spruce, *Pinus contorta*, and sycamore, with some willow and elder in very exposed sites. Since the commencement of the scheme about 300 applications have been dealt with and approximately 60,000 trees planted. In the last few years there does not appear to have been the same enthusiasm for the scheme as when it was first launched. This may be due in some instances to the lack of success, where plants were allowed to be smothered by grass and eaten by straying sheep, but there may also be some disappointment at the rate of tree growth which, on Lewis, is inevitably fairly slow. However, there are, next to the croft houses, many small plots of 100 plants or so which are beginning to show quite well.

In 1955, on a site at Eoropie, Ness, a crofter's scheme was incorporated with an exposure experiment where the Forestry Commission supplied plants, manure, some fencing material and labour. The site was on a reasonably good machair soil fully exposed to the Atlantic and there was planted a total of 320 trees of 20 different species chosen for their tolerance of exposure. By 1958 only nine plants were still alive, partly because of suppression by vegetation but mainly as a result of the severe exposure.

3. Shelter Belt—Moorland Grazings

One of the major agricultural developments in Lewis in recent years has been the improvement of 10,000 acres of moorland grazings by enclosure, manuring and reseeding. In this connection the North of Scotland College of Agriculture have organised a scheme for the planting of shelter belts on the margins of the newly reseeded areas. Free technical advice is given by a Forestry Commission officer and up to one thousand trees are supplied free of charge from F.C. surplus stocks to each crofter in the scheme, the crofter paying only for the transport of the plants. All the work of establishing and maintaining the shelter belts is done by the crofters under the supervision of the local Agricultural Advisers. Over the last two years, 40,000 plants have been supplied

by the Commission, the main species again being *Pinus contorta* and Sitka spruce. It is rather early to assess these belts, but establishment so far has been quite successful and there seems a fair chance that some useful shelter will be obtained. The future of tree planting in Lewis lies in the establishment of this kind of shelter rather than in any commercial afforestation.

ROYAL FORESTRY SOCIETY OF ENGLAND, WALES, AND NORTHERN IRELAND SUMMER MEETING AT TUNBRIDGE WELLS, KENT. MAY, 1963

By

C. PARLEY

Forester, South Scotland

The tour began on Monday, 6th May, at 8 p.m., in the Spa Hotel, Tunbridge Wells, with the Annual General Meeting of the Royal Forestry Society of England and Wales.

Next day we travelled by bus to the National Pinetum and Forest Plots at Bedgebury, established jointly by the Royal Botanic Gardens, and the Forestry Commission in 1925.

When we arrived at Bedgebury, Mr. James, the President of the Royal Forestry Society, introduced us to the staff who managed the Pinetum and Forest Plots. The Forest Divisional Officer gave us a short talk on the history of the plots and pinetum, and their plans for the future. The main idea being to collect as many conifer and hardwood species from nearly all the temperate regions of the world, plant them at Bedgebury, where they would be free from pollution by fumes and smoke. Here, a scientific study could be made of each individual type of tree, and foresters or tree lovers could visit the Arboretum and Forest Plots, where they could see, and get information about, trees both profitable as a crop, or purely decorative.

The party was divided into two, one half visiting the pinetum, the other half the forest plots. I was in the party that visited the forest plots in the morning and our guide took us between plots of oak, *Quercus rubra*, *Q. petraea*, *Q. borealis*, and *Q. mirbeckii*, all about 30 years of age; all seemed to be growing quite well with no great difference in their rates of growth.

The next lot of plots were very interesting, consisting of *C. leylandii*, *Tsuga heterophylla*, Lawson cypress and *Thuja plicata* and all seemed to be very suitable types to plant in a fairly dry area and produce a satisfactory return. The next two plots were the *S. gigantea* and *S. sempervirens*, both species growing extremely well and producing a tremendous increment. The usefulness of the crop was discussed and the two timber merchants present thought that there would be a market for it if sufficient supplies became available. The next plots were of Hybrid larch, Drummond Hill and Cawdor European larch, all of very fine form and growing vigorously. Next we saw plots of *Nothofagus procera* and *Nothofagus obliqua*. The former was very poor but the *obliqua* had grown so well that few of our conifer plots could better it in increment. *Picea omorika* was another interesting plot with a very large basal area per acre. In Kent this is a very profitable crop as many of the thinnings are sold for masts and spars for yachts.

After lunch we walked through the Pinetum where we saw many varieties of trees growing singly or in groups. Cypress Valley is one of the most beautiful glades anyone could wish to see, with the afternoon sunlight slanting through the trees, accentuating the various shades of green, yellow, blue and purple. From Cypress Valley we walked through *Thuja*, *Cryptomeria*, Douglas, *Sequoia* down Spruce Valley to the Swamp cypress on the edge of Marshall Lake, where we disbanded.

The next day a visit was paid to Summerhill Estate; here the main interest was the growing of chestnut coppice. A demonstration of layering of coppice was carried out to show one method of filling blanks in the plantation. We walked through coppice of various ages, one stand having oak standards which would always leave a useful crop should the demand for chestnut coppice cease. Another stand had been interplanted with European larch as a catch crop. The larch was removed ten years later and sold as rustic poles. It was a debatable point as to whether it was more profitable to grow a conifer crop or receive £50 to £100 per acre every 14 to 17 years for the chestnut coppice. One thing in favour of coppice is that small rural works which have been handed down from father to son, are still kept alive manufacturing hop poles, chestnut paling, stobs, etc. After leaving Summerhill we were taken to Redleaf Estate. Although this estate has only 286 acres of woodland, a great deal of thought and planning on the part of the owner and forest adviser was evident. Before planting, the soil is systematically tested by a soil expert, and the species to be planted is selected according to the suitability of soil and vegetation. All their plantations in production were heavily thinned and a large proportion of the remaining stems high pruned, the pruning being done with a Whitmore pruning chisel. The owner stressed that no other tool could compete with it in speed and efficiency. We saw a number of good stands of European larch, Hybrid larch and Japanese larch all heavily thinned and underplanted with *Tsuga*, Norway spruce, Lawson cypress, Leyland cypress, and *Thuja*. All species of undercrop were growing well. Other good stands growing pure were Oregon and Fraser River Douglas, Lawson cypress and Sitka spruce. The latter looked none too healthy. Most of the thinnings were sold standing to timber merchants, and we were informed that the profit was reasonable.

During the evening a dinner was held at the Spa Hotel and was enjoyed by all present, the guest of honour being the Mayor of Tunbridge Wells.

On Thursday a vist was paid to Paddockhurst Estate, size 2,600 acres, and managed by Mr. A. K. Hughes. There were good stands of Scots pine, Norway spruce, Corsican pine, Douglas fir and European larch, 40 years old, but again Sitka spruce was none too healthy. There were also good young stands of mixed conifer, and oak and chestnut. More ground was being cleared to plant chestnut. Here an interesting machine was being used to eradicate stumps, called the Vermier Stump Grinder. The cost was 50/- per hour or 27/6 per foot diameter. The removal of the stumps was to facilitate the use of machinery for weeding. Also of interest was a chestnut fence costing 10/- per yard, its sole purpose being to exclude the public and lessen fire risk.

After lunch we visited Holmbush Estate owned by Major Calvert. The prolific growth of scrub and heather made the growing of trees very difficult. Various methods had been made to remove scrub cheaply and in one area the rhododendrons had been bulldozed, but the crop of Norway spruce planted on the bulldozed ground had gone into check with the removal of the top soil. The checked Norway spruce made very good Christmas trees, so all was not lost. Sitka spruce, pure or with Corsican pine, was having a struggle to compete with the heather and methods of curbing the heather growth, or bringing the Sitka spruce out of check, were discussed. Two suggestions made were, (1)

spraying the heather with 2-4D to kill it, and (2) the use of phosphates to promote the growth of Sitka spruce. In many places where the original crop planted had failed, Scots pine had naturally regenerated and filled up most of the blanks. Growth in some of the older crops, especially European larch, was very slow.

On Friday morning a visit was paid to Eridge Estate owned by the Marquis of Abergavenny. Mr. Small, his Head Forester, informed us that they were mainly replanting areas felled during the war, with mixed conifer crops, e.g. Sitka spruce, Scots pine, Norway spruce, Lawson cypress and *Thuja*, and also making use of naturally regenerated Scots pine. Preplanting roads, cheaply constructed by bulldozer, were also examined. Next we visited the pinetum at Eridge Park where we saw a varied collection of very fine trees, many topping the 100 feet in height. From there we went to the Tulip Walk which, though not in full bloom, was magnificent. After this, goodbyes were said and the excursion disbanded.

Thanks to the organisation of Mr. James, the President and Mr. Leathart, the Secretary, the whole meeting was a huge success. I would like to thank the Royal Forestry Society of England, Wales and Northern Ireland, on my own behalf, for a very pleasant and interesting week.

FORESTRY POSSIBILITIES IN WALES

By

W. CRAVEN LLEWELYN

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I was instructed by Professor Fraser Story, Head of the Forestry Department of Bangor University, to make a survey of a 60-year-old five-acre plot of Douglas fir, on the banks of the River Ogwen, North Wales, It yielded approximately 330 tons per acre. It ranked amongst the highest yield per acre of areas I subsequently surveyed in Central Europe and certain parts of Russia.

When surveying the luxuriant timber production land of Kerry Hills, Montgomeryshire, the total valuation reached £60,000 and was subsequently sold at this figure. The prairie value of land on the upper reaches was 2/6 per acre. The planted areas worked out at £1. 1s. per acre. The land south-west of one of the plantations had risen in value from 2/6 to 12/6 per acre, and provided ideal pasture for an increasing flock of Kerry Hill sheep. It was an irrefutable example of arborescent plantations converting pasture hitherto of *Agrostis* and *Cyperus* to one mainly composed of *Festuca* and other useful grasses. There is no doubt that the planting of land of high altitude would provide additional source of income to sheep rearing.

The merciless onslaught on our comparatively limited acreage of woodlands —about four per cent of the total land area in Great Britain—will leave us in a very impoverished state for *at least* 20 years after the War, even if a scheme of afforestation were embarked upon at once. At the end of this period we shall

be in possession only of mining timber of the pit-prop class, of which about 40,000 tons were utilised weekly in the mines of South Wales in pre-War time.

In considering afforestation in relation to mining, it is very often said that by the time timber planted now reaches a point of maturity rendering it suitable for colliery purposes, science will have discovered a more economical and more readily available substitute in the form of a concrete or iron structure. Whatever may be the outcome of research in this direction, which certainly ought to be encouraged, it is extremely difficult to conceive of the elimination of prop-wood from mining operations. As a result of investigations and personal observations in regard to this matter, the writer has arrived at the conclusion that steel, concrete and similar substitutes prove rather successful in such places as the main galleries, but that as props in the stalls, where they are required to serve not only as means of support but also as a method of warning miners of danger arising from bad condition of the roof or other abnormality, they completely fail. In any case to postpone planting on a large scale in the hope of discovering satisfactory substitutes for timber in mining and commercial operations generally would be not only an unbusiness-like but a highly speculative policy.

Much could be done to improve our hillsides and pit banks, from an aesthetic standpoint, by planting with birch and various shrubs. In course of time the productivity of the soil would be so increased by the accumulation of organic matter formed by the decayed leaves of the trees and of the underlying herbaceous vegetation as to render it ultimately congenial for growing trees of more commercial value.

A question that naturally arises is, how can public or private bodies acquire the land necessary for afforestation? There should be no difficulty whatsoever. All afforestable lands, heath and mountain land, must be requisitioned by the State, and appropriate portions leased on the undertaking that it should be developed in accordance with pre-arranged terms; an unleased area should be directly planted by the State itself.

An inducement of this description would undoubtedly result in Corporations and water trusts planting the catchment areas of their water supplies, as the Corporation of Liverpool is doing at Lake Vyrnwy, Montgomeryshire, and the Birmingham Corporation at Rhayader, Radnorshire. It is now a recognized scientific fact that apart from the intrinsic value of woodlands around reservoirs they have other important advantages as, for example, in maintaining a regular and equal supply of water in the lakes.

Wales is especially adapted for growing the trees that are most in demand in Great Britain, such as the European larch (*Larix decidua*), Japanese larch (*Larix leptolepis*), Douglas fir (*Pseudotsuga taxifolia*), Norway and Sitka spruce (*Picea excelsa* and *P. sitchensis*). It may be interesting to note that eleven-year-old thinnings of the Douglas fir on the Llangoed Estate, Breconshire, yielded pit-props 6½ feet long with 5 inches top diameter. On the Penrhyn Estate, near Bettws y coed, a few trees of the above species when about 60 years old measured 110 feet high with 4 inches top diameter and with 16½ inches quarter girth in the middle, or, in terms of cubic contents, 208 feet.

Space will not allow of the citation of many concrete instances illustrating the suitability of South Wales for afforestation, but the following examples will be found instructive. In the neighbourhood of Llandovery a plantation approximately 40 years old was situated on the side of a mountain. The upper portion, contrary to the main body of the wood which had a gradient averaging one in five, grew at an altitude of over 1,200 feet, and on a gradient of about 1 in 100 with a north-eastern aspect. A survey of one acre of the said portion yielded the results herewith tabulated:—

Species	*Number of trees to the acre*	*Volume per tree*	*Total volume per acre*
Larch ..	312	3·2 cubic ft.	988 cubic feet
Spruce ..	156	5 „ „	780 „ „
Scotch fir ..	80	3·4 „ „	267 „ „
		Total ..	2,035 „ „

Taking into consideration the injudicious selection of trees at the time of planting and the subsequent unscientific if not neglectful treatment of the area, the above may be taken as a fair index of the timber-growing capacity of common land in South Wales.

The relationship of afforestation to small holdings also is a very important one; in fact, it is difficult to conceive of the successful development of the latter independently of the former. Afforestation would not only create and improve small holdings by giving protection against cold and dry winds to land that might otherwise be unsuited for cultivation, but the holder would be given opportunities to augment his income during the suspension of operations on the land in the winter months, by undertaking tree-planting and other work of a forestal character. The great benefit that some of the small holders in the most wooded parts of Carnarvonshire have derived from present activities in the home grown timber trade is demonstrative of the above contention. In winter, and in summer too if the holding was very small, they brought their horses, if they possessed any, to help in tushing operations; others assisted in cross-cutting or performed some useful work at the saw-mill, which was invariably erected in or in close proximity to the plantation.

Further, afforestation will also assist the social reformer to solve partly the unemployed question and the economist to augment the revenue of the country. It is nothing less than a national disgrace that in view of the suitability of our country for silvicultural operations the importation of forestry produce in 1913 into Great Britain amounted approximately to £43,000,000 or half of the world's exportation. (It is nowadays ten times that figure!—Ed.)

At present the mines of South Wales alone consume roughly 40,000,000 cubic feet per annum and about 20,000 acres have to be annually exploited to keep the mines supplied at the present rate of demand. Assuming that an extensive afforestation policy had been initiated about 40 years ago—40 years is about the average age of the coniferous plantations now being exploited for mining purposes—and that we could constantly supply the coalfield with only 50 per cent of its requirements, constant employment in the actual operations of dealing with timber standing *in situ* to the unloading stations, would be provided for thousands of men, skilled and unskilled. Furthermore, as a result of planting many subsidiary industries could have been created in the nature of manufacturing baskets and basket-ware, clog soles, cask hoops, dairy utensils, and various other wood products to which the small holder could turn his attention in the months of winter and in the leisure hours of summer.

A number of people in Wales at the present time appear to be hostile to the development of the forestry industry. Probably their antagonism is based on the idea that afforestation will retard the development of agriculture by encroaching upon land suitable for agricultural purposes. This is due to an erroneous conception of the science and the practice of forestry. They fail to

see that there exists a close parallelism between Agriculture and Forestry, that they are in fact cognate sciences. The latter aims at cultivating heath and mountain land, dingles and sand dunes, lands which are ordinarily of little value for arable purposes. Afforestation may, it is true, to a *limited* extent trespass upon the huge tracts of common land now employed for sheep-rearing. Sheep-farming, however, although very lucrative from the point of view of those engaged in it, is one of the least energetic forms of agriculture, and from the standpoint of national interest is much less valuable than silviculture.

Investigations in regard to this matter have yielded certain data not yet complete, but sufficiently complete to enable me to make a rough estimate of the comparative productiveness of waste lands when used for timber-growing and for sheep grazing. Taking an acre as a unit, the yield per annum of timber amounts to 48 cubic feet, that of mutton to 11 lbs. The latter may possibly be slightly underestimated but the former is knowingly placed at a low figure*. Practically all the coniferous plantations that I have surveyed in Wales on land hitherto occupied by *Nardus stricta* (Mat Grass), *Agrostis vulgaris* (Fine Bent), *Galium saxatile* (Heath Bedstraw), *Polytrichum*, *Sphagnum*, and many other plants of a similar kind, have yielded on an average 52 cubic feet per annum without proper silvicultural treatment. If, however, a displacement of sheep takes place it will be so small, that one can safely say that the effect on the nations' supply of mutton will not be felt at all†. In any case the economic potentialities of the mountain lands of Wales are too great to warrant our high lands being monopolised by the genus of *Ovis*.

The nation's source of real wealth will increase as the area of waste and derelict land diminishes; the converse is also true. Further delay in developing the common land is a loss cumulative in its extent and national in its effect. The need for the reclamation of waste lands demands serious attention. In the County of Glamorgan alone there are hundreds of acres of sand dunes, from Merthyr Mawr to Pyle and alongside the Gower Coast especially at Llangennith, which can be planted to produce timber of commercial value and utility such as is imported from France under the name of *Pinus pinaster* (Maritime Pine). Why should not these be utilised?

The primitive lands of Wales produced forests which in their bituminized form stand uneclipsed in the coal markets of the whole world. I am fully confident that Welsh soils can again produce forests which will not only be the pride of every Welshman but a constant source of wealth to the nation.

THE FORESTS OF GLAMORGAN

By

ARTHUR C. HAZZARD

Forest Worker, South Wales

I. Llantrisant

Across the Ely river from the high-set old town of Llantrisant rises Mynydd Garth Maelwg. In 1886 the Marquess of Bute had planted its slopes with European larch, Scots pine and Norway spruce. At the outbreak of World War I the value of this timber was such that by 1916 it was almost all felled.

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*The Report of the Forestry Sub-Committee of the Reconstruction Committee states 9 lbs. per acre for the whole of England, Wales and Scotland.

†According to the above Report, the loss is about one per cent of the total national consumption.

Three years after the armistice Mynydd Garth Maelwg had become a dense growth of bracken and bramble that all but hid the famous well of Ffynnon Maelwg and the twin Beacons.

It was into these unpromising acres that the Forestry Commission first came in Wales.

It is doubtful if the first forest workers who cleared this wilderness and replanted it with Sitka spruce, Japanese larch, Norway spruce, Douglas fir and Corsican pine appreciated that their laborious acres were the forerunners of Wales's most thickly-wooded county. Yet it proved to be.

Tragic King

One of the signposts at the approaches to Llantrisant Forest, now a 40-year-old forest of noble trees, reads: "Part of the Beauty and Wealth of Wales". It might well add "History" also.

For these wooded acres have played their part in the rich tapestry of Ely Valley history. They are set amid the country lanes through which the tragic figure of King Edward II fled to Pant-y-Brad, and the quiet meadows around Treferig over whose pastures the zealous Quaker pioneers once tramped to John Bevan's meetings in the old hall.

The forest slopes look across to old Llantrisant slumbering on its hill-top opposite, dreaming of the Black Prince and the Battle of Crecy, of King Edward II and Owain Glyndwr, of Saints Gwynno, Illtyd and Tyfodwg, and of intrepid old Doctor William Price, of Caerlan.

Locked in the very soil of these forest acres are the secrets of the Battle of Rhiwsaeson in A.D. 721 and the great mysterious twin Beacons on its hilltop, as well as all the lore and legend of the erstwhile healing well of Ffynnon Maelwg.

Replanting

The Ely Valley has long accepted Llantrisant Forest as part of its beauty and wealth—and history.

Fittingly enough, it was at the Cwm Ddu entrance to Llantrisant Forest that a year ago Lord Brecon commemorated the planting of a quarter of a million acres in Wales when, in a distinguished company, a grove of copper beeches was planted and a stone unveiled.

For 40 years the round of planting and maintenance, thinning and felling and replanting has gone ahead, and in 1963 the forest has acquired a new area over the crest of Mynydd Gelli Wnion above Maesycoed and Pontypridd, four miles north-eastwards.

Planting is now in progress over these slopes above Pwllgwaun that, in 1804, carried a crop of timber "of the best quality, fit for purposes that require timber of the largest dimensions".

It is the parent block of Mynydd Garth Maelwg, however, that is the best-known feature of Wales's oldest state forest. Seen almost in its entirety from the Beddau-Llantrisant road, and forming a conspicuous feature from the Tonyrefail-Talbot Green road, it is familiar also to train travellers between Llantrisant and Llanharan on the main Cardiff—Swansea line.

Bordering this line is the newer Coed Trecastell Block, stretching to Llanharry Common and the farmlands of the old Scuria Castle, above Llanharan.

Integrated

The produce that emerges from Llantrisant Forest ranges from telegraph and transmission poles, sawmill timber and pitwood to fencing stakes, rustic

poles and firewood, and in the minor produce market it yields foliage for nurserymen and many thousands of Christmas trees in their season.

A comprehensive review of these products would illustrate how closely integrated Llantrisant Forest is to a diverse section of the community. To public bodies such as borough, urban, rural and county councils; to the National Coal Board, the Post Office and the river boards; to civil defence and building contractors, to farmers and small-mine owners and timber merchants and many others.

II Rhondda

Nowhere in all Britain does reafforestation offer such a challenge and, at the same time, such a reward, as in Wales's newest state forest—that of Rhondda.

Here is a forest in the making actually within the boundaries of a borough; instead of the traditional forest "village" it has a teeming population of a hundred thousand in its very centre.

The problems of protection—especially from fire—demand a re-education and a new appreciation of the potentialities of Rhondda's erstwhile barren hillsides.

Timber extraction over these steep slopes calls for no little skill in road engineering; the choice of species for Rhondda's exacting climate and its bewildering variety of aspect and soil conditions is itself a silvicultural challenge.

Its rewards are no less exciting.

With its vivid industrial history leading to the almost complete denudation of its former wealth of timber, Rhondda now faces a new look in which not only are the industrial blemishes largely covered but these scarred acres made to yield a crop of timber such as Rhondda has not seen extracted for two hundred years.

Already twenty families, scattered between Clydach Vale, Gelli, Ystrad, Blaenrhondda, Treherbert, Cwmparc and Treorchy find their livelihood from the few hundred acres at Mynydd Tylacoch, Mynydd Maindy and Llwynypia Mountain now planted—that previously supported (if that is the right word in Rhondda) a few score of sheep.

The Challenge

And far from the Rhondda hillsides being shut off from the 100,000 inhabitants of the Valley, the forest roads will actually open them up. By the time this comes about a new code of behaviour and a fuller appreciation of values should match the growing wealth of timber and the new beauty and diversity of wild life that accompany it.

Herein lie both the challenge and the reward of Rhondda Forest.

The bleak and wet conditions of the plateau tops around the Rhondda mean the complete exclusion of all vegetation except *Molinia* or blue moor grass and rushes in the wetter areas.

In the shelter of the valleys this changes quickly to woodland of the oak, birch and mountain-ash type with alder in the damper spots, and this natural tree growth covered most of the ground up to mediaeval times. Evidence of this frequently comes to light.

When the inter-valley road was under construction from Treherbert to Rhigos over Craig y Llyn the trunks of many birch trees were dug up in a peat-bog at an altitude of 1,600 feet—and others have come to light when the forest workers on Mynydd Tylacoch above Cwmparc have dug drainage channels into the peat.

Even now in some of the more inaccessible ravines, where the ubiquitous sheep cannot crop the tender seedlings, a few scrubby oak and birch are still to be found.

But although Rhondda hillsides could be planted with hardwoods these would never develop into an economical crop, so large-scale planting is confined to the less exacting conifers.

Already in its first three years the Rhondda Forest has felt the keen edge of Rhondda's climate.

The disastrous year 1960 saw the rainfall in the upper reaches of the Rhondda total 118·9 inches for the 12 months. November was the wettest month of the year, with 23 inches of rain against an average of 9·8 inches for the previous 68 years.

To follow this came the tragic night of 3rd December, when 6·12 inches of rain fell at Llwynypia, on to ground whose absorption ability following the extremely wet November was around zero.

In 1961 came a period of drought followed by a late spring frost which dealt harshly with the young Japanese larch planted on Llwynypia Mountain above Blaenclydach.

The equally tragic winter of 1962-63, with its frost-bound months of lost planting time, is too fresh in the minds of Rhondda forest workers to need recording.

Rhondda Green

Tree-planting is now being resumed in Rhondda at Mynydd Maindy between Ton Pentre and Bwch y Clawdd, and already the fire patrols have been out over Gelli Goch and Craig Pontrhondda to protect the existing plantations.

Popular awareness of the vast project of reafforesting Rhondda's mountains is developing well. The first film shows were given to Ystrad Rhondda Boys' Club and others will follow at St. David's Church Youth Fellowship in Ton Pentre and at the very co-operative County Secondary School for Boys at Treherbert.

A forestry exhibit formed part of the fire prevention exhibition held recently at the Tonypandy Grammar School, and valley folk are being made aware of a new slogan, "Prevent Forest Fires: Keep Rhondda Green".

By such means can the efforts of Rhondda's forest workers result in a valley that is green again.

Green—and productive, when the axe on the school badge of Pentre Grammar School can take on a new significance.

III. St. Gwynno

Llanwonno was a place of beauty when Guto Nythbran ran barefoot along its parish roads. It was still a place of beauty when Paul Robeson leaned over the churchyard wall, drinking in the seclusion of the peaceful valley, looking back on the winding mountain roads he had tramped from the "Proud Valley".

Llanwonno is still a place of beauty today. The family of Darwonno, whose stained-glass memorial windows are a feature of the age-old parish church, have gone by now, but Saint Gwynno himself lives on—in the name of the great state forest that has grown up around his mountain-top retreat.

For although St. Gwynno Forest stretches from the source of the Clydach River on Coedcae Aberaman right down to its confluence with the Taff near Glyncoch, it is still the older portion around the hamlet of Llanwonno that is best known.

Lying in the hills that separate the Rhondda Fach from the Cynon Valley, the plantations of St. Gwynno stretch as far as the eye can see, totalling with its outlying blocks in the neighbouring Cynon and Bargoed Taff valleys over 7,000 acres.

Few will deny that St. Gwynno Forest is the scenic gem of North Glamorgan. Let he who seeks in Glamorgan some of the beauty of the Mawddach or the Dovey or the Rheidol go up beyond Old Ynysybwl to the Pistyll Goleu, the "Fountain of Light" waterfall tumbling into the little Clydach brook amid acre upon teeming acre of rich greens of spruces and larches, rising to the frowning Dduallt and distant Fforch Don.

Fire Risk

This lovely Clydach Valley has always been a summer haunt of picnickers and fishermen from Mountain Ash and the Rhondda Fach and Aberdare, and the Forestry Commission have set aside picnic sites, one conveniently near the Brynffynnon Inn in Llanwonno village and the second on the hillside overlooking Abercynon.

Surrounded by so congested an industrial district St. Gwynno Forest's main enemy is fire—and already this year some 15 valuable acres of growing timber have been lost.

The wooded beauty of St. Gwynno's great forest reserve deserves to be explored and better-known; to every visitor the forester would, however, impress the need for great caution. The match thrown carelessly from the car window is one source of trouble.

And do be careful with that cigarette—and knocking out that burning tobacco from your pipe. It is so very easy, and so very tragic, to destroy scenery that one has driven miles to see.

It was in 1937 that this great transformation of the Ynysybwl valley began to take shape, and it is still in Old Ynysybwl that the nerve-centre of this expanding forest is sited. Norway spruce on the frosty bottom stretches; Japanese larch on the central bracken areas and the hardy Sitka spruce and Scots pine on the moorland crests that reach 1,200 to 1,500 feet above sea-level —this is the general picture.

Long History

A programme of extraction roads is opening up these far-spreading plantations that are now yielding pitwood and fencing material from the thinnings.

Some idea of the extent of St. Gwynno Forest can be gauged when it is realised how diverse are the viewpoints from which its plantations can be seen. The road from Pantygraigwen in Pontypridd skirts the Hendre Rhys block; the Maerdy to Aberdare road fringes the Blaenaman section.

By train or by road up the Cynon Valley the Pen y Foel and Gilfach Rhyd plantations dominate the skyline; over Mynydd Merthyr the outlying blocks of the forest rise above Penrhiwceiber and Blaencanaid, and further towards the Rhymney Valley are newer areas around Deri and Llanbradach, Fochriw and Ystrad Mynach.

Forestry has a long history in Llanwonno parish. A manuscript at the London Record Office links up the charcoal-burning industry with the small iron-smelting furnaces.

Best Quality

We read how on 17th March, 1630, an agreement was made for the "cutting and charring of wood" destined for "the furnace of Penrees in the parish of

Llanwonno." The charcoal for mixing with the iron at the Pentyrch and Melingriffith forges during the 18th century was partly produced at Melingriffith.

But the cordwood used grew as far away as Llanwonno: the charcoal was bagged and carried to the works on the backs of horses and mules. In 1804 a *Star* advertisement offers for sale "480 oak timber trees growing in Penrhiwgwint in the parish of Llanwonno, and 255 oak timber trees growing at Penrhiwceiber and Wern Coch in the parish of Llanwonno."

This was described as "of the best quality and fit for the naval engineer and other purposes that require timber of the largest dimensions."

St. Gwynno Forest is well on the way to again supplying "timber of the largest dimensions." It is extremely unlikely that the "naval engineer" will be interested this time but so diverse are the uses to which softwoods are put nowadays in the pulpwood, chipboard and other industries that markets are ensured for all the thinnings and fellings that emerge from this expanding forest of the North Glamorgan moors.

IV. Rheola

The first Forestry Commission planters on the Rheola Estate in the Vale of Neath in 1922 can hardly have visualised that the forest they were creating would become the largest in Wales and the third largest in the United Kingdom.

For over the next 30 years the new plantations had extended to cover much of the intervening moorland between the valleys of the Nedd, Tawe, Llynfi, Afan, Corrwg, Garw, Ogwr Fawr and Ogwr Fach, and had developed as separate forests named Rheola, Crynant, Michaelston, Pelena, Margam, Dunraven and Cwmogwr.

The Coronation of Queen Elizabeth II provided the occasion for the merging of these separate units into the vast Coed Morgannwg, which will ultimately have 40,000 acres under plantations—occupying very nearly one-twelfth of the total area of Glamorgan.

The Rheola and Cymmer sections are perhaps the most spectacular areas of Coed Morgannwg. Head Forester Smith, who for 17 years has been part of the Rheola scene, has nurtured this forest from the pioneering days without adequate roads, no versatile Landrovers, no firewarning radio system, to the present highly integrated forest with its protective aids, its extraction routes—and its contribution to the economic life of the Vale of Neath.

By 1949 Rheola employed 128 men, and had itself developed in separate forest blocks. The central portion was Rheola North and Rheola South, lying on either side of Resolven. Rheola South which includes Resolven Mountain, is actually the oldest part of Coed Morgannwg, for it was here in the Tyrau Woods and Nant-y-Gleisiad that planting commenced in 1922.

A Main Road

The Rhigos block reaches the highest point in Glamorgan on Craig y Llyn at 1,969 feet above sea-level, and includes the impressive rock escarpments of Craig y Pant, Craig Isaf and Craig y Llyn itself. The progress made in this section is always in the public eye from the inter-valley road crossing Craig y Llyn from Treherbert to Rhigos.

The Pelena block extends over into the next valley of Cwm Pelena, and the Crynant block rises from the Dulais Valley to the Mynydd March Hywel ridge. Here, too, the main road from Ystalfera and Pontardawe affords a viewpoint.

Isolated from the others, but itself a landmark around Neath town, is the Duffryn block of replanted woodlands occupying the steep slopes of Mynydd Drumau and acquired in 1931 from the Dyffryn Clydach Estate.

It's Unique

No fewer than a quarter of a million people live close to Coed Morgannwg, and the fire protection costs annually reach a sizeable figure of thousands of pounds. Last year, for instance, a single fire destroyed 200 acres of Cymmer Forest, starting as a minor grass fire above Blaencwm, in the Rhondda, and ending as a two-mile long forest fire that in an hour had penetrated more than a mile and cost £13,384.

In 1963, too, during the drying winds that followed the first snowfalls, Coed Morgannwg had its fires. In the long run the safety of Wales's largest forest depends on everybody in the neighbourhood exercising more than usual care to safeguard what is national—and therefore their own—property.

The wording of one of the fire danger signs sums it up thus: "Part of the Beauty and Wealth of Wales. Please Protect It."

For 10 years, all through this fire risk, Head Forester Evans has planted up the bulk of the old Dunraven forest to its present magnificence, following his previous service in neighbouring St. Gwynno Forest. These forests of Rheola and Cymmer, and indeed Coed Morgannwg as a whole are quite definitely not typical Forestry Commission areas.

Coed Morgannwg is unique in its proximity to industry (with numerous coal workings actually in the forest—using forest roads), in its urban population around every fringe and in its rich archaeology and history.

Ancient British trackways and Roman roads abound (the Sarn Helen over Hirfynydd traverses the north block of Rheola); Celtic crosses and burial tumuli and monastic remains are frequent, and at Llyn Fawr its plantations border the lake which yielded one of the richest Bronze Age hoards in Wales.

In The Vale

Much of Coed Morgannwg is the 20th century successor to the great forest of Coedffranc which stretched from Neath to Aberdare. In its setting here in the wide Vale of Neath, Rheola Forest has many places of outstanding beauty and natural interest.

There is the Sgwd Rhyd yr Hesg waterfall on the Melincourt brook at Resolven, the lonely mountain tarn of Llyn Fach near Craig y Llyn, and the sweeping vistas of the spruce plantations on the Hir Fynydd.

And in spite of many difficulties such as atmospheric pollution, it is known that the Vale of Neath can produce some fine softwood timber. At Aberpergwm a Silver fir measured in 1934 had reached the exceptional height of 145 feet, with a breast height girth of over 13 feet, making it one of the largest trees in all Wales.

In variety of species as in variety of scenic outlook, Coed Morgannwg has much of beauty to offer. Little wonder last summer's evening bus trips "to The Forest" proved so popular.

V. Margam

The newest of the historic stones on Margam Mountain is 10 years old this year. It was on 27th June, 1953, that the Princess Royal unveiled a commemoration stone to record the name of Coed Morgannwg.

Through this wooded hinterland of the highly industrialised coastal belt runs the main forest highway, Ffordd y Frenhines, the Queen's Way.

It traverses in turn the five forests that were then combined to form Glamorgan Forest—Margam, Rheola, Michaelston, Cwmogwr and Dunraven.

A switchback journey along the Queen's Highway, now developed from centuries-old ridgeway tracks and mediaeval cart-tracks, offers magnificent

vistas of Coed Morgannwg. Interspersed with the generally 15- to 20-year-old plantations are the thicker and older plantations already showing the future pattern of this rolling expanse of over 50 square miles of terrain.

Undoubtedly one of the main beauty-spots of the forest is the reservoir supplying Port Talbot, in the Cwm Wernderi valley where the trees come down almost to the water's edge. It was on Graig Emroch near the village of Goetre that planting was first started here in 1921.

Bleak Valleys

From the modest 126 acres of that year have developed the lovely Margam Forest section of Coed Morgannwg that now affords Port Talbot the splendid wooded hinterland that few such highly industrialised towns are able to enjoy. For, without doubt, the Afan and Corrwg valleys that form this hinterland were among the bleakest in all South Wales.

Writing in *The Story of Glamorgan*, published in 1908, C. J. Evans described the area thus: "The upper reaches of the Afan are situated among mountains whose sides are precipices hardly covered by vegetation of any kind. The rocks peep through the soil in all their bald nakedness. Below Cymmer the valley widens a little, though all the way down it is one of the wildest and most rugged of the valleys of the county."

Add to this the despoilation caused by coal and metal working, and some idea is obtained of the unpromising terrain out of which the forest workers have created the present beauty.

Fire Risk

And now 30 years later the visual effect of this transformation of the Afan Valley is being felt in its neighbour the Rhondda. As the plantations in the new Rhondda Forest begin, the recollection of the neighbouring Afan helps to create interest and appreciation in the Rhondda.

The Afan Valley is the natural route for Rhondda folk to Aberavon, Port Talbot, Margam, Neath and Swansea. Whether by train (before Dr.Beeching's axe fell) or by road over Bwch y Clawdd, the Rhondda traveller must needs pass through or alongside some of the extensive plantations of Margam and Michaelston.

"If this is how the Rhondda will improve in a few years . . . ." And so the good news is passed and the success of one forest helps to stimulate another.

Imagination

This Afan Valley section of Coed Morgannwg has caught the imagination of the children of Cymmer Afan Secondary School. Their four-acre school plot of woodland, with the start of which Head Forester Lloyd was actively concerned, has given them the honour of being pioneers of an experimental offer to rural schools as part of the Forestry Commission's long-term policy of making the public forest-concious and forest-proud.

The main enemy of these Margam and Michaelston plantations is fire. Between 1921 and 1957, 1,600 acres of plantations in various stages of growth were destroyed by fire IN MARGAM FOREST ALONE.

Steel Accent

The old Cwmavon Stack of a former industrial era has given way to other mountain-top landmarks in Coed Morgannwg, the fire look-out towers. Above Resolven are one on each side of the Neath Valley in the Rheola Forest section.

There is one above Blaengwynfi: another overlooking Bryn, Port Talbot and Maesteg, and yet another high above the Afan Valley near Pontrhydyfen. In conjunction with these, the forest road system is planned both for timber extraction and for forest protection.

The network of forest roads necessary for such an area as Coed Morgannwg becomes a major engineering feat when it is realised that a mile of road is required for every 80 to 100 acres of plantations.

Coed Morgannwg thus needs 250 to 300 miles of mountain roads. And these over such slopes as the windward side of Craig y Llyn, the wettest area in all Glamorgan, around Glyncorrwg, where the steepness of the slopes can best be appreciated by reference to the old Blaencorrwg Farm slide-cars. Wheels were of little use on these gradients.

Copper, iron and tinplate have all played their part in the industrial history of the Port Talbot area and its hinterland. Today the accent is on steel. When the great oak forests of Margam Mountain (which gave it its old name of Pendar) disappeared the only trees worth mention in the district were the exotic orange trees of Margam Abbey.

In History

Yet deep in Port Talbot's municipal history, wood—as well as metal—has played a strange part. During the Civil War the Mayor of Aberavon, in fear of losing the town's charter, hid the precious document in a hollow cut into a block of wood used for chopping.

When Cromwell's soldiers came into the neighbourhood and searched the house for the charter they never dreamed of its hiding-place. The wood from this block was afterwards formed into a chest in which the public records were kept.

Aberavon's charter safe—and the exotics of the 20th century tending rather to the economically useful larches and spruces and firs rather than the citrus trees of Margam Orangery.

The Forest of Margam on the hill, like the City of Steel on the moors, must adapt itself to the times.

The Beauty of Coed Caerdydd

If I were asked to name the most attractive walk between two neighbouring pubs in Glamorgan I would unhesitatingly say the road between the Lewis Arms, in Tongwynlais, and the Black Cock, on Caerphilly Common.

It affords splendid views of one of the units of Cardiff's own forest, in this case the old Fforest Fawr along the ridge dominated by Castell Coch.

There are several others that go to make up Coed Caerdydd—the Cwrt yr Ala Woods, at Dinas Powis; the Leckwith Woods, above the Ely estuary; the Wenvoe Castle Estate woodlands, between Barry and Wenvoe, and the woods that fringe the Garth Mountains at Morganstown.

This scattering of small woods together make up the Coed Caerdydd forest, occupying the hinterland of the capital city in the Taff and Ely basins. The unusual combination of forests and mining valleys (as in Rhondda and St. Gwynno); forest and steel-making (as at Margam); forest and coastal scenery (as in Gower) has a parallel here where a forest is linked with Wales's capital city.

The Castell Coch woods have long been a favourite haunt of visitors to Cardiff due to the proximity of Castell Coch itself. Oak and ash and sycamore thrive on these limestone slopes that reach up to Blaengwynlais, interspersed

with conifers replacing the tangle of coppice and bramble and broom that occupied this ridge recently.

Marsh Plants

The walk to the Blue Pool and the old yellow-ochre and iron workings make this small wood an area of much interest, and the wild life is particularly prolific. An equally attractive walk in the Cwrt yr Ala block is from Pen y Turnpike in Dinas Powis to the village of Michaelston-le-Pit.

Westwards into the Vale of Glamorgan the scattered woods of Coe Caerdydd give way to those of Hensol Forest, now incorporated into the Tair Onen unit.

Hensol began as a block of Llantrisant Forest but became an independent unit before being merged into the present forest and nursery of Tair Onen. These Hensol woods amount to nearly 800 acres and were established some 30 years ago.

A few outlying areas such as Craig Llansannor and certain parts of the Talygarn estate are also included. Beauty spot of the forest is the lake called Pysgodlyn Fawr with its dense growth of marsh plants.

The change from the largely hardwood area of Coed Caerdydd is marked here in the Hensol woods by the preponderance of Japanese larch, Corsican pine, Sitka spruce and some Norway spruce.

Well Chosen

Forest names in Glamorgan commemorate saints and villages, capital city and peninsula, mining valley and former estates. They are invariably well chosen, and in particular Coed Caerdydd shows a regard for the Welsh language that is refreshing in modern Cardiff. But at Tair Onen these days there is far more than an ash tree.

In the 100-acre nursery of Tair Onen, north of the A48 and 10 miles out of Cardiff, the Forestry Commission manages one of the largest forest nurseries in Britain.

Established in 1936, this nursery has exceeded the total of 200,000,000 young trees for use in the forests of England and Wales.

Two hundred million trees represent a vast amount of activity at Tair Onen Preparation of seedbeds; fertilisation; the sowing of seed; weeding; transplanting—all this goes on before the main business of lifting the young trees for planting out in the new forests that Tair Onen has helped to create and maintain.

It is little wonder that some 40 houses and twice that number of workpeople make Tair Onen into the nerve-centre of much of the work of the Glamorgan forests. Repair depots and machinery stores are centred here for the heavy machinery and the forest lorries that ply to and from Tair Onen to the distant forests.

It is convenient to end this survey of the Forests of Glamorgan at the point where most of them originate—a forest nursery. Forestry in Glamorgan can claim now to be an industry that has taken its place in the richer diversity that followed the erstwhile dependence on coal-mining, and this is especially true in the valleys of the north.

Opened Up

It is an industry, nevertheless, that unlike the spoilation of former generations, brings beauty and grandeur to the valley and mountain scene—in fact it has hidden much of the despoliation that the valley-dwellers have lived alongside all their lives.

The miracle of it all is that here in Glamorgan half the population of Wales live. There are other great forests in Wales besides Coed Morgannwg and St. Gwynno—there are the beautiful Coed-y-Brenin in Merioneth; Rheidol and Dovey; Ystwyth and Tarenig; Hafren and Aeron; Deudraeth and Taliesin; Bannau and Talybont.

Yet nowhere is the challenge greater and nowhere are the scenic changes and new occupations more marked and more valued than in the valleys of Glamorgan.

Here, too, over these steep slopes the forest roads have opened up much of the mountain area that was previously inaccessible to all but the most agile. Opened up for walkers—where walking can be the pleasure it once was before the traffic reached its present proportions on our motor roads.

For there can be pleasure as well as profit in the forest of Glamorgan. One great enemy remains—fire.

A great deal of wealth and a great deal of beauty has now been added to the heritage of Glamorgan. With care and diligence we can protect as well as appreciate it.

IMPRESSIONS OF FOREST MANAGEMENT IN UPPER BAVARIA

By

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Divisional Officer, Directorate for England

General

These are impressions only as they are based on a single day's excursion taken during a visit to the Game, Forestry and Timber exhibition at Munich in September, 1963. I was however, privileged to be taken by the Director of Forestry for Upper Bavaria and had the advantage of being accompanied by a very fluent English speaking District Officer who, in addition to being second-in-command in one of the Districts we visited was also a lecturer in the Forestry School at the University in Munich.

Forests visited

These lay between 2,000 ft. and 5,000 ft. in the Berchtesgadener Alps and were in the Reit-im-Winkl and Ruhpolding Districts, famous as ski resorts as well as forests. The scenery was of course magnificent, with the high Alps on the Austrian border going up to 10,000 ft. and the Valleys studded with lakes. Slopes are precipitous but the forests which clothe them are all under management. There appeared to be no such thing as "unplantable" except for bare rock above the tree line.

Growing Stock

The forest has been under systematic management for many years. The aim is to obtain a composition on northern and eastern aspects, of Norway spruce 60%, Silver fir 20%, beech 10%, other broadleaves mainly sycamore, elm and ash 10%. On southern and western aspects the proportion of beech is slightly increased at the expense of the conifers to provide additional shade on these steep Jurassic soils exposed to the sun.

Silvicultural Systems

In the *protection* forests at the higher elevations and on known unstable slopes a form of selection system is practised, trees only being felled when physically mature, and no clear felling taking place.

The rest of the forest area is regenerated on an average rotation of 140 years by a group cum strip system. Advance groups of beech, about 1/20th acre in extent are established either by planting or by opening round a seed tree when there happens to be a mast. About 20 such groups are formed per acre on a narrow front. When these beech groups have been established for about 5 years, a seeding felling is carried out to link up the groups with spruce and silver fir regeneration. These strips are about 150 yards wide and about 5 acres in extent.

Before the present system of forest roads was made the strips had to be up and down the slope to permit extraction by shute. The forest road system has enabled the strips to be swung through 90° and they are now invariably with their long axis on the contour. This has greatly speeded the regeneration particularly on southern and western slopes where trees on the edge give protection from isolation.

There is no fear of windblow, but snowbreak sometimes occurs.

Roads

I understand that it is only in the past 5 years that a forest road system has been started; it is certainly fearsome country in which to build roads, with precipitous rocky slopes and snow-swollen gorges. The Director was obviously proud of what had been done and made the driver of his big black Mercedes take us to the road head of several new alignments, opening up views of unparalleled magnificence but which showed the difficulty of the tasks ahead. These roads cost about £4,500 per mile, and are aligned and made under the District Officers' supervision with Directorate Equipment. Forest workers are trained in shot firing and blasting in courses at the Directorate Forest Workers Training School at Laubau. A consultant engineer must be called in to advise on bridges over 45 feet. Metalling is entirely of the small scree washed down the hillside gullies, and is easily spread and repaired by grader. The ruling gradient is about 1 in 15, but there were certainly steeper sections in the roads I travelled.

Treatment of Scars caused by Road-making

In such steep terrain the cut into the hillside has to be considerable, even in rocky ground with a steep angle of repose. This, and the spill below the road, leaves an unsightly scar. The Bavarians have been quick to find a remedy, which not only heals the scar at once, but prevents erosion of the exposed banks.

I was shown the process which is as follows:—

1. Half rotted straw is placed on the bank to cover it, held either by wooden pegs previously driven in, or if the surface is too rocky to hold pegs, by slats of wood with large protruding nails.
2. A balanced fertiliser is applied.
3. A seed mixture containing 15 species of grass and herbs including 9 legumes, is then sown on the straw, after a small quantity of mycorrhiza has been added. The mycorrhiza is necessary, I was told, to ensure healthy rooting of the seeds after germination. It is marketed commercially in tins and looks like tea dust.
4. The straw is then sprayed with bitumen to seal the whole cover.

The seed mixture germinates remarkably quickly, and I saw banks with a complete mat of lush vegetation which had been treated only two months previously. They were still sowing at the end of September with every prospect of obtaining a cover of vegetation before the winter, which comes early in the Alps.

A striking advantage of this method is that it obscures the road scar as soon as it is done; the bitumen-sprayed straw gives an inconspicuous dark brown cover, gradually giving way to green as the seed mixture germinates.

The cost is very small and this might have application in this country where our newly bulldozed roads on a hillside cause scars, slow to get cover by natural vegetation. The mechanical effect in arresting wash and erosion of the newly exposed soil is of course a further advantage.

Utilisation and Extraction

Felling and grading is done by the forest staff, and the timber sold at roadside. The grades are standard throughout West Germany and are saw timber, (which is further subdivided into grades), pitwood, pulpwood, and firewood. There are specialist merchants for each grade. The lots are auctioned or sold by tender.

Extraction to roadside is by shute, cable, horse or man with sledge, or a combination of these. As the road system is developed so the shute which causes considerable damage to the logs, and sledging which is both laborious and dangerous (one man load is one ton!), tend to be eliminated. They have rejected the Wissen cable system as too complicated and developed a much simpler one of their own. This is not surprising in a territory well equipped with ski-lift cables. "Landings" for cable-extracted timber are constructed on the roads when they are made.

It is estimated that the road network, when completed, will give a saving of about 1/- per h.ft. in extraction costs.

Afforestation and Acquisitions

One District Officer told me he was afforesting about 150 acres per year, all old pastures often bought to extinguish forest grazing rights which are steadily being eliminated. Cost of land, even rough high elevation pastures, is high, about £50 per acre, but the forest service is buying all it can at that price. Acquisitions are largely financed by sale of building plots for much higher prices per acre in forests round Munich and other large cities.

The species used in afforestation are Norway spruce and Grey alder. The alder is first planted at about 10 feet by 10 feet and then the spruce planted through it as $4\frac{1}{2}$ feet by $4\frac{1}{2}$ feet. No weeding or protection is necessary.

Protection

The forests all contain red and roe deer, chamois and wild boar. Populations are however maintained in equilibrium with the forest; I saw no significant damage and was assured that it would not be tolerated. About 70 red deer and 100 roe were shot in one forest each year to maintain a stocking of about "3%" (i.e. 3 deer per 100 hectares = 250 acres) which was the tolerable density. Only advance groups of beech had to be fenced.

Shooting by private persons is permitted under licence, a reasonable red deer costing about £40, and a roe about £7. Capercailzie and blackcock are much prized objects of forest stalking, the fees for them being £23 each caper (cocks only) and £18 for a blackcock! All licences carry stringent conditions regarding weapons, experience, etc., and the sportsman must be accompanied by a forest stalker to act as guide.

Public Access and Recreation

Except in the winter sports season, access is limited to walking. There is an "on the spot" fine of 7/6d. for any private car found on a forest road. Camping is only allowed on specified sites which are leased to a camping association.

The complete absence of forest notice boards was surprising and delightful. There was not even one telling motorists that they would be fined if found on the forest road. The only indication of Forest Service property was a red deer head which is the recognised sign of a Forest Office and was even used as such in the marble corridors of the Ministry building in Munich over the door of each room occupied by Forest Service staff!

Forest Workers Training School

I was shown this delightful school at Laubau, where forest workers in Upper Bavaria are given courses of about 14 days, duration on all practical aspects of forestry. New techniques are demonstrated and taught. Ropeways, explosives and blasting for roadwork, tools and equipment, methods and work study. The standard of comfort is very high indeed and I was told that forest workers competed to be nominated for courses.

Working Plans

The surveys are carried out by teams under Directorate Control. The local District Officer writes the Plan. The standard of the maps which I was shown was extremely high.

Organisation and Administration

There are six Regional Directors in Bavaria who are responsible direct to the Minister of Forests. Each Regional Director is assisted by a small staff of senior grade staff officers, whose duties are mainly functional, in controlling about 60 District Officers. Districts are of about 15,000 acres of State Forest plus a variable area of private woodlands.

In the District Office there are three or four "office technicians", extremely well equipped with all the most modern office aids.

All the pay of the forest workers is processed by computer in the Regional Director's Office in Munich, and is disbursed by money order direct to the worker from there on the basis of information supplied by the District Office.

Conclusion

My general and lasting impression is one of an extremely competent staff fully in control of every aspect of forest management in this incredibly complex and difficult environment, where slight errors of judgement could lead to difficulties if not disaster.

FOREST STALKING IN BAVARIA

General

1. This report is based on brief visits to three separate Districts, one in the Plains and two in the Alps near the Austrian border, cocupying a total of 1¼ days. Game management was discussed together with forest management and both the short time available and language difficulties made intensive questioning and research impossible. Nevertheless some interesting information was obtained.

2. The forests visited were:—

EGLHARTING, a "plains" forest of about 5,000 hectares 20 miles from Munich. About half of this forest is fenced in as a game reserve having been for several centuries the traditional hunting ground of the rulers of Bavaria and their important guests. It holds red, roe and fallow deer, wild boar and wild sheep or moufflon. Norway spruce is the predominant tree, with some admixtures of pine, larch and beech in places.

REIT-IM-WINKL and RUHPOLDING. These are Alpine forests near the Austrian border, running up to the tree line at about 5,000 feet. They are Norway spruce, Silver fir, beech forests, the proportions varying with elevation and aspect. They contain red and roe deer, wild boar and chamois, and some highly prized capercailzie and black game.

The Status of Game

3. As expected, game in the form of deer, boar, chamois and certain birds is regarded as an essential and natural product of the managed forest in Bavaria as in other parts of Germany. Indeed the President of the State, in opening the Exhibition at Munich, made very clear references to the role of the forest in providing "hunting"—(i.e. stalking), protection and timber, giving approximately equal weight to the importance of each role. In view of the fact that the Bavarian state Forests are now producing an annual surplus of 70 million deutschmarks (about £6·5 million) this evaluation is of great interest.

4. Those who take part in the sport of forest stalking—as traditional and distinctive in dress and customs as fox hunters here—are numerous and highly respected. An immense and specialised trade is founded on forest stalking—rifles and targets, special clothing and equipment, binoculars and game bags, dogs and literature, brooches and other mementoes from trophies, outfits for women as well as men—all stemming from the forest, in its role as a habitat for game.

Numbers and Damage

5. Expecting both from hearsay, and from the importance accorded to game in the Exhibition, to find considerable damage, I saw in fact very little. Indeed I was given firm assurances both from the Director (a keen forest stalker himself whose record red deer head was in the Exhibition), and all the District Officers I questioned that damage significantly affecting forest management would not be tolerated.

6. I was told that the stock was maintained at about 3% (i.e. 3 beasts per 100 hectares) of red and roe, with sex ratios 1 : 1. An annual census is taken resulting in a plan of the number to be shot to reduce down to the required level. In one district this number was 70 red deer and 100 roe. Numbers of wild boar and chamois are likewise regulated.

7. In that part of the Eglharting forest in which game is deliberately preserved at a higher level for special reasons, equilibrium with the forest is maintained by setting aside about 1% of the area as "lawns" or grazing areas and by winter feeding.

Protection

8. In the regeneration areas only the advance groups of beech are protected by netting where necessary, which is by no means everywhere. In the Alps there is often more beech regeneration than is needed. They do not consider it necessary to fence spruce and silver fir regeneration and I saw no evidence of damage to these species.

General Conditions for Stalking

9. A Federal shooting licence is obligatory. These are issued for weekly, monthly or annual periods and cost from £1 to £4. 10s.

10. The applicant must produce an insurance policy covering injury to persons of about £15,000 and injury to property of about £1,500. Policies are available at short notice, the annual premium being approx 30/-.

11. In addition the applicant undertakes to have such tests as may be required of his proficiency with the rifle. Tests are invariably given by the forest staff before allowing an unknown applicant to shoot.

12. The licence, when issued, is about the size of a passport, with the holder's photograph in it, particulars, list of close seasons, etc. It must be renewed each year.

Stalking Fees

13. These are fixed in each state and in Bavaria are approximately as follows:—

Red Deer

(a) *Stags*

A basic fee of £4. 10s. per stag is supplemented by a charge for antler weight on a rising scale, and a further charge according to number of points. An average stag might cost £60
and a very good one £100

(b) *Hinds* .. £2

Fallow

(a) *Buck*

The basic fee of £4. 10s. has a wider range, supplementary charges are for antler weight only, giving a charge for a reasonable head of £40
and a very good one of £70

(b) *Doe* £2

Roe

Bucks are charged at £1—£10 each according to age and antler weight. No charge is made for does which are not shot by sportsmen, but controlled out of close season by the forest staff.

Wild Boar

£1—£30 according to age.

Chamois

£30—£50.

Capercailzie

£23 each!

Blackcock

£18 each!

14. All sportsmen must be accompanied by the forest stalker and pay his fees which are 4/6 per hour with a minimum of £1 a day and maximum of £2. A supplement of 50% is charged for Saturdays, Sundays and recognised public holidays.

15. The charges for red and fallow are considerably higher than ours, but the trophies are much better than we could produce. The charge for roe bucks is more similar and the British heads compare with the German ones.

16. The astonishing thing is the very high charge for caper and blackcock. These are scarce and very highly prized for their feathers as well as being very worthy and wily birds to stalk.

17. With licence, insurance and stalking fees as well as equipment, forest stalking is certainly not cheap, and the game has to be worked for; 4 days stalking for one red deer stag is not unusual.

18. It seems that our existing charges under licence are about right for our conditions, but need re-examining particularly to scale up the charge for the better trophies. It is however preferable to keep all charges moderate.

Rifles

19. A wide variety was on display at the Exhibition, but the 7 mm. Mannlicher seemed to be generally favoured for all deer, pig and chamois. This is encouraging in view of our decision to use the ·270 which is very close to the 7 mm.

Training

20. The forest stalkers, who are responsible for control of game and for acting as guides to the sportsmen stalking on licence, are highly trained over a period of about 5 years.

A FORESTER'S FIRST IMPRESSIONS OF DENMARK

By

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(With photos on the centre pages)

No visitor to Denmark, after spending a few days in Copenhagen (as we Britons persist in writing Köbenhavn), savouring its cuisine and its Carlsberg or Tuborg ales, and enjoying the spectacular delights of its Tivoli Gardens, would be so foolish as to imagine he had seen Denmark. Likewise, if I, who had but a couple of hours in the capital and spent most of my three weeks' holiday in mid-Jutland, attempted to describe this country, it would be like staging "Hamlet" without the Prince of Denmark. Mention of Hamlet reminds me that I did have a day in the large and beautiful state forest of Gribskov, near Hilleröd and only a short distance from Helsingör; before moving west to Jutland we visited (on a deplorably wet morning) Kronborg Castle, where, some days later, the Stratford-on Avon Company was due to perform the play. The association of Hamlet with Elsinore was, of course, a creation of Shakespeare's fantasy; the traditional Hamlet having been a prince in Jutland in the thirteenth century, long before Kronborg was built about 1580 during Shakespeare's boyhood. There was, however, an older castle, or fortress, on the same site, dating from 1425. Travelling from Randers to Rosenholm, ancestral home of the Rosenkrantz family, I saw a sign post to "Hamlet's grave", but as I had not time to follow it and no such place was shown on my map, I do not know whether it is of any significance in this connection.

To return to Gribskov. Of the several forests I visited in Denmark, this was, I think, the only one with much oak and I measured the heights and girths of some very fine 180 year old trees, growing in mixture with mature and young

natural beech near the Esrum Lake. There are indeed many stands of oak, some of high quality, in other parts of Denmark, principally in the south of Sjaelland and in Fyn, where fine textured soils preponderate. In the south of Fyn I visited the elegant manor house of Egeskov (*Eg*, oak; *skov*, forest) and its splendid gardens; but it seems that little oak remains on this estate. Most of the oak in these eastern parts is pedunculate; the fragments of natural or semi-natural oakwoods which I noted in the Silkeborg area of mid-Jutland were nearly pure sessile oak.

Beech is of course the native tree par excellence of Denmark and it is to be found in all parts, except—or, at most, only sparingly—in the west of Jutland. It should be remembered, however, that beech-oak forest, or mixed broad-leaved forest, dominated much of Denmark in pre-historic times. More intensive exploitation of the oak for building and other uses, coupled with the aggressive tendencies of the beech, which can regenerate in partial shade, gradually changed many of these mixed forests into nearly pure beech forest. The first beechwood I saw was a fine stand near Kerteminde on Fyn; as happened only too often elsewhere, cloud and heavy rain prevented me from obtaining photographs or measurements.

Apart from the beech in mixture with oak in Gribskov, I examined several beechwoods near Silkeborg and a fine municipal forest at Aarhus, on the east coast of Jutland. I had read somewhere that the finest Danish beechwood is on Bornholm in the Baltic; but such a long digression was not feasible on this visit.

The best mature beechwoods actually encountered were about as good as the best English beechwoods and I noted a considerable range in performance in relation to soil-vegetation type. The soils I examined were all sandy—sands and loamy sands, perhaps approaching a sandy loam in some part of the profile. In the Silkeborg district, and evidently also in the Gribskov and Aarhus beech-woods examined, they are derived from terminal moraine and outwash of the glaciers, sometimes with thin blown sand cover, and usually with frequent stones and boulders, granites from the Scandinavian peninsula and sometimes flints from the chalk. In the Gribskov and Aarhus beechwoods, parent material of similar constitution is derived from glacial, or fluvio-glacial, till. In moist sheltered depressions numerous herbs flourish on this friable and well aerated medium. In the Sönderskov beechwood *Mercurialis perennis* dominated considerable areas (in the only wood where I observed it), but here, as elsewhere, *Asperula odorata* was more generally abundant, as was also *Oxalis acetosella*. Frequent too were *Circaea lutetiana*, *Galeopsis* sp., *Geranium robertianum*, *Lactuca muralis*, *Urtica dioica*, *Viola riviniana;* the grasses *Calamagrostis arundinacea*, *Melica uniflora*, *Milium effusum;* wild raspberry, *Rubus idaeus;* the fern *Dryopteris austriaca*, the moss *Catharinea undulata;* and seedling beech and rowan. The 90/100-year-old beeches on this favoured site had a mean height of 104 feet. (30·3 m.) and breast high diameters ranging from 45—61 cm. in the sample measured (girths 55—76 inches).

There was not such a rich flora in the Aarhus beechwood, which was older, with more general invasion by grasses (*Milium effusum*, *Melica uniflora*, *Agrostis* spp. and, locally, *Deschampsia flexuosa*). *Asperula* and *Oxalis* were again the dominant herbs, and there was plentiful regeneration of beech and ash. Seven beeches with good crowns showed a mean height of 32·5 m. (106½ feet) and mean diameter at breast height of 66 cm. (girth 81·7 inches).

On a rather less favourable site in the Silkeborg district, with moderate exposure to the west wind and a local tendency to mor formation,the beeches (approximately 100 years old) showed a mean height of 27·5 m. (90·2 feet), mean breast height diameter of 50 cm. (girth 62·5 inches). *Oxalis* was the charateristic herb, with grasses *Melica*, *Milium* and *Calamagrostis arundinacea*.

Mercurialis was absent, *Asperula* rather less plentiful, while *Majanthemum bifolium* indicated the rather less favourable humus condition.

Finally, on a more exposed slope of the same ridge, a good example of *Deschampsia flexuosa* beechwood with mor humus was examined. The trees had a mean height of only 21·4 m. (70½ feet) and the diameter growth was poor and very variable, ranging (at breast height) from 28—50 cm. (girths 34—62 inches). With *Deschampsia* in the ground flora were associated *Vaccinium myrtillus*, *Luzula silvatica*, *L. pilosa*, *Oxalis*, *Rubus idaeus*, *Calluna vulgaris* (in gaps) and an assortment of calcifuge mosses (*Dicranum*, *Hypnum*, *Polytrichum*, *Mnium hornum*).

It was instructive to find this wide range in beech growth within one small area where the climatic and topographic differences are negligible; the differences in moisture and nutrient supply, coupled with the degree of exposure to the prevalent westerly winds, must account for the range in performance.

Some general features of the beechwoods seen may be alluded to briefly:—

1. Some of the stands were fairly dense. In 1946, when I was privileged to tour some Hanoverian beech forests with the late E. Wiedemann and T. R. Peace, we met one forest officer just returned from a study tour of Danish heavy crown thinning procedures in beechwoods and, I expected such thinnings to be fairly general. It may be that the practice originated with some prophet honoured save in his own country; but I suspect that in Denmark, as elsewhere, new ideas are slow to take root; while in the windy climate of Jutland overstocked stands must be opened up gradually.
2. The manner in which the beech flourishes just above high water mark on the Kattegat coast of Jutland (the same phenomenon was observed near Kerteminde on Fyn) is in marked contrast with its complete absence from North sea coastal districts of W. Jutland, where the climate is dominated by the strong west winds. The poverty, dryness and, in some places, instability of the sandy soils are additional factors adverse to beech there.
3. In most beechwoods regeneration appears to come fairly readily. I should not think that seed years are more frequent in Denmark than in southern England and the reasons for the more plentiful regeneration are probably the scarcity of rabbits and the absence or rarity of the blackberry, *Rubus fruticosus*.
4. Plentiful regeneration notwithstanding, I saw a good many young plantations of beech. Though a reduction has been made in the number of plants used, the spacing is still close by our standards, 125 cm. (say 4 feet) between rows, 60—90 cm. (2—3 feet) between plants in the row. Furthermore, the beech is still planted pure (at least in the Silkeborg District, where in a locality frequented by tourists, amenity is important); but whenever frost, deer, etc., cause a blank, Douglas fir is planted instead. As one Head Forester put it "When our beech fails, we make money with Douglas fir".

As to softwoods, we are wont to lament that we possess only one native coniferous tree. Denmark has not even that; I saw a great deal of common juniper (fastigiate and relatively tall) on the heaths near Silkeborg and the yew occurs naturally in south Jutland. But the Scots pine, which flourished in Denmark in the early post-glacial period, became extinct, so that all existing stands are (or can be traced back to) artificial creations, mostly from Swedish, Norwegian, or Scottish seed. I saw a good deal of young Scots pine in the dune plantations of West Jutland; but even there it is not one of the principal trees

and in the Silkeborg district, as in Gribskov, much the commonest conifer is the Norway spruce, which has been planted in place of the broad-leaved trees on large areas of acid heathy soil, as well as in moist depressions unsuited to the beech. On most of the sites where I observed it, the spruce was regenerating freely and in Gribskov it seemed that the regeneration was being successfully exploited. Hr. Munk Jörgensen, who conducted me through Sönderskov near Silkeborg, said that regeneration by planting was often preferred, because the growth of the natural seedlings was painfully slow. (Incidentally this seems to hold also for the Douglas fir regeneration in the New Forest (Bolderwood), which I saw in July of this year). I saw some fine stands of Norway spruce, near Silkeborg and to south and south-west, near Velling, but obtained no measurements or other data. It was used in some early coastal dune planting about 100 years ago near Vejers, but (as we should now expect) did not relish the maritime environment.

The heaths and dunes of West Jutland are, on the contrary, the principal home of the Sitka spruce in Denmark. It was first used about 60 years ago to replenish an unsatisfactory plantation of mountain pine on one of the sandy flats a couple of kilometers from the shore; and in this situation grew so well that it was widely used in subsequent planting, even sometimes on the dry infertile sandhills, where, not surprisingly, it failed. It is now restricted to sites of good water supplying capacity and at least moderate fertility—preferably where a thin layer of blown sand (fostering a deep-growing root system) overlies fine-textured glacial drift.

Sitka spruce stands salt spray well and maintains an erect stem in conditions of exposure. Since the war attacks of *Dendroctonus micans* have killed many trees and occasioned anxiety about the remainder; but there is evidence that moisture deficiency during the growing season increases susceptibility (the summer drought of 1947 initiated the outbreaks) and it is believed that a stricter selection of sites for spruce may prove a valuable precaution. At the same time, trials are being made of Sitka spruce from a region where the summer rainfall is very small.

In most of Denmark the fields are bounded by electric fences, widely used also for controlling grazing within the pastures. But in West Jutland the electric wire is supplemented, or wholly replaced, by lines of Sitka spruce, or white spruce. Most of the spruce shelter hedges I saw were about 12 feet tall, aligned approximately N/S and composed of a single row of trees; but I noted too some recently planted spruce hedges. Here and there a poplar, or Swedish whitebeam hedge may be seen; but Sitka spruce is regarded as the best living screen.

Some notes on the coastal sand plantations will be contributed later and the other species used need not be considered here. The only other tree of importance which I encountered in the state forests is Douglas fir, of which I examined small stands of about 80-year-old trees in Vesterskov and Sönderskov, both in the Silkeborg district. The Vesterskov trees were growing by themselves in a sheltered bottom and looked very good; a photograph was taken, but no measurements. The Sönderskov Douglas firs owed their existence to the policy of planting Douglas firs in failures in beech plantations and occur irregularly scattered amongst beech of about the same age. They are on the whole of very good form, and several have been marked as seed source trees. I took measurements of heights and breast-height girths of six, as follows:—

Breast-height girth, inches	85	91	96	105	67	89
„ „ diameter, cm.	69	74	77	85	54	72
Total height, meters	36·7	37·3	36	38	37·3	35
„ „ feet	121	123	119	124	123	115

The sandy soil on which they are growing is podzolised, with a conspicuously

bleached layer from about 9—16 inches; at about 30 inches (75/80 cm.) depth the fluvio-glacial till appears, with frequent stones in a matrix of sandy loam texture, compact and very moist. At and near this horizon boundary there was a prodigious development of more or less horizontal Douglas fir roots, many of them following the remains, or the channels, of roots of antecedent forest trees.

I shall now leave the forests to make a few comments on some Danish towns. With the notable exception of Aalborg (90,000 inhabitants) in north Jutland, too far from Silkeborg to be comfortably visited in a day excursion, we passed through, even where we did not linger in, nearly every important town. The two strongest impressions which a couple of hours in Copenhagen made on me were the preponderance of red brick and the lack of any dominant twentieth century stamp on the architecture of the centre. I had read something about Stockholm and seen some photographs; my advance image of Copenhagen resembled my (probably quite false) image of Stockholm, with broad well-laid-out streets and many massive modern buildings in ferro-concrete. Instead, the part of Copenhagen which I saw has a pleasing old-world air, with its many turreted, gabled, brick and tile buildings. It was perplexing to find later that the Raadhus, or Town Hall, which I had assumed to be 3-400 years old, was built in 1906.

Odense, principal town of Fyn and, with a population of well over 100,000 the third city of Denmark, is renowned as the birthplace of Hans Christian Andersen, who left Odense to seek fortune elsewhere at the age of 14 and returned, celebrated and prosperous, in old age. In the house where he was born there is an absorbing collection of objects descriptive of his life and work and the many journeys he took through most of the countries of Europe. Adjoining the Hans Andersen memorial gardens stands the cathedral dedicated to St. Knud; with his brother and 17 attendants he was slain a short distance from the church in 1086; his remains are in the crypt. He was descended from the monarch of Norway, Denmark, England and the Hebrides who is better known to school children as the King Canute who defied the tides of the Channel. Odense cathedral has too a fine altar-piece by Claus Berg, an artist of the early sixteenth century.

Viborg is an attractive old cathedral town in a picturesque part of north central Jutland with lakes and woods in the vicinity. The original cathedral was a Romanesque building of granite; this and succeeding structures were devastated twice by fire and once (in 1501) by lightning. In the last century the building suffered further from neglect until, about 1860, it was planned to rebuild it, once more with Jutland granite and in the original Romanesque style. The cathedral was opened again in 1876 and is said to be the largest granite church existing; the only other large granite church I know is the one in the centre of Launceston. In most parts of Denmark bricks were in use many centuries ago; at a time when the industrious ancestors of the East Anglian folk, wanting natural building stone, were using flints for buildings of every size and shape, the Danes, similarly situated, had found out how to make bricks.

Viborg Domkirke is, however, chiefly remarkable for the series of mural paintings of the principal events described in the Old and New Testaments, which almost completely cover the walls. These magnificent frescoes were executed between 1901 and 1906 by Joakim Skovgaard, with some assistance from Niels Larsen Stevns (some of whose similar work can be seen in the Hans Andersen museum in Odense) and other collaborators.

In spite of the ravages of fire there are some fine seventeenth century houses in the neighbourhood of the cathedral. Among new buildings in the centre is the headquarters of the Danish Heath Society (Dansk Hedeselskabet), of which something will be said later.

Unlike Viborg, the smaller town of Silkeborg (c. 30,000 inhabitants), near where we stayed, is comparatively modern and is noteworthy chiefly for the beauty of the many lakes and forests which grace its surroundings. A castle and village date from olden times, but the present town may be said to spring from the enterprise, in the middle of the last century, of one Michael Drewsen, who started a paper factory on the Gudenaa (largest river of Jutland) in 1844. A little later Drewsen built the not very handsome tower on the Himmelbjerget summit (147 metres, say 450 feet, highest point but one in Denmark) from which splendid views can be had of the surrounding lakes, woods and fields; he commissioned also the building of a paddle steamer (the Hjejlen, still in service) and inaugurated the pleasure cruises between Silkeborg and the foot of the Himmelbjerget and other points on the interconnected series of lakes which extend south-east from Silkeborg.

Silkeborg has a small museum, with modern and not so modern paintings, objects illustrating rural life in Jutland in past centuries and many Bronze Age and Iron Age archaeological finds. Outstanding among these is the c. 2,000 years old "Tollundmand" (Tollund man), discovered in 1950 by two men digging peat in a bog in Bjaeldskov Dal, a few miles west of the town. Perfectly preserved in the peat, even to the wrinkles on the brow, the body was naked apart from a leather girdle and leather skull cap; round the neck was a leather thong. A professor of Archaeology in Aarhus, approached by the local police with a view to solving the mystery of this ancient (or possibly not so ancient) murder, contributed an article to the *Illustrated London News*. He was able with some confidence to identify the Tollund man as the victim of ritual killing, a recognised feature of early Iron Age civilisation in the Scandinavian countries. The delay in obtaining an expert opinion meant that the entire body could not be preserved, but head and shoulders, with leather trappings, are in the museum, with all the relevant information. It was possible, however, to analyse the stomach contents in Aarhus, where the botanists found no trace of animal food, but identified no fewer than 19 species of grasses and herbs, a few of which were already known to have been cultivated by our Iron Age ancestors.

The Tollund man may have done something to put the new Aarhus University on the map in scientific circles; its establishment some twenty years ago is perhaps a symbol that Jutland is in no sense a poor relation of the more populous islands. The largest town after Köbenhavn, Aarhus provides an interesting blend of the old and the new; the ferro-concrete Town Hall, or Raadhus, occupies a central position and the University buildings, in light-coloured brick, make a pleasing impression of symmetry and coherence of design. Among the older streets near the port stands the beautiful cathedral, reputed the largest in northern Europe. But it is certainly not the dimensions which impress visitors, particularly those familiar with the vast Gothic cathedrals of Canterbury, Winchester, Chartres, Amiens and the rest. Aarhus domkirk is remembered chiefly for its fine proportions and the many treasures to be found in it—a set of magnificent vestments, a richly carved pulpit, a marble font, a very graceful candelabrum in the crossing and the great fresco on the west wall of the south transept. The last is partly obscured by a late seventeenth century memorial tablet to a city dignitary; but on the whole Danish churches are little encumbered with memorials of the kind too often seen in English churches, where their form seldom reflects the grace of the lives which they commemorate.

Aarhus's principal museum ("den gamle by" or olden village) is remarkable, consisting of a typical Jutland village reconstructed from old houses acquired in different parts of the country (many in or near Aalborg in the north), carried piecemeal to Aarhus Botanic Garden and rebuilt in the form of a little town on a site by the stream. There are a few score of houses and they are still being added to; you can find butcher, baker, candlestick-maker, post office, midget

town hall, water mill, as well as a windmill on the adjoining ridge. Many of the houses have collections of objects illustrating rural life in Jutland in past times.

South of the city and flanking the Kattegat shore for a considerable distance, there is an extensive municipal forest, mostly of mature beech—but regenerating with great freedom in many places. Wandering through these woods in view of the sea I thought that, if there was one forestry appointment more attractive than that I now have, it would be the charge of these fine beechwoods on behalf of the citizens of Aarhus.

This is a good place to leave the towns and return to forest and field. Something has been included about the State Forests, but these are only one of the three officially sponsored forestry enterprises in Denmark. The other two are the Hedeselskab, promoting the afforestation of the heaths, and the Klitdirektorat, which looks after the extensive plantations on coastal sands in West and North Jutland and exercises some control over recreation along these coasts. Neither organisation is important outside Jutland.

The headquarters of the Danish Heath Society, which originated in 1866 as a voluntary association of landowners, is in Viborg, but the main action station is at Tvilum, a few miles north-east of Silkeborg. There Hr. Nyholm, who visited Alice Holt in 1958, supervises a central seed store and seed testing laboratories, manages the four local nurseries (100 acres) and prepares also the cropping programme for ancillary nurseries near Kolding in East Jutland (40 acres) and near Esbjerg in the west (60 acres). Hr. Nyholm kindly showed me over the Tvilum seed store and nurseries and explained how he tries to deal with the many difficult environmental factors which affect one part of the land or another. These include frost, wind, imperfect drainage, infertility and weed competition. For the most part, as far as I could see, nursery techniques do not differ greatly from those in Britain; but polythene is not used for plant storage and packing, and an appreciable amount of sowing and lining-out is done in late summer and early autumn. On my visit on 23rd August, I watched a gang of men transplanting pines 2 inches apart into the five deep, narrow furrows, 10 inches apart, cut by a tractor-drawn machine.

The Heath Society supplies about 13 million plants yearly, of which 4–6 million are purchased from other nurseries; of the total, about 9 million are used in heath afforestation, the rest sold to private customers, nurserymen, etc. Norway spruce heads the species list with 3 million plants; about 1 million plants each of Sitka spruce and lodgepole pine (which has in recent years supplanted mountain pine as the main species for difficult infertile ground) are supplied. Scots pine, mountain pine, white spruce and thorn amount to half a million each or more.

The work of the Danish Heath Society gained fresh impetus in 1938, in the very dry spring of which much damage was caused to Jutland farms by sand storms. There was at times considerable unemployment and accordingly the Heath Society prepared a scheme for employing a corps of men and giving them training in planting in all the affected areas. These men, now known as the Heath Society's plantation workers, carry out all the planting and associated work on the heaths.

The operations of the Klitdirektorat are restricted to the mobile dunes and the adjacent sandy flats affected by sand blown from the sea in the past. These comprise a broad belt on the west and north coasts of Jutland, and considerable areas on north-west and north coasts of Sjaelland. Hr. P. Thaarup, who contributed a paper to the symposium on coastal afforestation at the British Association's 1954 meeting in Liverpool, supervises the work from an office in Vejers, 15 miles north-west of Esbjerg. In this locality, the oldest plantations, a little over 100 years old, are to be seen. At that time, Norway spruce, Austrian

pine and dwarf mountain pine were tentatively considered the most suitable trees, but none fulfilled early hopes. Norway spruce revolted against the maritime climate, as we should now expect. Austrian pine, after starting well, was afflicted by disease (*Crumenula* sp.) at 15-20 years, surviving only where some measure of isolation provided better conditions for the tree and worse conditions for the fungus; and mountain pine grew extremely slowly, suffering much in exposed positions from reddening and loss of needles. Thus its chief merit is as a dune stabiliser and provider of low shelter on mobile sand near the coast—functions that can be exercised by marram grass, which is fostered by planting along the coastal fringe. Recently, more use has been made of tall-growing French provenances of mountain pine, which seem less sensitive to salt. These are considered suitable for the dry dunes, where moisture is insufficient for Lodgepole pine, spruce or Silver fir.

On heaths and dunes in Jutland, Lodgepole pine, due to its greater production, has in recent decades been used for much of the ground formerly allotted to mountain pine. I was shown a six-year-old provenance trial in which (as in other lodgepole plantations of mixed provenance) the severe 1963 winter had picked out the coastal forms.

Sandy flats, often with only a thin blown sand cover, preponderate, and on these Sitka spruce usually grows well, particularly if given some shelter from the relief, or from trees to windward; on the best Sitka spruce sites a thin layer of blown sand overlies retentive boulder till. In the first stand I was shown, a 40-year-old plantation near Vejers, abundant natural regeneration was a feature. The bark beetle, *Dendroctonus micans*, caused serious trouble as a sequel to the drought year 1947, and has been endemic and sporadically very troublesome in the dune plantations of this species since then. Another hazard is *Fomes annosus*, which is expected to become more prevalent as the initial plantations reach maturity and are cut down and replaced; but a favourable circumstance is that, unlike the sand at Pembrey, Newborough and Dunnet, the Jutland sand is not alkaline. I found no trace of free lime in the several places where I tested for acid, and Hr. Thaarup informed me that the sand is nowhere calcareous. In fact I observed a suspiciously calcicole flora in one young plantation (on a site previously cultivated and therefore possibly limed); but it was an isolated observation and I had no wish to affront my guide by calling an acid bottle as witness.

There is space for mention of two only of the many other species, major or minor, used at one time or another on the dunes. White spruce (*Picea glauca*) was much favoured in the last, and the early part of the present, century for planting in Jutland on account of its northerly natural distribution and tolerance of a cold climate. It has proved disappointing on the dunes, because of slow growth and susceptibility to salt spray; though still used a good deal for shelter on farm land and afforestation of inland heaths, its place near the sea has been taken by Sitka spruce.

In 1899, on a relatively good site in Vrögum Plantation near Oksböl, European Silver fir was planted and this is now a very impressive mature stand. Other plantations made about that time suffered from *Adelges*, or frost, or both, and the species fell into disfavour; but in spite of *Adelges*, its performance was promising on favourable sites, where some cover from other trees protected the young Silver firs from frost and wind during the establishment period. Interest in *Abies alba* has been stimulated by the *Dendroctonus* and *Fomes* injuries which have shaken the confidence placed in Sitka spruce as the best tree on the sandy flats; several small younger stands were seen elsewhere.

At this point, a few remarks on Danish soils seem appropriate, but these must be brief and tentative on account of deficient knowledge. Broadly, the

soils of west Jutland are poor in comparison with soils of east Jutland and the islands and it is in West Jutland, therefore, that visitors can see most of the afforestation (usually with exotics) of waste lands too poor for profitable agriculture. This is partly because in the coastal strip the soil is largely composed of sterile marine sand. But the main reason for the poverty of the soil is the circumstance that Jutland west of the central Jutland ridge was not covered by ice during the last glaciation; the soils have been derived mainly from the re-sorted, more or less coarse sediments of the preceding (Riss) glaciation and, as the climate favours podzolisation, they are in general more strongly leached than soils of similar texture in east Jutland and the islands.

My limited acquaintance with Jutland soils indicates that much of the land is covered with rather sandy boulder till, sometimes overlain with sterile blown sand, but otherwise, in the centre and east, showing little evidence of serious leaching.

In much of Denmark the country rock is the Cretaceous Chalk that we are familiar with in south-east England; but it is only in a few places, as near Aalborg in north-east Jutland, that this comes to the surface. While chalky boulder till forms the parent material of the soil in many places, siliceous material brought by the ice from Sweden and Norway is commonly an important ingredient of the glacial, or fluvio-glacial drift, from which the Danish soils have been derived. In much of Sjaelland, Fyn, the southern islands and parts of east Jutland this is fine-textured, and drainage impedance may be a problem; in north Sjaelland and most of Jutland coarse-textured drift yields soils which are freely drained, except in the valleys (partly occupied by lakes) where peaty swamps occur.

Coastal cliffs are rare, as are quarries in a country lacking mineral wealth; accordingly the Salten Profile, near where we stayed, exposing various strata from the Jurassic up, is often visited by geologists and student parties.

The soil pattern, somewhat inadequately sketched in the preceding paragraphs, accounts in large measure for the pattern of land use. Forests and plantations, composing about 9 per cent of the land surface, preponderate on the difficult clay land and on the infertile sand of west Jutland; but they are not wholly confined to land unsuited to agriculture. I saw relatively few potato fields, though these were commoner in west and central Jutland; nearly all were badly affected by the blight, *Phytophthora*. At, or just before, harvest, cornfields form an attractive and conspicuous feature of the landscape; nevertheless, I was at first surprised by their frequency (oats and barley, less often wheat and rye) in a country associated particularly with dairy produce. But it must be remembered that, in addition to feeding a population of 4½ millions, Danish farms provide most of the winter keep for the large numbers of cattle, pigs and poultry.

The farms are well laid out and well maintained, with substantial buildings usually arranged round a square or rectangular yard. Brick and tile exteriors are the rule, but thatched roofs are often seen. (It is said that the town Silkeborg owes its name to an old word, Silje, for the reeds or rushes used in thatching). It surprised me to see so many hawthorn seedbeds in the Tvilum nursery, for I scarcely saw a thorn hedge on the whole tour. In the windy parts of west and north Jutland great use is made of screens (usually aligned N/S) of Sitka and white spruce on field boundaries; but electric fences are the normal method of defining pasture and arable land.

Denmark has few sheep; it is interesting that one of the important sheep pastures is on land north of Esbjerg reclaimed from the sea, like Romney Marsh; it was the threat of inundation of these pastures by blown sand which prompted the first measures of dune afforestation in the middle of last century. Our neighbour in Salten was a horse-dealer/farmer and we encountered horses

frequently; but though these are perhaps used more than on lowland English farms, Danish farming is now highly mechanised.

Our desire to be shown over a typical Danish farm led me one morning, when rain ruled out an all-day excursion, to approach our neighbour and ask if we might trouble him, or one of his farmer friends, in this way. Herr Christensen spoke not one word of English and only such few words of German as would enable him to sell horses to his German customers. So after some inconclusive exchanges he took me to the corner shop, kept by a Latvian refugee, who spoke fluent German—and some half dozen other languages, I was told, but not English. He asked me if we wished to see something old and historic and I assured them that this was of no account. After some further perplexing, polyglot, palaver, it dawned on me that both were convinced of my intention to *buy* a Danish farm; I was asked if I had plenty of cash and warned that so many Germans had bought Danish farms since the war that the Danish Government was doing all in its power to restrict such transactions. Fortunately, a reference to the old manor house of Rosenholm (60 km. from Salten) which we saw next day, allowed me to extricate myself gracefully; neither would suppose that I had come from England to bid for a property which, besides being still the home of the Rosenkrantz family, is a place of historic interest and natural beauty open to the public on payment of half-a-crown.

Throughout our tour we enjoyed friendly relations with the good natured, contented Danish people—contented because not much embroiled in the cauldron of power politics, and successful, by hard work and resourcefulness, in making the most of their limited natural wealth. They are not, of course, without their apprehensions, for example in regard to Britain's entry into the Common Market; it was said that this would force Denmark in too, or squeeze her farmers out of the British market for dairy produce. I assured my forester friend (who is also a small farmer) that he need have no immediate anxiety on this account; I suggested that our entry might be delayed until we had (*a*) reformed our currency; (*b*) adopted the metric system of weights and measures; (*c*) made an effort to learn as much about our future associates in the Community as the Danes, for instance, learn about the many German, English and Swedish visitors they welcome each summer; and (*d*) learnt to drive on the right.

Before concluding, I should like to return to Gribskov in North Sjaelland, where, close to the village of Nödebo and amidst this large and attractive forest, a Government training school for foresters and forest workers has just been opened. The large thatched building which was the former forest lodge has been adapted to provide administrative offices, and library and common rooms for the students; while the former out-buildings have been reconstructed as up to date kitchens and refectory. Only the blocks of study bedrooms for the men are new. Hr. Erik Oksbjerg, who has taken charge of the new school, visited Britain in 1961 and 1962. We are indebted to him and his assistant (Hr. Nielsen) for the opportunity of seeing over the school; and most grateful to him and his wife for putting their house in Salten at our disposal for the 16 memorable days we spent in a picturesque part of Jutland.

THE CHOICE OF SPECIES

By

ROGER LINES

District Officer, Research Branch

Introduction

The forester is faced with two questions:—

(a) What will grow on my sites, i.e. what is silviculturally best suited?

(b) Of these species to which should I give preference?

The answer to this second question involves consideration of their relative volume and value production and also decisions about how many species can find a profitable market. I propose to deal mainly with the first question.

Site Factors which Limit the Choice of Species

Before considering what species to plant, it is best to consider the range of sites available for planting. Are these for afforestation or reforestation? What is known about the site factors? In many cases the climatic data for a site is very scanty and needs extrapolation from a meteorological station several miles away. Climatic divisions such as those of Anderson and Fairbairn (1955) for Scotland are useful on a country-wide basis but of little help to the local officer. The important factors governing the choice of species are: precipitation, including its seasonal distribution and the amount of snow, the temperature regime, including the minimum/maximum and mean temperature and, if available, the growing season length in days. The concept of "accumulated temperature" shown in figure 4 of Bulletin No. 30 (Macdonald *et al* 1957) is a useful indication of summer warmth. In Britain tree growth will depend as much on exposure to wind as on summer warmth and it is highly unlikely that data on wind velocities will be known. In places where persistent high winds are likely to restrict the choice of species the use of exposure flags is recommended (Lines, 1963).

High temperatures are never limiting to tree growth in the United Kingdom and extremely low winter temperatures affect few species in Britain (exceptions are *Pinus radiata*, *Eucalyptus* and to some extent Douglas fir) but Spring and Autumn frosts are very important. Damage by Spring frosts is often spectacular, but autumn frost damage, particularly to Sitka spruce and Western hemlock may be more important than has hitherto been assumed, because these species often continue their growth well into the autumn. Soil and vegetation are obvious limiting factors in the choice of species and the work of Cajander (1926) and Anderson (1950) is too well known to need further comment. It should be noted, however, that the increasing tendency to plant infertile peat and heath soils is extending the range beyond that given in Anderson's book and for poorer peatland it is now realised that only two species offer much hope, *Lodgepole pine* and *Western hemlock* (Edwards, 1962). Much recent research on the poorer peats suggests that the present yardstick of the type of ground vegetation is not an infallible guide. One can foresee the time when the Acquisition officer will go out armed with polythene bags for peat samples and the price paid for the land will depend upon the nutrient content of these. In the Trial Forests of North Scotland, choice of species is already based on analysis of the peat.

In Britain, for all its small size, we have a wide range of climates from near Arctic on the higher hills of Scotland to a mild Maritime climate in Cornwall and an approach to Continental conditions in the Brecklands of East Anglia. It is not likely that the forester will have such a range within one district, but it is valuable to make a local classification of sites so that any species trials can be planted on sites which are representative of the range of variation in the district. It is unusual for the forester to have to make his choice of species without some help from a study of existing woodlands, though these often do not include the species which he wishes to plant.

The Species Concept

W. R. Day (1950), has pointed out that "(1) A species is a relative unity", its characteristics are governed by a distinct genetical constitution, (2) "This constitution necessitates a corresponding environment for adequate develop-

ment and accordingly, however widely a species may be distributed geographically, there will be certain fundamental elements of similarity in the character of the environment within which it is able to establish itself. (3) A species is a variable within itself and not a constant. This variability is expressed in its essential genetical constitution and necessitates a corresponding variability in environment if the species as a whole is to express itself fully." Common failings are:—

(*a*) to treat the species as though its environmental range was unlimited; perhaps the most glaring examples of this have been the widespread use of Corsican pine on upland sites in Britain with consequent dieback disease, and the tendency, still present today, to push Sitka spruce beyond the environmental limit in which it will grow healthily to maturity.

(*b*) to treat the species as though it were an unity lacking provenance or racial variation. Here one may cite the catastrophes due to using Alpine provenances of European larch, which have large seeds and therefore often give good one-year seedlings, only to suffer from canker when planted in the forest; or the loss in production caused by using unsuitable origins of Lodgepole pine (e.g. more than 2,000 lbs. of seed of the unsatisfactory Lulu Island or Langley provenances were bought between 1949 and 1955 before it was realised that the trees of this origin were unsuitable for exposed sites).

In the older Forestry Commission species trials the provenance variation has inevitably been disregarded and in most cases each species is represented by the most widely used provenance, e.g. Queen Charlotte Islands for Sitka spruce, Central Alps or Black Forest for Norway spruce, and Morayshire and "Thetford" for Scots pine. However, some of the minor exotics such as *Abies grandis*, *Picea engelmanni* and *Pinus strobus*, whose provenance variation is not well known, may be represented by origins which are below the optimum for growth in Britain, e.g. in one species trial *Abies grandis* is represented by a provenance from Vancouver Island and another from Cascade Mountains, Oregon. The former is clearly superior. Which does one take to represent the species? *Picea engelmanni* has been used in several species trials, but the seed came largely from Colorado and the one species trial using British Columbian seed shows it to be more promising. *Pinus strobus* used in a number of species trials came from exotic stands in Italy and the original provenance is unknown.

There is always a danger with minor species whose seed is difficult to obtain that collection may be made from a single individual, resulting in inbreeding depression or even cross fertilization with an adjacent tree of a related but different species in a policy woodland. It is now becoming difficult to obtain true European larch as there is so much natural cross fertilizationwith Japanese larch or Hybrid larch, not only with home collected seed but also with seed imported from the Continent. Fortunately in large-scale practice the effect is usually beneficial.

Similarly Norway spruce in the Hartz Mountains of Germany is now probably 90% or more from alien sources!

The Natural Distribution of Species

We can now use species from every continent, so the extent of choice is enormous, but one may ask why species are distributed as they are at present? What limits the natural range of a species? As present-day species have mostly evolved one hundred to two hundred million years ago (Seward 1933) they should have had plenty of time to find their best ecological niche, but due to the

separation of the continents (theory of Continental Drift) and (much later) climatic changes such as the glacial periods, they may not achieve their optimum growth at any point in their natural range. Scott (1962) states that *Pinus elliottii* (Slash pine) grows better in New Zealand and Queensland than in its home in Florida, though New Zealand is 4° farther from the Equator and Queensland 4° nearer to it than its native home in the U.S.A. Similarly, *P. radiata* is a relict species confined by climatic factors to poor sandy soils extending over a few square miles in California, whereas there are now 1½ million acres of plantations of this species in five other continents, with Chile, Australia, New Zealand, South Africa, and Spain as leading countries.

Champion and Brasnett (1958), give several examples of the factors which cause the limitation of the natural range of species. Some may be fairly complex, such as the inter-relation between Douglas fir, Western hemlock, Western red cedar and Sitka spruce in coastal Washington. Here Douglas fir achieves optimum growth right up to the point in the coastal "fog belt" where it is replaced by the more tolerant hemlock and cedar or by Sitka spruce on wetter soils. The governing factors here are therefore not primarily climatic but an interaction of competition with other species, lack of regeneration sites because of fewer fires and more ground vegetation, and wetter soil conditions. *Sequoia sempervirens* appears to be restricted at its northern limit by cold winters, which are exceptional but recur sufficiently frequently to prevent it extending North.

The species of the Pacific North-West coast of the United States and Canada are of particular interest to British foresters. As early as 1823 David Douglas was sent there by the Royal Horticultural Society and 130 years later R. F. Wood went there for the Forestry Commission (Wood 1955a). The climatic comparisons which he made show that the range of summer warmth in Britain is equivalent to a great latitudinal range on the Pacific coast. British precipitation follows a substantially different pattern to that on the Pacific coast, the main difference lying in the greater relative proportion of summer rainfall in Britain. The climate of South-east Alaska and the Queen Charlotte Islands is much more similar to that of North England and Scotland than is that of Oregon or California, as summer rainfall increases northwards. No perfect climatic match is possible, and even if it were this would not explain the success of the introductions from the Pacific coast. It has recently been suggested (Silen, 1962) that trees from this area have inherently better growth rates. Perhaps the prime requisite for success of any introduced tree is a naturally faster growth rate. This may explain why in North-east America introductions from Europe of Scots pine, Norway spruce and European larch have proved successful on a wide scale, whereas no introductions in the Pacific coast area have shown much promise. The pattern of inherent growth rate for American species is known only for *Pinus ponderosa*, and it is significant that the provenances which grow most rapidly in the U.S.A. are also those which are rapid growers in New Zealand. Similarly, Douglas fir provenance experiments in Europe suggests a pattern of inherent growth differences, rather than good climatic matching. One of the best discussions regarding the native distribution of Pacific North-west species in relation to growth in Britain is by Wood (1955b). The international provenance experiments with Scots pine, European larch and Norway spruce, each of which are planted on a wide variety of sites in Europe, tend to substantiate this idea of inherently vigorous strains, rather than the widely assumed notion that the local race is the best!

Planning a Species Trial

This has been covered in some detail by Edwards and Howell (1962), so that it is only necessary to summarise their findings. Species trials involve a

continuous programme of experimentation from the arboretum stage until the species is accepted into normal practice. The objects of the trials must be clear and the experiment planted so that it can satisfy these objects. Once the nursery technique is worked out for raising a species, then forest trials can be started. Nursery trials of species with different requirements are impossible and the object should be to give each species its optimum practical treatment. The fundamentals of experimental technique such as independent replication, randomization, etc., must not be forgotten.

Looking to the Future

The publication of Bulletin 30, *Exotic Forest Trees of Great Britain* (Macdonald et al. 1957), showed that a mass of information was available about more than 150 species growing in arboreta, forest plots, or species trials. Casting the net so wide, it is natural to ask whether any of the minor species showed much promise of becoming more important. The most promising ones were: *Abies amabilis*, *Abies veitchii*, *Cryptomeria japonica*, *Cupressocyparis leylandii*, *Eucalyptus*, and *Nothofagus*. To these might be added *Pinus strobus*, if the *Cronartium* rust can be controlled, as now seems possible. How many others are regarded as "unpromising" due to obtaining seed of an unsuitable provenance in the past, is hard to say.

Abies amabilis was considered by Wood (1955a) as worthy of further trial. It grows at higher elevations than Douglas fir in Oregon, but in the Olympic Peninsula and further north it descends and forms the climax forest with hemlock. Having a lower warmth requirement than *Abies grandis*, it should do well on the hills of Western Britain. At Crarae, Argyll, it has produced 2,396 hoppus feet in twenty-three years, which equals Quality Class II Norway spruce.

Abies veitchii is the most promising Japanese fir, which combines a fast rate of growth with comparative freedom from Spring frost damage; further trials should be made when the present young plots have been assessed again.

Cryptomeria japonica. On the most suitable sites *Cryptomeria* fairly springs out of the ground, and in the table given by Champion and Brasnett (1958) shows the biggest volume production of any species in the world, with a mean annual increment over a fifty-year rotation of 470 hoppus feet per acre in Japan. Quality Class I Sitka spruce in Britain produces 298 hoppus feet per acre on a fifty-year rotation by comparison. Although the indications are promising, this species can only be used safely where frost is not important, and it will probably find its place on some of the more fertile sites in the West.

Cupressocyparis leylandii. This hybrid is still very much a question mark. It has grown amazingly well in Wales on very exposed sites but in Scotland and Northern England it shows less promise and on infertile soils it appears to have little future. On a heath site at Allerston, Yorks, for example, it is a virtual failure, though it is very promising on polluted sites in the Pennines. It must be raised from cuttings, which is a handicap for its large-scale use.

Eucalyptus. Here the taxonomist's jungle makes it difficult to sort out which species or varieties show promise. No one doubts the very rapid growth of some of them (for instance, *E. subcrenulata* is 55 ft. high in fourteen years at Kilmun, Argyll) but the *Exotics* Bulletin is cautious about recommending their wider use. In Eire a number of species have reached more than 100 ft. in height, but the timber of the species which will grow in Britain is inferior and, unless it can be used for pulp or chipboard, the eucalypts must still be confined to the trial plot stage. Some work on *Eucalyptus* pulp has been done in Eire, but large-scale *Eucalyptus* planting has yet to follow. Selection in Britain for cold-resistant individuals should not be a lengthy process since they bear seed at an early age.

Nothofagus. Early indications were promising for both *Nothofagus procera* and *Nothofagus obliqua* (Macdonald et al 1957) and good plots of both exist, (one of *Nothofagus obliqua* at Lael, Wester Ross, is growing as fast as Douglas fir.).

Nothofagus procera is more difficult to establish except in the west where it grows equally as well as *Nothofagus obliqua*. On the whole the latter species is to be favoured, especially in the South. In Scotland results of the 1955 to 1956 trials have been conflicting, with considerable shoot die-back on both species in East Scotland.

The most recent trials have been with Bosnian pine, *Pinus peuce*, and Mountain hemlock, *Tsuga mertensiana*, The former is very hardy and resistant to *Cronartium* rust, and the new trials are to assess its performance relative to Scots pine which would be the logical alternative on these sites. Mountain hemlock has only been represented by high-elevation southern interior provenances in our early trials. Obtaining seed of Alaskan origin has enabled new trials to be made, comparing it with western hemlock.

Western hemlock is something of a problem species. On the one hand it is very susceptible to butt-rot by *Fomes* and on the other it is the best alternative "whitewood" species for all those sites on the drier eastern half of the country where it is becoming clear that Sitka spruce is not growing well.

One change in forestry practice which has already been responsible for starting a new series of species trials is the reforestation programme. The species used in the second rotation will frequently be different from the original pioneers, both because a wider range of species is now possible, and also to arrest any possible trend towards site deterioration which may result from the first crop.

Apart from these changes it can be said that major alterations in the present choice of species are unlikely. No one now believes there is a "wonder species" growing in some remote valley which will revolutionise British forestry and the main advances are likely to come from using genetically superior seed of our present species, and a more accurate distribution of our present species on the sites to which they are best suited.

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PINUS CONTORTA IN IRELAND

by

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Some notes on a symposium sponsored by the Royal Forestry Society of England, Wales and Northern Ireland held in Omagh on Saturday, 9th March, 1963.

Four papers were presented by guest speakers from the Research Section of the Eire Department of Lands, Forestry Division, Dublin, and the meeting was presided over by His Grace the Duke of Abercorn. The Royal Forestry Society had kindly issued an invitation to all Northern Ireland foresters and a large number turned up to enjoy an instructive and stimulating day.

The first speaker was Mr. O. V. Mooney, Head of the Research Section, who detailed the history of the origin and provenance of the species.

Very little indeed is known about *Pinus contorta* and priority is being given to research on this species. One of the earliest known plantings in Ireland was in 1884, at one of the Guinness Estates, the trees now being almost 100 feet in height. Before 1934, plantings of *Pinus contorta* in Eire totalled less than 10% of the whole but since 1954 the percentage has risen to nearly 30%. The species now makes up some 84,000 acres out of a total of 356,000 acres planted.

Pinus contorta comes from the western side of America. The species can be divided into two varieties; the coastal variety and the inland variety. The inland variety (var. *murrayanna*) has larger, more yellowish-green needles, the trees have smaller crowns, fewer branches per whorl, and are less heavily furnished, compared with the coastal variety. The inland variety is also considerably less vigorous especially on the poor peat sites common in Ireland. The coastal variety is better suited to Irish conditions and is able to suppress and kill quickly the heather vegetation, and, as far as is known, does not permit the re-entry of sphagnum moss.

At present, seed comes almost entirely from America, the best variety coming from the coast of Washington and the Olympic Peninsula, but eventually it is hoped to produce enough seed from sources in Eire.

Mr. J. O'Driscoll elaborated on the improvement of the species by selection and breeding. There are two methods of producing seed from selected home grown stock. The first, by seed orchards, takes some time to build up, but is the more satisfactory. Some seed orchards are already in existence, each containing not less than 20 clones, that is to say, there are grafts from at least 20 different plus or elite trees in each orchard.

Some 60 plus trees have been selected from stands in Eire at present. Branches from the tops of these trees are obtained by shooting them down with a shotgun. The branches are grafted on to usually 2+1 or 2+1+1 stock while the stock is growing and the grafts dormant, to enable the graft wound to heal quickly. The trees in the orchard are kept small to ease seed collection.

The other method to provide a supply of seed is by seed stands. A stand which contained more than 75% straight stemmed and vigorous trees would be called a "plus" seed stand. All inferior trees would be removed in early thinnings and the crowns of the selected seed trees released from any competition from their neighbours. Fertilisers would now be applied round the selected trees to cover a radius of 1½ times that of the crown. A compound fertiliser containing N, K and P in the ratio of 2:2:1 is found best to stimulate an increase in the number of female flowers. In subsequent discussion, Mr. R. Parker of the Botany Department of Queen's University, Belfast, pointed out that this fertilisation tended to change the sex characters of *Pinus contorta* which is a bisexual tree, suppressing the production of male flowers while stimulating production of female flowers.

Mr. P. M. Joyce then outlined how Yield Tables for the species were prepared, using sample plots, mainly temporary ones.

The last speaker, Mr. A. M. S. Hanan, gave an idea, from the limited knowledge available at present, of the properties and utilisation of the timber.

Pinus contorta makes up only 3½% of the timber in America, and is regarded mainly as a scrub timber there. However, in the Rocky Mountain region some 45% of the transmission poles used are of *Pinus contorta*, as are a large proportion of the pitprops used in this area. It has uses as pulp when used along with other pines such as pitch pine, and has taken over from spruce in some regions.

A few years ago a large parcel of *Pinus contorta* was sent from Ireland to the Forest Products Research Laboratories in Princes Risborough, Buckinghamshire, and from the tests carried out on this parcel comes most of the information available about the properties of the timber.

The Irish timber was found to have a very high proportion of heartwood—from 50–60% compared with Scots pine, which has usually 25%. The ring width was remarkably uniform throughout, but there was a large proportion of juvenile wood, making the timber weaker than that of Scots pine or Sitka spruce. The timber was found to have 150% moisture content when felled and a weight of 27 lb/cubic foot at 25% moisture content.

The timber was easily worked, of intermediate hardness and took a high finish when planed. It was found to be straight grained, not as Sitka spruce which invariably has spiral or inclined grain. This straight grainedness led to easy kiln drying without warping—any distortions being due to large knots.

It has been found up to now suitable for making cardboard having no disadvantages over any other pine. It is used for pitprops and here in Northern Ireland has been found very satisfactory when used in rail fences.

The papers were followed by a discussion in which the merits of Sitka spruce and *Pinus contorta* were argued among other topics. It may turn out to be that *Pinus contorta* is a species of considerably more value than has been thought up to now in Northern Ireland, and that as a result of this symposium, the plantings of this species will show an appreciable increase.

LODGEPOLE PINE IN ULSTER

By
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The gratifyingly large numbers of District Forest Officers and Foresters who attended the Royal Forestry Society meeting in Omagh on Saturday, the 9th March, 1963, must undoubtedly have been impressed with the interesting and original data on lodgepole pine which the four experts provided in their papers.

The speakers revealed that 84,000 acres of lodgepole pine have been planted in Eire, representing more than 25% of the government afforested area and the proportion in the current programmes is even higher. In Northern Ireland the percentage of lodgepole pine has rarely exceeded 15% and in 1962 dropped to 6%.

This information immediately prompts the question as to why lodgepole pine is being planted on such a relatively small scale in Northern Ireland where site conditions are very similar to those in Eire. The official silvicultural policy in this Forestry Division confines the planting of lodgepole pine to infertile shallow peat over rocky knolls or to other infertile peat areas which are liable to severe frost. Planting in mixtures is not permitted.

There are several important reasons to justify this policy and these may be summarised as follows:—

General Development in the Past

A survey of the fairly extensive plantations of lodgepole pine both pure and in mixture with Sitka spruce has often shown the pine to have grown very badly. Frequently the stands have failed or become moribund and in quite a number of cases the spruce has exceeded the pine in volume production.

Since lodgepole pine was invariably confined to the very worst planting sites—frequently very borderline from a tree growth point of view—this is not an unexpected result. In addition the provenance of lodgepole pine seed obtained must remain very suspect and one rarely sees examples of the vigorous shade-casting coastal varieties which we know are the most promising for our site conditions.

A careful assessment of the mixed lodgepole pine—Sitka spruce stands which still exist has suggested that if the spruce can be got through the early period of 'check' the subsequent growth of this species can exceed that of pine.

Seed Source

Undoubtedly lodgepole pine seed of the wrong provenance has been used in the past and the lecturers made it abundantly clear that if a more suitable strain of seed were obtained in the future we could expect far better results. They also admitted the considerable difficulty of getting the right type of seed and this has been confirmed by our own Nursery Officer who, in spite of considerable efforts, has been unable for several years to obtain lodgepole pine seed of the most acceptable provenance.

Until such time as selected seed stands or seed orchards are producing sufficient of the most suitable strains of seed there seems to be a case for limiting the planting of lodgepole pine of a doubtful strain.

Heather Suppression

Experiments over the past 10 years have indicated fairly conclusively that on most peat sites early 'check' of spruce is associated with root competition

of heather and that lodgepole pine, possibly due to a different rooting horizon, does not suffer this competition to the same extent.

A number of successful methods of overcoming this early 'check' of spruce have been discovered so that the early advantage that the pine obtained and which was so often so strikingly obvious in mixed stands now no longer exists; on most peat sites which have been properly treated one can expect as satisfactory a growth of Sitka spruce to the canopy closing stage as can be obtained from lodgepole pine.

Volume Production

From the closed canopy stage to economic maturity the growth rate of trees on deep peat is dependent primarily on the release of nutrients from the peat as it decomposes under the complex biological and chemical actions associated with drainage and tree growth. There is little evidence to suggest that lodgepole pine is any more efficient than Sitka spruce in promoting this action so long as the main drainage system of the peat area is maintained. On the other hand there are indications that the greater shade and needle fall from a thriving spruce stand can produce a greater break-down action in the peat and lead to an increased volume yield, whereas the greater amount of light which can reach the forest floor under a pole-sized pine crop may provide suitable environmental conditions for a re-invasion by *Sphagnum* and a subsequent fall-off of tree growth.

Fertiliser Application

Ultimate yields of timber on the infertile blanket bog areas will undoubtedly be limited by lack of nutrients, but current experiments are throwing a good deal of light on tree crop requirements and, just as in present-day agriculture, it is likely that periodical application of suitable fertilisers will become standard forestry practice in the near future. When this occurs one may expect that the yield of spruce timber to meet the demands of local markets will be increased.

Markets

Entirely apart from the silvicultural and ecological aspects of lodgepole pine growth outlined above, the over-riding economic factor influencing the growing of a species must be the saleability of the produce. In most countries one could rely upon the versatility of potential markets to permit adaptation to any wood product so long as there was an assured sustained supply. In a country as small as Northern Ireland potential markets are extremely limited and the consequent adaptability reduced; in addition the relative smallness of the potential pine yield could not easily be used as an inducement to start a special market.

At the present time it is possible to forecast with some certainty that the existing markets—chipwood, pulpwood and boxwood, which are all capable of expansion—will remain, and as all of these are keen to get spruce and none will willingly take lodgepole pine, the present great difficulty of disposing of this wood will remain.

THE USE AND MISUSE OF SITKA SPRUCE

By

M. V. EDWARDS

Divisional Officer, Research Branch

1. Sitka spruce is the most commonly planted species. No data are published about the acreages planted, but it is clear from the annual records of number of

plants used that Sitka spruce has been the most used species since separate species records were published in 1947. The second commonest species has been Scots pine, the third commonest formerly Japanese larch, but since 1956 to 1958 Lodgepole pine. The fourth commonest species has been Norway spruce. Records of numbers of plants used do not distinguish species planted in mixture, in which one may be intended to nurse another, being itself cut out in thinnings, but action of this sort may be expected not to decrease (possibly to increase?) the relative importance of Sitka spruce.

2. Crop assessments from the forests where older plantations exist have recently been recorded in quality classes by Working Plan Parties. Data for North, South and West Scotland Conservancies are given in Tables 2, 3 and 4 (data from the Management Officers, Scotland). It will be seen that the area of quality class I Sitka spruce is negligible, but if the remaining quality classes II—V are put alongside quality classes I—IV of the other species, the patterns are rather similar; see Table 1. The picture in East Scotland would most probably conform to this pattern, but it is not available.

The reason for the difference in the pattern of Sitka spruce from the other two species is uncertain. The quality classes were based on growth in sample plots, and many of these may have been on specially good sites. Sitka spruce, being a new exotic, was often planted on picked land. This difficulty is a fundamental one in the use of quality classes for exotic species whose growth is not adjusted to their habitat.

Even after making the adjustment and lowering the Sitka spruce by one class, it will be seen that the proportion of Sitka spruce to other species in higher classes is least, and that below *any* quality class greatest; whereas the proportion of Scots pine in the higher classes is greater and that below *any* quality class least.

In spite of this, Sitka spruce still retains an absolute lead over the other species. Even after adjustment of the quality class, the production of Q.C. II Sitka spruce is greater than that of Q.C.I. Norway spruce, for example; and Q.C.V. Sitka spruce produces a much greater volume than Q.C.IV Norway spruce or Scots pine. But a high proportion of Sitka spruce *below* any quality class may not be much advantage over other species which *can* reach a quality class.

The question then at issue is whether it is wise to grow a species at a relatively low level of its potential productivity, because it may then be subject to difficulties and need relief from check or other troubles, or whether it would not be better in the long run to use a species which is less demanding and which, though its actual productivity may be lower, may be growing at a higher level of its potential productivity and therefore with less liability to trouble.

It appears that the future prospects of Sitka spruce are much lower than might appear from consideration of the published Yield Tables. This suggestion is based on various assumptions which may not prove correct, for example, the Working Plan data are not a random sample of all areas planted with Sitka, but it will be seen from the footnotes to the Tables that they cover a good proportion of the total area. There is also the basic difficulty that choice of site for different species has varied over the years, and the growing influence of ploughing and manuring complicates the issues. Will the extension of Sitka spruce to poorer sites, which has occurred since the overcoming of early difficulties by ploughing and phosphating, result in an even greater area of Sitka spruce able to attain only the lowest quality class, or perhaps not even that?

3. Although older plantations of Sitka spruce were mainly planted without ploughing or phosphate, this is comparatively rare for younger plantations.

Table 1.

PERCENTAGE AREAS OF MAIN SPECIES BY ADJUSTED QUALITY CLASSES (FROM TABLES 2, 3 AND 4).

Yield in H. ft. per acre

Species	*Quality Class*									
	I (*SS II*) %	*Yield to* 50 *yrs.*	II (*SS III*) %	*Yield to* 50 *yrs.*	III (*SS IV*) %	*Yield to* 50 *yrs.*	IV (*SS V*) %	*Yield to* 50 *yrs.*	*Below any Q.C.*	*Yield*
Sitka spruce	2	11,500	10	9,800	25	8,300	35	6,700	28	?
Norway spruce	4	10,300	20	8,000	25	5,900	30	3,900	21	?
Scots pine	2	7,200	28	5,300	37	3,600	25	2,200	8	?

These usually start growth very well. Nevertheless Research Branch has become increasingly involved in the study of plantations on the earlier shallow, spaced-furrow ploughing which are showing disquieting symptoms at an age of roughly thirty years or a height of 40 ft. Part of the trouble is due to the effect of wind on shallow rooted crops, but in places there has also been a slowing-down of growth both in height and volume.

4. Sitka spruce has a high moisture requirement, or, possibly, an intolerance of high transpiration losses; there is some indication that relief from excessive transpiration is of more importance to the health of the species than is a large absolute supply of soil moisture. Research work on the upland heaths suggested that it should not be planted where the mean annual rainfall is below 40 inches (Zehetmayr, 1960, p. 83–141). Rainfall limits may vary with the latitude and the consequent differences in evaporation rate, and rainfall limits of 35 to 40 inches per annum were mentioned by Macdonald *et al*, (1957, p. 87). The limits will of course also be influenced in detail by the topography and soil of the particular site.

5. Sitka spruce has rarely been planted on poor deep peat which is unable to supply its nutrient needs, but great use of it has been made on richer, shallow peats typically bearing *Molinia coerulea* before planting. It is on these shallow-rooted peaty gley soils that growth starts off well but tends to decrease later.

6. It is suggested that the problems of the use or misuse of Sitka spruce can best be considered from the following aspects:—

(i) *Moisture*
   (a) Rainfall in relation to latitude and evapo-transpiration rate, vide Fig. 7 of Bulletin 30. (Macdonald *et al.* 1957).
   (b) Rainfall in relation to topography, i.e. moisture relations on water-losing or water-accumulating sites, exposure, etc.
   (c) Rainfall in relation to soil, i.e. retention or supply of the moisture needed by the trees, perhaps measured by mechanical analysis of soil.

(ii) *Soil Poverty*
   (a) The elimination of poverty by manuring on poor (i.e. not bearing luxuriant *Molinia*) peats.
   (b) The elimination of poverty on mineral soils (cf. 6(i)(c)) perhaps measured by chemical analysis of soil.

(iii) *Soil depth.* Inability to root deeply in heavy soils.

7. Research work might attempt to fix the limits for planting Sitka spruce in relation to:—

(i) *Mean annual or growing season rainfall* modified as necessary in relation to latitude and topography.

(ii) *Soil characteristics within the adequate rainfall zone*, determined both:—
   (a) on the basis of the principal pre-existing vegetation.
   (b) directly.

In all cases the limits so fixed for Sitka spruce need to be considered in relation to the success of alternative species, i.e. their likely productivity over a long period in terms both of kind and quality of timber and its volume. This necessitates a detailed appraisal of the value of Sitka spruce timber in relation to that of other species, particularly for saw timber, boxwood, pulp and other possible uses.

8. Other points for consideration will be concerned with matters of technique such as:—

(i) *Provenance.* Few detailed data exist, but it seems unlikely that any change of provenance from the common standards of Queen Charlotte Islands and Washington would affect the future of the species materially.

(ii) *Manuring.* No doubt improvements could be effected, especially on the poor soils (para. 6(ii)), but manuring could also influence other species and Sitka spruce might be relatively little affected.

(iii) *Drainage of soil.* Deep drainage appears to have possibilities in improving the depth of rooting, etc., but the extent of the improvement and any consequent improvements in stability, growth or health cannot yet be measured.

(iv) *Cultivation of soil.* Together with shallow drainage, soil cultivation has been an important factor in the establishment of the younger crops of spruce. The permanence of the effect remains to be estimated in the future.

(v) *Insect damage.* The importance of *Neomyzaphis* needs to be established.

REFERENCES:

MACDONALD, J. *et al.* 1957 Exotic forest trees in Great Britain. *Bull. For. Comm.* No. 30.

ZEHETMAYR, J. W. L. 1960 Afforestation of Upland Heaths. *Bull. For. Comm.* No. 32.

TABLE 2: AREAS OF SITKA SPRUCE RECORDED BY WORKING PLAN PARTIES, SCOTLAND

Acres

Conservancy, Scotland	*Quality Classes*						*Unclassified*		*Total*
	I	*II*	*III*	*IV*	*V*	*below V*	*Young (Under 11 years)*	*In check*	
North	6	115	559	1,502	2.039	2,939	3,436	1,095	11,691
South	—	75	685	1,624	1,351	2,333	6,833	298	13,199
West	—	102	1,223	2,822	5,123	1,707	6,376	334	17,687
Total	6	292	2,467	5,948	8,513	6,979	16,645	1,727	42,577
					Percentages				
As surveyed	0	0·7	6	14	20	16	39	4	100
Adjusted*	0	2	10	25	35	28	43		100

N.B. Definition of "check" uncertain.

42,577 acres recorded out of estimated total of S.S. to P.58 of 149,900 acres planted = 28 per cent.

* Adjusted on the assumption that the "unclassified" areas develop according to the same pattern as that already classified.

TABLE 3: AREAS OF NORWAY SPRUCE RECORDED BY WORKING PLAN PARTIES, SCOTLAND

Acres

Conservancy	*Quality Classes*					*Unclassified*		*Total*
	I	*II*	*III*	*IV*	*below V*	*Young (Under 11 years)*	*In check*	
N	71	484	961	1,155	1,703	374	149	4,897
S	198	709	226	343	340	937	65	2,818
W	252	1,277	1,864	2,203	558	2,835	39	9,028
Total	521	2,470	3.051	3,701	2,601	4,146	253	16,743
				Percentages				
As surveyed	3	15	18	22	16	25	1	100
Adjusted*	4	20	25	30	21	—		100

N.B. 16,743 acres recorded out of estimated total of N.S. to P.58 of 59,100 acres planted × 31 per cent.

* Adjusted on the assumption that the "unclassified" areas develop according to the same pattern as that already classified.

TABLE 4: AREAS OF SCOTS PINE RECORDED BY WORKING PLAN PARTIES, SCOTLAND

Acres

Conservancy	*Quality Classes*					*Unclassified*		*Total*
	I	*II*	*III*	*IV*	*below IV*	*Young (Under 11 years)*	*In check*	
N	89	1,428	2,214	1,558	446	3,241	229	9,205
S	77	513	331	257	149	639	44	2,010
W	42	441	551	203	56	1,706	13	3,012
Total	208	2,382	3,096	2,018	651	5,586	286	14,227
				Percentages				
As surveyed	1	17	22	14	5	39	2	100
Adjusted*	2	28	37	25	8	—		100

N.B. 14,277 acres recorded out of estimated total of S.P. to P.58 of 66,300 acres planted = 21 per cent.

* Adjusted on the assumption that the "unclassified" areas develop according to the same pattern as that already classified.

TWO KINDS OF COPPER BEECH

Translated extract from "Mitteilungen der Deutschen Dendrologischen Gesellschaft" vol. 52, 1939) 111-122). "Die Spielarten der Rotbuche, Fagus sylvatica L." (The varieties of beech.)

By
G. KRÜSSMANN
Contributed by: F. C. FRAASS
Clerical Officer, Research Branch

p. 117 25. var. *cuprea* Lodd. (= *var. cupreata hort.*)

With this variety, the leaves are not red, but more greenish-red. In fact, all shades are to be found ranging from the almost green to dark red. The seedlings of "*Fagus sylvatica purpurea*" must also be designated with this name because in many cases they turn quite green in early summer. Although in the case of youngish plants this phenomenon does
p. 118 not occur to the same extent, there are many instances of seedlings plants which can be observed to turn completely green in a gradual process.

26. var. *atripunicea* West. (= var. *atripurpurea* Reg., = var. *purpurea* Ait. × var. *sanguinea* Rchbch. = var. *atrirubra* Duroi = var. *colorata* DC).

The leaves are coloured from a deep dark brown to almost black. In the case of old trees with dense crowns which do not admit light into their interior, the intensity of colouring decreases gradually. The red colour originates from the anthocyanin contained in the epidermis cells of the cell sap.

There is still a divergence of opinions as to the significance of the leaf colouration (Zick, *Deutsche Dendrologischen Gesellschaft Yearbook*, 1936, p. 266). A sowing of the nuts produced in large number will result in 40–60% reddish seedlings, but rarely in black-red type. As stated above, the seedlings have to be designated as "var. *cuprea*." It would be advisable to use this procedure also for trade purposes. *Fagus sylvatica purpurea* has grown in many localities in Europe from seed of the common beech. According to HEGI the three oldest sites where "*Fagus sylvatica purpurea*" occurred spontaneously are on the Starrenberg near Buch im Irchel, Canton Zürich (already known before 1680), in the Hainleiter forests in Thuringia (first mentioned in 1772) and in the Bagarina Valley in South Tyrol where the variety was found in 1840. Its appearance in gardens is not reported until after 1750. WILLKOMM (*Forstl. Flora*, 440) mentions in a foot note that BECHSTEIN found an old "*Fagus sylvatica purpurea*"—considered to be the parent tree of all trees of this variety cultivated in Germany—in the Oberspier forest near Sonderhausen. In 1877 this tree had reached a height of 27 metres and a stem diameter of ·97 metre; its age was estimated at approximately 200 years. There is an old tree in the Tharandt forest garden, age 110 years, height 15 metres, stem diameter 80 cm. It is unnecessary to name further trees in stands as these can be found everywhere in large number.

A NURSERY BONUS SCHEME

By

J. T. FITZHERBERT & E. G. HOLLOWELL

Divisional Officer and Forester South Wales

Introduction

Recent improvements in techniques arriving at increased yields of seedlings per pound of seed would be of little value if there were no corresponding improvement in treatment of the seedlings.

It has been apparent to us that Lining Out was the operation that needed greatest attention and that the emphasis should be on quality rather than quantity.

Although the cost per 1,000 "forest" plants had to be the ultimate target a definite quality standard had to be set. In order to achieve and maintain this it was decided:—

(1) That all piece work had to be stopped and measured day work introduced—with a high rate of supervision (1 supervisor to 9 workers). This was actually done for two seasons.

(2) A further help in the reduction of losses would be to ensure that all plants were *lifted and lined out* on the same day. (We realised this might occasionally mean the loss of a little time at the end of the day but extensive use of machinery, on the other hand, speeded up this operation considerably.)

Our normal Lining Out team consists of what we call an eight-shelter squad. Made up of 8 "Filling in" shelters each of 3 workers plus 6 extras for tidying up, applying fertilisers etc. making a total of 30 workers. In addition there is the Lining Out Tractor and Rotovating Tractor.

We have found that with this team and consistent with the quality of work desired, 110-120 thousand plants lifted and lined out per day was a good day's work.

Yields

Slebech Nursery started in 1950 with a completely unskilled squad. We expected teething troubles and Table A below shows the varying percentage yields of usable plants of the major species lined out over the years 1950 to 1962.

Costs

No matter what improvements one makes in techniques or production the ultimate test is the cost per 1,000 plants fit for the forest. It was felt that an increase in the cost of lining out could be tolerated provided the gain in survival was high enough. The difficulty was to establish the optimum balance between quality and quantity.

It was also considered that a truer cost of production would be obtained by basing the cost per 1,000 plants on the survival figure rather than the problematic piece-work rate for lining out.

TABLE A : PERCENTAGE YIELDS FROM PLANTS LINED OUT

Species	*Aver.* 66/62	62	61	60	*Aver.* 57/59	59	58	57	*Aver.* 50/56	56	55	54	53	52	51	50
J.L.	86	87	90	84	75	63	85	76	69	75	83	—	75	80	64	36
H.L.	81	100	91	51	77	77	—	—	—	—	—	—	—	—	—	—
S.P.	93	93	—	—	—	—	—	—	38	—	9	31	—	78	35	—
D.F.	94	96	92	95	63	57	77	55	61	51	64	—	54	76	55	66
N.S.	87	84	80	—	75	83	—	67	72	77	100	61	54	76	66	—
S.S.	84	88	75	88	59	54	64	—	72	75	89	57	79	87	58	57
P.C.	84	75	100	77	—	—	—	—	45	—	—	18	—	72	—	—
A.Pr.	62	62	—	—	61	100	64	20	78	57	100	77	—	—	—	—
All Spp. Over	84	87	88	79	68	72	72	54	62	—	—	—	—	—	—	—

These entries are obtained from N.R. form

(We feel that a three-year average is a reasonable one to work on for our purpose and this is incorporated into the scheme.)

Below in Table 'B' are shown the varying costs per 1,000 of plants fit for the forest:—

TABLE B: COST OF FOREST PLANTS PER 1000

F.Y.	*Total Cost of L/O*	*Quantity at Stocktaking+1*	*Cost per Thousand (Forest Plants)*
62	£1615	2756 M.	11/9
61	1898	2865	13/3
60	2300	2102	14/10
59	2613	2810	18/7
58	1455	1856	15/8
57	1644	1729	19/3

These unit costs include the increased production costs resulting from the movement of wages and hours of work. That this is quite substantial is shown in Table C below:—

TABLE C: MOVEMENT OF WAGES

Year of Wage Increase	*Wages Increased to*	*Hours per week*	*Approx. Rate per hour*	*Weekly Wage Index taking 1956 as 100*	*Hourly Wage Index 1956 as 100*
1962	188/6	43	4/4½	133·9	150·3
1962	181/6	43	4/2½	132·1	144·3
1960	172/6	45	3/10	125·9	131·4
1960	163/6	45	3/7½	119·4	124·6
1958	159/6	46	3/5¾	116·2	118·8
1957	153/6	47	3/3	111·7	111·7
1956	137/–	47	2/11	100·0	100·0

It will be seen that although the weekly pay risen by one third, the rate per hour (influenced by a shorter week) has risen by as much as a half. (This materially affects the new system which is based on hourly work rather than on a flat piece work.)

Application

On analysing Tables A-C you will notice that we were improving in the correct directions. So were happy to continue but the men via their Unions once again asked for piece work. This was rejected but a Bonus System based on quality was offered, the basic essentials being:—

(a) Percentage survival of plants for the forests;

(b) Cost per 1000 for lifting and lining out.

From our figures, which we were able to show the Union Representatives, we settled on the following basic details:—

(1) Percentage survival had risen from 55 to nearly 84. We settled for 81% as the first datum.

(2) Cost of lifting and Lining Out had dropped on the average over the last three years by 4/6 per 1000. We were prepared to split this between Workers and Department—2/3 each.

(3) This cost and survival which we were prepared to accept was from an output of 110,000-120,000 per day, for the whole nursery squad of 30 workers plus 2 tractor drivers. We were prepared to make a round figure of 1000,00 per day the second datum line. Only after achieving this figure would Bonus be paid, and then on the total output e.g. say 106,000 at 2/3 per 1,000 etc.

(4) Having decided on the basic units:—

(a) Percentage survival (81%)

(b) Payment per 1,000 (2/3)

(c) Output per day (100,000)

We then had to evolve a workable system. A system which was fair to both parties and took into account such natural hazards as rain in mid-afternoon, tractor breakdowns, and most important of all possible variations in the percentage survival—plus or minus—the basic figure. We also had to base our figures on a standard gang in case a crafty forester reduced the workers but not the datum line.

Thus the final terms of the Bonus scheme were as follows:—

(1) No bonus would be paid unless the datum of 100,000 plants lifted and lined out was achieved in the day.

(2) There will be no extra bonus rate for anything achieved over the 100,000 other than the normal payment calculation e.g. 106,000 at 2/3 etc.

(3) The Bonus datum is calculated for an eight shelter squad:—

i.e. 8 shelters with 3 workers each..24 plus
2 tidying up+2 gangers+1 applying fertiliser
+1 carrying plants.....+30

(4) Bonus payment would be 2/3 per 1000 on an 81% survival.

(5) If survival improves or deteriorates the bonus will be recalculated thus:—

$\frac{27}{81}$ d.$=\frac{1}{3}$ (Hence the choice of 81%)

An improvement to 90% gives the following:
$90\times\frac{1}{3}=30$d.$=2/6$

A deterioration to 75% gives the following calculation.
$75\times\frac{1}{3}=25=2/1$

(6) All plants must be lifted and lined out on the same day by the same squad i.e. the 30 workers spend the first quarter of the day lifting and then turn to lining out.

(7) A count will be made at mid-day. If the quality and rate of work are up to Bonus standard and there is a mechanical or weather breakdown in the afternoon the squad will be paid a pro-rata bonus in the figure achieved even though under the daily 100,000 datum total.

(8) Survival figures will be calculated each year from the average of the three previous years. The basic details always being 81% at 2/3 per 1,000.

(9) We felt one further refinement would help us. We kept the tractor drivers outside the main calculation. The ploughman who is the key man for accuracy, speed, etc., was therefore paid a separate bonus of 1d per 1,000. (Not much over his share of $\frac{27}{810}$.) The second tractor is hired and was also kept out for simplicity.

Comments

With this system we do not profess to achieve the lowest costs or the greatest output. We contend that *for our conditions* we can produce plants at a very economic figure. We also feel that our squad should benefit from their labours provided we get a day's good work. The possibility of a fluctuating bonus keeps everyone on their toes. All the gang benefit, not only the few keen healthy piece workers but also the older men and women.

It may be of interest to record that after the first year's results the survivals have gone up from 82% to 84%. This is most encouraging.

Future Use

It is proposed to extend this system to another nursery; the procedure will be as follows:—

(1) From Nursery Returns check percentage survivals over the last three years.

(2) Set the survival rate that is acceptable and that *can be achieved.* If the figures are not acceptable then close supervision on day work for a year or two may be necessary to produce the figures.

(3) For the last three years calculate from the *Total Cost* of Lining Out and the *Total plants* lifted for forest use the actual cost per 1,000 of Forest Plants. (By this we mean plants fit to go out through the nursery gate.) All species, ages and sizes must be included in these calculations.

(4) Decide what is a fair and reasonable cost of raising forest plants per 1,000.

If the trend in (3) above shows an improvement this may decide the figure. If not further study for a year or two may be necessary.

(5) If the trend in (3) above shows an improvement (as it did at Slebech at 4/6 per 1,000) this improvement could be the basis for the bonus. Failing that one could decide on a reasonable figure.

(6) Set a daily datum figure of lining out for a known squad. These can easily be obtained from recent records. If the nursery is not lifting its own seedlings for lining out this would be the place to make the allowance for time saved. Either the datum would be increased perhaps to 130,000 a day or some other form of adjustment, e.g. Reduced squad.

As I have mentioned earlier the system seems to be a success and we are now thinking of other jobs to which it can be applied. We are flattered that a request for the furtherance of the scheme has come from the workers. We hope in the near future to be able to extend it.

THE USE OF HOP MANURE IN NURSERIES

By

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It has been recognised for a long time that in order to maintain the fertility of our forest nurseries, particularly where there is a sandy soil, it is necessary to maintain the organic content of the land on which the trees are grown

There is of course the other side of scientific opinion which indicates that one can grow equally good plants by treatment with pure inorganic fertilizers

and this must be recognised, although in the writer's experience inorganic fertilizers give the best results in areas of high rainfall and where the soil has a higher chemical content in its natural state.

A subtle difference exists in areas of low rainfall where it is not purely a matter of the availability of chemicals arising from the use of organic or inorganic fertilizers but with a very light sand soil there is a need to provide in the soil a means of retaining the limited moisture available and making it accessible for plant and root development.

Thus the use of organic fertilizers becomes a matter of soil mechanics as well as that of purely chemical improvement or maintenance.

The very great forestry expansion following World War II required an advance in nursery technique if the desired supply of suitable planting stock was to be forthcoming. and in the drier localities mentioned above a move was made to get away from the traditional organic fertilizer of the type of farmyard or poultry manure, both of which although carrying the necessary chemicals introduced very large quantities of weeds to the nursery beds. This entailed a quite inordinate cost on weeding.

The first post-war efforts at producing what might be called a weed-free organic fertiliser were on the lines of compost. Many and varied were the substances used as the activators, dried blood, liquid blood, night soil, etc., but after several years the most successful, readily available and the easiest was found to be hop waste which mixed with chopped up barley straw gave a very satisfactory organic additive to nursery soils.

However the quantities of hop waste compost required were very large, involving also a relatively expensive article in view of the labour required in preparation and the transport.

By 1955/56 the rising cost of labour and the difficulties in obtaining suitable quantities of straw at an economic price made our thoughts turn elsewhere and the direct application of raw hops to nursery ground was resorted to.

This gave very satisfactory results over a period of years, there were however difficulties in the cost of rehandling ex railway waggons as apart from a few local supplies of hops large quantities had to be obtained from Messrs. Wakeley's in London. Both raw hops and pressed hops were used but both tended to lumpiness which gave uneven distribution on the ground.

It must be appreciated that even when practising a nursery technique based on organic fertilizers such as hop waste an application of artificial fertilizer in the form of a balanced N.P.K. is necessary. This in turn results in a further cost in applying it to the ground.

Hop waste was applied at the rate of 10 to 15 tons per acre on seedbeds and about 7½ tons per acre on lining out ground, but with a large nursery programme it will be seen that the handling of a large bulk of material was involved.

Some three years ago discussions took place with Mr. Day of Messrs. Wakeley on the possible use of the Hop Manure manufactured by that firm.

Hop manure is manufactured by taking raw hops, pressing them, then shredding and adding a balanced N.P.K. fertilizer and there are numerous different suppliers, the process operated by Messrs. Wakeley's is however far and away the most satisfactory for forest nursery use, as they mix N.P.K. (as granular crystals) while the pressed hops are still moist and the salts in the hop leaves form a chemical bonding with the N.P.K. granules, resulting in an excellent distribution throughout the product which remains very stable. As an example hop manure of this manufacture still has visible granules of N.P.K. adhering to individual hop leaves after two years fully exposed to the elements.

It was found by analysis that the N.P.K. added in the manufacture of this

hop manure conformed very closely to the standard quantities of artificial fertilizers previously applied to nursery ground as a separate operation; but because the N.P.K. was so well distributed among the shredded hops it was much more readily available to the plant in the soil. The hop manure is very friable and can be spread very evenly over the soil.

Because of the increased potential fertility of the hop manure as compared with plain hop waste, the rate of application is reduced to 6 to 7 tons per acre on seedbeds and about 4 tons per acre on lines. The hop manure is merely spread on the ground immediately prior to ploughing and cultivation in late summer or early autumn.

Trials were organised with hop manure in 1960/61 and more general use was made of it in 1962 and 1963 on the dry sandy nurseries in East Anglia.

The more normal trade use of hop manure is in market gardening but this presents a seasonal requirement resulting in the manufacturing plant virtually standing idle for the summer months. As used by the Forestry Commission hop manure can be supplied in bulk through the summer and stored in pens until required in the early autumn, thus it was possible for Messrs. Wakeley to keep their plant working more continuously through the year and as a result a very favourable price was quoted.

It is appreciated that at first impressions the price of hop manure appears high, compared to say, plain hop waste, but there are so many factors involved and the reduction of money spent on direct labour is such that the use of hop manure does result in an overall financial saving. This naturally varies with haulage distances, shape of nursery etc., etc., but the net financial saving is between £2 and £4 per acre per annum.

A net financial saving is not all that one is looking for if the resulting nursery stock is not all one desires, and it will be appreciated that there are so many involved factors, seasonal, climatic, managerial, etc., which can affect nurseries, that after only some three years use of hop manure it is wrong to be too dogmatic. It is however apparent from the improved results achieved that a great deal of the credit must go to use of hop manure.

Over a range of nurseries the production of useable one-year seedlings has shown an increase of 50% over the national average for both Scots and Corsican pines, and it is difficult to attribute more than a small part of this increase to anything else than the use of hop manure.

Both seedlings and transplants have very well developed and fibrous root systems and there is no doubt that the ready availability of nutrients and *water* from the hop manure is responsible both for this and for the remarkable survival of Corsican pine through prolonged drought periods.

I would recommend very strongly the use of hop manure on a much wider scale.

THE "ROSE" SIX-DRILL TREE SEED SOWER

Contributed by the
DIRECTORATE FOR SCOTLAND

Introduction

This implement is designed to sow a three-foot wide seed bed with drills at six-inch intervals, the tractor wheels running in the alleys between the beds. The sower is rear-mounted by Ferguson three-point linkage, and is completely mobile.

Adjustable openings enable a wide range of sizes of seed to be sown, and

the "Armstrong" Broadcast Adaptor converts the drill sower into a broadcast sower with the minimum of trouble.

Fertilisers can also be drill or broadcast sown as a separate operation.

The machine has been used at Forestry Commission nurseries at Ledmore and Bareagle, in Scotland, with success.

Design

The machine is constructed from mild steel angle-iron in the form of a framework which carries six seed hoppers. Two pneumatic-tyred wheels on a fixed axle drive agitators inside the hoppers and, when the cut-off slide is opened, seed is allowed to fall through the delivery tubes and the drive is simultaneously engaged. A freely suspended wooden roller is attached to the front of the frame to break down rough soil—any weight of roller may be fitted to provide the required consolidation of the seedbed; this levelling assists in the follow through of six mild steel drill shoes, each of which is attached to the seed delivery tubes by a steel floating sleeve.

The shoes open the drills to the required depth of $\frac{1}{8}$ in. to $\frac{1}{4}$ in.; attached to the shoes are small, mild steel cuffers which cover the sown seed with soil. These cuffers may be removed and a grit distributor attached behind the sower if a grit covering is desired. To each shoe is attached a small independent wooden roller which consolidates the soil behind the cuffers.

Inside the hoppers are brass rotary agitators and brushes which ensure even flow of the seed and keep the exit holes free. The exit holes are of varying size, set in a circular plate which may be adjusted according to the size of seed and required density of sowing; transparent panels are set in the seed delivery tubes and the flow of seed can thereby be examined.

Broadcast Sowing

If broadcast sowing is required the floating sleeves, drill shoes, cuffers and small wooden rollers are removed. The "Armstrong" Broadcast Adaptor Plate is then bolted on to the rear of the frame; the height, above ground level, of this plate can be adjusted. When sowing, the seed flows through the delivery tubes on to the angled lower section of the plate and bounces off it on to the ground; even diffusion is attained by adjusting the height of this plate.

When sowing broadcast the 3 in. compaction roller should be mounted to the rear of the machine. The seed is then pressed into the soil where it can be retained, even in windy weather, until covered with grit or some other suitable seed-bed cover.

Sowing Fertilizers

Fertilizers are sown as a separate operation, either drill or broadcast, and it is preferable to fit a large fertilizer hopper over the seed hoppers.

Operating

Within certain limits (about 1–4 m.p.h.)the tractor speed does not affect the density of sowing as the direct drive ensures that the *rate* of sowing increases as the speed. Factors which influence the sowing density are: size of hole, size of seed, shape of seed, whether dressed or not (red lead, for instance, tends to accelerate the flow), whether stratified (stratification and resultant dampness inhibits seed flow). Seed *must* be clean; needles will certainly block the holes.

Setting the Correct Size of Hole

It has been found that $\frac{1}{2}$ in. between seedlings in the drills is desirable for most forest tree species; obviously the germination and number of seeds per

pound must be taken into account when sowing, and trials and experience will indicate the correct size of hole to use for the size, pre-treatments and germination of the seed to be sown. As a guide, however, a table is given showing the number of *particles* of seed size sown per inch per drill according to the species and hole-size used:—

Number of particles sown per inch per drill

Hole No.	1	2	3	4	5	6
Large						
(*Abies procera*)	1	½	—	—	—	—
Medium						
(*Corsican pine*)	13	5	4	3	1	—
Small						
(*Scots pine*,	23	19	18	7	3	1
Hybrid larch)	12	11	10	6	2	1
Very Small						
(*Sitka spruce*,	—	31	23	12	4	—
Tsuga heterophylla)	—	27	18	14	5	—

Notes

1. Hole No. 1 is the largest size.
2. The above figures are for clean, undressed, unstratified seed, and are approximate.
3. They are intended solely as a guide to help the operator start off with a likely hole size.

Applying the Table to Actual Sowing

The particles placed by the drill will not all be viable seeds, and the relationship in sowing is as follows:—

$$\frac{100}{\text{germination \%}} \times \text{desired spacing of viable seeds} = \text{desired spacing of particles}$$

and hence the hole number required.

The germination/survival factor should be considered in deciding what is the desired spacing for the viable seeds.

Notes on Calibration

The following points may be of assistance where seed of an unusual size is to be sown or when pre-treatment (such as soaking) makes the flow of seed abnormal; in such cases a sheet of greased paper 3 feet wide can be laid on the ground and seed drill-sown on to it. The seeds can then be counted per unit length; more accurately, a known weight of seed (containing a known number of seeds) can be sown and the distance to do this with any hole size measured. The seeds can simply be run into polythene bags, tied on to the delivery tubes, so that none is lost.

The machines are made by Mr. J. Black, Blacksmith, Redgorton, Perthshire, Scotland, and orders can be made direct or via Director, Forestry Commission (Scotland), 25 Drumsheugh Gardens, Edinburgh 3.

The cost is approximately £110 plus £20 for the broadcast adaptor, but current prices should be obtained direct from the maker.

PLANTING IN STRAIGHT LINES

By

FORESTER W. A. BOLLARD

Forester-in-Charge, Foremark Woods, Derby.

The original planting of a wood influences its future management tremendously and the straighter the rows of plants, the easier that management will be.

In the Midlands where most of the planting is done in old woodlands, often devastated and generally chock-full of stumps, old trunks, branches, brushwood and dead vegetation, I found the necessity for straight systematic planting even more essential than usual in order primarily that the plants could be more easily found during weeding operations which often have to be done thrice in one season. Furthermore, the labour supply is not always stable and therefore it is better to have the planting done systematically so that it may be followed more easily by successive workers.

Most woods are still planted direct by hand using either a spade or mattock and it is with this method that the following suggestions are chiefly concerned.

Planting sticks are used and are prepared before the planting season. Sticks may be selected and collected during the felling of scrub and should be straight from 5½ ft. to 6½ ft. long and approximately ¾ in. to 1¼ in. in diameter top and bottom. The selected sticks are then taken to the shed where the men shelter during wet weather and the rest of the manufacture may then be done during wet weather.

The sticks are peeled and pointed at the thick end and left in the shed for some time in order to season.

Normally planting is done at 4, 5 or 6 feet spacing and the stick described and illustrated is primarily for these spacings. Naturally the stick may be made to suit any spacings.

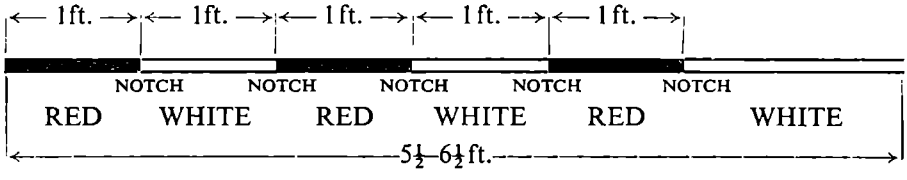


DIAGRAM OF A PLANTING STICK

After being allowed to season, the thin end of the stick is sawn off and then carefully measuring from this end, notches are cut with a penknife at intervals of one foot, making five notches in all for a length of five feet. Each stick should be made exactly the same to avoid any future confusion.

The sticks are next painted alternately red and white so that each stick from the top or thin end will have foot lengths of red, white, red, white and finally red with the pointed length left plain. Red and white were chosen because they are the most obvious and contrasting colours, particularly useful when planting in dull, foggy or misty weather. Normally it is necessary to give each stick two coats of paint and it should be carefully done. This operation completes the manufacture of the planting sticks.

When planting is to commence, each man should have six planting sticks which is actually the minimum; if the rows are long, the land undulating or visibility poor, more sticks would be necessary.

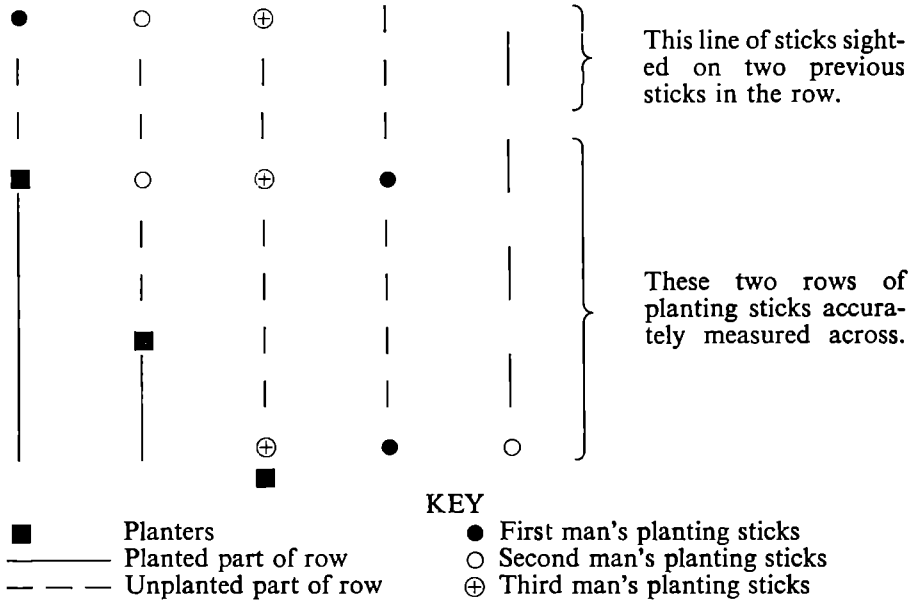
At the planting site, the direction of the rows of plants is decided, bearing in mind future extraction, weeding and general care and attention.

Then, for example, in the case of rows about 100 yards long—the end of the row being easily seen from the other end—the first man places his first stick firmly and vertically at the starting end of the row, and then takes his second stick to a point in the direction decided, approximately 20 yards from the far end of the row, and sticks it firmly and vertically in the ground. Finally the last stick is taken to the end of the row where the planter very carefully sights it on the other sticks and places it in the ground, thus making a long straight line of sticks.

If there are more planters, each man must measure accurately at right angles to the first planting line, using the planting stick as his ruler, the exact distance agreed between the rows, and stick his planting sticks in opposite, and exactly at the agreed distance from, the sticks in the first line. The last stick should be sighted into line and measured *only* if there is some doubt that the distance between the rows is not correct.

Each man, now having a straight line of planting sticks, may commence planting. As soon as the planter reaches his first stick, it is removed and carried across to be measured accurately again from the last line of sticks, thus becoming the first stick in the planter's next row. Planting continues to the second stick, and exactly the same as was done with the first stick, so it is done with *this* stick. The planter continues to the last stick carefully in order to keep his row as straight as possible, and as this distance has been made as short as possible the error should become negligible. Upon reaching the last stick, the planter removes it and sights it carefully on the last two sticks which he moved across, thus forming a straight line of planting sticks ready for his second row which may be commenced from the other end.

A DIAGRAM OF THE POSITIONS OF PLANTING STICKS AS PLANTING PROGRESSES BY THREE MEN



The distance between the plants in the row may be measured either by using a thin stick of the correct length, or by using the spade or mattock shaft which the planter is using. Usually it is one complete shaft-length plus a bit which can be marked by a notch on the shaft. Again the more accurately this can be done the better, but plants should never be planted *closer* than the agreed distance, as it is almost certain that they will be beheaded by the weeders.

To summarise, I would say that in derelict woodlands and in localities where plantations take a number of years to become established, and where labour is changing continually, it is essential that a good start is made. The little extra care and preparation described in these notes are well worthwhile, and will undoubtedly contribute towards a reduction in the heavy cost of establishment under these conditions.

REPLANTING FELLED CONIFER AREAS, INCLUDING WINDBLOW

By
G. D. KEIGHLEY
District Officer, North Wales

Introduction

Many old established practices in forestry have been modified in recent years and arising from developments in the treatment of scrub in particular, the practice of clearing and burning of lop and top of conifers justifies critical examination.

The practice of clearing lop and top before replanting has been justified in the past to ease planting and facilitate weeding and control of rabbits. The presence of brash could make weeding costly and difficult especially when control of pine weevil meant delaying replanting for several years. The virtual extermination of rabbits by myxomatosis, and the use of D.D.T. for the control of pine weevil, together with more recent developments in the chemical control of weed growth, have completely changed the situation, and complete clearance of brash no longer seems necessary. Clearance and burning prior to replanting is:—

(a) Expensive—£15 to £25 per acre without overheads.
(b) A fire risk during the operation.
(c) A possible source of *Rhizina* infection.
(d) Destroying twigs and branches as a source of organic matter returning to the soil.
(e) Exposing the leaf litter to more rapid decay and drying out.
(f) Exposing the soil thereby encouraging the rapid germination of weed seeds.
(g) Exposing the soil to rapid variation in temperature and moisture content.

Leaving the brash scattered uniformly over the site would reduce all the above factors. In practice, any selective or partial clearance of lop and top is relatively expensive, is probably more dangerous for fire, and is difficult to supervise. A common method has been to gather the lop and top into racks and without burning, to plant as far as possible into the racks. However, this reduces the planting by, say, 20% and costs from £10 to £20 per acre, and suffers from the disadvantages indicated in (d) to (g) above.

In recent years replanting directly into undisturbed lop and top has been

done at Cynwyd Forest on a practical scale, and results are sufficiently promising to justify certain recommendations. Simultaneously it is understood that the Research Branch have been investigating in situ mechanical chopping of brash and information supplied by them will be referred to later in this report.

At Cynwyd planting through brash was started under European larch in the late 1950's and was extended onto clear felled or windblown areas of Norway spruce, Sitka spruce, Scots pine and Japanese larch over an area of some 200 acres between 1961 and 1963. The final results will not be known until each replacement crop is fully established and even then it will not be a controlled experiment comparing the various methods. However, the work already done was on a large enough scale for valuable experience to be gained on management and silvicultural problems.

Methods Used and Practical Recommendations

Lop and Top

Was left on the ground without any clearance being done; where necessary, timber contracts could specify that trees will be trimmed down to 1½ in. diameter to reduce the size of tops. The date of felling can be critical and to avoid unnecessary loss of production, it is recommended that evergreen species should be felled during the previous Summer so that most of the needles will have fallen before replanting in the following Spring. Larch can be felled during the Winter and replanted. Norway spruce may justify special contracts for felling in the Mid-October to mid-December period, coinciding with the Christmas tree market; replanting through branches, which will retain their needles until about the middle of June, is practicable where the yield of Christmas trees shows a profit of say, more than £20 per acre.

Re-planting

The brash of larch, Norway spruce, Silver fir and *Tsuga* lies flat and to a depth of between 9 and 18 inches; it allows enough light for tree growth as soon as the needles have fallen from the branches. Sitka spruce and pines give a deeper but less compact cover and even though Sitka spruce breaks down slowly it still admits sufficient light for tree growth. Plants used on areas treated to date have been the best 1+1 transplants available from Maelor Nursery and have generally been in the size range of 12 to 15 inches; Sitka spruce has been the principal species used, with some *Tsuga* and *Abies grandis*.

A special spade was used and is shaped like a narrow wedge three inches wide and twelve inches long on a short strong handle,

The planters were instructed to keep strictly to straight lines and to plant at normal spacings within the rows and between the rows; the trees were planted within the rows at this spacing, but an exceptionally dense pile of brash could be jumped by multiples of the normal tree spacing (it was found in practice that less than 5% of the normal stocking was omitted). Wherever possible, trees were planted on the raised ground immediately behind a stump. The planter roughly cleared a hole in the brash with the spade, made a planting slot, placed the plant, knocked soil and humus round it and then made a second slot to one side which closed the planting hole. The planting was done on piece-work with a hindrance allowance due to the brash of 4/- per 100 (56/- per acre) for Norway spruce, larch, *Tsuga* and *Abies Grandis*, whilst for Sitka spruce and pine the allowance was increased up to a maximum of 12/- per 100 (168/- per acre). These costs are without overheads. The plants were often below the top level of the brash, but with ideal growing conditions of shelter, moisture and humus, they generally grew well in the first year and this

coupled with the settling of the brash made most of them clearly visible at the end of the first growing season.

Drainage

Essential main drains should be clean before felling commences and blockages at crossings of extraction routes should be cleaned out by the Timber Merchant during extraction or by Forest staff immediately after extraction. On most sites, it is considered that main and subsidiary drains can still function with brash over them for about five years; in that time, the brash should have rotted enough and the new crop should be tall enough to place the debris between the rows of trees, and full maintenance of drains has been delayed until this stage is reached. Planting on the highest spots available can materially assist the trees during this period. This method of replanting may not be suitable for very wet areas.

Weed Control

Bramble and other woody weed growth, which is sufficiently strong under the old crop to be likely to affect the new crop, should be treated by chemical spraying before felling commences; some 100 acres have already been treated in this way using 5 pints of Emulsifiable 50% 2, 4, 5-T, Ester (5 lbs. acid per gallon) in 15 gallons of water per acre (3 pints for bramble) and spraying the chemical with a Mistblower. This method would be recommended for *any* replanting, but is particularly suitable when the brash is not going to be cleared. Clean forest floors, or areas chemically treated before felling, are not likely to become infested with weeds during the first year after planting, but edges and open patches may already have some weeds present and these should be treated with 50% 2, 4, 5-T or a mixture of 2, 4-D+2, 4, 5-T (3 lbs. acid per gallon) at the rate of $2\frac{1}{2}$ pints or $1\frac{3}{4}$ pints respectively in 15 gallons of water per acre, using the Mistblower and applying the chemical in August. The Mistblower should be directed to put as little chemical as possible on the young trees. Chemical or hand weeding can be repeated as necessary until the crop is established but experience to date indicates that little chemical or hand treatment should be necessary. Some three-year-old plantations have needed only about one sixteenth of the area weeded at a total cost to date of about £10 per acre on these patches. The most troublesome areas are likely to be sites which have suffered from sporadic windblow, or Larch and Pine stands, in which weeds have become established, but these can be treated chemically immediately before felling.

Size of Coup

It will already be apparent from the comments above that the time taken to plant the area is a greater management factor than weeding, etc. Sitka spruce and pine sites are the most expensive to plant and progress may be limited to 300 trees per man day, and this factor must be taken into account when determining the size of each coup in each working block in relation to the staff available for replanting. Similarly, the likely rate of progress of the Timber Merchant must be considered in determining the acreage of clear felling by any one merchant in a particular year. The area of Norway spruce to be felled at a time which coincides with the Christmas tree market can be even more critical.

Cold Storage of Plants

The management problems of progress by the Timber Merchant and the rate of replanting can now be reduced to a large extent by placing some of the

transplants in a cold store in February so that planting can, if necessary, be delayed until moist periods in May and early June. This method has been used successfully during the 1963 season and could be particularly useful for Norway spruce areas, where as indicated earlier, the lateness of felling for the Christmas tree market can result in needlefall being held back until May or June. Planting at this time makes it easier to see any natural regeneration and this can save a considerable number of plants particularly on the edge of stands.

Mechanical Chopping of Brash

It is understood that brash of pine and some spruce has been treated with a mechanical chopper, at a cost of about £5 10s. 0d. per acre and that the results have been good on slopes up to about 1 in 15 and on sites where the stumps are low. This method should give the same or better results than planting direct through the brash, but it is unlikely to be possible on steep sites and would probably be more expensive for larch and Norway spruce.

Notes of Work Done and Results Achieved to Date

The areas replanted at Cynwyd and Goror forests include the following:—

European larch: 180 acres have been under-planted between 1942 and 1962 and this is the species under which the methods referred to above have been gradually developed.

Japanese larch: 42 acres of 35-year-old larch was reduced to 35 trees per acre and under-planted in 1963 following the chemical treatment of the bramble and thinning in the Summer and Autumn of 1962. An allowance of only 2/- per 100 plants was necessary for the hindrance of the brash.

Scots pine: Was under-planted with *Abies grandis* on 30 acres in 1961 and 63.

Norway spruce: 67 acres, 37 years old was replaced by Sitka spruce in 1961 and 1962 (low quality crops planted on sites which were too high and exposed and yet which were capable of producing Quality Class III S.S.). 4/- per 100 trees was allowed for the hindrance of brash.

Sitka spruce: 55 acres, 37 years old replanted in 1961, 1962 and 1963 with Sitka spruce; some of this area was windblown. 12/- per 100 trees was allowed for the hindrance of the brash.

Douglas fir: Some 10 acres, 36 years old, has suffered windblow in the gale of 15th and 16th December, 1962 and will be replanted in 1964. Site inspection indicates that this brash will be slightly easier than Sitka spruce.

In general, bigger plants were used than would be feasible on most exposed sites if lop and top had been completely cleared. Selected 1+1 stocks are preferred. Growth to date has been good, with moist soil conditions even in a dry spring.

Survival has been good, and beating up to 100% has been done in Year One, partly because it was considered desirable to walk the whole area to free trees from overhanging brash. Apart from this annual visit in Year One and possibly Year Two, it is desirable to walk the area as little as possible, since brash can be kicked inadvertently onto the trees. Beating up will now be restricted to losses over 20%, if this occurs.

Control of hares, rabbits, sheep, etc. is important, but less weedgrowth should result in less vermin. Since brash restricts the activities of hawks etc., voles could spread from adjoining rides or grass banks; break-back traps could be used to determine the density of population in these rides or banks in the autumn before planting, and poison used to reduce the number of voles. (Details from Research Branch). Some damage to leaders has occurred with

resultant forking due to brash, hares and blackgame. Singling of leaders at about Year Five may be desirable.

Provisional costings indicate the following establishment costs per acre excluding draining, fencing and protection:—

	Labour			*Materials*			*Total*		
	£	*s.*	*d.*	£	*s.*	*d.*	£	*s.*	*d.*
Planting through *S.S. brash* at £1/100 plants	14	0	0	—			14	0	0
SS 1+1, Welsh Intra F.C. Price	—			7	0	0	7	0	0
BU with 150 plants?	1	10	0	1	10	0	3	0	0
Weed and Spray chemicals, prune	10	0	0	1	10	0	11	10	0
	25	10	0	10	0	0	35	10	0
Labour and Supervisory Overheads say							14	10	0
						Grand total	50	0	0
Planting through *NS brash* at 12/-/100 plants	8	8	0	—			8	8	0
Other Common items as above	11	10	0	10	0	0	21	10	0
	19	18	0	10	0	0	29	18	0
Labour and Supervisory Overheads say							12	2	0
						Grand total	42	0	0

Allowing too much time between felling and replanting would increase the risk of weed competition and the loss of one year's growth would cost, say, one year's m.a.i. of 160 H.ft. × 1/3d/H.ft. = £10 per acre.

The sites used to date have an annual rainfall of between 35 and 50 inches with a period of spring drought in most years; soils are peat of varying depth (6-12 in.) over clay or are shaley loams. Slopes vary from fairly steep to nearly flat. Variations in rainfall, soil or slope do not appear to have affected the rate of breakdown of brash in the last three years.

For fire danger, the best safety factor, perhaps, is to plan the size of the clear felling area so that the danger is restricted in any one block of the Forest and not to fell an adjoining area for, say, 7 years. It is considered that scattered brash from this method is less combustible than dead weedgrowth on a cleared area; a close watch for the spread of weedgrowth into the brash on dangerous boundaries is recommended and if this occurs, brash should then be moved back from the boundary or public footpaths and placed between the rows of trees at least ½ chain from the edge. A balance should be struck between the help given by the brash for quick crop establishment and suppression of weedgrowth as against the possible temporary increase in fire danger.

Plants were dipped in D.D.T. solution except on sites where there was no evidence of Pine weevil; all areas were inspected for damage and plans were made for follow up with spraying of D.D.T., but this has not been required to date.

Conclusions

It is considered that this method of planting direct through conifer brash shows advantages which outweigh the initial difficulty of planting. The programme should be arranged so that planting is carried out as soon as possible after felling; allowing only enough time for needlefall with all species (except Norway spruce when Christmas tree sales are an important factor).

It is realised that this method has been tried on immature stands only, but the higher volume of saw timber stands will come from so few trees relatively that the lop and top should not make this method impracticable. So many of our high-volume-producing and short-rotation species are on steep sites that these would be unsuitable for mechanical methods of ground preparation; full trials of this method are recommended to gain experience of management and silvicultural problems before large-scale felling of saw timber crops commences.

SEASON OF PLANTING

By
MAURICE NIMMO
District Officer, Research Branch

Our knowledge of the right season at which to plant is of course based on experience—centuries of it. In our maritime climate with (normally!) considerable periods of open weather throughout the winter, we have often a good deal of freedom of choice and the question is not so sharply critical as it is in other countries; in fact it has not been a very active subject of research. Possibly it has not been active enough.

Broadly speaking, experiments on season of planting can be of two kinds (i) intensive work under closely controlled site conditions, with very frequent intervals of planting, and careful observations on climatic and soil conditions. (ii) a more generalised approach, with wider intervals between planting times, "normal" planting conditions, and little study of the weather and soil conditions in relation to success and failure. Most of our experiments have been of the latter type. It is a purely empirical approach, and tells one little about why certain things happen. However, if repeated frequently enough, such experiments may present a reasonably clear picture of the hazard to which trees are exposed when planted at a particular season.

The British climate is so incredibly variable, however, that it would be very difficult indeed to carry out sufficient experiments to obtain a really satisfactory sample but, nevertheless, it has been thought worthwhile to present what results there are, unsatisfactory as the evidence may be.

It will perhaps be most convenient to consider first what results have been obtained in experiments on individual species before going on to a general discussion of the whole problem. The data for all our main experiments are summarised in Table 3 on page 86 and Figures 1 and 2. All these trials were located in mineral soils in areas of moderate rainfall and it will be seen that because they deal with exacting species or difficult sites, the losses were decidedly high.

In Scotland and Wales a little work was done with Sitka spruce on deep peat in high rainfall areas, the results suggesting that, between September and May, planting date had very little effect on survival rates—which were generally high; but the supporting data were rather weak and, in any case, the site conditions, with ample water supply almost all the time, were not representative of the country as a whole.

Figure 1

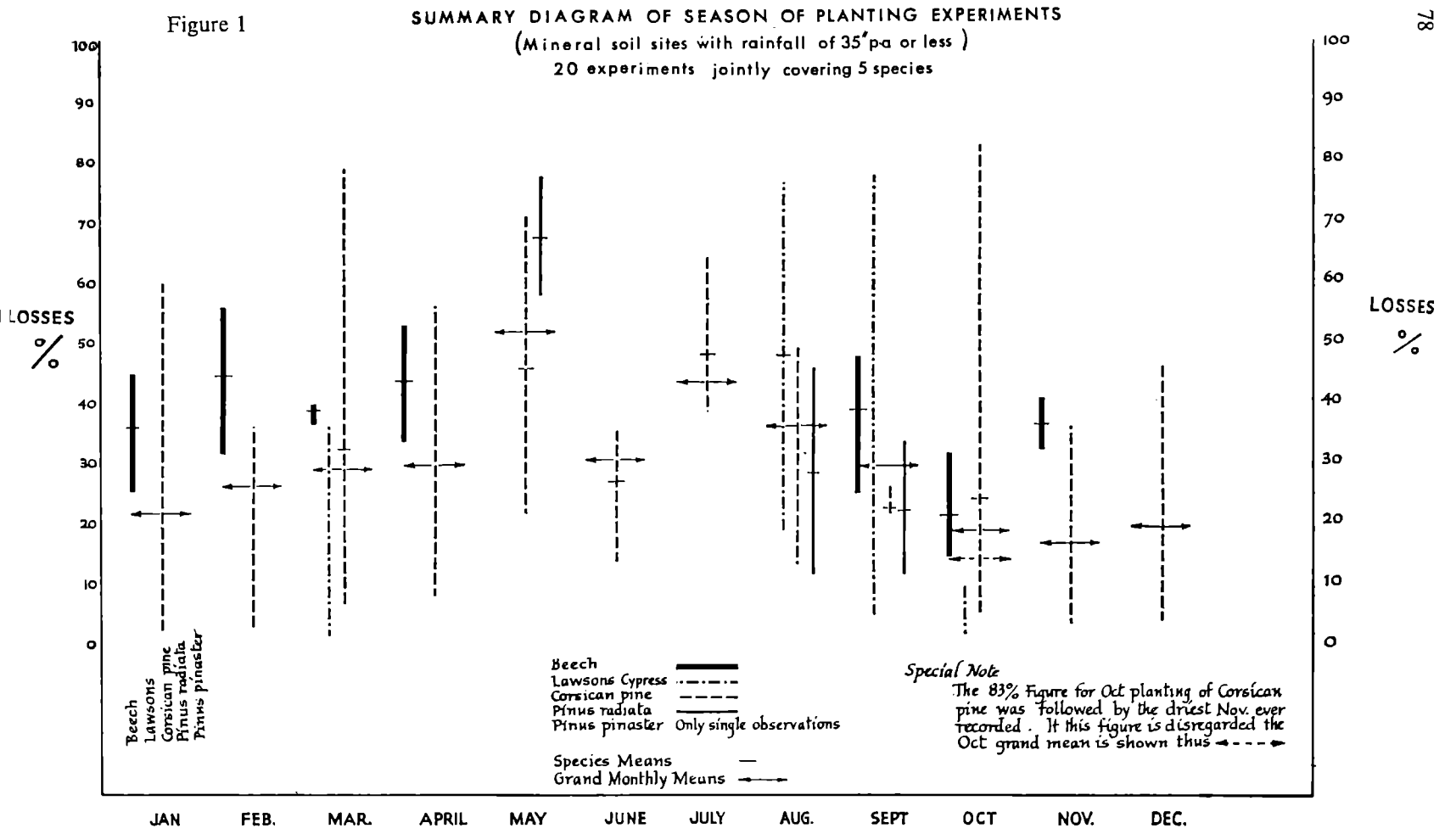
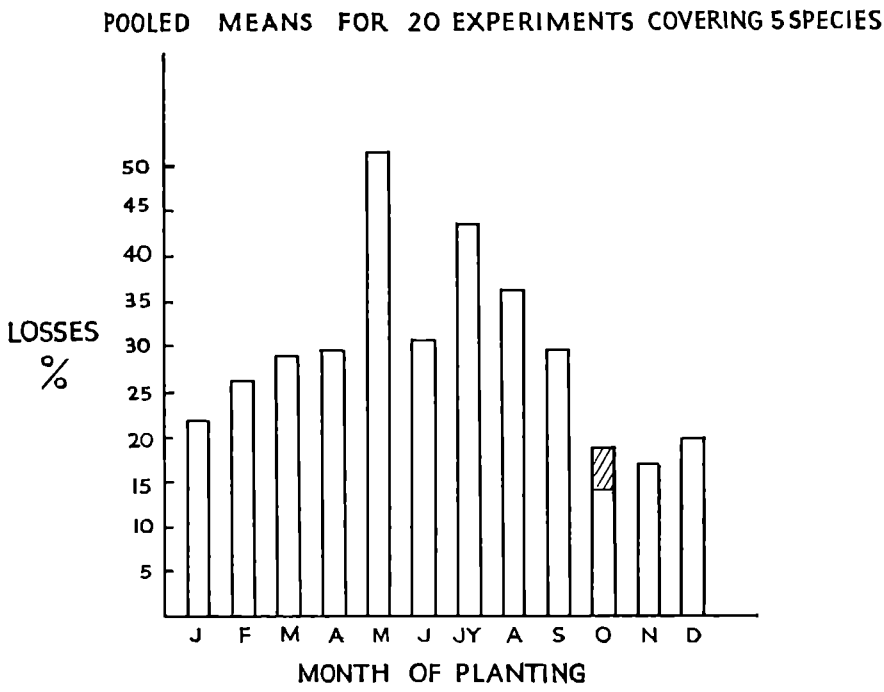

SUMMARY DIAGRAM OF SEASON OF PLANTING EXPERIMENTS
(Mineral soil sites with rainfall of 35" p.a or less)
20 experiments jointly covering 5 species
LOSSES %
100
90
80
70
60
50
40
30
20
10
0
Beech
Lawsons
Corsican pine
Pinus radiata
Pinus pinaster
Beech
Lawsons Cypress
Corsican pine
Pinus radiata
Pinus pinaster Only single observations
Species Means
Grand Monthly Means
Special Note
The 83% Figure for Oct planting of Corsican pine was followed by the driest Nov. ever recorded . If this figure is disregarded the Oct grand mean is shown thus
JAN
FEB.
MAR.
APRIL
MAY
JUNE
JULY
AUG.
SEPT
OCT
NOV.
DEC.

Figure 2



I. Review of Experimental Results

(i) Corsican Pine

This species, notoriously subject to high losses on planting, has received most attention, being included in 11 experiments—the earliest laid down as long ago as 1922. The first six were described in Research Branch Circular No. 3 (Forestry Commission 1936), but for the purposes of this report all eleven are considered, and summarised in Table 3 and Figs. 1 and 2.

At first glance, the losses for this species seem to show little definite pattern over the seasons, but on closer inspection it will be seen that this is mainly due to the effect of one most unusually high loss of 83% in the October planting at Wareham experiment 80, 1945–46. Meteorological records show that this particular planting date was followed by the driest November ever recorded. If we discount this figure, as something of a freak, we find a clearer pattern of survival rates with season, although there are still many inconsistencies.

October has given very good survivals. On this evidence there seems little to choose between any of the months, November, December, January and February, which if not outstandingly good have at least not shown major disasters. There is a strong suggestion here that they are better than the spring months of March and April. One's guess would be that suitable weather and soil conditions in October would best suit this difficult species.

(ii) Pinus radiata and Pinus pinaster.

With these two difficult species our evidence is not strong (2 experiments with *P. radiata* and 1 with *P. pinaster*) and amounts to no more than a demonstration that reasonable survival can be obtained by planting in late summer and early autumn (early September to late October). At Wareham, however, beating up some experiments with these species between December and February gave heavy losses over several years. The single March planting in our experiments with these species gave good results, but it is a very risky month for droughts and drying winds and another year's results could easily be very poor.

(iii) Lawson cypress

The experiments with this species were repeated over a period of three years and it is unfortunate that droughts and periods of frost made it impossible to lift and plant on the same dates in each of the three seasons. Even so, it is obvious that August and September plantings are liable to very heavy losses, whilst October gave very good results. No reliance can be placed on the one season's results for January, February, April or November, but the three seasons' results for March planting suggest that this month would usually be fairly good. It is interesting to note that these results are totally different from those obtained in Danish work with the same species, planted under optimum conditions (Bornebusch 1939) which showed August to be one of the best months.

(iv) Beech

On woodland sites, beech has not proved a troublesome species, but on chalk downland it has often shown very heavy losses, and, for this reason, three years' work on quite a large scale was carried out at Queen Elizabeth Forest in the years 1938 to 1941. Owing to drought in the nursery at the time of lifting, only one series could be planted in August, but otherwise the experiments were quite satisfactory, though the failures were on the high side even for this difficult site. For this species, and under these site conditions, October gave much the best result. Very high losses were experienced in both August and April; there was little to choose between the other months.

(v) Douglas fir

In Britain there is very little experimental evidence on this species but, because it has proved to be difficult, many notes and observations have been made on practical scale plantings and there is considerable agreement on a number of points.

Belgian experience (Galoux 1955), gained from 45 different plantings—involving 164,000 trees in the two years 1953 and 1954, gave very irregular results but indicated that the two best periods were from late August to early December and from early April to Mid-May; also that March results were found to be much inferior to those in April. Two other points from the Belgian experiments were that partial overhead shade reduced losses by 20% and that there was a marked relation between the number of days between lifting and planting and the rate of survival. Forestry Commission experience is exactly the same on both these points, although different conclusions have been reached on choice of planting dates. British experience suggests that high losses are likely in plantings made before the end of September, and there is a good deal of evidence that the period from late November until mid-March is best avoided in favour of late planting from late March till the end of April or even early May if conditions are damp. There is some evidence that date of planting is less critical in Scotland than in England and Wales, possibly because there is less risk of really dry soil conditions. There is ample evidence all over Britain that

Douglas fir is particularly subject to root rot in cold wet soils. In this respect drainage is most important and sites with badly impeded soils should be avoided.

(vi) Sitka Spruce and Norway Spruce

It may seem strange that with these two widely used spruces there is remarkably little experimental evidence concerning season of planting, but the fact is they are both less exacting in this respect than, say, Douglas fir or Corsican pine, and consequently there has been no pressing need for research work on them. As mentioned at the beginning of this report, one or two experiments carried out in Scotland and Wales on deep peats suggested that between October and April the date of planting had very little effect on survival, a conclusion largely supported by many notes and observations from forest staff all over the country.

Taking the country as a whole, there is no doubt that there has been more late planting than early planting of spruces because there has been, for many years, a generally accepted ruling that the planting order for species should be larches first, pines next and spruces last; this order of precedence being based on time of commencement of root and shoot growth, coupled with the likelihood of damage to opened buds during transit and handling of plants. There seems no reason to doubt that on favourable sites spruces would give good results with October planting but that in practice it may often be wiser to use this favourable month for more difficult species. It must be remembered, however, that Sitka spruce is often planted on sites subject to such severe winter conditions that planting is best delayed till spring.

(vii) Larches

Although there is no experimental evidence on season of planting larches in Britain, they are species well represented in other research work and are often subject to heavy losses on planting. The general ruling that they should be planted before pines and spruces was well founded because both root and shoot development start earlier than with any other commonly planted trees.

It should be noted, however, that larches grow very late into the autumn and there is a risk of die-back of leading shoots if moved before the late growth has hardened off. Unusually good results have sometimes been obtained with spring planting, in good damp conditions, even after the plants are quite green with opening buds, provided the roots are kept moist. This is possible only because all the first buds to expand belong to short shoots and the main growing points do not develop until later. From general experience, it seems that the main causes of the rather frequent severe losses are not usually directly connected with time of planting but more closely with the characteristics of the species as transplants coupled with the fact—(well illustrated in some early experiments at Thetford)—that larches are extremely subject to drought damage.

In the nursery larches are particularly strong growers and, after lifting, they are very liable to be unbalanced as regards root/shoot ratio. This is often the case even with 1 + 1's while, with older plants, the root system is nearly always quite inadequate. Thus there exists an unfortunate dombination of factors, i.e., a plant likely to have a root system insufficient for its shoot development combined with a natural tendency to suffer from droughts and, particularly in the case of Japanese larch, often planted in extremely exposed situations.

Combined Evidence on the Above Species

If we lump the evidence for all the species (see Table 3 and Figures 1 and 2), a somewhat clearer pattern emerges. It does appear that the late autumn months

of October and November have a great advantage, over the period May to September and the suggestion that October and November are better than the spring months of March and April is quite strong. This is perhaps all that should be said, and the extreme variability of the results is well shown in Figure 1.

II. Influence of Weather Conditions and Soil Temperature

The decidedly inconsistent results in many of our seasons of planting experiments seem to lend support to that rather unkind but well known saying —"The only certainty about the weather in Britain is that you can never rely on it!"—Nevertheless there are certain well marked patterns which are of importance in considering season of planting.

(i) Rainfall

Although Britain has a much more evenly distributed annual rainfall than many parts of the world, drought remains the greatest hazard to newly planted trees over most parts of the country.

The following Table gives the monthly means in inches for the period 1916–1950. (Met. Office—Rainfall Averages 1916–1950).

RAINFALL TABLE — Table 1

	England	*Scotland*	*Wales*	*Means*
January ..	3·35	5·66	5·83	4·95
February ..	2·44	3·93	4·08	3·48
March ..	2·13	3·30	3·34	2·92
April ..	2·30	3·30	3·18	2·93
May ..	2·44	3·20	3·34	2·99
June ..	2·10	3·19	3·07	2·79
July ..	3·05	4·19	4·13	3·79
August ..	3·04	4·50	4·56	4·03
September ..	2·84	4·71	4·45	4·00
October ..	3·38	5·81	5·78	4·99
November ..	3·55	5·29	5·67	4·84
December ..	3·21	5·29	5·56	4·69
Totals: ..	33·83	52·37	52·99	46·40

From this, it will be seen that while June is the driest month in all three countries there is very little to choose between March, April, May and June and the whole of this period is relatively dry.

The greatest risk to newly planted trees is a period of drought when the new shoots are just beginning to grow but the roots are not yet much developed. This critical time varies with the species and latitude from early March to late May. April is perhaps the worst risk for lack of rain while drying winds are more common in March. (See Section (iii)—'Wind'). From October to January, lack of rain is seldom troublesome! Where heavy winter snow is often experienced, spring planting is to be preferred.

(ii) Temperature

The effect of low temperature can be of very great importance both above and below ground level. Periods of severe frost during the winter,

especially if combined with freezing winds, can kill both foliage and shoots of newly planted trees, and, with small plants, frost-lift may cause severe losses. Therefore, on exposed and elevated sites, especially in the north, it is usually best to delay planting till the spring, but on more normal sites, particularly with difficult species, earth temperatures are much in favour of autumn planting.

The following table—(Met. Office—Soil and Earth Temperatures 1959) gives the monthly means for earth temperatures at 4 ins., 8 ins. and 1 ft. for southern England:—

EARTH TEMPERATURE TABLE

Monthly Means Degrees Fahrenheit Table 2

	Jan.	*Feb.*	*Mar.*	*Apr.*	*May*	*June*	*July*	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
4 in.	38·3	38·4	41·9	48·7	55·9	62·9	65·6	64·4	59·1	51·0	44·2	40·0
8 in.	38·9	39·0	42·4	48·6	55·6	62·5	65·4	64·5	59·9	51·9	45·2	40·7
1 ft.	39·6	40·2	43·2	48·2	54·2	60·6	64·3	63·6	59·3	53·2	45·6	41·5

The roots of newly planted trees are normally at a depth between 4 ins. and 8 ins. and, taking the generally accepted figure of 42°F as the lowest temperature at which roots are usually active, (Met. Office—Glossary 1961), it will be seen that there can be very little activity between December and late March but the soil temperature is well up in October and still reasonable in November.

No doubt it is this combination of warm soil and adequate rainfall that makes October such a good month for planting. April is also good as regards soil temperature but is more subject to droughts. Spring frosts often cause losses but these are not usually correlated with date of planting.

(iii) Wind

The amount of damage that may be caused to newly planted trees by prolonged periods of strong wind is often underestimated and some of the worst losses of all have occurred on exposed sites following several days of freezing winds. One-year seedlings are particularly subject to damage by wind-frosts, perhaps because they have no core of older wood to give them greater resistance.

Another important aspect of wind damage is the loosening of the plants, especially in the case of furrow-top planting, thus rendering them more liable to the effects of drought—particularly if large plants have been used.

For these reasons, spring planting is rather safer than either autumn or mid-winter work on high elevation or unusually exposed sites, but in less exposed places planting in autumn is likely to be decidedly better than in mid-winter because of the higher soil temperature.

The over-ruling effect of moisture and temperature condition is well illustrated by the following example.

In Canada, at Kananaskis Experimental Station, Ackerman and Johnson carried out weekly planting of *Picea glauca* throughout the frost-free period (i.e., May to October), repeating the experiment for the three years 1952–54.

The results showed a marked advantage in Spring planting both as regards survival and height growth; the mean losses for the three years increasing from a May average of 3·0% to an October one of 19·6%. Annual variation was considerable—for example, the 1952 mean for October losses was 8·0% while that for the same month in 1954 was 37·2%.

On the face of it, these results seem surprising, considering the general success of October planting in Britain, but a study of the Kananaskis rainfall and temperature patterns provides the explanation, May and June being wet months, while there is a marked fall-off in rainfall towards the autumn with much the lowest figure occurring in October. During the three years of the study May averaged 3·15 inches, June 6·0 inches and October 0·93 inches.

Temperature figures show that by October the soil may already be at too low a temperature for root activity and it is most interesting to see that the highest losses of all (37·2% in October 1954) coincided with the lowest soil temperature (38·1°F) as against 47·0°F for October 1952 when the losses were only 8%.

Thus, in Canada, as in Britain, the best results coincide with times of maximum soil moisture coupled with soil temperatures favourable to root growth.

III. General Conclusions

The British climate being what it is, there can be no completely safe period during which good results can be guaranteed and, in any case, the size of planting programmes usually makes planting in any particular short spell quite out of the question. There are, however, certain broad principles that can be followed to at least avoid too frequent cases of very heavy losses. It is good to remember that the vagaries of weather do work both ways, and although an untimely drought may cause havoc, likewise an unexpected wet spell has saved the situation many times when, according to averages, high losses seemed inevitable.

(i) If the data from experiments (summarised in Table 3 and Figures 1 and 2) are studied, it will be seen that October and November gave the best overall results and that, if the one abnormal figure of 83% is discounted, October is slightly the better of these two months.

(ii) From December to April, there was a gradual increase in losses, followed by very poor survival in May. June is poorly represented in the experiments, so one cannot be too sure of the validity of the relatively low figure for that month.

(iii) July, August and September all give high losses, but with a gradual decrease in that order. Although one or two good results have been obtained, it is obvious that the risks are too great for any large scale summer planting in Britain.

(iv) Long term averages for both rainfall and temperature give good support to the probable success of October and November planting and, in addition, autumn planting gives a good chance for the soil to settle closely round the tree roots before winter sets in, holding the plant more firmly and reducing the chances of drying out, but there are several points to be stressed in favour of spring planting in certain circumstances:—

(1) Areas of extreme exposure due to high elevation or unusual local topography.

(2) Places subject to very severe winters with the probability of deep snow, freezing winds and many gales.

(3) If seedlings or very small plants have to be used in areas known to be subject to severe frost lift.

Under these conditions, most often met with in Scotland, North England and North Wales, it is best to delay planting until spring to avoid the trees being "on the hill" during the most severe weather. In milder districts exacting species should be planted in autumn,

preferably in October and not later than November; while the less sensitive species can take their chance whenever planting may be possible.

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PLANT LOSSES (%) IN RELATION TO MONTH OF PLANTING
(Data from Forestry Commission Research Branch Experiments) Table 3

		Replications	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Corsican pine														
Culbin 1922–23	1 acre plots uniform ground	1	7·6	5·8	8·8	8·2	30·7	13·0	64·6	49·2	20·8	11·4	8·4	17·4
,, 23–24		1	19·1	2·0	10·7	15·5	20·9	35·1	38·0	34·4	26·9	4·7	16·8	6·4
,, 24–25		1	1·6	7·0	6·0	7·4	38·0	33·0	41·6	12·6	21·8	18·8	9·4	5·6
Cannock 1922–23			14·0	29·0	32·0	56·0	71·0	—	—	—	—	—	—	23·0
Thetford 1923–24		1	14·0	36·0	62·0	52·0	46·0	—	—	—	—	—	36·0	35·0
,, 24–25		1	16·0	22·0	20·0	27·0	70·0	—	—	—	—	—	—	16·0
,, 25–26		1	4·0	8·0	18·0	32·0	—	—	—	—	21·0	6·0	3·0	—
Allerston 1923–24		1	26·0	24·0	22·0	23·0	43·0	—	—	—	—	—	—	—
Wareham 67 1943–44		3	18·0	22·0	79·0	—	—	—	—	—	—	13·0	3·0	3·0
,, 80 1945–46		5	37·0	23·0	61·0	—	—	—	—	—	—	83·0*	28·0	46·0
,, 84 1946–47		6	60·0	—	35·0	—	—	—	—	—	—	32·0	18·0	25·0
	Total		217·3	178·8	354·5	221·1	319·6	81·1	144·2	96·2	90·5	168·85	122·6	177·4
	Means		19·8	17·9	32·2	27·6	45·7	27·0	48·1	32·1	22·6	24·1:14·3	15·3	19·7
Lawson cypress														
Wareham 31 1937–38		5	0·0	—	0·0	—	—	—	—	18·0	4·0	9·5	—	—
,, 47 1939–40		5	—	54·5	36·5	—	—	—	—	76·5	77·8	8·0	—	—
,, 54 1940–41		5	—	—	4·0	4·0	—	—	—	—	48·0	1·0	0·0	—
	Total				40·5					94·5	129·8	18·5		
	Means		0·0	54·5	13·5	4·0				47·8	43·3	6·2	0·0	
Beech														
Queen Elizabeth 27 1938–39		4	25·0	31·0	40·0	53·0	—	—	—	49·0	24·5	14·0	32·0	—
,, ,, 37 1939–40		4	45·0	47·0	36·0	45·0	—	—	—	—	47·5	18·5	41·0	—
,, ,, 41 1940–41		4	38·0	56·0	40·0	33·0	—	—	—	—	44·5	31·5	—	—
	Total		108·0	134·0	116·0	131·0					116·5	64·0	73·0	
	Means		36·0	44·7	38·7	43·7				49·0	38·8	21·3	36·5	
Pinus radiata														
Wareham 126 1958		2	—	—	—	—	77·4	40·7	29·8	11·0	11·0	—	—	—
Croft Pascoe 16 1956		4	—	—	21·9	—	57·1	—	—	45·5	33·6	21·2	—	—
	Total						134·5			56·5	44·6			
	Means				21·9		67·2	40·7	29·8	28·2	22·3	21·2		
Pinus pinaster														
Croft Pascoe 16 1956		4	—	—	17·9	—	63·3	—	—	29·7	3·1	11·0	—	—
	Total		325·3	367·3	550·8	356·1	517·4	121·8	174·0	325·9	384·5	283·6	195·6	177·4
	Means		21·7	26·2	29·0	29·6	51·7	30·4	43·5 (Discounting Oct.1945)	36·2	29·6	18·9 (200·6) (14·3)	16·9	19·7

* This planting was followed by the driest November ever recorded! ! (1945).
The November planting was late and caught the December rains.

PLANTING METHODS FOR PEAT AFFORESTATION

By

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The development of ploughs for draining and providing turf for planting of peat is a well-known story. Since the last war, the two most common types of plough used have been Cuthbertson's Single Mould Board Plough (type F) and the Double Mould Board Plough (type P). These have been used both singly and in various combinations, depending on the degree of drainage required. The former has usually tried to fulfil a double function of providing a drain and a ridge of turf for planting, whereas the double mould board plough draws a shallower furrow of little drainage value and provides two thinner planting ridges. These ridges are commonly planted by a simple notch method in the centre or side of the ridge. In some regions, e.g. Northern Ireland and North East England, a semi-circular spade is used to remove a plug and the plant is inserted into the hole so formed, the plug being replaced. In all cases the trees' roots are placed in the vegetation "sandwich" between the ground surface and the inverted turf.

The Single Mould Board Cuthbertson Plough produces a fresh turf of approximately 12 to 18 inches in height, through which it is not possible for the planted trees' roots to reach the sandwich layer via a simple notch. Therefore, either the generally recognised short-term benefits of getting the roots into the "sandwich" have to be forgone, or alternatively, the high turf must be reduced at the planting spot prior to planting. This is done in the so-called "Step-method" of planting which enables the tree-roots to reach the vegetation sandwich and incidentally affords the tree some protection against blasting in its first few years, and has also been found in some cases to be safer against blackgame damage.

The most popular tool for planting peat is a well-sharpened garden spade and with it, two or three strokes are required to make the step, and a further two strokes to remove a wedge of turf for insertion of the plant. The cost of this method is therefore considerably higher than a simple notch and the extra time required has often led to "stepping" being done as a separate operation before the onset of a large planting programme. In Northern Ireland, a rotary disc attachment for the single mould board plough has been developed to reduce the high turf as it is ploughed, and some efforts to develop a cutter bar for the same purpose have been made in this country. However, neither of these plough attachments have received general acceptance and "stepping" by hand with a garden spade continues.

In 1960 Mr. Meschechok and Mr. Øien of the Norwegian Forest Research Institute visited various afforestation experiments and presented the Research Branch with a new Norwegian planting spade which is used successfully in Norway on ploughed deep sphagnum peats. In essence, the tool has the shape of a large garden spade with a flange at each vertical edge. These in theory enable it to cut three sides of a block of peat from a plough ridge at one blow. By leverage, the block of peat is removed and the second insertion of the spade in the step so formed makes the notch in which the tree is planted. The advantage of the spade lies, therefore, in the reduced number of strokes required to prepare the planting spot, viz. two strokes instead of four or five.

As preliminary trials by Research Foresters and Conservancy Staff were encouraging, twelve additional spades were purchased for more extensive trials

in the 1962 and 63 planting seasons. The spades, together with detailed instructions, were sent to the following Conservancies: North, West and South Scotland and South Wales. The Research Staff of these areas also made further trials.

The trials were mainly qualitative and although there is no record of the times for which the spades were used, the almost universally unfavourable reports subsequently received suggested that more critical trials are not required.

Summary of Reports on the Norwegian Spade

The cutting edges are approximately double in length compared to the garden spade, hence absolute sharpness is paramount and more frequent maintenance is required. On fibrous peat, great force is required to drive the spade to an adequate depth with one stroke. Repeated strokes would invalidate its main advantage. On the wettest fibrous peats, the cutting edges tend to become clogged and require frequent cleaning, and the peat block in the spade is often unwilling to fall free. This spade is a very specialised tool requiring a complete absence of stones and mineral soil, and peat of uniformly favourable texture, in contrast to the universally applicable garden spade. Several users described it as too heavy, clumsy and badly balanced. These defects might not have been voiced had the tool been suited to the conditions. In conclusion, the Norwegian planting spade's advantages are confined to the cutting of steps (boxes) in deep amorphous peat, and where this is done as an operation separated in time from planting, the spade may have a use.

Future Planting Methods

Ploughing and drainage layout has recently come under a detailed review by the Research Branch. One of the results has been a clearer differentiation between drainage and cultivation, and on peat ground a recommendation is made that planting turf should be provided almost wholly by the double mould board plough. Drains should be recognised *ab initio*, and be made with a single mould board plough or a deepened version of it. Trees should not be planted within 5 ft. of the drain edge, that is to say that the turf from the drain will not be planted. If this recommendation gains general acceptance, the need for step planting will obviously decrease.

PROTECTION OF POPLAR FROM DEER IN WYRE FOREST

By
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Because of the high cost of making and fitting stake and rabbit netting guards to protect poplar plants from the rubbing attacks of fallow deer, a small trial using old polythene bags was started a year ago.

As the results are encouraging—both trees and bags have come through unharmed—it is thought that the information may be of value to other foresters who might like to carry out small trials of their own before embarking wholeheartedly on this type of protection.

Polythene bags, punctured but otherwise reasonably intact, are suitable and should be of heavy gauge material having dimensions 45 in. length by 24 in. width. This type of bag is in general use for transporting transplants from the nurseries.

Two stakes per tree are required and these do not need to be very stout, 2 in. top by 4 ft. in length are strong enough. They have to be driven in each side of the plant, (on the north-south line as a precaution against sun-scorch),

the distance apart being the width of the bag to be used, or just slightly less to make fitting easier.

The polythene bag to be fitted has to have a hole made in the centre of the bottom—this is best done by folding the bag lengthways and then snipping off the corner produced by the fold.

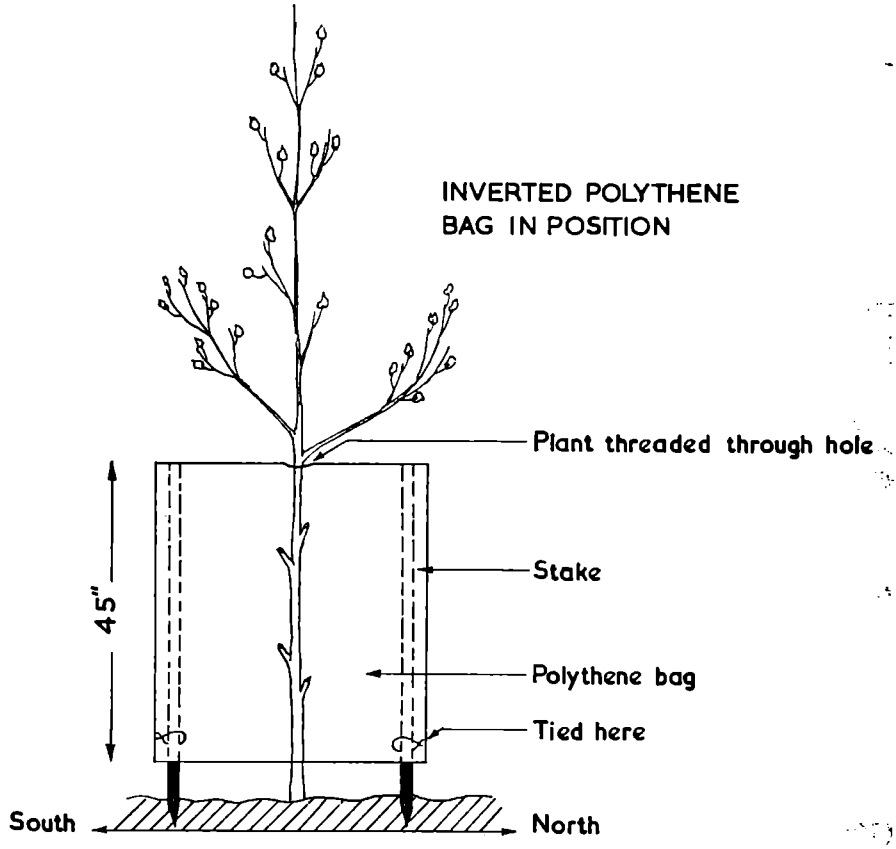
All is ready now to thread the tree through the hole, at the same time bringing the open end of the bag down over the stakes and finally securing it to the stakes with string.

If the poplar are growing vigorously they should become unattractive to deer as rubbing sticks in about 5 years, and it is reasonable to expect the bags to remain sound for the same period if untorn ones are used at the outset.

If replacement of a bag becomes necessary and it is not possible to fit it in the manner described above, it is suggested that two bags are cut open and wrapped with overlap round the stakes and securely tied to them, thus giving the tree the same protection as the original bag did.

Included in the trial were trees having the protection of only one stake which carried a strip of polythene, and this proved to be a deterrent to deer, but carrion crows ripped it to shreds!

Obviously the foregoing cannot be conclusive evidence that fallow deer will not set about the trees so guarded in the future. However, on past experience it is quite certain that the trees would have been attacked and severely damaged had no protection been given.



Protection of Poplar from Deer

A FRENCH APPROACH TO THE IMPROVEMENT OF WOODLANDS BY ENRICHMENT

A Translation of the French Forest Service Leaflet
Techniques de l'Enrichissement

By
H. L. EDLIN

TECHNIQUES OF ENRICHMENT

A Study by the Consultative Committee for Replanting

Foreword

By F. du Vignaux
Directeur Général des Eaux et Forêts

This note is a resumé of the conclusions recently reached by the Consultative Committee on Replanting, concerning one of the essential aspects of the technique of afforestation.

The Law of September, 1946, in setting up the National Forestry Fund, has brought into view the urgency of the work of reconstruction, and also its size. Problems of great diversity confront the professional foresters. Above all the replanter must often face unfavourable natural conditions, subject to sudden, often unforeseeable, changes. Though he must never under-estimate the risks of failure, he must never lose sight of the fact that afforestation has to be an economically viable operation, in terms of financial, economic, and social gains.

The intention of the Consultative Committee on Replanting, set up in 1951 by the Minister of Agriculture, is to make known those methods that appear to it, in the present state of knowledge, the most dependable, both from the point of view of low risk of failure, and from that of probable economic success. These studies do not pretend to deal fully with their subjects, since a large programme of experiments is under way, directed by the Forest Research Station at Nancy.

The Committee will no doubt have to revise one day, as an outcome of these experiments, some of the ideas that it is making public today. But those conclusions that it has already reached, make up at the present time a useful guide for replanters, both in the State forest service and on private estates.

One must beware of prescribing infallible methods, applicable in all places and to every circumstance. There is no ready-made technique of afforestation. Success, in this matter, always depends on the attention that the replanter gives to the countless factors that give to every site its peculiar character. This makes every essay in afforestation a fresh problem, depending for its solution on a devoted application of skill, always difficult.

This note will have achieved its purpose if it persuades all concerned that they must never neglect any of the factors involved, nor overlook the appropriate answers to each and every problem.

TECHNIQUES OF ENRICHMENT

(*Marginal Keynote:* The enrichment of existing woods has first priority in the plan of replanting, because of its economic merit. This is because its success is

favoured by the pre-existing forest conditions around it, and also because mixed stands are always better than purely coniferous ones).

Seventy per cent of our woods consist of broadleaved trees, but a high proportion of these woods give little saw timber or pulpwood. Moreover, the great majority of plantations approaching maturity consist of pine trees, and this situation cannot ensure a sustained yield from the forest. Hence the great urgency of enrichment, and of changes of species, in the scheme of economic replanting.

Though they are less spectacular than the work on bare land, and do not increase the total area under forest, enrichments of wooded country are certainly the most rational steps we can take. They make possible the progressive change of poor woodland to a *mixed stand, biologically and economically sound.*

This transformation is readily achieved thanks to the wooded character of the existing stand, however poor it may be. Experience shows that, even under the driest climates, the competition from the roots of trees or large shrubs is very largely offset by the protection that their shade gives to young forest trees. Also, that the herbs (and above all the grasses) and the low woody plants (heather is implied here—*Translator*) which grow on cleared land compete cruelly with young forest trees.

In a bad year, one can expect to get, below woodland shade, a "take" of over 70%; whereas on bare land nearby the failure may be virtually complete. (*Keynote:* But the methods to follow are not so simple as those used outside existing woods).

As against this, the methods used are not so simple as those used outside existing woods. They are far more flexible because of variations in both the nature and the amount of the cover; this is sometimes so irregular or poor that it does not give proper protection nor ensure reduced beating-up.

But even in the worst case, enrichment is more rewarding than the planting up of bare land, that is to say, land without trees or shrubs.
(*Keynote:* Methods vary with the amount of the cover and the species concerned in it).

This variation in the character of the existing stand that is to be enriched allows us to distinguish two groups of methods. On the one hand, the enrichment of partially stocked stands; on the other hand, the substitution of a full stocking of one type of trees by another full stocking composed of other, more valuable, species.

CHAPTER 1

THE ENRICHMENT OF BROADLEAVED STANDS

(*Keynote:* Above all, one must use conifers, though broadleaved trees must still play a part).

This involves the filling of the gaps in a more or less incomplete stand with species of economic value, usually conifers. This method resembles at times the planting of bare land, but every degree of variation can exist, according to the sizes of the gaps.

However, there is always some shelter or at the very least some lateral protection that helps the introduced species.

The resulting stocking will be a mixed one, by smaller or larger groups, wherein the original broadleaved trees play a sylvicultural role, though sometimes an economic one also.

1. Enrichment of Pure Coppice, or Coppice from which Valuable Timber Trees have been Removed

This concerns those coppices that, as a result of the nature of the soil, or of sustained mismanagement, can no longer supply, even after a period of rest, a worthwhile yield of firewood or, more important, pulpwood.

(a) Oak coppice (*Querius robur, Q. pubescens and Q. pyrenaica* (?)), of the West and South-West (of France), consisting of the rare slow growing strains, scattered amongst heaths and certain undershrubs (willows, alder, buckthorn, hawthorns, etc.).

(b) Ruined coppices made up, more or less entirely, of undershrubs, which often take the place of better species after forest fires, war damage, or the ravages of rabbits.

In both these cases, the value of the produce is just about nothing; and they never promise to form a full overhead cover on which the forester could work to prepare for the introduction of enrichment species.

One must therefore proceed to carry out an improvement operation by bands. This permits the use of machines that will, to greater or less degree, wipe out the roots and lessen accordingly future cull stems, as they work the soil. (*Keynote:* In pure coppices the process of enrichment is perhaps best achieved after a thorough clearance by bands.)

We will next distinguish two cases arising from the nature of soil and climate.

1. Sandy Soils in an Atlantic Climate

This concerns mainly the heaths of the West and South-West, which have a very consistent vegetation cover.

Bands two or three metres wide may be cleared by the "Landes Clearance Machine" (*debroussailleuse landaise*), followed by a harrow; or else they may be cleared by a rotavator. Then they are sown with Maritime pine (*Pinus pinaster*) seed.

These bands are separated by unworked bands of the same width.

2. Calcareous soils: sandy soils in a less-pronounced Atlantic climate

Clearance by hand, or for preference by machine, should only be done in strips of 1 metre or 1½ metres (3 to 4½ feet) wide. These will be separated by unworked strips of a width that will vary according to the density of the final stocking desired.

One will plant, at 1½ or 2 metres (4½ to 6 feet) apart along the strips, species that, in their youth, will stand a certain degree of shade; or even, where the climate is less sunny, shade-bearers. Black pine (*Pinus nigra*), Corsican pine, Weymouth pine, Douglas fir, Sitka spruce, or true cedar, according to the nature of the soil and the climate, and various silver firs to be mentioned later.

The treated areas must be carefully tended (1) and the intervening strips should be worked through more or less quickly according to the species used:

4 to 5 years for pines and Douglas fir.

6 to 8 years for true cedar and Sitka spruce.

15 to 20 years for silver firs.

(1) It is not possible to recommend with certainty the use of herbicides, which are still the subject of experiment; they may be used to restrict the growth of cull stems. (This was written in 1959—*Translator*).

II. Enrichment of Coppice-with-Standards Including Valuable Species but Also having Gaps

(*Keynote:* One only completes the natural regrowth where it is insufficient in quantity or quality.)

This method is essentially applicable to broadleaved woods having some economic value. Useful species must not be too scarce, and must show prospects of at least partial natural regeneration. Introductions will only be made in gaps that are not closely surrounded, and where natural seedlings are lacking.

The number of trees used is proportional to the width of the gaps, which will be gradually enlarged, according to the rate of development of the "cones of regeneration", which may be natural or artificial.

The choice of species likewise depends on the size of the gaps. Typical shade-bearing species such as European silver fir (*Abies alba*), *Abies nordmanniana*, and *Abies grandis*, may be used in narrow gaps amid tall stands. Species that are semi-shade-bearing, such as Douglas fir, Norway spruce, and true cedar are used in the wider gaps.

On deep rich, fresh, fertile soils, occasionally flooded or at the least having a fairly high water-table, one can consider, *in large gaps that will not quickly close in*, the use of quick growing hardwoods (Hybrid poplars) or trees of high timber value (Black walnut for example).

In all these instances, the number of trees introduced per acre is quite low, being 300 to 1,200 per hectare (120 to 480 per acre).

(*Keynote:* Close watch and maintenance are indispensable for many years).

Such tasks are relatively light, but they are quite unsuited to chance execution and still less to only casual oversight, with upkeep work on a haphazard basis. On the other hand, they are particularly applicable to fairly small private woodlands which are closely looked after by the owner or his skilled agent, and also to conveniently placed woods under professional forestry control.

However, precautions must always be taken to ensure that, by negligence or forgetfulness, the results of many years work are not put in jeopardy; for the works of improvement must be kept up for anything up to ten years.

In many establishments, there has been set up for this purpose, a working plan in which all the operations are carefully noted down, and provision is made for the automatic resumption of the periodic tasks.

Records kept at various levels of control (Conservancy, district, beat) will help to avoid any failures to take prompt action. Such failures are especially dangerous where the vegetation is vigorous, and where species with high demands on light have been used.

Examples: State Forest of Sainte-Geneviève, Inspection of Bar-le-Duc (Meuse). The introduction (since 1935) of silver fir and spruces in gaps and poor patches of a wood of valuable species has given remarkable results.

Private woodland of l'Artembouchet (Vosges); enrichment using various species over the past 40 years.

CHAPTER 2

THE SUBSTITUTION OF SPECIES

These methods consist of substituting, more or less progressively, species that have a much higher economic value for existing species that are of little interest either economically or silviculturally.

I. Substitution of Species in Coppice or Coppice-with-Standards by the Method of the Shelterwood Felling

1. General

This is really the conversion of stands which produce materials unsuited to modern needs, although their composition and density are fairly satisfactory, and their volume production is acceptable.

(*Keynote:* The substitution of species must be progressive....which rules out a clear felling or strip cutting....and also the use of light-demanding species. Broadleaved trees must not be entirely left out).

The work of substitution must be achieved progressively. It can be done by virtue of the shelter given by the existing stand, but without exposing the ground. So we must recall here two (actually three!) rules that must never be lost sight of under these woodland conditions.

(a) The ease of working offered by a clear cut or by strip working is an illusion. Sunshine stimulates the cover of herbaceous plants and these, together with useless adventitious tree stems, compete with and kill many of the newly introduced trees, despite the most arduous weeding.

(b) Light-demanders, and especially pines, must be entirely excluded from these enrichment plantings. They are so drawn up by the cover that they can never be saved in time, either by weeding or thinning.

(c) Substitution should never be complete, and *a certain proportion of broadleaved trees must always be maintained for silvicultural reasons.*

2. Technique

The method consists of planting below a "shelterwood felling"; after the felling and removal of the trees concerned in it.

It is largely used on the main plateau of the Jura, and its principles are very clear.

(*Keynote:* One carries out a "shelterwood felling" in a stand nearing maturity, and then one plants shade-bearing conifers).

(a) **Coppice-below-Standards**

Early removal of all big trees, and of those branching low down, is most important, since their later removal would cause most serious harm to the young trees.

On the other hand, one aims to leave poles and saplings which are tall and slender and have narrow crowns. These should be evenly spaced out and their form should lead to high quality timber later.

Timber stems arising from coppice stools should be reduced (to one per stool).

(b) **Simple Coppice**

Reserve from 800 to 1,200 stems per hectare (320 to 480 stems per acre) as evenly spaced out as possible, keeping only one per stool so as to form new high forest stems.

In both these instances, the coppice crop must be at its normal age for coppice rotation cutting, or not much beyond it.

In every case, the produce from the shelterwood cutting will be quite substantial, so that any loss of yield will be reduced to the minimum.

The new plantation will aim at filling the cleared spaces to the rate of 2,000 plants per hectare (800 to the acre) at the very maximum. (This is when no stems at all from the original stocking are found acceptable for the new mixed stand that it is desired to obtain). Only shade-bearers can be used.

Unplanted strips will be left at suitable intervals to allow of the cutting and removal of stems from the old cover, that is from the over-crop.

This over-crop protects the newly introduced young trees. It also checks the growth of adventitious plants; in particular the vigour of useless coppice shoots is lessened by the action of the young "stored" stems, which have been left on each stool. Weeding is therefore reduced.

(*Keynote:* Thereafter the cover is lightened by successive thinnings.)

Beating up operations will be pointless, for the natural regrowth of broadleaved trees will do all the filling-in required.

The first operations to reduce the cover by progressive steps will start 5 to 10 years after the planting is done. In two or three stages the greater part of the original stocking (with the exception of some good stems of chance origin) will be removed. This will take from 10 to 25 years according to the species used, its speed of growth, and its demands for light.

In practical terms, one completes the change of crop in:

20 to 25 years for European silver fir.

15 to 20 years for European silver fir in the southern mountains, and for silver firs of Mediterranean species.

10 to 12 years for *Abies grandis* or Western hemlock.

Example: Forêt des Moidons (Jura). According to E. Lachaussée in *Revue Forestière Français*, December 1949. Pages 459-462.

On the average *per hectare* in five cuttings of coppice-with-standards composed of oak, beech, ash, and hornbeam aged 40 years:

The shelterwood cutting gave 4·75 cubic metres per hectare of marketable timber and 120 steres of firewood. (Say: 50 hoppus feet timber, 1,000 hoppus feet (solid) firewood per acre)).

There was an immediate planting up of 2,000 silver firs and 200 beeches per hectare. (800 silver firs and 80 beeches per acre).

First thinning at 50 years (10 years after the enrichment) gave 3 cubic metres per hectare of timber and 30 steres of firewood. (Say: 30 hoppus feet timber and 250 hoppus feet (solid) firewood per acre.)).

Second thinning at 60 years (10 years after the enrichment) gave another 3 cubic metres of timber and 40 steres of firewood. (Say: 30 hoppus feet timber and 350 hoppus feet (solid) timber per acre)).

There remained standing after this last operation around 70 cubic metres of timber stems per hectare. (Say: 800 hoppus feet per acre). This total volume had hardly changed since the shelterwood cutting, but the proportion of wood of 50 centimetres diameter and above had been reduced below 50%. (50 centimetres diameter=15 inches quarter-girth).

The young silver firs had reached 3 to 5 metres (10 to 16 feet) tall. (Not very rapid after 20 years—but they were in shade and silver firs are slow starters—*Translator*).

They will be almost completely freed 25 years after the shelterwood cutting and at an age of 50 years one will get (as shown at La Faye de Montrond), a high forest stand of mixed broadleaved and coniferous trees scaling from 200 to 250 cubic metres per hectare (2,200 to 2,750 hoppus feet per acre) and produ-

cing 5 cubic metres per hectare (55 hoppus feet per acre) in place of the 3·5 cubic metres per hectare (38 cubic feet per acre) for the original coppice-with-standards (Not high figures by west-of-Britain standards, but fair enough for Mid-European mountains—*Translator.*)

II. Substitution of Species in Pine Stands by the Methods of Progressive Fellings

(*Keynotes:* This substitution is especially desirable in pine plantations of artificial origin. After the cover has been lightened, one brings in shade-bearing conifers, but favours a mixture of broadleaved trees whilst so doing.)

This method is applicable to pinewoods ripe for felling, where natural regeneration is not possible and often not desirable.

It applies in practice to planted woods of Scots pine where repeated rotations would have dangerous results owing to the deterioration of the soil. Also to Black pines (*Pinus nigra*) which only regenerate naturally with difficulty and which do not adequately protect the soil, especially in southern climatic zones.

The biggest and branchiest pines will be cut out first, after which the trees reserved will be those most well drawn up and suitable spaced.

The planting involves only 2,000 trees per hectare (800 per acre) at the most, as it is mainly to fill gaps. This number would be reached only when no natural regeneration came from the previous crop, even in patches.

At the opposite extreme, the planting can be by clumps, and have at first only a complementary part to play; but it would allow of a change-over, following a build-up by natural regeneration, to a mixed forest stand.

One uses shade-bearers (silver firs—hemlock) and semi-shade-bearers. True cedars below black pines (*Pinus nigra*)), and *wherever there is no natural understorey of broadleaved trees*, 10 per cent of broadleaves (beech, sycamore, etc.) whose silvicultural role is indispensable.

The first operations for the progressive lightening of the cover begin 5 to 10 years after the planting. After two or three cuttings, virtually all the original stocking (apart from young saplings arising by chance) will have been removed, in the space of 10 to 25 years, according to the species used, its speed of growth, and its demands for light.

In practical terms, one can secure the change-over in:

20 to 25 years for European silver fir.
15 to 20 years for European silver fir in the mountains of the south, and for Mediterranean silver firs.
10 to 12 years for *Abies grandis* or Western hemlock.

Example: In the state forest of Barres on deep sandy soil (Orleans Sand). Stocking on D.80 hectare consisting of Scots and Corsican pines, sixty years old, topped by some giant old pines 120 years old, and mixed with poor quality oaks and a few silver firs; coppice growth of oak and sweet chestnut and some thorn bushes formed the under-storey.

A shelterwood cutting in 1943 removed (per hectare) 300 trees (120 per acre) of which 15% were over 40 centimetres in diameter (12 ins quarter-girth). The area occupied by the trees removed was equal to that left under the 430 stems per hectare (170 per acre) left standing. (See table, p. 97).

Planted in November 1943 with 2,000 *Abies grandis* (800 per acre), aged 1+2, spaced 2 metres by 2 metres (6 by 6 ft.) apart. Damage by Pine weevil (*Hylobius*) in the following year.

The successive fellings are set out in the following table, with their yields per hectare.

The last felling was done, and the timber worked up, by woodmen who

were only semi-skilled. Extraction was done by horse, under a forestry contractor. Damage was insignificant. The silver firs were, at the end of 1952, 2 to 5 metres (6 to 16 feet) high, and their average annual growth exceeded 50 centimetres (20 inches).

AN ENRICHMENT OPERATION IN THE FRENCH FOREST OF BARRES

Year	*Nature of Operation*	*Number of stems*		*Volume*		
		Conifer	*Broad-leaved*	*Timber*	*Firewood*	
1946-47	Shelterwood cutting	252 (100)	43 (16)	170 m^3 (1,900)	150 steres (1,200)	
(?) 1943	Windfall	25 (10)	—	12 m^3 (130)	3 st. (24)	
1948-49	Thinning	165 (66)	80 (32)	63 m^3 (700)	50 st. (440)	
1951-52	Final Cutting	150 (60)	—	95 m/ (1,000)	20 st. (160)	12 (5) pines of good form have been retained.

N.B. Main figures are metric measure, per hectare.
Figures in Brackets are *per acre* in hoppus feet where appropriate.

Translator's Comment. Some of these French problems and methods are remarkably similar to our own, but we do not always share their view that a mixed broadleaved-conifer forest is the only acceptable solution.

AIR POLLUTION IN FORESTRY

By
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Introduction

It is very difficult to make any proper appraisal of the effects of air pollution in forestry, partly because land subject to pollution tends to be in coastal areas or at high elevations, where trees are subject to exposure and often also to the effects of poor soil and impeded drainage. It is therefore difficult in many cases to decide whether poor growth on such sites is the result of pollution or of the effects of exposure, wind-blast, poor soil conditions and other similar factors, or perhaps a combination of some or all of these. As a result of these difficulties, there has been a tendency to attribute all damage to trees to pollution in areas where smoke is present, and pollution has for example been cited as the cause of the death of groups of trees that were in fact killed by the Honey fungus,

Armillaria mellea. Much diagnosis of pollution damage has therefore been highly speculative.

Undoubted pollution damage may be *acute*, when high pollution levels cause marked necrosis of leaves, areas of bark, etc., and sometimes deaths of trees. It may also be *chronic*, when prolonged exposure to lower levels of pollution damage tree growth without the production of any well-defined symptoms.

There have been occasional good examples of acute pollution causing marked and sometimes sudden injury to forest and other trees. These have usually been associated with emissions of high concentrations of pollutants from the chimneys of factories and other industrial establishments isolated from towns (in which in winter domestic chimneys are a major course of pollution), and near forest areas. In some cases (as in that of the aluminium smelter at Fort William), the pollution has continued over a relatively long period, and produced striking effects on trees concerned. In others (as in that of pollution from brickworks chimneys in the Woburn area, recorded by Peace, 1958), acute damage has been associated with special weather conditions, and has produced its visible effects in a short space of time.

Acute cases of this sort are often spectacular, but it appears likely that in many areas pollutants are normally present at a level high enough to cause slow, chronic damage. In such cases it is difficult or impossible to diagnose pollution damage with certainty because symptoms are vague, or quite indistinguishable from general poor growth attributable to many factors.

Sources of Pollution

The domestic and industrial chimneys that pour pollutants into the atmosphere emit a mixture of solid materials and gases, and at present it is usually held that from the point of view of damage to trees and other plants, the gases are of far greater importance than the solids. The major pollutant gas is sulphur dioxide, 5 million tons of which (from the burning of 200 million tons of coal and 20 million tons of oil) are emitted per annum (Wilkins, 1959). The other main pollutants are fluorine (from brickworks and aluminium smelters) sulphur compounds other than sulphur dioxide, gaseous hydrocarbons (from vehicle exhausts), and nitrogen oxides.

Extent of the Problem

It is difficult to estimate how large an area is currently affected by air pollution. The industrial Pennines are affected: local damage also occurs in South Wales, the Birmingham area, the London Basin, and the Clyde/Forth basin. The forest importance of "chronic" pollution, as defined above, is still a matter for dispute, however. Under severe conditions of exposure, as at Hope Forest (N.W.(E)), it seems possible that even relatively low levels of pollution by sulphur dioxide may tip the balance, particularly against the spruces. In the Pennines, the area that might be expected to be capable of growing a reasonable tree crop in the absence of pollution appears to amount to some tens of thousands of acres, while choice of species is limited over at least twice this area. The area in Scotland in which pollution restricts afforestation is appreciably less, but the forests of Lennox, Cumbernauld, Selm Muir and Blairadam, all appear to be affected to some degree. Fluorine slowed down growth during and just after the war at Leanachan Forest, while recent acquisitions down wind from the aluminium works at Kinlochleven have had to be made with caution.

Work done by (a) Pathology and (b) Silvicultural Sections

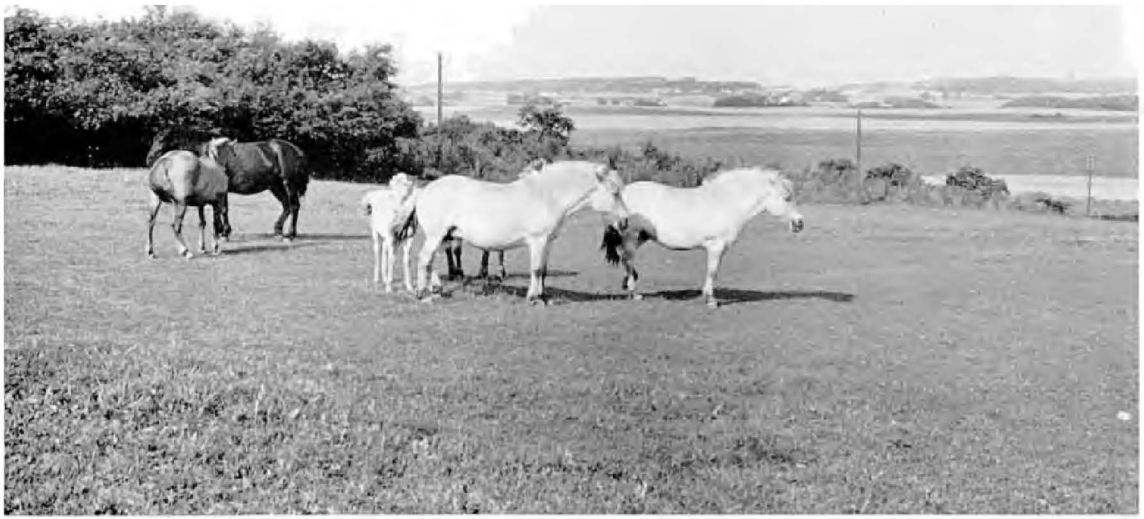
(a) Work by *Pathology Section* has been confined mainly to survey work and the study of special cases of acute pollution damage that arose mainly as

Danish beechwoods near Silkeborg, East Jutland. Ninety feet tall at 100 years (Quality Class II): growing on a stony, sandy, loam of fluvio-glacial origin.

The seaward forest edge at Husby, West Jutland. Mountain pine, *Pinus mugo*, stunted by salt-laden gales which sweep the sand dunes. Climate too cold for Corsican or Maritime pines.

Sitka spruce, background, resist salt winds well at Husby, West Jutland; only exposed seaward branches suffer. Mountain pine, foreground, are crippled when they exceed three feet tall

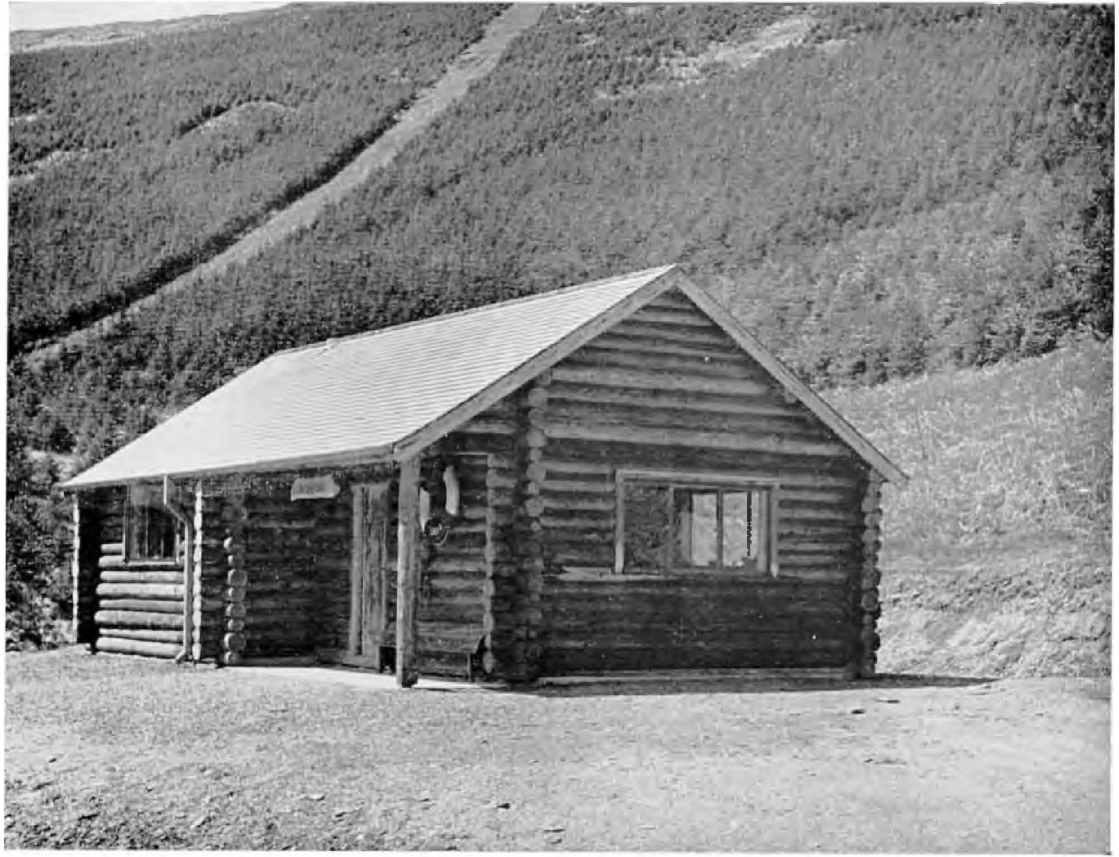
Natural regeneration of Norway spruce and Douglas fir at Vesterskov, Silkeborg, Mid Jutland



Mid-Jutland landscape. Woods of pine, spruce and beech amid farms and lakes.
The horses came from Norway

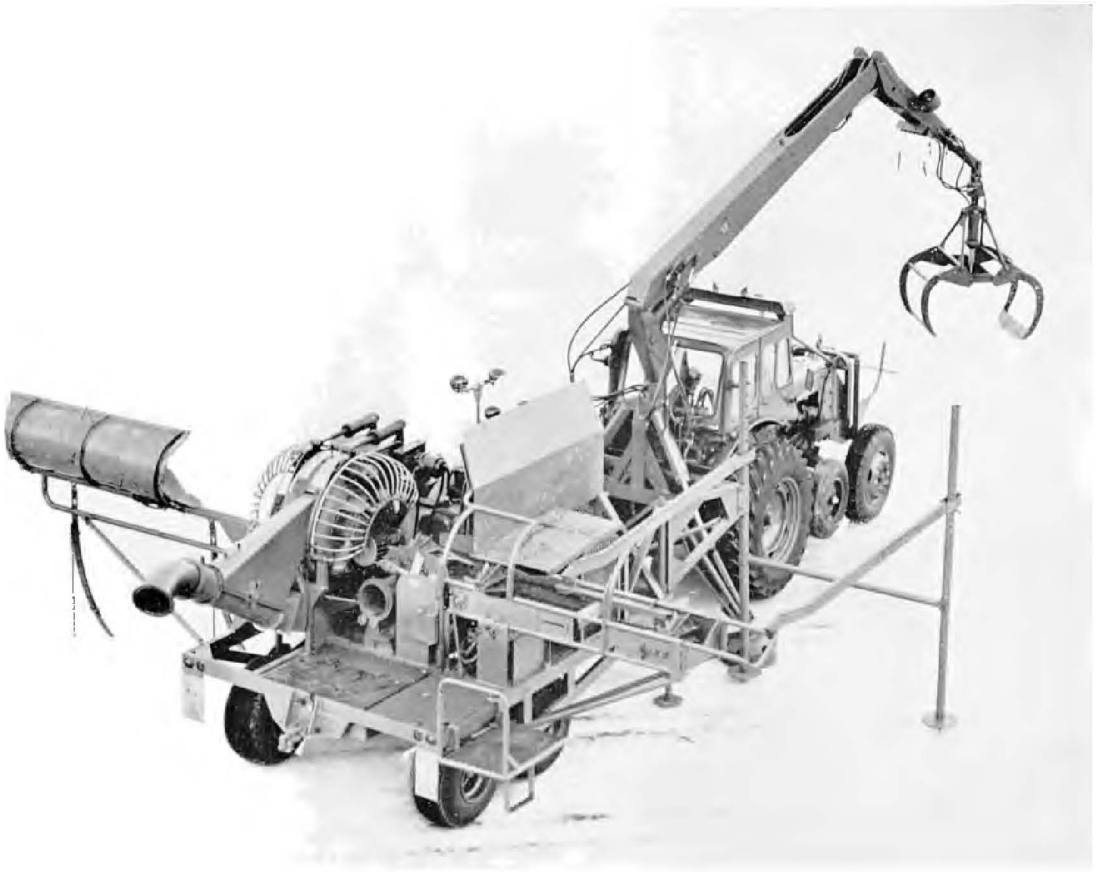
Noble fir showing good resistance to salt-laden gales on the West Jutland coast

Spruce planted amid brash at Cynwyd Forest, North Wales

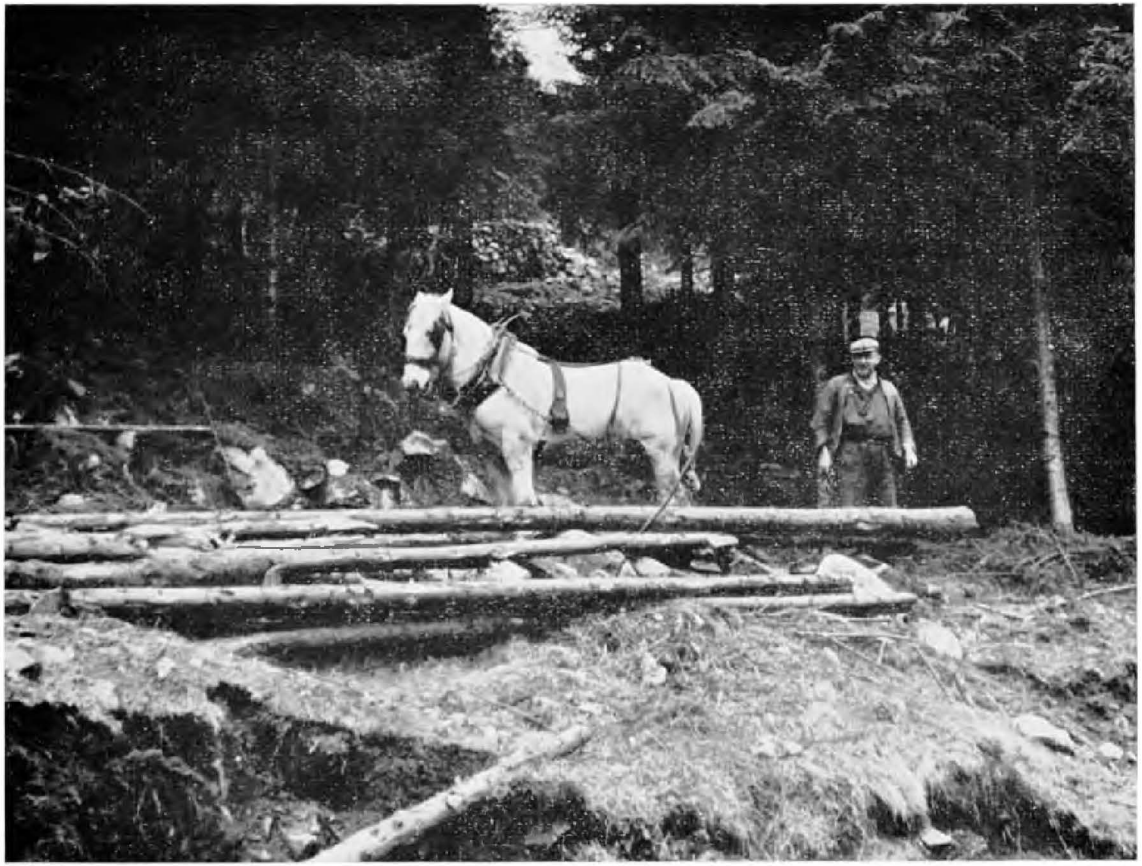


The Log Cabin at Hendre Ddu, Dovey Forest, North Wales

Inside the Log Cabin, details of construction are well seen. Note wooden beds.



Trailer-mounted Cambio Debarker for use with tractor



A Welsh timber haulier and his horse, Coed y Brenin Forest

Who said starlings?

Kielder Camp in 1961

Kielder Repair Depot, 1963, on the same site

Helicopter rescues an invalid from Dartmoor Forest, January 1st, 1963

Sunshine and snow in Dartmoor Forest

Lorry-mounted Cambio Debarker (Karlskrona Cruiser) at work in Sweden

The Lorry-mounted Cambio Debarker (Karlskrona Cruiser) seen from the opposite side

advisory queries. These included the study by Peace (1958) of the effects of fluorine pollution at Woburn, already noted above, and they suggest that pollution damage may be particularly severe when mist, fog or fine rain deposit fumes, and drier weather then follows. Conditions of 'inversion', when fumes remain in a layer of still air near the ground, are also favourable to fume damage. Wind might therefore be expected to disperse and dilute fumes and so reduce the damage they cause. One of us (R.J.L.), however, as noted below, when using lead dioxide gauges, consistently obtained higher readings in exposed sites than on sheltered ones. This is further discussed below.

At the present time, some study is being made of conditions around the Esso oil refinery at Fawley, where shelter and screening belts of various tree species have been planted, and autometer pollution gauges are being maintained. This work may be extended somewhat to include the site of a new power station to be built in the same area. Some further observational work will be carried out in South Wales.

(b) *Silvicultural Section.* The pollution problem has been mainly a northern one, except for some investigations by Day and Sanzen-Baker (1938) in South Wales, Hope Forest, etc. Day and Sanzen-Baker concluded that factors other than pollution were the main sources of damage in the areas they studied, however.

In 1956, in co-operation with the Electricity Generating Board, a survey was begun of sulphur dioxide concentrations around the Kincardine on Forth power station, using lead dioxide candles. The survey will continue until the station is in full operation. Despite predictions of heavy pollutions, there has been little change so far in the monthly readings compared with those found before the power station was built.

A network of 24 lead dioxide candles was set up in 1957 to cover a range of sites in the Pennines where plantations already existed or were planned. Observations over three years showed that (contrary to expectation) the upland sites between the Pennine cities did not give lower readings than those in the suburbs of the towns themselves, but in general rather higher ones.

This lead to a re-appraisal of the reliability of the lead dioxide gauge, and a suggestion that the gauge indicates not the *concentration* of sulphur dioxide in the air, but rather the *total quantity* of the gas that has passed over the candle. If this is so, a higher wind speed would result in a higher rate of sulphation if the gas concentration remained the same, and further there would be no satisfactory way of translating the lead dioxide gauge results into the concentration as read by the volumetric sulphur dioxide apparatus. It may be said, however, that even the high values obtained at the worst polluted forest sites were below those found necessary to cause "acute" symptoms in fumigation experiments. Nevertheless, chronic (as opposed to acute) pollution is still considered likely to be at least one of the causes of poor growth in the Pennine trial plantations. No proper investigations of the operation of this chronic pollution have been made, though early leaf senescence may be one cause of damage. The possibility of some improvement of the soil microflora has also been considered. This may be unlikely, although when the late Dr. M. C. Rayner examined the roots of Sitka spruce from Hope Forest in 1938 she found no mycorrhiza. This in itself means little, however, as she made similar findings in other areas (e.g. at Wareham), where pollution was not a problem, but soils were unsuitable for the growth of micro-organisms (and often of trees also).

Observations with lead dioxide gauges were also made for three years at Lennox Forest, and at two sites at Cumbernauld. The figures obtained were about twice those at Kincardine, and about equal to the less polluted Pennine stations.

In 1960, a ring of lead dioxide gauges was set up around the site of the Lurgi high-pressure gas plant in Fife, to see whether the plant would cause a dangerous increase in sulphur dioxide at Blairadam Forest. The plant has since come into production, and has been in operation for over a year, but no appreciable rise in pollution levels has been recorded.

Investigations were continued at South Pennines (Hebden Royd) Forest in 1960, when a new technique, using zinc plates, was tried. These plates corrode in the acid atmosphere, and the monthly loss in weight gives an indication of the level of pollution by acid gases. Comparison of lead dioxide gauges with adjacent zinc plates gave a high correlation, and it is proposed to extend the survey with zinc plates to a wider range of sites. In view of the above remarks on lead dioxide gauges, it will be necessary to consider whether the zinc plates indicate concentration, or total quantity of pollutants passed over them.

From the above brief introduction it will be seen that the study of pollution presents many difficulties, one of the most fundamental being that of dissociating the effects of pollution from those of exposure and soil. All too often it is merely a matter of opinion whether or not trees have been affected by a polluted atmosphere. Further work is needed particularly to evaluate methods of pollution measurement, and to relate their results to effects on plants, and to design experiments that will separate the effects of pollution from those produced by other adverse factors.

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PROGRESS AND RECOVERY FROM DIE-BACK IN LARCH

By

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When the Drumtochty Experiments 4 P.51 and P.52 were laid out, three strips of the previous European larch crop, which had suffered from die-back, were left as a form of control to the new experiments and for further study of the development of the old crop. This larch had been planted in 1931 and was then twenty years old, and it had been raised from a general collection of seed in East Scotland.

The first of these strips was between two columns of the P.51 Latin square and was divided into five plots comparable with the rows of the square. The other two strips lay between blocks of the P.52 experiment and each of these strips was treated as a single plot.

The mean results of the five plots of the control to the P.51 experiment and of the two plots of the control to the P.52 experiment are:—

	Percentage of trees dead	Number of Survivors			
		No sign of dieback	Suffering from dieback	Apparently Hybrid Larch	Total
		1951			
Control to P.51	58	23	123	11	157
do. P.52	84	47	35	2	84
		1961			
do. P.51	0	123	8	15	146
do. P.52	0	73	7	4	84

It is probable that the die-back had reached its maximum incidence about 1951, having killed half to over four-fifths of the total crop. In the "Control to P.51" eleven trees disappeared between 1951 and 1961 enumerations, and though they were therefore not recorded in the percentages of trees dead, it may be presumed that they had in fact died and disappeared.

Of the trees enumerated in 1951 a number had been recorded as "apparently hybrid" although until that date it had been supposed that the crop was pure European larch, and the number of trees in this category increased on reclassification in 1961. Such a change is not uncommon as hybrids are distinguished by various characters such as colour of twig, and these are variable. Cone characteristics were also made use of, and it has been found that at this age the hybrids frequently bear cones, but the pure European is less prolific.

The surviving non-hybrid trees in most cases had passed through the die-back phase and had lost their lower partly-dead crowns and developed new upper crowns in the course of normal growth. Though the surviving trees are only a small proportion of the original crop, the appearance of the better parts of the crop is now well stocked, the trees having spread their crowns and filled up a great deal of the blank spaces. In the poor parts, however, there are still many blanks. In general the European larch trees are of poor habit while the hybrids are vigorous and coarse.

Recovery from die-back thus appears to consist in the successful passing of trees through the stage at which they are susceptible, without either dying or losing so much vigour that they are unable to continue growth. Examples of Pressley borings, showing slowing down of growth by canker, and subsequent recovery, may be seen on page 120.

The Resistance of Hybrid Larch

The importance of the resistance of hybrid larch to die-back has been noted in previous experiments where the existence of die-back has been studied. Owing to the impossibility of certainty in recognising hybrids, no figures are given, but the resistance of trees showing hybrid characteristics has been recorded as follows:—

Blackcraig Experiment 2/50

An investigation of 1950 into a crop of European larch of two provenances mixed, 27/60 from East Scotland and 28/66 from Murthly Estate, Perthshire, planted in 1931. This crop suffered severely from die-back but certain trees were noted as apparently resistant. These were marked and their growth recorded in comparison with surrounding individuals. After seven years, it

was found that the mean annual girth increment of the selected trees had been 0·77 inches as compared with a mean of 0·28 inches for the control trees. It was then noticed that the selected trees all appeared to be hybrids.

Durris Experiment 1 P.40

A provenance experiment including European larch from Bohemian, Scottish, Austrian and Alpine provenances. In 1947 it was recorded that no die-back had occurred in any provenance, but that there was evidently a proportion of hybrid trees in the Bohemian provenance. By 1951 die-back had become serious in the Austrian and Alpine provenances but only a few of the Scottish and Bohemian trees had died. In the last provenance, the hybrids, which constituted about 4% of the total crop, were not only free from die-back but were nearly double the height of the other trees. The progress of the die-back is still being recorded. (Details in *Ann. Rep. For. Res.* for 1956, page 41, in the last paragraph of which for "twenty-five" substitute "forty"; for "sixteen" substitute "twenty-five"; and for "ninety" substitute "eighty").

Cardrona 1 P.37

An experiment with hybrid larch of different generations and provenances. This experiment has shown that although second generation hybrid larch is reasonably resistant to canker, the same is not true of the third generation hybrid, of which some 10% still bore stem and branch cankers at the age of 23 years, after the removal of many trees in three thinnings.

It should be noted that these experiments furnish no evidence as to the degree of resistance of the hybrid, partly because of the difficulty in recognising hybrids, and partly because there is no record of how many trees which might have appeared to be hybrids did in fact die. It is possible that only a proportion of hybrids are resistant, and they may depend on the resistance of the parent trees.

Mixed Larch Seed

In connection with these results, it may be noted that hybrids are frequently found in stocks of plants raised from European larch seed. This is so common in Scottish seed that it appears very difficult to be sure whether Scottish European larch seed can be obtained pure. And the evidence above shows that it can also happen in imported seed. An "adulterated" mixture of species is evidently becoming common in seed from Europe, though probably not in Japanese larch seed from Japan.

METHODS OF COUNTING ROE DEER

By

RICHARD PRIOR

Stalker, Cranborne Chase Forest, South West England

In Cranborne Chase we are carrying out a study of roe deer with the object of finding out the causes of forest damage and methods of controlling it. This forest of approximately 2,000 acres forms part of a large complex of woodland on a chalk subsoil. The Commission holdings are in isolated blocks of 100 to 400 acres within the complex. Originally hazel with standards, much of it has been replanted in small plots with a variety of conifer and mixed plantations. Roe density is high, varying from 1 : 9 acres to 1 : 25 acres, and there is a herd of approximately 150 fallow deer as well, about a quarter of which may be found at times in our woods. Being chalk country, there is much natural browse

of bramble and hazel shoots to support this large population. We get localised browsing damage at the end of winter, but the chief trouble is fraying.

When the study was commenced in March, 1962, the problem of census technique was tackled without reference to existing thought, with the hope that some new ideas might emerge which could subsequently be compared with similar work going on in other areas. It was soon obvious that we had problems which were peculiar to this type of woodland, and which would not occur, for example, where the seasonal movement of deer is contained within a forest block. We have no natural barriers or deer fencing, so a winter concentration of deer in one place, which gives rise to browsing damage, may have no bearing on spring and summer distribution, and the location of fraying.

We therefore had two separate aspects to tackle; control of numbers over the whole complex, private and Commission woods alike, and the prevention of fraying in our own blocks. The winter concentrations tend to move according to weather and available food, whereas during the summer the buck maintains a territory, and the population remains relatively steady from April until August. With only one operator, it was obvious that everything could not be attempted at once over the whole area, so two blocks of about 300 acres each were taken as a study area. Intensive work was carried out in these for the first year, and the main effort concentrated on working out a method for determining the summer population. We find at the end of the second summer season, that cross-checking begins to be possible, and that census figures produced in April are correct to within 10% or better.

The records which we use are, of course, only suitable for a detailed experiment, and will need to be simplified before the method is generally useful. In addition, where herds are more self-contained, winter counts would probably be easier, particularly where undulating ground and more open woods than we have, make direct observation possible.

Tours are made at first and last light. This allows detailed analysis of sex, age and individual peculiarities of undisturbed deer. High seats are not very useful for census work, as one tends to spend too much time looking at the same deer. Binoculars are essential, and a stick which comes to eye level allows them to be steadied for prolonged study. Many people think that it is impossible to recognise individual deer, but the bucks at least are easy, as each has different antlers. Remember that most shepherds can recognise each individual sheep of their flock. Each deer seen is noted down in a field note-book with all possible particulars. On return home, the number of deer seen is recorded on the Daily Sheet, which has spaces for male, female and young in each forest compartment. For convenience the fawns of a year are assumed to be yearlings from the beginning of the following April. Each buck which has been closely studied is also entered on a separate page of the Buck Record. He is given a number, and an estimate of age and antler dimensions is put down. When he is seen again, the date is entered on his page, with the compartment number. If the location of these bucks is marked on a map, it can usually be seen if one holding a territory has been overlooked during a tour.

From these two records a number of deductions can be made. As entries on the Daily Sheet lengthen, it is possible by totalling the columns, to see the proportion of bucks to does, the Doe Ratio. Reference to the Buck Record will show the individuals seen. Therefore an *observed* total population figure can be obtained by multiplying the buck total by the Doe Ratio. For example, if the bucks recorded are 10, and the Doe Ratio 1 : 1·5 (bucks:does) then the *observed* total is 25 deer. This, of course, applies in the spring, when the year's fawns have not arrived. It is not the *actual* total, as some are unseen, and a factor must be applied to arrive at this. The factor depends on the period of

observation, the type of woodland and the skill of the operator, and can only be tested for accuracy by cross-checking results at the year end. In our own conditions, for a month's survey over 600 acres in April, the unseen factor is 34%, which must be added to the observed figure. It requires a certain amount of nerve to convince yourself that so many deer remain unseen, but returns over a year or two will prove it. Of course, an infuriated forester fresh from the latest patch of damage requires no such convincing.

At the end of the summer, the Buck Record will be pretty accurate, and that is the moment to check with the spring count. One or two bucks will have moved in during the period, but a full-time deer man will have a fair idea which these are.

Application to Larger Areas

This method is definitely for a restricted area, but, by rotating the study block through various parts of the forest from year to year, a positive census of the whole can be made in time. The following methods, less accurate but taking less time, can be used to arrive at population figures for the rest of the forest.

(1) *Comparison.* Comparative figures can be produced where the block to be surveyed is similar to one where an accurate census has been made. There are two methods, one involving pure field work, the other records.

Field work on a strange block will involve detailed examination of browsing, scraping, tracks and all static evidence of deer occupation, as well of notes being taken of all deer which happen to be seen. This can be done during the day. The comparison of these signs is made with a block containing woodland of similar type over which a detailed census has been made.

If the block had a census made in a previous year, a direct comparison can be made with that of the current year, to see if the total has risen or fallen. Changes in the state of the block, e.g., felling or clearing of undergrowth, should, however be considered.

(2) *Territories.* During the spring the roebuck marks his territory with a number of scrapes and fraying stocks. A careful worker can determine from these approximately how many buck territories are in the block, and from this arrive at a population figure, allowing say 2·25 deer per territory disregarding the year's fawn crop. This is not particularly accurate if the deer density is high, but is a useful way of making a census when, for one reason or another, it has been left until after the leaf flush.

Application of one or another of these techniques or a combination of several, gives us a fairly accurate idea of the number of roe in the forest at the start of the buck season on 1st May, and this is the basis, with reports from the tree-growing side, of our shooting plan. The reduction of damage, and anticipation of situations where damage is likely to occur, such as new plantings, is obviously the major consideration, but without the solid foundation of a good census and a shooting plan thoughtfully prepared, much money and effort can be thrown away without achieving the object of growing trees and conserving the deer.

MID-GALLOWAY AREA FIRE PLAN

By
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and others
South Scotland Conservancy

GLENTROOL FOREST PARK AND ASSOCIATED FORESTS

1. Description of the Area Covered by the Plan

The Forests included in this Plan consist mainly of extensive young coniferous plantations, planted largely since the war although some were planted as early as 1922. They lie within the area roughly bounded by the Cree valley in the west and by the Water of Ken in the east. Altitude varies from sea level to nearly 3,000 feet (Merrick 2,764 feet) but the highest planting barely reaches 1,500 feet. The total area of the units directly participating in the scheme is some 155,000 acres (242 square miles) of which some 85,000 acres will ultimately be planted. At present about two thirds of the area are planted. In addition a number of other units which are dependent on the scheme for outside assistance amount to another 4,500 acres of which 3,500 acres are planted to date.

Numerous glens and ridges break up the whole area, causing some variation in climatic conditions and making communications difficult. Rainfall over the area varies from under 40 inches to over 60 inches per annum. The mean January temperature is between 36–40°F. while the mean July temperarure is between 58–60°F.

Between February and June these forests are particularly vulnerable owing to the persistence of dead molinia grass and to the practice of muirburning by farmers. There is also some danger later in the season due to the popularity of the area with tourists, hikers, climbers and fishermen who frequent the Forest Park.

The area is subdivided as follows:—

Forest	*Unit*	*District*	
Cairn Edward	Cullendoch	Gatehouse	Area Fire H.Q. Grentrool.
	Bennan	Dalry	
	Clatteringshaws		
The Garraries	The Garraries		
Dundeugh	Dundeugh		
Carrick	Balloch	Barr	
	Starr		
	Tairlaw		
Changue	Changue		
	Kilgrammie		
Glentrool	Glentrool	Newton Stewart	
Kirroughtree	Kirroughtree		
Penninghame	Penninghame		
Arecleoch	Arecleoch		

(APPENDIX I, p. 114, gives representative names and addresses of staff)

2. Area Fire Headquarters

An area Fire Headquarters will be set up at Glentrool for the purpose of estimating the daily Fire Hazard (by the Canadian Method), for the co-ordination of mutual assistance between units and for calling in outside help.

(a) *Area Fire Officer.* A District Officer will be appointed for the general administration of the plan, co-operation between the other District Officers concerned and for liaison with outside sources of assistance (except in the case of the Military and R.A.F. See para. 7 (b)). These duties will be in addition to his normal ones and he will generally remain on call throughout the fire danger season. He will be responsible for proposing amendments to the plan in the light of practical experience and in consultation with the other District Officers.

(b) *Fire Warden.* During the fire danger season this will be a full-time appointment, filled by a Forester working under the general supervision of the Area Fire Officer. If considered necessary, a relief for the Fire Warden will be arranged by the Area Fire Officer after consultation with S.F.O. It will be the Fire Warden's responsibility to calculate the daily fire hazard from the meteorological data available from the station under his control and that supplied to him by Foresters in charge of out-stations. He will keep a Hazard Book in the form of a daily log, showing the dispositions of all men and equipment on each day for which a grade of hazard exists. In the event of a fire it will be his responsibility to mobilise such men and equipment as are called for by the Forester in charge of the unit at which it occurs. When a serious fire of some duration occurs, he will ask the District Officer concerned to arrange for food and accommodation for fire-fighters in accordance with the Unit Standing Fire Plan.

Note. It is emphasised that neither the Area Fire Officer nor the Fire Warden is responsible for the control of actual fire-fighting operations. This is the responsibility of the Officer-in-charge of the fire.

(c) *Meteorological Station.* Owing to the diversified nature of the area it is inadvisable to rely on data from a single meteorological station. In addition to a main station at *Fire Headquarters* there will be three out-stations at *Kirroughtree*, *Changue* and *Dundeugh.* These will be the responsibility of the Forester-in-charge of these units. The Fire Warden will take readings three times daily at 0800, 1200 and 1500 hrs. G.M.T. or B.S.T. He will receive forecasts daily from Monday to Friday at about 0745 hrs. from the Meteorological Office, Prestwick Airport, which will cover the next 24 hrs. and an outlook for the week-end will also be received on Friday at 1500 hrs. Foresters-in-charge of out-stations will take readings daily at 0800 hrs. and pass on the information to the Fire Warden as detailed in Para. 3. The Fire Warden will calculate the hazard from the information received and will issue this together with the forecast for the next 24 hours daily at 0815 hrs. as detailed in Para. 3 (a). On Friday afternoons between 1515 and 1530 hrs. he will issue a provisional hazard and forecast for the week-end which will be notified to all units and personnel in accordance with Para, 3 (a). He will have authority to issue forecasts on other afternoons if he deems it necessary.

3. Fire Hazard Assessment (See also Appendix II, p. 114)

Meteorological stations will report readings at following times:—

Dundeugh	—	0800 hrs.
Kirroughtree	—	0805 hrs.
Changue	—	0810 hrs.

(a) 0815 *to* 0830 *hrs.*

1. Fire Warden to report hazard and meteorological report to Kirroughtree, Changue, Dundeugh, Bennan, Penninghame and Arecleoch.

2. Changue will notify its District Officer, Balloch, Starr, Tairlaw and Kilgrammie.
3. Kirroughtree will notify its District Officer, Kilsture and Bareagle.
4. Dundeugh will notify its District Officer, Corriedoo, and Garcrogo, which will notify its own District Officer.
5. Bennan will notify Clatteringshaws, The Garraries and Fleet. The last will notify Cullendoch, Laurieston, Glengap and its District Officer.

(b) 1515–1530 *hrs. on Fridays and other afternoons if necessary*

Fire Warden will report provisional hazard and Prestwick forecast for the week-end, or the following day, to all units and personnnel in accordance with Para. 3 (a).

When the Warden reports hazard to the Foresters in carge of Class A Units, they will report to him the dispositions of their lorries and fire fighting teams.

At the time of passing information as to their dispositions to the Fire Warden, Foresters-in-charge should also give a personal estimate as to the grade of fire danger at their unit. In the light of this additional information, the Fire Warden may (with the approval of the Area Fire Officer) modify the state of preparedness at that unit with special regard to the degree of patrolling required, curtailment of controlled burning, etc.

It is emphasised that the general grade of hazard for the whole area will be the highest shown at any out-station and not the average.

On receipt of the grade of hazard it will be the responsibility of the Forester-in-charge to put into effect the necessary precautions at his unit.

The following grades of hazard will be used:—

Grade V	0	Nil
Grade IV	1–4	Low
Grade III	5–8	Moderate
Grade II	9–12	High
Grade I	13–16	Extreme

When the grade of hazard is II or I each Forester-in-charge must daily warn his men verbally as to the danger.

All public holidays within the Fire Danger Period will be graded as *at least Grade III.*

(*Appendix III*, p. 115, gives details of precautions to be taken).

Flag Poles. Warning of the daily grade of hazard will be given by coloured flags flown from poles erected at each unit and sited where they are likely to be seen by the greatest number of workers. The Forester-in-charge will be responsible for seeing that the appropriate flags are flown as follows:—

Grade IV	One yellow flag
Grade III	Two yellow flags
Grade II	One red flag
Grade I	Two red flags

4. Fire Detection and Reporting

Fire detection will be based on the use of look-out towers, supplemented by patrols. Reporting will be by field and public telephone or by radio.

(a) *Look-outs.* Towers or cabins will be erected on suitable sites to give maximum cover. Where suitable, these will be fitted with devices for taking bearings and all will be connected by telephone or radio to the

forest office. Foresters-in-charge will report all outbreaks at their unit immediately to the Fire Warden, giving the position or bearing from the look-out. Manning of look-out towers under the scale of precautions will be the responsibility of the Forester-in-charge.

(*Appendix IV*, p. 115, gives the location and responsibility of look-outs.)

(b) *Patrols.* Mobile patrols will be used to cover areas not adequately served by look-outs. Preferably these should be by motor vehicle except at points much frequented by the public, e.g., The Bruce's Stone, Glentrool.

(c) *Communications.* To enable speedy reporting by patrols and fire teams, a network of field telephones should be established at those units where public telephones are few and far between. The use of portable instruments which can be plugged in anywhere along the line is recommended. It is also essential that there should be two separate public lines at Area Fire Headquarters, so that one may be kept for emergency calls only. To help with communications and with actual fire-fighting, walkie-talkie wireless sets will be supplied to those units with the greatest need, as they become available.

5. Mutual Assistance within the Area Scheme

(a) *Classification.* In order to clarify the position, forest units within the scheme have been classified in three groups:—

Class A Units	supplying aid to other units.
Class B Units	in emergency supplying aid to other units.
Class C Units	dependent on other units.

Class A Units

Bennan	:	Priority for Clatteringshaws, Corriedoo, Cullendoch, Dundeugh, Garcrogo, Garraries.
Glentrool	:	Priority for Arecleoch, Kilgrammie, Starr, Tairlaw.
Kirroughtree	:	Priority for Bareagle, Clatteringshaws, Garraries, Kilsture, Penninghame.

Class B Units

Clatteringshaws	:	Aid to Bennan, Corriedoo, Dundeugh, Garcrogo, Garraries, Kirroughtree.
Dundeugh	:	Aid to Bennan, Clatteringshaws, Corriedoo, Garcrogo, Garraries, Starr, Tairlaw.
Balloch	:	Aid to Arecleoch, Changue, Kilgrammie, Starr, Tairlaw.

Class C Units

Arecleoch	Changue	Cullendoch	Garraries
Penninghame	Starr	Tairlaw.	

Class A Units will have:—

1. Fast and reliable vehicles.
2. Standard fire equipment.
3. Specially trained teams.
4. An Assistant Forester in charge of each team.
5. Motor vehicle with mobile radio.

(b) *Equipment*

(See *Appendix V*, p. 116, for details of disposition.)

Equipment from *Class A and B Units only* will be called on by Fire Warden to go to another unit.

The number of lorries not available during working hours for fire-fighting at each unit should be reported daily to the Fire Warden, who will enter their location in the Hazard Book. Out of working hours, if the grade of hazard warrants it, the Fire Warden may (with the permission of the Area Fire Officer) order a certain number of lorries and drivers to remain on call.

(c) *Labour*. The number of workers available for fire-fighting within the scheme is as detailed in *Appendix VI*, p. 117.

Outside working hours, in the event of an emergency, the following numbers may be contacted at their homes by arrangement with the police:—

Newton Stewart	(telephone 100)	37 men;
Wigtown	(telephone 3100)	11 men;
Creetown	(telephone 340)	15 men.

Only Class A and B Units will be called on by the Fire Warden to supply labour to other units.

It is important that no unit is left completely unprotected by sending assistance to other units, and no more than 75% of the labour force at a Class A or Class B Unit may be sent to help at another unit.

Subordinate supervisory staff will accompany labour going to another unit, but the Forester-in-charge will not leave his charge without a direct order from his own District Officer or, in exceptional cases, from the Divisional Officer.

6. Mutual Assistance Outside the Area Scheme

(a) *Assistance FROM Units outside the Scheme*. The following units outside the area may be called on by the Fire Warden to assist.

i. Newton Stewart District : Bareagle
(1st call for Loch Ronald Section, Penninghame.)

ii. Gatehouse District : Fleet
(1st call for Cullendoch and Laurieston.)

(For men and equipment available, see *Appendices V* and *VI*, pp. 116–117.)

(b) *Assistance TO Units outside the Scheme*. The following units, while not within the scheme, are completely dependent on Class A Units within the Scheme for outside assistance:—

i. Newton Stewart District	Kilsture	1st call on Kirroughtree.
ii. Dalry District	Corriedoo	1st call on Dundeugh.
iii. Dalbeattie District	Garcrogo	1st call on Bennan.

Foresters-in-charge of these units will report all fires to the Fire Warden after having, if necessary, called on the appropriate Class A or B Unit for assistance.

In the event of a serious fire at any other unit outside the scheme, the Fire Warden may send assistance on application by the appropriate District Officer and providing adequate reserves are maintained.

7. Other Outside Assistance

(a) *South Western Area Fire Brigade.* The following fire brigade stations are within reach and may be called upon to give assistance:—

Newton Stewart	Maybole
Girvan	Dalmellington
Ayr	Castle Douglas
Colmonell	Gatehouse-of-Fleet
New Gallaway	Dumfries.

(*Appendix VII*, p. 117, gives details of men, equipment and telephone numbers.)

As laid down in the Fire Protection Code, the Fire Service should be notified of all fires. This should be done by the Forester-in-charge giving the message "FIRE" or "SERIOUS FIRE" at the unit. The Area Fire Officer will be responsible for liaison with the Firemaster and for arranging suitable combined exercises outside the danger period.

(b) *H.M. Forces.* Arrangements exist for assistance to be given by members of the Services stationed within reasonable distance. District Officers will be responsible for maintaining liaison with O. i/c H.M. Forces within their districts. Applications for assistance by the Services should be made through Conservator South (S.).

(*Appendix VIII*, p. 118, gives details of military camps, etc.)

(c) *Forrest Estate.* This dedicated Estate has now been integrated unto the Mid Galloway Plan and is classified as a Class B Unit capable of sending up to 8 men to an outside forest by day.

(d) *Local Outside Assistance.* Foresters-in-charge should maintain close liaison with neighbouring farmers and others who would be willing to give local assistance. These may be called upon by the Forester himself to help his own squad.

8. Fire Rendezvous Points (F.R.P.s)

Fire Rendezvous Points will be established throughout the area and numbered consecutively. These should be situated on a hard road and where possible near a telephone. Maps showing F.R.P.s should be made on the $\frac{1}{2}$-inch scale and must be displayed in Area Fire Headquarters, all Forest and District Offices and be carried in all area vehicles. Enough copies should be issued to the South Western Fire Brigade for distribution to each sub fire station. Other copies may be issued as available to the Police, H.M. Forces, landowners, factors, etc., who may be called upon to assist.

(*Appendix IX*, p. 118, gives a list of all F.R.P.s.)

9. Action to be Taken in the Event of a Fire

I. *By Look-outs, Patrols, etc.* The person seeing a fire or suspected fire will immediately report it to the Forester-in-charge, giving its position or bearing.

II. *By Forester-in-charge.* On receiving a report, the Forester-in-charge will take the following action:—

(a) Take steps to call in his men to pre-arranged assembly points, by means of rockets, sirens or other means.

(b) Inform Fire Brigade.

(c) Inform the Fire Warden, giving position or bearing.

(d) Proceed with available men to investigate, assess the danger, and do what he can to put it out with his own resources.

(e) Report back to the Fire Warden as soon as possible that:—

i. the fire is out;

ii. the fire is under control with his own resources;

iii. further assistance is required.

If he reports that further assistance is required, he must give his assessment of the danger and the numbers of men and type of equipment required. He will, if necessary, also take steps to set up Fire Control Centre and Fire Control Points as laid down in para. 10 below. He will also give the appropriate F.R.P. number(s).

It will be the responsibility of the Forester-in-charge to make the first attempt to contact his District Officer. If he is not immediately available, the Forester should ask the Fire Warden to make further attempts.

III. *By Fire Warden.* On receiving a report from a Forester-in-charge he will immediately:—

(a) Inform District Officer concerned.

(b) Warn all Class A Units to stand by for immediate call.

(c) Inform appropriate Police Station.

(d) Inform Conservancy Office or, out of office hours, S.F.O.

(e) Inform Area Fire Officer.

On receiving a further report that the fire cannot be controlled by local resources, and depending on the Forester-in-charge's assessment of the danger, he will:—

(f) Call out assistance from Class A and B Units as appropriate.

(g) Call out S.W. Fire Brigade, if this has not already been done by Forester-in-charge.

(h) Inform other District Officers.

(i) Inform all other Foresters-in-charge.

The Fire Warden only informs the District Officer concerned, if this has not already been done by the Forester-in-charge.

The position of the fire and appropriate F.R.P.s. will be quoted in all messages.

IV. *By District Officers.* On being informed that a fire has broken out in his district, the District Officer concerned will take what steps he considers necessary to control the fire. This will include taking personal charge at the Fire Control Point.

10. Action to be Taken at a Fire

The following action will be taken by the Officer-in-charge of the fire:—

(a) *Fire Control Centre.* This will normally be at the nearest public telephone and may often be the Forest Office. It will be permanently manned by a responsible person who will pass messages between the officer-in-charge of the fire and Area Fire Headquarters. All such messages will be recorded in a special book, which will include time of receipt.

(b) *Fire Rendezvous Point.* All outside assistance will report at the F.R.P. to which they have been directed. This will be permanently manned by a responsible person who will re-direct incoming assistance to the Fire Control Point or elsewhere on the instructions of the officer-in-charge of

the fire. Use must be made of "To the Fire" signs between this point and the F.C.P. to minimise confusion and reduce the use of guides. The man at the F.R.P. will keep a record in a notebook of the times of arrival of all assistance, numbers of men, etc., and pass all such information to the officer-in-charge of the fire.

(c) *Fire Control Point.* This will be set up by the officer first in charge of the fire (normally the Forester-in-charge) at a point where the fire-fighting can be controlled. It will be indicated by a red disc or pennant by day and a green lantern at night. The location of the Fire Control Point will be reported to Base Control and from there to Area Fire Headquarters. All subsequent changes of location will also be reported. The officer-in-charge will report the arrival of all assistance through Fire Control Centre or direct to Area Fire Headquarters. Communications between Fire Control Point, F.R.P. and Base Control will be maintained by runner, despatch rider, field telephone or walkie-talkie, as available. The officer-in-charge of the fire should have a Fire-Fighting Map on the 6-inch or 2½-inch scale and a Log Book in which all decisions and orders should be recorded. Message pads with duplicate leaves should be used for all messages sent by runners, despatch riders, etc.

(d) *Assistance.* Men arriving at the fire area will report at the Fire Control Point for instructions from the officer-in-charge of the fire.

(e) *Reliefs.* In the event of a long fire, the Fire Warden will arrange for the supply of reliefs for both fire-fighters and supervisory staff. He will also assist the District Officer with arrangements for food and accommodation.

11. Action After Fire is Under Control

No one will leave the scene of the fire without direct orders from the officer-in-charge. Patrols will be posted to damp down and see that the fire does not break out again. Suitable steps will be taken to refill water supplies. Squad leaders will check their men before returning to their own units.

12. Fire Reports

The Forester-in-charge of the unit at which the fire occurs will be responsible for preparing reports on necessary forms. It is essential that this should be done as soon as practicable and should include a detailed history of the fire with times clearly noted of the various actions taken, arrival of assistance, etc. (See revised Fire Protection Code.)

13. Revision of the Plan

The Plan will be revised annually at a meeting of the personnel involved.

14. Unit Standing Fire Plans.

These will be prepared by District Officers in accordance with the revised Fire Protection Code, and Mid Galloway Fire Plan.

15. Annual Fire Plans

These will be prepared by Foresters-in-charge for submission with Annual Financial Estimates in accordance with Fire Protection Code.

16. Maps

The following maps will be prepared and distributed as shown:—

Scale	*Area Covered*	*Distribution*
6″	Each of smaller units	District Officers, Foresters-in-charge.
2½″	Larger units and whole area	Fire Warden (Carrick, Cairn Edward, Glentrool).
	Each District	District Officers.
½″	Whole area (showing F.R.P.s)	Conservator, Divisional Officer, Area Fire Officer, District Officers, Fire Warden, Foresters-in-charge, S.W. Fire Brigade, Area F.C. vehicles, and as available, Police, H.M. Forces, etc. (District Officers and Foresters-in-charge of adjoining areas to be included.)

17. Distribution of the Plan

Copies of the plan will be held by the following officers:—

Director (Scotland)
Conservator (South Scotland)
Divisional Officer (West Division of South Scotland)
Area Fire Officer
District Officers—(5)
Foresters: Arecleoch, Balloch, Bareagle, Bennan, Changue, Clatteringshaws, Cullendoch, Dundeugh, Fleet, Garraries, Glentrool, Kilsture, Kirroughtree, Laurieston, Penninghame, Starr, Tairlaw, Glengap, Garcrogo, Corriedoo, Kilgrammie.
Fire Warden.

APPENDIX I

STAFF LIST—ABBREVIATED

Area Fire Officer:	Mr. D. Graham-Campbell	Kirkmulloch, Dalry, Castle Douglas (Tel. Dalry 250).
Fire Warden:	Mr. H. C. B. Park	Drumlaw, Glentrool Village, Newton Stewart (Tel. Bargrennan 214).
District Officers:		
Newton Stewart	Mr. J. D. MacNab	District Office, Creebridge, Newton Stewart (Tel. 267). (Home) Standalane, Palnure, Newton Stewart (Tel. 276).
	Mr. J. D. Whitaker	District Office, Creebridge, Newton Stewart (Tel. 267).
	(Continues)	
Foresters:		
Arecleoch	Mr. D. J. McNaught	The Aldons, Barrhill, Girvan (Tel. Barrhill 255). (Look-out Hut: Tel. Barrhill 276.)
Bareagle	Mr. H. O. Armstrong	Rydal Mount, Dunragit, Stranraer. 261. (Office) Tel. Dunragit 251. (Home) Tel. Dunragit
	(Continues)	

APPENDIX II

Meteorological Equipment

A. Main Meteorological Station at Fire Headquarters

i. *Thermometers:* 1 set Maximum-Minimum, 1 set Wet and Dry Bulb, 1 Grass Minimum — All these to be mounted in Stevenson type screens.

ii. *Other Instruments:* 1 Anemometer, Cup contact, Mk. II.
1 Rain Gauge 5″ Mk. II.
1 Rain Gauge 5″ measure.

iii. *Tables:* 1 set Relative Humidity Tables (M.O.265).
1 copy set Canadian Fire Hazard Tables.
(Dominion Forest Service, Forest-Fire Research Note No. 5).
As in use at Kielder.

B. Meteorological Out-stations

The minimum requirements for these are:—

1 Rain Gauge 5″ measure.
1 Rain Gauge 5″ Mk. II.
1 set Wet and Dry Bulb Thermometers
1 set Maximum-Minimum Thermometers — In Stevenson type screens.

Wind force will be estimated at out-stations according to the Beaufort Scale.

APPENDIX III

Scales of Hazard and Precautions

The arrangements to be made in the case of each grade of hazard are as follows:—

Grade V	Nil	Normal forest work for all personnel except as provided for in the Unit Standing Fire Plan.
Grade IV	Low	
Grade III	Moderate	All look-outs to be manned. Class A Unit fire teams to be on 10 minutes' mobilisation. Railway patrols to be out, and other patrols out in accordance with Unit Standing Fire Plan. All other personnel on normal work.
Grade II	High	All fire teams to be on immediate mobilisation so far as possible. All lookouts manned and patrols out. All workers grouped for ease of mobilisation. Outside assistance to be warned.
Grade I	Extreme	Fire protection takes priority over all other work. All personnel on immediate mobilisation so far as possible, lookouts manned, patrols doubled. No men alone or in groups at work in forest. Hazard to be assessed and reported 4-hourly.

APPENDIX IV

Look-out Towers and Cabins

Location	*Unit responsible*	*Area covered*
Cairn Edward Hill	Bennan	Cairn Edward, Laurieston, Corriedoo
Benniguinea	Clatteringshaws	Cairn Edward, Garraries, Corriedoo
Dundeugh Hill	Dundeugh	Dundeugh, Bennan
Glencaird	Glentrool	Glentrool
Arroch Hill	Glentrool	Glentrool
Glenrazie	Penninghame	Penninghame, Kirroughtree
Larg Hill	Changue	Changue, Balloch
Tairlaw Rig	Tairlaw	Tairlaw, Balloch
Craiglee	Starr	Starr
Standard Knowe	Arecleoch	Arecleoch, West side of Glentrool, Penninghame
Kenick Hill	Laurieston	Cairn Edward (part), Laurieston, Glengap and Fleet (part)

APPENDIX V

Fire Fighting Equipment

Unit	*Lorries*	*Vans*	*Land Rovers*	*Land Rovers with water tank*	*Trailers*	*Wheeled Trailers for Tractors*	*Pumps*				
							Hathaway	*Hathaway Hose (feet)*	*Allman*	*Allman Hose (feet)*	*Wizard*
Bennan	2	1		1	1		2	1550	2	888	19
Glentrool	4	2	1	1	1	1	3	1000	2	400	16
Kirroughtree	4	With W/T 1				2	2	3525			5
Class A Units	10	4	1	2	2	3	8	3600	4	1288	40
Clatteringshaws	1	1					1	480	1	430	11
Dundeugh	1	2					2	1620	1	600	8
Balloch	1		1				1	360	1	250	9
Class B Units	3	3	1				4	2460	3	1280	28
Arecleoch		2					2	1200			11
Changue			1		1				1	250	5
Cullendoch			1				1	1000	1	250	6
Garraries	1			1			1	900			6
Penninghame	1						1	1200			10
Starr		1			1		1	700			4
Tairlaw		1					1	450			6
Class C Units	2	4	2	1	2		7	5450	2	500	48
Mid Galloway Area	15	11	4	3	4	3	19	11510	9	3068	116
Bareagle	1	1					1	720			5
Corriedoo							1	500			3
Fleet	1	1					1	1000	1	250	7
Garcrogo			1		1		1	650			4
Glengap	1						1	450			6
Kilgrammie		1							1	250	9
Kilsture		1					1	975			7
Kyle											4
Laurieston	1	1					1	450	1	480	7
Total outside Area	4	5	1		1		7	4745	3	980	52

APPENDIX VI
Labour Available for Fire-Fighting

District	*Unit and Class*	*Labour available*	
		During Working Hours	*Outwith*
Newton Stewart	Glentrool (A)	60	30
	Kirroughtree (A)	45	20
	Penninghame (C)	11	5
	Bareagle	25	15
	Kilsture	10	—
Dalry	Bennan (A)	25	17
	Clatteringshaws (B)	12	6
	Dundeugh (B)	13	10
	Garraries (C)	8	1
	Corriedoo	2	2
Barr	Balloch (B)	11	9
	Arecleoch (C)	9	4
	Changue (C)	4	3
	Starr (C)	7	3
	Tairlaw (C)	10	5
	Kilgrammie	4	1
	Kyle	—	—
Gatehouse	Cullendoch (C)	6	—
	Fleet	22	18
	Glengap	8	4
	Laurieston	9	10
Dalbeattie	Carcrogo	4	3
		294	157

See para. 5 (c)—during working hours, not less than 25% of labour at Class A and B Units must remain at the forest.

APPENDIX VII
South-Western Fire Brigade Stations

Firemaster: Mr. H. R. Mackay. Fire Brigade Headquarters, 1 Station Road, Ayr. (Tel. 67471–2–3–4)

Station	*Telephone No.*	*Personnel*	*Equipment*	*Remarks*
Newton Stewart (part-time)	Newton Stewart 222	1 Sub. O. 1 Lead. Fm. 8 Firemen	1 HRT. 100 gall. 1 Towing Unit 1 Major Trailer pump 1 Light Trailer pump	
New Galloway (part-time)	Dumfries 2222	1 Sub. O. 1 Lead. Fm. 8 Firemen	1 HRT. 100 gall. 1 Major Trailer pump 1 Light Trailer pump	

(*Continues for* 8 *further stations*)

APPENDIX VIII

Military Assistance, etc.

The Cameronians — Winston Barracks, Lanark. Tel. No. LANARK 491.

(Application to be made through Conservator—see para. 7 (b))

Ministry of Supply — Kirkcudbright Range. Tel. No. TOWNHEAD 855.

(Assistance to be called by District Officers)

APPENDIX IX

Location of Fire Rendezvous Points

F.R.P. No.	*Locatio*	*Unit*
1	Garpel Burn	Starr
2	Girvan Bridge	Tairlaw
3	Bargrennan/Straiton road 200 yds. N. of Tairlaw march	Balloch and Tairlaw
4	South Balloch Farm	Balloch
5	Forester's House	Balloch

(*Continues for* 58 *further entries*)

APPENDIX X

Use of Radio

(1) Radio Control, Discipline and Procedure

(i) Radio will be used in accordance with the instructions in the Fire Code, Section G, sub-sections d, e, f and g. Because of the present distribution of radio equipment, Glentrool Main Station will always remain as Radio Control, and so in the event of one sub-station wanting to speak to another sub-station, permission must first be obtained from Glenfire Control. If a sub-station asks Glenfire Control for permission to speak to another sub-station but fails to make contact with Glenfire Control, it should try a second time and if it still fails to make contact, it should carry on and speak *briefly* to the other sub-station without further delay.

(ii) In all normal transmissions Glenfire Control will be involved and in every such case it will be for Glenfire Control to end the transmission by using the Code Word 'Out'. This ensures that all other stations, some of which may be waiting to broadcast, can hear when the air is free.

(iii) The Callsign 'Glenfire' is to be used at the beginning and end of all transmissions. (See Fire Code Section G e 1).

(iv) In the event of a Mobile or Packset being sent to a fire, etc., at another unit, it will adopt the Callsign of the unit to which it is sent. (For example, if Fox 1 Packset was sent to Clatteringshaws, it would become George 3).

(v) Each set must have its Callsign clearly marked on it. (See Fire Code Section G e 2 (iii)).

(2) Distribution of Sets

Station	*Radio Held*	*Callsign*
Glentrool Main Station	Main Set	Glenfire Control
Glentrool Forest	1 Mobile Set	Able Mike
	4 Packsets	Able 1, 2, 3 and 4

Station	*Radio Head*	*Callsign*
Bennan Forest	1 Mobile Set	Fox Mike
	3 Packsets	Fox, 1, 2 and 3
Clatteringshaws Forest	1 Mobile Set	George Mike
	2 Packsets	George 1, 2
Balloch Forest	1 Mobile Set	Oboe Mike
	3 Packsets	Oboe 1, 2 and 3
Kirroughtree Forest	1 Mobile Set	Baker Mike
Tairlaw Forest	3 Packsets	Queen 1, 2, 3
Garraries Forest	1 Mobile Set	Item Mike
	1 Packset	Item

(3) Allocation of Callsigns

Conservator	—	Zebra
S.F.O.	—	Yoke
Mr. Fergusson	—	Dog One
Mr. MacNab	—	Dog Two
Mr. Graham-Campbell	—	Dog Three
Mr. Whitaker	—	Dog Four

Glentrool	—	Able	Corriedoo	—	Jig
Kirroughtree	—	Baker	Cullendoch	—	King
Penninghame	—	Charlie	Glengap	—	Love
Arecleoch	—	Easy	Laurieston	—	Nan
Bennan	—	Fox	Balloch	—	Oboe
Clatteringshaws	—	George	Starr	—	Peter
Dundeugh	—	How	Tairlaw	—	Queen
Garraries	—	Item	Changue	—	Sugar

(4) Phonetic Alphabet

Able	George	Mike	Sugar	Yoke
Baker	How	Nan	Tare	Zebra
Charlie	Item	Oboe	Uncle	
Dog	Jig	Peter	Victor	
Easy	King	Queen	William	
Fox	Love	Roger	X-ray	

(5) Important Code Words

Correction—An error has been made in the transmission. The correct version is:—

I say again—I am repeating transmission.

I spell—I shall spell the next word phonetically.

Out—This is the end of my transmission to you. No reply is expected.

Over—This is the end of my transmission to you. A reply is necessary. Go ahead and transmit.

Roger—I have received your last transmission satisfactorily.

Wilco—I have received your message. I understood it and will comply.

Say Again—Repeat all your transmission.

Wait—I must pause for a few seconds.

Wait Out—I must pause for longer than a few seconds.

Fire Flash—Emergency Call for attracting attention of Control Station. (For use see Fire Code Para. G f 4 (ii)).

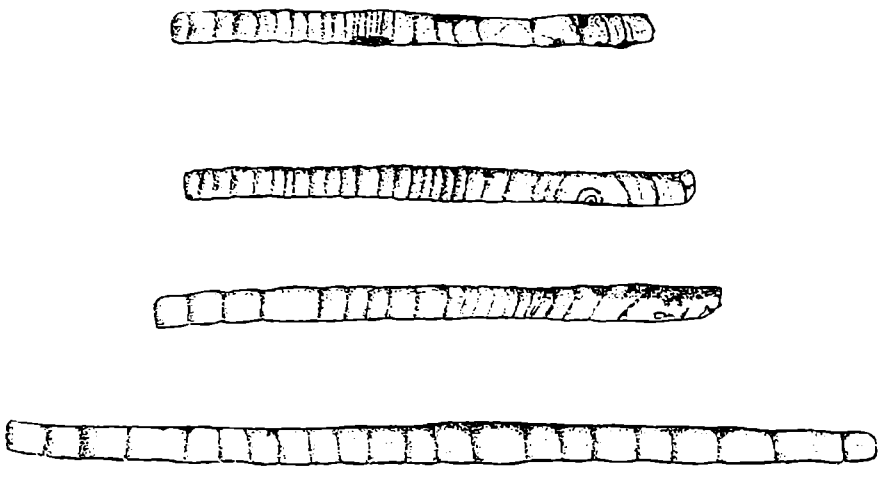
(6) Examples of Conversations

(1) *Sub-station calling Glenfire Control*

"Glenfire Fox Mike to Glenfire Control. Over."
"Glenfire Control to Glenfire Fox Mike. Loud and Clear. Over."
"Loud and Clear . . . . . (conversation follows) . . . . . "
"(End of conversation) Glenfire Fox Mike to Glenfire Control. Over."
"Glenfire Control to Glenfire Fox Mike. Out."

(2) *Sub-station calling another Sub-station*

"Glenfire Fox Mike to Glenfire Control. Over."
"Glenfire Control to Glenfire Fox Mike. Loud and Clear. Over."
"Loud and Clear. May I speak to Fox One. Over."
"Go ahead. Over."
"Fox Mike to Fox One. Over."
"Fox One to Fox Mike. Loud and Clear. Over."
"Loud and Clear . . . . . (conversation follows) . . . . . ."
"(End of conversation) Fox One to Fox Mike. Over."
"Glenfire Fox Mike to Glenfire Fox One. Out."
"Glenfire Fox Mike to Glenfire Control. Transmission to Fox One completed. Over."
"Glenfire Control to Glenfire Fox Mike. Roger. Out."



Examples of Slowing down of Growth of European larch by Die-back, followed by Recovery, as shown by Pressler borings.—See page 100.

SAFETY AND SURVIVAL MEASURES IN FOREST FIRES

We are indebted to the Forests Department of Western Australia for permission to reproduce the following recommendations, which they issue to all their forest staff and workmen. Australian fire hazards are higher than ours, but situations can arise here in which such measures could be vitally important.

1. Personal Safety Measures

(a) *Wear suitable clothing—*

Preferably woollen garments—never synthetics.
Long trousers (tucked into socks or gaiters), sleeves rolled down and shirt buttoned to the neck.
Strong leather boots—never sandshoes or sandals.
Handkerchief or dust mask to cover face and mouth.
Protective helmet.
Carry matches—for lighting back-burn if necessary.

(b) *Avoid danger areas—*

Dense scrub thickets.
Steep slopes above fire.
Swamps.

(c) *Develop observation to aid a "sense of direction".*

Note landmarks, roads, tracks, creeks, ridges, clearings, burnt country (i.e., "safe ground").

(d) *Insist on prior instructions*

Know burning drill, signals, rendezvous and escape routes.
If you do not know how to keep a straight line—ask for instruction.

(e) *Learn recommended individual survival measures*

(A detailed bulletin on this subject is held by the overseer—borrow it and read it.)

(f) *Keep yourself physically fit*

Eat well, get a full quota of sleep, and, when burning or fire fighting drink more than even thirst demands.

2. Individual Survival Measures (If fire has cut escape route)

(a) *Conserve energy*

Don't panic—panic drains physical and nervous energy and clouds judgment.
Don't run unless absolutely necessary.

(b) *Shield body from radiated heat*

By clothing as already discussed in "Personal Safety Measures". Heat saps energy—leads to exhaustion and collapse.

(c) *Take refuge*

Light back burn and step on to burnt country.
Use running streams and dams; gravel pits; clearings in forest; large open rock outcrops or even large logs.
Assume prone position on ground (air is freshest and coolest at ground level), limit breathing rate and fill lungs as pockets of fresh air arrive.

(d) *Move through flames*

Should this become necessary—

Do not delay in front of the flames.

Use clothing to best advantage as a shield.

Select area not obstructed by dense growth, logs or uneven ground.

Select point where flame front depth is at a minimum.

Await, if possible, a lull in the fire when flame height will be reduced.

Take some deep breaths and move through as quickly as possible on to burnt ground. Bend low before inhaling.

Finally, to quote directly from the C.S.I.R.O. publication *Bushfire Sense:*—

In most bushfire tragedies the people are usually dead or nearly dead before the flames actually touch them. By laboratory and field measurement and from the study of case histories of people who have either lost their lives or saved them when encompassed by fire, it is now abundantly clear that radiated heat is the main peril leading to exhaustion and collapse. Radiation causes heat stroke, which is essentially a state of utter exhaustion. Shielding yourself from radiation and desisting from any behaviour or activity such as fear, panic or flight that saps your strength are therefore vital.

Many of the rules for safety and survival listed above are based on these considerations.

3. First Aid for Burns

(a) Avoid handling the affected area more than is necessary. See that your hands are as clean as possible.

(b) Do not apply lotions of any kind.

(c) Do not remove burned clothing and do not break blisters.

(d) Cover the area (including burned clothing) with a prepared sterile dressing, or whatever clean bandaging material is available.

(e) Bandage firmly except when blisters are present, in which case bandage lightly. (Where face is burnt, cut bandaging material in the shape of a mask with a hole for breathing.)

(f) Immobilise the affected area by suitable means.

(g) Treat for shock.

(i) Reassure the casualty.

(ii) Lay him down—position depending on injuries.

(iii) Loosen clothing about neck, chest and waist.

(iv) Wrap him in blanket, rug, coat or whatever cover is available.

(v) If he complains of thirst he may be given sips of water, tea, etc., but not alcohol.

(If casualty is badly burned he must be removed for medical aid as quickly as possible. It should then be borne in mind that unless it will take more than four hours to reach such aid he should not be given anything by mouth as he will almost certainly need an anaesthetic. Should such delay be inevitable, water, to which salt has been added (at a rate of half a teaspoon to two tumblers), is the best drink.)

Note—All gang vehicles and others used during burning and firefighting should carry a complete approved First Aid Kit which should include:—

A good quantity of wide bandages and a packet of common salt.

4. Vehicle Safety Measures

Certain measures are necessary to safeguard vehicles during controlled burning operations.

(a) *Parked Vehicles*

More often than not vehicles will be parked for a greater part of the time and so should be:—

(i) Parked facing in such a way that they can move directly out of the area on a known safe route.

(ii) Left with the ignition key in the lock.

(iii) Parked on a cleared or previously burnt area.

(iv) Parked so that other vehicles may pass easily and safely.

(v) If a man is left with the vehicle he should know the outline of the whole operation—what other members of the gang are doing, any rendezvous with the others, and any communications schedules.

(b) *Driving through Fire and Smoke*

Should it become necessary to drive through a burning area or one heavily covered with smoke, the following should be observed:—

(i) Drive at a speed commensurate to safety.

(ii) Keep cab windows wound up.

(iii) Switch on lights and blow horn occasionally.

(iv) Avoid having inflammable material exposed on the truck.

(v) If men are travelling on the truck tray they should have water available—either powered pumper and tank or knapsack sprays.

"ACCIDENTLY DONE, ON PURPOSE"

By

W. J. DAVIES

Forester

When examining the Forest Accident Book, it appeared to me that several of the entries failed to qualify as accidents when looked at in the light of the Concise Oxford Dictionary definitions of ACCIDENT, and ACCIDENTAL.

ACCIDENT. Event without apparent cause, unexpected; unintentional act; chance; *unforeseen course of events.*

ACCIDENTAL. Happening by chance, undesignedly, and *unexpectedly.*

A few entries from the Accident Book will illustrate this:—

Struck by Lightning. Unexpected; chance.

Cut Finger While Sharpening Reap-hook. Unexpected? Without apparent cause? Surely not; the man must have been sharpening his hook wrongly or awkwardly or carelessly.

Thorn in Finger. Unexpected.

Sliver of Bracken in Finger. Chance.

Cut Leg by Reap-hook being deflected. Without apparent cause? Surely not—the man was taking a blind swipe and didn't notice the piece of twig that would deflect his hook.

What's this next one—Wasp sting! ACCIDENT? How can it be an accident? Surely, if the wasp had used its sting, it had used it deliberately.

Let's follow up this "accident"—or should it read "incident"!

A Forest Worker is weeding. So far his wasp nest score to date has averaged out at seven nests per acre. Mostly the nests have been underground, only the occasional one being of the Tree wasp variety.

The Tree wasp nest, hanging as it does from the branches of a tree or in low brambles, is fairly easily seen. The underground nests are not quite so easily spotted, so that in a wasp-prone area, the Forest Worker has to pay almost as much attention to looking out for wasp nests as he has to in making sure he doesn't cut off the trees he is weeding.

One of the qualifications of ACCIDENTAL i.e. UNEXPECTEDLY has been eliminated.

The presence of a nest is quite often indicated by a constant stream of wasps in and out of the nest. The actual entrance hole of the nest may be hidden, or not easily seen, but the nearer one gets to the nest, the greater the activity becomes and, apart from a notice saying "Beware, Wasp Nest", no greater warning can be given; or need be given.

Be that as it may, the Forest Worker we are following has either disregarded the warning or has his mind set on reaching the drink that is waiting for him at the end of the row. He drives his hook into the vegetation that conceals the entry to the nest and in less time than it takes to tell, inside the nest Martial Law is declared, and complete mobilisation is put into effect. Incoming wasps join up with the outgoing wasps and the immediate vicinity. If the nest becomes an ominous buzzing cloud of wasps who are all instilled with one idea: TO ATTACK.

If the Forest Worker hasn't put the greatest possible distance in the shortest possible time between himself and the nest, HE IS ATTACKED.

If he is stung he is stung as a deliberate act by the wasp.

Where was the accident in cutting over the nest? The warning had been given first in the seven nests per acre. The busy traffic to and from the nest had confirmed it, so that it wasn't unexpected. Had the Forest Worker taken evasive action sooner, or had been off his mark just that little smarter, he wouldn't have been stung.

It was no accident.

Once, I was stung by a wasp. I had placed a free-will offering at the entrance to a very strong wasp nest that had been found in a bank. The offering consisted of a spoonful of Cymag wrapped up in a small piece of cloth. It had been tied to the end of a length of stick, dipped in water and then placed, very carefully, against the hole. It had been done quite deliberately, and to see how my gift was received I stood well away from the nest watching through a pair of binoculars.

The effect was immediate, but as I watched, I saw a wasp come out of the entrance. It paused on the pile of corpses that was mounting at the hole, and then flew straight up the line of sight of my binoculars, and stung me right between the eyes.

Accident?—not on your life.

I personally can recall only two incidents concerning wasps that could be called accidental.

The first incident concerned a wasp that had been well and truly swatted. As it fell to the floor, in a last gesture of defiance it ejected its sting, which remained sticking out of the corpse. When my bulldog sat on that dead wasp he found out, accidentally, where death kept its sting.

The second instance concerned me. One day, when a boy, I was given a

slice of bread and jam for tea. In the jam on the slice of bread was a wasp that had drowned itself in the jam pot. I didn't spot the wasp until it was too late, and in my impatience to get outside the bread and jam, the sting of that dead wasp was helped into the roof of my mouth—by me. Now, that *WAS* an accident.

POWER SAW SAFETY RULES

Reproduced by courtesy of the Power Saw Manufacturers Association, U.S.A.

The safe operation of a Power Saw rests entirely with the operator.

Safety Clothing

The first step in achieving safety is to be properly and safely clothed.

1. Use a safety helmet.
2. Use safety pants, leggings or pads.
3. Use safety footwear.
4. Use eye protection device
5. Use snug fitting garments.

Operation of a Chain Saw

The second step in achieving safety is in following the training instructions provided by safety groups:

1. When moving any distance, stop the saw and always carry it by the handlebar with the guide bar to the rear and in such a manner that it may be thrown clear in the case of a fall.
2. When fuelling a chain saw, follow all the fire precaution rules (See PART IV).
3. To start the saw, place the saw on the ground and be sure no one else is near it.
4. Before starting to cut, have a clear place to work, a secure place to stand, and a safe exit from falling limbs and trees.
5. Depending upon conditions, be sure proper notch or under-cut is made.
6. Fellers must give timely and adequate warning to other persons in the vicinity of the tree being felled.
7. Use a power chain saw, with *caution*, to cut off heavy limbs. Smaller limbs are usually hard and brittle, and increase the danger of flying chips and splints. Do not stand on the tree while limbing. Limb from the opposite side of the tree. Use extreme caution when cutting limbs supporting log.
8. When bucking, always stand on the high side of the log, place bumper against log, use both hands on saw, have a firm grip and keep the saw under control at all times. Learn when and how to undercut, bores and the use of wedges. Avoid "kickback" of saw caused by binding and snagging.
9. Keep body clear of exhaust system at all times.
10. Guard against chain and bar coming in contact with stones, dirt or other foreign matter.

PREVENTIVE MAINTENANCE OF POWER CHAIN SAWS

Breakdown time is lost time, and much of this can be prevented by using preventive maintenance. The definition of "preventive maintenance" can best be described by "a stitch in time saves nine". Applied to a man in preventing

an accident to himself or his fellow workmen before it happens, it means eliminating physical pain, loss of earning power, and in many instances, hardship to his family. Applied to the chain saw, preventive maintenance means inspection and correction. Breakdowns are prevented before they happen, thus keeping the earning capacity of the saw at its maximum.

1. Know and follow only the manufacturer's instructions regarding operating, adjusting, repairing, cleaning and lubricating of your power chain saw.
2. Inspect and clean your saw at regular intervals. Keep all nuts and bolts tight. Particular attention should be paid to all controls such as throttle, ignition and chain oiler.
3. Be sure carburettor air cleaner is clean at all times.
4. Use quantity and quality of oil recommended by the manufacturer. Do not change oil mix.
5. Keep engine cooling system clean. Do not allow accumulation of debris in fins of cylinder.
6. Be sure exhaust muffler is in good condition and exhaust ports are in a clean condition.
7. Be sure your chain is always sharpened and jointed to the manufacturer's specifications. Always maintain correct tension as recommended by the manufacturer. Inspect chain periodically and replace any cracked or damaged parts. Keep chain well lubricated.

FIRE PRECAUTIONS

Fire Prevention

Power saw fires are all preventable. Ignorance or disregard of the following conditions could cause a fire. Every company has its own regulations regarding the use of the power saw in the woods; but in general there are basic rules that an operator should observe.

Fire Prevention Rules:

1. Allow hot saw to cool two or three minutes before refilling the fuel tank.
2. Place saw on bare ground before adding fuel.
3. Use funnel and approved safety can with spout, to avoid spilling fuel. Do not fill tank to top.
4. Remove all traces of fuel and oil on the saw before starting engine.
5. Do not start engine at place of refuelling. Be at least ten feet away.
6. Use proper mixture and grade of oil and gas to minimize carbon formation. Follow manufacturer's instructions.
7. Do not wait for engine to run out of gas before refuelling. If the saw stops in cut, removal may be difficult; refuelling while saw is tilted may cause spilling of fuel.
8. Check fuel lines and connections frequently for fuel leaks. Vibration is liable to loosen fuel feed lines.
9. Clean the carbon from muffler at least once a week. Tighten muffler bolts to avoid cracking or breaking during operation—never operate saw without muffler.
10. Check insulation on spark plug wire, and keep connection tight.
11. Do not use a saw that is backfiring, missing or otherwise not running properly. Have it repaired immediately. Never take the risk of starting a *forest fire.*

12. Do not leave hot saw on dry litter or slash. Set it on log, stump or bare ground.
13. When moving from one cut to another, examine ground and sawdust pile, to insure no spark or ember is left behind to start a forest fire. A special check should be made when leaving the cutting area.
14. Keep an approved extinguisher handy, but never strap it on the saw.
15. Do not leave saw idling when unattended.
16. Do not leave cutting area earlier than 15 minutes after shutting off saw at end of day.
17. Do not leave empty fuel or starter fluid cans in the bush. These have been known to explode and start fires.
18. *Remember the ember.* Your life is at stake if you start a fire in a high hazard area while fire weather prevails.

A GUIDE TO HOME-GROWN TIMBERS

By

J. R. AARON

District Officer, Headquarters

A. SOFTWOODS

1. Scots pine (*Pinus sylvestris*)	*Alternative Names:*	Baltic redwood, Red deal, Yellow deal, Red pine, Scots fir.
	Weight	33 lb. per true cubic foot (Seasoned).
	Properties	Fairly good strength properties; works, nails and finishes well; easily treated with wood preservatives; preservative treatment required when used in contact with the ground.
	Uses	A good general purpose softwood. Suitable for joinery, flooring, carpentry and general construction, box and packing case manufacture, particle board, fibre board, certain types of pulp, all types of pitwood, estate work, railway sleepers, telegraph and power transmission poles.
2. Corsican pine (*Pinus nigra var. calabrica*)	*Weight*	32 lb. per cubic foot. (Seasoned.)
	Properties	Moderate strength properties; works, nails and finishes well; easily treated with wood preservatives; preservative treatment required when used in contact with the ground; fairly stable in changing conditions of atmospheric humidity.
	Uses	A general purpose softwood. Suitable for boxes, all types of pitwood, fibre board and ground wood pulp manufacture, woodwool, and general estate work; selected material is suitable for joinery.

3. Lodgepole pine (*Pinus contorta*)	*Weight*	29 lb. per true cubic foot. (Seasoned).
	Properties	Fairly good strength properties; works, nails and finishes well; seasons well; fairly stable in changing conditions of atmospheric humidity; if used in contact with the ground preservative treatment is required.
	Uses	A good general purpose softwood, suitable for joinery, carpentry and general construction, furniture and flooring.
4. European larch (*Larix decidua*)	*Weight*	37 lb. per true cubic foot. (Seasoned).
	Properties	Good strength properties; heartwood is moderately durable; resistant to abrasion; fairly stable in changing conditions of atmospheric humidity.
	Uses	All types of pitwood; outdoor structural work; well suited to estate work on account of the durability of its heartwood; river and marine work; selected material is in demand for boat-building, wagon construction, and vat manufacture.
5. Japanese larch (*Larix leptolepis*)	*Weight*	33 lb. per true cubic foot. (Seasoned).
	Properties	Good strength properties; heartwood is moderately durable; fairly stable in changing conditions of atmospheric humidity.
	Uses	All types of pitwood; general estate work; selected material for structural work and joinery.
6. Hybrid larch (*Larix eurolepis*)	*Properties*	Resembles European larch but usually has fewer growth rings per inch.
	Uses	As for European larch.
7. Norway spruce (*Picea abies*)	*Alternative Names:*	White deal, Baltic whitewood, White pine, Swiss pine.
	Weight	24 lb. per true cubic foot. (Seasoned).
	Properties	Reasonable strength properties considering low density; seasons rapidly; has clean white colour; works, nails and finishes well; not usually attacked by wood staining fungi; fairly stable in changing conditions of atmospheric humidity; preservative treatment required if used in contact with ground.
	Uses	Especially suitable for the manufacture of box shooks and woven fencing. Also used for all types of pitwood, particle board, fibre board, woodwool, ladder poles, flag poles, and carpentry. Selected material is suitable for joinery and kitchen furniture. Estate work. The leading pulpwood species.

8. Sitka spruce (*Picea sitchensis*)	*Alternative Name:*	Silver spruce.
	Weight	25 lb. per true cubic foot. (Seasoned).
	Properties	Reasonable strength properties considering its low density (i.e. has a high strength/weight ratio). Works easily but it is sometimes difficult to obtain a good finish; clean white colour; can be kiln dried rapidly without marked increase in the amount of degrade; fairly stable in changing conditions of atmospheric humidity; preservative treatment required if used in contact with the ground.
	Uses	All types of pitwood, particle board, pulp and fibre board manufacture, box and packing case manufacture, woodwool, carpentry and general construction. Selected material is suitable for joinery and kitchen furniture. The bark has a high tannin content and can be used for leather manufacture.
9. Douglas Fir (*Pseudotsuga taxifolia*)	*Alternative Names:*	Oregon pine; Columbian pine.
	Weight	30–34 lb. per true cubic foot.
	Properties	Excellent strength properties; works and finishes well; heartwood is moderately durable; fairly stable in conditions of changing atmospheric humidity. Somewhat difficult to impregnate with preservatives.
	Uses	A first-class structural timber. Also suitable for pitwood, joinery, flooring, furniture, fibreboard manufacture, and estate work.
10. Minor Softwood Species	**Silver firs** (*Abies spp.*)	Low density clean white timbers, not durable unless given preservative treatment, easy to work giving good finish, but low resistance to impact. Can be used for estate work, boxes, fibreboard manufacture and joinery (selected material).
	Western hemlock (*Tsuga heterophylla*)	General purposes softwood with fairly good strength properties suitable for all types of pitwood, carpentry, flooring, and fibreboard manufacture.
	Western red cedar (*Thuja plicata*)	A special purpose softwood; heartwood is durable making it useful for greenhouses, seed boxes, estate work (especially gates) and cladding of timber houses; cleaves easily and can thus be used for roof shingles.

B. HARDWOODS

1. Alder (*Alnus glutinosa*)	*Weight*	33 lb. per true cubic foot. (Seasoned).
	Properties	Easy to work. easy to treat with wood preservatives.
	Uses	Wood turning.
2. Ash (*Fraxinus excelsior*)	*Weight*	43 lb per true cubic foot. (Seasoned).
	Properties	Good strength properties, especially in resistance to impact; clean white colour; easily treated with wood preservatives.
	Uses	Selected material for sports goods such as hockey sticks, shunters poles, coach building, handles and shafts of tools, furniture manufacture. Lower grade material can be used for wood turning and estate work.
3. Beech (*Fagus sylvatica*)	*Weight*	45 lb. per true cubic foot. (Seasoned).
	Properties	Works fairly easily, has excellent strength properties, easy to treat with wood preservatives.
	Uses	Furniture, wood turning, estate work, charcoal manufacture, mining.
4. Birch (*Betula spp.*)	*Weight*	41 lb. per true cubic foot.(Seasoned).
	Properties	Excellent strength properties. Works fairly easily, readily treated with wood preservatives.
	Uses	Wood turning, furniture, cooperage (especially herring barrels); a general purpose hardwood suitable for estate work if treated with preservative; charcoal manufacture.
5. Chestnut (Sweet) (*Castanea sativa*)	*Alternative Name:*	Spanish Chestnut.
	Weight:	34 lb. per true cubic foot. (Seasoned).
	Properties	Durable in contact with the ground; cleaves readily; works and finishes well; fairly stable in conditions of changing atmospheric humidity.
	Uses	(a) Large timber. Furniture, flooring, wood-turning, estate work. (b) Coppice. Estate work, hop poles, cleft paling fences.
6. Elm (*Ulmus* spp.)	*Weight*	English elm and Dutch elm 34 lb. per true cubic foot. (Seasoned). Wych elm 42 lb. per true cubic foot. (Seasoned).
	Properties	Moderately good strength properties. easily treated with wood preservatives; handsome figure.
	Uses	Coffin boards, sea defences, port installations, wood turning, furniture, estate work.

7. Oak (*Quercus robur & Q. petraea*)	*Weight*	45 lb. per true cubic foot. (Seasoned).
	Properties	Heartwood durable in contact with ground; resistant to abrasion; handsome figure.
	Uses	Furniture, coffin boards, sea defences, veneers, railway waggon construction and repair, estate work, flooring, cooperage, barge building, mining.
8. Poplar (*Populus* spp.)	*Weight*	23–33 lb. per true cubic foot. (Seasoned).
	Properties	Clean white colour; easy to work; peels well; resistant to abrasion; good strength-weight ratios; difficult to treat with preservatives.
	Uses	Matches, chip baskets, waggon bottoms, brake blocks, light boxes and crates.
9. Sycamore (*Acer pseudoplatanus*)	*Alternative Name:*	Plane (Scotland).
	Weight	38 lb. per true cubic foot. (Seasoned).
	Properties	Clean white colour, easily treated with wood preservatives, works and finishes well (but is advisable to pre-bore nail holes to avoid splitting). Often has a fine figure.
	Uses	Furniture, food utensils, turning, textile woodware, estate work, veneers, rollers, mining.

10. Minor hardwood species The following special suitabilities can be mentioned:

Apple for mallet heads and turnery.

Cherry for furniture.

Holly has clean white colour, can be used for turnery, textile woodware; can be stained black to resemble ebony.

Hornbeam (the home grown timber most resistant to abrasion) for flooring, chopping blocks, sea defences and machinery parts.

Horse chestnut has a clean white colour and is stable in changing conditions of atmospheric humidity; for indoor shelving in contact with food materials.

Lime for turnery.

Maples for furniture, turnery and flooring.

Plane (i.e. London plane, not sycamore) timber is known as lacewood and is used for furniture, turnery and panelling.

Walnut for furniture, panelling, turnery and ornamental woodware.

C. SPECIES SUITABLE FOR VARIOUS USES

The following lists indicate species which are well suited to the uses specified; however, omission of a species does not necessarily mean that it is unsuitable for that particular purpose.

Where more than one species are shown, they are generally listed in order of suitability.

Boxes	Norway spruce, Lodgepole pine, Scots pine, Sitka spruce, Douglas fir, poplar.
Cable Drums	Norway spruce, Sitka spruce, Scots pine, Lodgepole pine, Douglas fir, Western hemlock, European larch, Japanese larch.
Carpentry	Douglas fir, European larch, Lodgepole pine, Scots pine, Norway spruce, Sitka spruce, Japanese larch.
Charcoal	Beech, birch, oak.
Chipboard	Spruces and pines.
Coffin Boards	Oak, elm, pine.
Estate Work	Chestnut (sweet), oak (heartwood), European larch, Japanese larch, Douglas fir (heartwood)—all without preservative treatment. Any other softwood with preservative treatment. Oak containing sapwood can also be used if given preservative treatment.
Fibre board manufacture	Pines universally acceptable.
Flooring	Hornbeam, beech, oak, sycamore, maples, elm, Scots pine, Douglas fir, Western hemlock, Lodgepole pine.
Food containers	Norway spruce, Sitka spruce, Western hemlock, sycamore, birch, poplar.
Furniture—High Quality	Oak, sycamore, elm, beech, maple, plane, cherry, chestnut.
Furniture—Kitchen	Norway spruce, Lodgepole pine, Scots pine, Western hemlock.
Gates	European larch, Douglas fir, oak (heartwood), Western red cedar, Japanese larch—all without preservative treatment. Any softwood except Corsican pine with preservative treatment.
Houses—External Cladding of	Western red cedar, Norway spruce, and Sitka spruce, oak, elm, larches. In the humid British climate, preservative treatment is always advisable.
Joinery	Lodgepole pine, Norway spruce, Sitka spruce, Scots pine, Douglas fir, Western hemlock.

Mining Timber, sawn	Practically all species of hardwood and softwood can be used except Western red cedar.
Packing cases for Heavy Machinery	Douglas fir, Scots pine, Lodgepole pine, Western hemlock.
Pallets & Stillages	All species except Western red cedar.
Paper	See under Pulpwood.
Particle Board	Spruces and pines.
Pit-props	All conifers except Western red cedar may be used—props with any marked bow should be excluded.
Pitwood	All conifers except Western red cedar are suitable.
Pulpwood (Groundwood)	Norway spruce, Sitka spruce, pines (not universally acceptable).
Pulpwood (Chemical)	Some mills use hardwood exclusively, and some use spruces exclusively; a few accept a wide range of species.
River Defences	European larch, oak, chestnut, Japanese larch.
Roof Trusses	Douglas fir, Scots pine, Lodgepole pine, Norway spruce, Sitka spruce, Western hemlock.
Sea Defences	Elm, oak, Douglas fir, European larch, Japanese larch, beech, Scots pine.
Seed Boxes	Western red cedar.
Shingles	Cleft oak, cleft Western red cedar, sawn Norway spruce. Preservative treatment is advisable in our moist climate.
Shuttering for Concrete	All species of softwood.
Structural work	Douglas fir, European larch, Scots pine, Lodgepole pine, Japanese larch, Western hemlock, Norway spruce, Sitka spruce, Scots pine, oak.
Turning	Sycamore, beech, birch, ash, elm, alder, and many other hardwoods.
Waggon Construction and Repair.	European larch, Japanese larch, oak.
Wood flour	Norway spruce—home grown not generally used.
Woodwool	Norway spruce, Sitka spruce, Corsican pine, Douglas fir, Japanese larch.

D. NOTES ON DURABILITY AND PRESERVATIVE TREATMENT

Natural Durability

When wood is used in damp locations or in contact with the ground it is liable to become decayed as a result of attack by wood destroying fungi. Some species of timber are more resistant to attack by such fungi than others; this inherent resistance is termed natural durability. Degrees of natural durability have been defined by the Forest Products Research Laboratory as follows:—

(1) **Durable** (Life in contact with ground 15-25 years)

Home grown timbers falling into this category include oak (heartwood), Western red cedar (heartwood) and chestnut (heartwood). No preservative treatment is required if sapwood is excluded.

(2) **Moderately durable** (Life in contact with ground 10-15 years)

Home grown timbers falling into this category include Japanese larch (heartwood), European larch (heartwood) and Douglas fir (heartwood).

(3) **Non-durable** (Life in contact with ground 5-10 years)

Home grown timbers falling into this category include elm and practically all softwoods (except larches, Western red cedar and Douglas fir). Preservative treatment is necessary for most outdoor uses.

(4) **Perishable** (Life in contact with ground less than 5 years)

Sapwood from all species, and the heartwood of all common hardwoods (other than oak, chestnut and elm) fall into this category. Preservative treatment is essential for outdoor uses.

The charring of fence posts does not increase their durability to any useful degree.

Preservative Treatment

Many species of wood are susceptible to decay when used in contact with ground or in damp localities. The decay is caused by attack by wood destroying fungi, but it can be prevented if the wood is treated with a wood preservative. The preservative treatment involves the impregnation of the wood cells with substances that are toxic to the fungi. Preservative treatment also increases the resistance of the timber to attack by wood boring beetles, termites and wood-destroying fauna in the sea.

Species of timber differ considerably in the ease with which they can be impregnated, and different methods of treatment may be employed depending upon their resistance to impregnation. Most estates can, for example, construct a simple "hot and cold tank" type of plant, but this is not effective for treating the more resistant species. The methods generally used in Great Britain are as follows:—

1. Hot and Cold Tank

A suitable preservative for this method is coal-tar creosote. The timber is immersed for some hours in a tank of hot preservative which heats the air within the cell cavities. This air expands and forces some of it to bubble away. It is then allowed to cool, when the contracting air within the cells draws preservative into the wood. The tank can then be reheated to drive off the excess preservative within the wood, which is lifted from the tank whilst still moist.

This process is suitable for small sized material of Scots pine. Corsican pine, lodgpole pine, Norway spruce, Sitka spruce, birch, beech, elm, sycamore and ash. It is not recommended for larches or for Douglas fir.

2. Pressure Treatment

Coal tar creosote and certain water-borne preservatives are suitable. Special equipment is required. It can be used for practically all species, but low temperature/pressure combinations are advisable for the spruces otherwise collapse of the wood tissue may occur.

3. Brushing, Spraying, Dipping and Steeping

These methods seldom give satisfactory results, and are not recommended.

E. NOTES ON SEASONING

Seasoning merely means the drying of timber to remove the sap. When timber is felled it usually has a moisture content exceeding its dry weight, and in some tree species it can exceed 150% of the oven dry weight. Seasoned timber on the other hand has a moisture content of only 12% to 22% of the oven dry weight.

Seasoned timber has the following advantages over unseasoned timber:—

(i) It is lighter in weight and thus easier to handle.

(ii) It is unlikely to be attacked by wood destroying fungi.

(iii) It is less likely to shrink.

(iv) It is easier to work, finish, paint and varnish.

(v) It is less likely to corrode nails and screws.

(vi) It is easier to treat with wood preservatives.

(vii) Wood staining fungi are less likely to develop.

(viii) *It is stronger when used for support, as in a pit prop.*

Seasoning is usually undertaken by one of two methods.:—

(i) **Air seasoning**

This involves stacking the timber out of doors in such a way that air can circulate freely and allow the moisture in the wood tissue to evaporate away. The process takes several weeks, the actual time required depending upon the dimensions of the timber and the prevalent atmospheric conditions of wind speed, temperature and humidity.

(ii) **Kiln Drying**

This involves placing the stack of timber in a kiln in which warm air and steam can be circulated by means of fans. The rate of drying and the final moisture content of the wood in a kiln is controlled by adjusting the temperature and humidity of the circulating air. It is a much quicker process than air seasoning.

F. NOTE ON WEIGHT

The figures given for the weight of each species are *averages*, assuming seasoning to a moisture content in the region of 18 to 20% of oven-dry weight. Considerable variation occurs even when samples are seasoned to the same moisture content. *Unseasoned* timber of all species is, of course, substantially heavier.

THE FOREST PRODUCTS RESEARCH LABORATORY/FORESTRY COMMISSION HOME-GROWN TIMBER RESEARCH COMMITTEE

A Review of the First Five Years' Work, 1958–63

Since the Forest Products Research Laboratory was founded nearly 40 years ago to study the science and technology of timber, its programme of research has always included the study of home-grown timbers. The importance of close co-operation between those who study timber and those who grow and market it has always been recognised. The Forestry Commission, with its own planting programme and with responsibilities towards the private woodland owner also, has had a special interest in the work of the Laboratory and liaison between the two has always existed officially and through informal personal contact between individual research workers.

In 1958 a re-orientation of the Laboratory's programme enabled a larger proportion of its research effort to be devoted to home-grown timbers and it was decided in view of this to form a Committee with special responsibility for co-ordination of work in this field. The Committee was instructed to keep under review all the joint work of the Laboratory and the Commission, to consider proposals for new research projects, to arrange for the requisite liaison, and to make recommendations to the Directors of the Forest Products Research Laboratory and the Research Branch of the Forestry Commission. The Committee, having members who are directly concerned with utilisation or research in forestry or timber technology, has proved a useful forum where investigations can be planned, results can be discussed, and the relative importance and urgency of various alternative research ptojects can be assessed.

The aim of the investigations has been to provide the technical data which are needed in the formulation of forestry policy and in the utilisation of the timber which is produced. A major aim of forestry policy is to secure the best return from any given site, and whilst the forester's choice of tree to be planted is limited by what will grow well under local conditions, it is obviously important also to have adequate information on the relative merits of timber of various species and the effects of silvicultural treatment on timber quality. Optimum utilisation also calls for technical information about timber quality and yield and may require in addition data on conversion and processing. With the Forestry Commission's increasing output of timber, this aspect of the Laboratory's work is becoming more important.

In its first five years the Committee has had twenty meetings and has considered more than one hundred papers. The research under review falls into three main categories. The first of these comprises investigations into the basic properties and utilisation of specific timbers. These include anatomical, chemical and physical properties, seasoning properties, strength, working properties, resistance to fungus and insect attack, and reaction to preservative treatment. Conversion and grading studies have also been carried out and the inter-relations of provenance, growth conditions, silvicultural treatment and technical properties have been investigated.

The first species investigated was Sitka spruce, the most widely planted exotic forest tree in Britain. Representative material from a wide range of sites was examined and the results were published in Forest Products Research Bulletin No. 48 *Properties of* 30–37 *year old Sitka spruce Timber.* Other species which have been the subject of investigation on a large scale since the Committee

was formed are lodgepole pine, European larch and Japanese larch (with limited tests on hybrid larch) and work has started on Norway spruce. Material for these general investigations has been obtained by sampling sites in different parts of the country, chosen so as to take into account the principal factors believed to influence the properties of the timber. Investigations on a smaller scale, aimed at assessing suitability for planting in this country, have been carried out on certain species of minor importance such as Turkey oak, red oak, *Pinus holfordiana*, *Abies grandis*, and *Metasequoia*. An investigation of *Pinus strobus* is under way.

In the second category are special investigations of the particular characteristics of a species, for example the relation between the characters of bark and wood in birch, the peeling properties of poplar, the gluing characteristics of Scots pine, the conversion and seasoning properties of Forest of Dean oak, and the pulping characteristics of home-grown softwoods.

Projects in the third category are concerned with home-grown timbers in general. These have covered a wide range of subjects. The pattern of variation in wood structure within the tree has been and is still being studied, not only to extend our knowledge of wood anatomy but also to minimise the number of samples needed to assess the properties of a given species. The moisture content and specific gravity of freshly felled conifers have been measured on a wide statistical basis primarily to provide data of use in marketing. Methods have been developed for evaluating timber quality in standing trees; these are of special interest where the tree is required for breeding purposes. Other projects have been concerned with the strength of home-grown pit-props, sawmilling problems, seasoning and preservation techniques, the control of fungi and insects attacking timber and the use of home-grown timber in structures. A study of the effect of thinning treatment and pruning on timber quality is in hand, and tests of the suitability of home-grown softwoods and hardwoods for plywood manufacture are about to begin.

It will be seen that some of the investigations are of an exploratory nature, preliminary to the planning of productive research, some are yielding results which influence the planting programme, where the economic benefits will be felt many years ahead, and some are yielding results of immediate value in pointing the way to improvements in forestry practice or timber utilisation. The underlying purpose of the whole research programme is to improve the quality of home-grown timber by selection, breeding and silvicultural treatment, and to make timber production more profitable by helping to develop better methods of conversion and processing. The progress of the work has been recorded in the Laboratory's Annual Reports, and the results of completed investigations may be found in official publications issued by H.M. Stationery Office and in forestry and timber journals. A selection of relevant titles is appended.

H.M. Stationery Office Publications

Obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2/13A Castle Street, Edinburgh 2, or through any bookseller. Prices in brackets include postage within the United Kingdom.

Forest Products Research (1961)	5s. 0d.	(5s. 5d.)
Forest Products Research (1962)	6s. 6d.	(6s. 11d.)
Handbook of Hardwoods (1956)	20s. 0d.	(21s. 2d.)
Handbook of Softwoods (1960)	10s, 6d.	(11s. 3d.)
F.P.R. Bulletin No. 48. Properties of 30–37 Year Old Sitka spruce Timber (1962)	3s. 0d.	(3s. 4d.)

F.P.R. Special Report No. 16. Variation in Tracheid Length in *Picea sitchensis* Carr. (1963)	4s. 0d.	(4s. 4d.)
F.P.R. Special Report No. 17. Sawmill Study: Work Cycle Times on a Rackbench (1963)	2s. 0d.	(2s. 4d.)
F.P.R. Special Report No. 18. Bark Form and Wood Figure in Home-grown Birch (1963)	4s. 0d.	(4s. 6d.)
F.P.R. Record No. 31. Non-pressure Methods of Applying Wood Preservatives (1961)	22s. 6d.	(2s. 0d.)
F.P.R. Home-grown Timbers Series: Douglas fir (1963)	2s. 0d.	(2s. 3d.)
F.P.R. Leaflet No. 37. Selecting Ash by Inspection (*Revised* 1962)	1s. 0d.	(1s. 3d.)
F.P.R. Leaflet No. 43. Prevention of *Lyctus* Attack in Sawn Hardwoods by Use of "Contact" Insecticides (*Revised* 1960)	8d.	(11d.)
F.P.R. Leaflet No. 49. Grading of Sawn British Softwoods (1955)	8d.	(11d.)
F.P.R. Leaflet No. 52. Grading of Sawn British Hardwoods (1958)	6d.	(9d.)
F.P.R. Leaflet No. 53. The Preservative Treatment of Timber by Brushing, Spraying and Immersion (1962)	8d.	(11d.)
F.P.R. Leaflet No. 54. *Ernobius mollis*. A Bark Borer of Softwoods (1963)	1s. 0d.	(1s. 3d.)

Other Publications

Reprints of the articles listed below may be obtained on application to the Director, Forest Products Research Laboratory, Princes Risborough, Aylesbury, Bucks.

General and Miscellaneous

ANON. Tests on the Timber of Home-grown Red Oak. *Quart. J. For.*, 1964, 58 (1), 55-61.

BRAZIER, J. D. The Timber of Young Plantation-grown *Metasequoia*. *Quart. J. For.*, 1963, 57 (2), 151-153.

DINWOODIE, J. M. W. Wood Pulping in the United Kingdom, *Scot. For.*, 1964.

KNIGHT, R. A. G. and DOMAN, L. S. Gluing Oak with Resorcinol Resins, *Wood*, 1958, *24* (9), 365-369.

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BUILT OF WOOD

(especially home-grown)

By

GEOFFREY FORREST

Conservator, Directorate for Wales

(*Reprinted from "Agriculture", January* 1964)

In a good many parts of England and Wales it is not so long ago that most of our farm buildings were, by tradition, built wholly or mainly of timber—and home-grown timber at that. Many of these, some of which must be 150–200 years old, are still in use and testify not only to the quality of the timber used but to the wisdom of those who built in this material so many years ago.

In many other countries—notably perhaps in Scandinavia, Switzerland, Austria, Canada and the United States—the tradition of making almost all buildings in timber has continued; everywhere you go in the country districts you see charming examples of well-designed, well constructed houses, churches and farm steadings.

The Case for Wood

It might be true to say that the timber trade has paid too little attention to the potential market for timber in our own agricultural industry, and in consequence there has recently been a complete swing away from timber to steel, concrete and asbestos. Granted these materials have many advantages, but so has timber, as I shall point out in this article.

People have begun to think that steel, bricks and concrete, because they are harder than timber, are also more durable. But is this so? Bricks and concrete can easily be damaged by a knock from a tractor but are not so easily repaired; steel has to be kept painted or it soon rusts. When you go fully into the matter it becomes apparent that there are disadvantages as well as advantages in their use.

During the last few years several new firms have started to manufacture timber houses, offices and other buildings for industry. To judge not only from their advertisements but from the amount of work either completed or under construction, they are having a great deal of success. Timber is also being used very widely for such things as deep litter and broiler houses. All this points to a revival in the use of timber for different kinds of building in this country. I suggest there is a great deal more scope for its use on our farms today.

Recently a lot of interest has been shown in the use of exterior grade resin-bonded plywood. This material, much of which is produced from Douglas Fir grown in British Columbia, has been widely used for some time in Canada where it has proved very successful. It is strong, light and has excellent insulating qualities. Now that it is readily available in this country it seems likely that its use will increase steadily.

The Advantages of Timber Buildings

The cost is usually lower than that for comparable buildings of other materials.

Ease and speed of construction, plus adaptability.

Excellent insulating properties. A one-inch-thick timber board gives much the same insulation as 9 inches of brickwork, so the building is warm in winter and cool in summer.

Suitability for use either in prefabricated sections or for building up on site. The use of a certain amount of prefabrication means that four walls and a roof can very quickly be put up, and after that workmen can carry on under cover and are not held up by bad weather.

Low cost of maintenance.

Ease of repair. Almost anyone can replace a broken cladding board or splice a new section on to a door post, but to repair brick, concrete or steel work often calls for a craftsman.

Freedom from condensation troubles that so often plague buildings with steel roof members.

Animals do not injure themselves so easily on timber as on harder materials.

Foundation loadings are lighter and better distributed, resulting in less damage from settling or subsidence.

By no means the least important is their ability to blend with their surroundings.

One subject nearly always crops up when one discusses timber construction —dry rot. It is true that a lot of damage has been caused by this fungus in recent years, but it is said that no serious outbreak has ever occurred in an all-timber building. Nevertheless it is much better to be on the safe side and one should always specify that all timber be protected by one of the several well-tried commercial preservative treatments. These give complete protection against all forms of fungal and insect attack. The additional cost of treating all the timber needed to build the average farm cottage is about £18—so low a figure that it is surprising that anyone should build without using one of them. The benefit of such protective treatment is now so well recognized that the Ministry of Agriculture will not sanction grants for wooden buildings unless the timber has been treated by one of the approved methods.

On Holdings in Wales, For Example

In Wales the Forestry Commission owns a large number of small farms, most of which are occupied by its own workers. These little holdings are the remains of larger farms where the hill grazing has been afforested, leaving a small area of bottom land with a farmhouse and buildings.

Unfortunately most of them were in bad order when they were acquired and the Commission has been faced with the very difficult problem of replacing the existing old and often semi-derelict range of buildings with something modern, adaptable and easily constructed. They had to be adaptable to allow for possible future amalgamations, and they had to be easily constructed because many of these holdings are in very remote situations where tradesmen do not like to spend any longer time than necessary. Something which could be partly prefabricated and quickly built up on site was clearly indicated. It was also necessary to have a design which would be susceptible of several different layouts because of the severely limited amount of level ground available on these small mountain farms.

A number of these farms are in traditionally milk-producing areas but most are livestock rearing places. It was important to have one standard plan so it was decided that the design must be sectional and, since the buildings on some farms would have to comply with the dairy regulations, that the size of the standard section should be that of a two-cow standing. In this way one could have stalls for 2, 4, 6 or more dairy cows, while equally one could provide a series of boxes of different sizes suitable for use on the livestock rearing type of farm.

Standard Design

With the ready help of the Farm Buildings Advisory Officer on the staff of the Regional Land Commissioner for Wales, a set of standard designs was worked out. Because the holdings are small and we wanted to keep the cost of the permanent equipment as low as possible without sacrificing efficiency and good design, it was decided to do without feeding passages in the cowhouses. The resulting section measures 14 ft. × 13 ft., and the building is made up of any required number of them.

Home-grown timber, of which the Forestry Commission is a very large producer, best fitted all these requirements. Many people, still thinking in terms of war-time scarcities, believe that trees grown in this country are in some way inferior to those grown abroad. This is a misconception. What has been unsatisfactory, and indeed is still often unsatisfactory, is the system of grading of home-grown timber—or perhaps the lack of a system of grading! This problem

is, however, being overcome, and as more and more timber from our home forests comes on to the market there should be no difficulty in securing good quality stuff suitable for almost all purposes. Even at this moment, provided the timber is properly selected, it is entirely satisfactory for constructional work.

A point to remember in all cases of timber construction is that if particularly large timbers are used the cost of the building will quickly go up. We kept this carefully in mind in the design of these farm buildings. The exterior skin consists of 4 in. × 1 in. cladding, and most of the framing is 4 in. × 2 in. The portal frames, where the largest sizes are used, consist of two 6 in. × 2½ in. timbers bolted together.

Forestry Commission Specification

Many contractors will no doubt prefer to use imported timber because it is at present not always easy to obtain home-grown material in the right grades. But it may be of interest to people anxious to promote the use of home-grown timber to quote the specification used by the Forestry Commission for its own buildings:—

General:	All timber to be home-grown and to comply with specifications B.S.S. 1860 and C.P. 112.
Timbers:	(a) Internal and external load-bearing wall frames and exterior cladding to be Scots pine, European or Japanese larch or Douglas fir. (b) Internal woodwork to be for preference any timber specified for load-bearing wall frames, otherwise to be Sitka or Norway spruce.
Rate of Growth:	Very fast-grown timber is not to be used. Four growth rings per inch will be acceptable as minimum.
Moisture Content:	Shall be within the following limits:— (a) All internal doors and other internal joinery 20%. (b) All external doors and other external joinery 23%.
Method and Type of Preservative	The preservative treatment to be used shall be that specified by an approved commercial process and the treatment must be carried out exactly in accordance with the manufacturer's instructions.

A HOME-GROWN TIMBER HOUSE

by

F. W. HOLDER

Chief Architect, Agricultural Land Service

Reproduced from "Agriculture" February 1962.

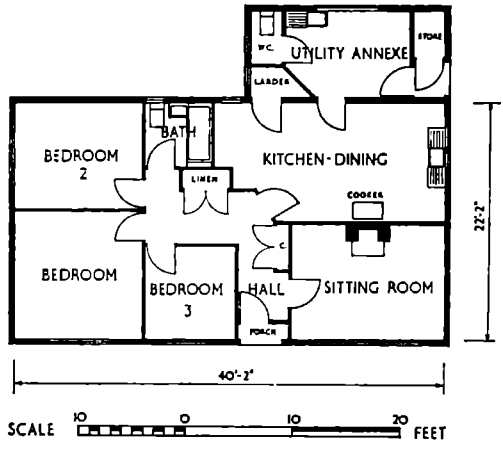
In this country home-grown timber is not usually thought of as a building material. To show that it can be used successfully for this purpose, the Forestry Commission has constructed a bungalow almost entirely of timber from its own forests.

The Forestry Commission has recently completed, on its Research Establishment at Alice Holt, Hampshire, a bungalow constructed almost entirely, above the foundations, of home-grown timber. This building was designed by Mr. S. W. Edwards, the Commission's Chief Land Agent for the Directorate of England, who was also responsible for the supervision of the work. The

drawings were produced at the D.S.I.R.'s Forest Research Laboratory at Princes Risborough, where the preparation of the roof trusses and other prefabrication were undertaken. The timber used for carcassing was Sitka spruce, from the forests of Argyllshire, and the joinery was made from New Forest Scots pine. The largest scantling was 5 inches × 2 inches cross-section, and the maximum length of any member was 9 feet.

Home-grown timber is associated in the public mind with pit-props and similar uses which call for small or medium-sized pieces. The Christmas-tree legend dies hard, and the Commission, in undertaking this experiment, has set out to show the ways in which good use can, in fact, be made of the "thinnings" and small trees in its forests.

The bungalow contains a sitting room, a large kitchen-dining room, two double- and one single-bedrooms, bathroom (with W.C.) and linen cupboard. In addition, there is a small utility room, or wash-house, incorporating a second W.C., fuel store and larder. The larder is approached from the kitchen-dining



Layout of bungalow

room. In area, the individual rooms conform to Ministry of Housing and Local Government recommendations, as set out in the Housing Manuals. The total superficial area of the bungalow is approximately 890 square feet, with an additional 140 square feet in the "utility annexe".

Cooking is by means of a "Rayburn" stove in the kitchen-dining room, which also supplies the hot water, and there is an electric immersion heater in the hot-water storage cylinder for summer use or as a supplement to the solid fuel system. The sitting room has an open-hearth fireplace, and power points have been supplied to all bedrooms so that portable electric fires can be used. Heat loss is minimized by the internal chimney stack which serves both the sitting-room fire and the cooker. All plumbing is in copper tube.

Details of construction

Construction is simple, and consists of brick foundation walls upon which prefabricated timber panels are erected. The panels, which form the external walls, are framed in 4 inch × 2 inch Sitka spruce, covered on the outside with double boarding (spruce) and internally with aluminium foil-backed fibre-board. Internal partitions generally are lined on both sides with fibre-board. An exception is the utility annexe, where the internal finish is vertical tongued-

and-grooved V-jointed boarding, with natural wood oiled finish. It is worth noting that the fibre-board used for internal wall and ceiling linings, and also the hardboard facings to the internal flush doors, has been manufactured in Britain, out of timber from North Wales forests.

The external walls have been designed to carry the weight of the timber roof, so that, if desired, the internal partitions can be moved independently of the main structure. The roof trusses are of timber, spaced at 2-foot centres, and are "built-up" of thin sections, nailed together. The use of nails as an alternative to bolts in this type of construction has been advocated for many years by the U.S.A. Forest Products Research Department as a simple and effective method, which does not require the same degree of skill and precision as bolted construction. Roof coverings are red-coloured concrete "Double Roman" tiles on boarding for the bungalow, and felt to the flat roof over the utility annexe.

The use of tiles as a covering, instead of wood shingles, is a valid criticism, but in this instance the only suitable home-grown material is oak, and this happened to be unobtainable at the time it was needed. The Forestry Commission was also in some doubt as to the possible behaviour of oak shingles, and as cedar could not be considered because it is an imported timber, the well-tried and maintenance-free tile covering was preferred. The use of waterproof felt under-tiles is regarded in some quarters as being a better weather repellent than boarding, but in this case it was probably thought that boarding would give added rigidity to the roof, bearing in mind that it is supported on the external walls only. Boarded floors on joists are used throughout, except in the utility annexe, where the floor is of concrete.

All the timber used in the construction of this bungalow has been treated with preservative. The method adopted was a diffusion process in which a highly soluble boron salt (disodium octaborate tetrahydrate, marketed under the name of "Timbor") was used. The preservative was applied by spray before the timber was stacked for seasoning. This process has been used widely in New Zealand, but so far not to any great extent in this country. The external cladding, in addition, received one coat of oil preservative. The insulating boards used in the internal linings were given a coating of flame-retardant paint before leaving the factory. Work on the bungalow, which is now occupied by a Commission Forester and his family, was begun in the spring of 1961 and completed in autumn of the same year. The builder was Mr. M. Ventham, of West Liss, Hants, who was responsible for the foundations, drainage and site works; for assembling the timber components on the site and erecting them; and for internal services and decorations.

Comfort and appearance

The degree of insulation provided is such that interior conditions should be very comfortable during the coldest weather. Some heat may tend to be lost through shrinkage of the floorboards, but, once again, timber flooring was essential to the experiment and any limitations on this score must be accepted. The insulating boards used for internal wall linings are of the softer, "spongier" type, and either have not been damped before fixing or are beginning to swell through moisture in the atmosphere. The condition is aggravated by initial movement and drying out in the structural timbers prior to the building "settling down", and cracks are apparent at the joints of the insulating board. Later on, it may be necessary to fix wooden cover strips over all joints to hide the cracks. It might have been an advantage to have used a denser type of board in the first instance.

Aesthetically, the combination of natural wood walls, red-tiled roof and

white painted windows is most pleasing, and the interior colour schemes are well-considered. The oak (home-grown) entrance door in natural wood finish strikes a rather discordant note; its small glass panes contrasting unhappily with the windows with their large areas of glass. Fortunately, the door is tucked back into a small lobby, so the contrast is not too obvious to the passer-by.

Apart from these minor criticisms, the experiment appears most successful, and the total cost of the bungalow, at about £2,500, compares very favourably with that of more "traditional" dwellings of the same standards of accommodation.

THE LOG CABIN OF HENDRE DDU

by

HENRY J. HOOPER

District Officer, North Wales

The slate quarrying at Hendre Ddu near Aberangell, Merionethshire, has long since finished. The large sheds, however, which contained the slating machinery and equipment are still to be seen. One of these is now used by the Forestry Commission as a timber produce shed. The whine of the saw can still be heard but no longer is the slate being cut. In its place is timber brought from the nearby forest.

High up on the hills to the west can still be seen the reservoirs which produced the power for the machinery in the quarry sheds. Hendre Goed and Hendre Ddu cottages still lie in the sheltered valley. Once they housed the quarry workers but now they are used as holiday cottages. Southwards runs the line of the old Hendre Ddu tramway passing Gartheiniog Farm and Capel Soar (a small chapel). The tramway is now a narrow but well-surfaced road.

The pattern of life has changed in the valley and on the hills. Agriculture, of course, still remains as before, but the quarrying has been replaced by Forestry.

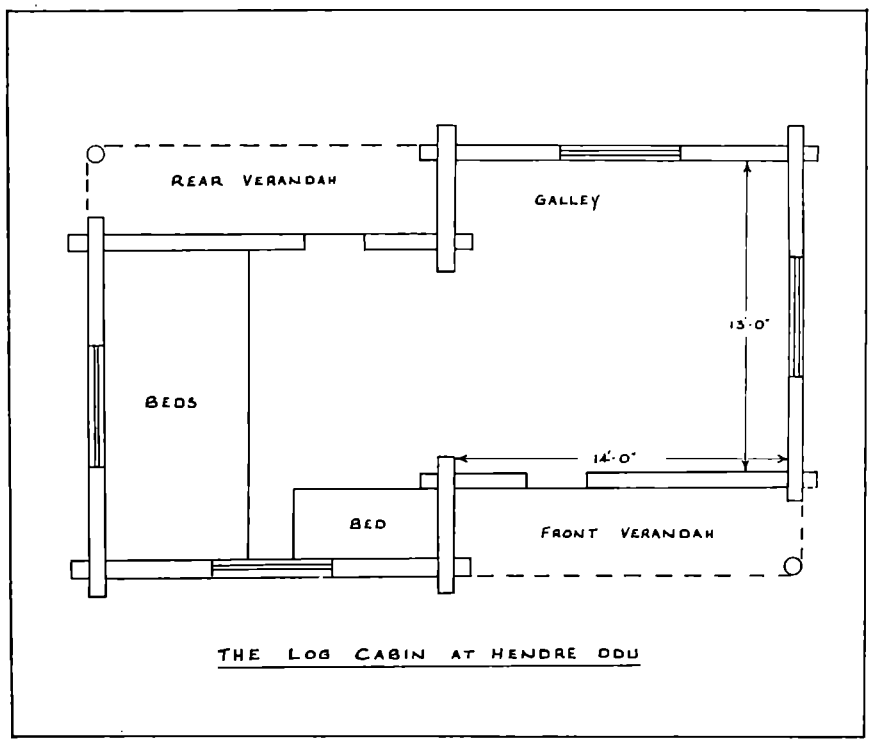
Amongst this pattern of change there has developed a new and exciting pattern of adventure. This has been brought about by the Aberdovey Sea School. You may well ask what connection there is between a Sea School and the remote hills of Hendre Ddu in Wales. The activities of the School cover not only seamanship but also athletics and expeditions. It is to do with expeditions that Hendre Ddu plays its important part. Each course at the School normally includes a four-day trek through the Dovey Forest area. Such expeditions may take place in all weathers. Opportunities for self-discipline and team-work occur amid the rigours of the four-day adventure.

One of the night stopping places during the four-day trek is the Log Cabin of Hendre Ddu.

The Cabin is situated just below the headwaters of the Afon Angell which flow down from Mynydd Dolgoed. It is one of these small tributaries that supplies the water for domestic needs at the Cabin.

The site itself has been bulldozed out of the bank above a forest road and it dominates the topmost reservoir which originally served Hendre Ddu quarry. Set above the north-west tip of the reservoir, the Cabin commands a fine aspect open to the south and south-east.

Immediately above the Cabin are plantations of Norway spruce, and on the higher slopes more hardy Sitka spruce plantations have been established.



THE LOG CABIN AT HENDRE DDU

A little to the north-east are some plots of Red oak (*Quercus rubra*). The various plantations are twelve years old, having been established in 1951.

The Cabin is set in a saucer of land with hills ranging around it from nearly 2,000 feet in the north to a modest 500 feet where the Afon Angell flows past Gartheiniog at the south-east. The whole of this gathering ground feeds into its southern channel whence it finds its way to the Afon Dyfi (River Dovey) itself.

It is over the Mynydd Dolgoed, which is the hill to the west, that the young adventurers travel. Using compass and map to find their way, often blinded by driving rain, it must come as a welcome sight to see the Log Cabin nestled on the lower slopes by the reservoir. The thought of shelter and a welcome hot drink must make the final trek seem easier.

The Log Cabin itself is of true log cabin design. The logs which form the main structure are of Western red cedar or Thuya (*Thuya plicata*). These trees were planted in 1930 at Coed Pantperthog at a site on the south bank of Nant Cwmcadian near Corris in Merionethshire and less than half a mile from the border of Montgomeryshire. This plantation is within the boundaries of Dovey Forest, so it can be truly said that the timbers of the Log Cabin were grown in the local forest itself.

Due to the taper of the logs there is a limit to the length of a section of a log cabin. The type of logs available will also control this measurement. The logs from Cwmcadian allowed for a convenient internal length of 14 feet. The log cabin therefore has two portions 14 feet long by 13 feet width. There is a 4 feet return wall where the walls have to be jointed and this provides two verandahs as the plan above shows.

The photographs clearly show the method of jointing the structural timbers. Even the gutters and downpipes are made with timber. The roof is of wood shingles of Canadian origin.

The young men who use the Log Cabin include in their work such items as construction of dams for fire protection, high pruning of trees and felling and extraction of timber. It is with little surprise therefore that one learns that these same young men actually built the Log Cabin. This was done under the expert guidance of a forest worker from Cwmllinau, a nearby village, and the supervision of the Forestry Clerk of Works.

The Log Cabin was officially opened in May 1962 by the Chairman of the Governors of The Outward Bound Trust. More than 18,000 young men have passed through the Aberdovey Sea School. Now, each year the young men who attend this specialized course of training will continue to trek across the mountains of Merionethshire and one of their adventurous routes will take them towards the ridge of Mynydd Dolgoed over which they will cross seeking the shelter of the Log Cabin of Hendre Ddu.

THE RECONSTRUCTION OF KIELDER REPAIR DEPOT

By

T. A. MURDOCK, A.M.I.C.E., A.M.I.Mun.E.

Conservancy Engineer for the N.E. (E) Conservancy, Briar House, Fulford Road, York

For some years now visitors from both London and from the Conservancy Office have wilted visibly when confronted with the stark squalor which characterised that piece of Northumberland which lies adjacent to the River North Tyne and also to the C.200 Bellingham–Kielder road, and which languished under the name of Kielder Camp.

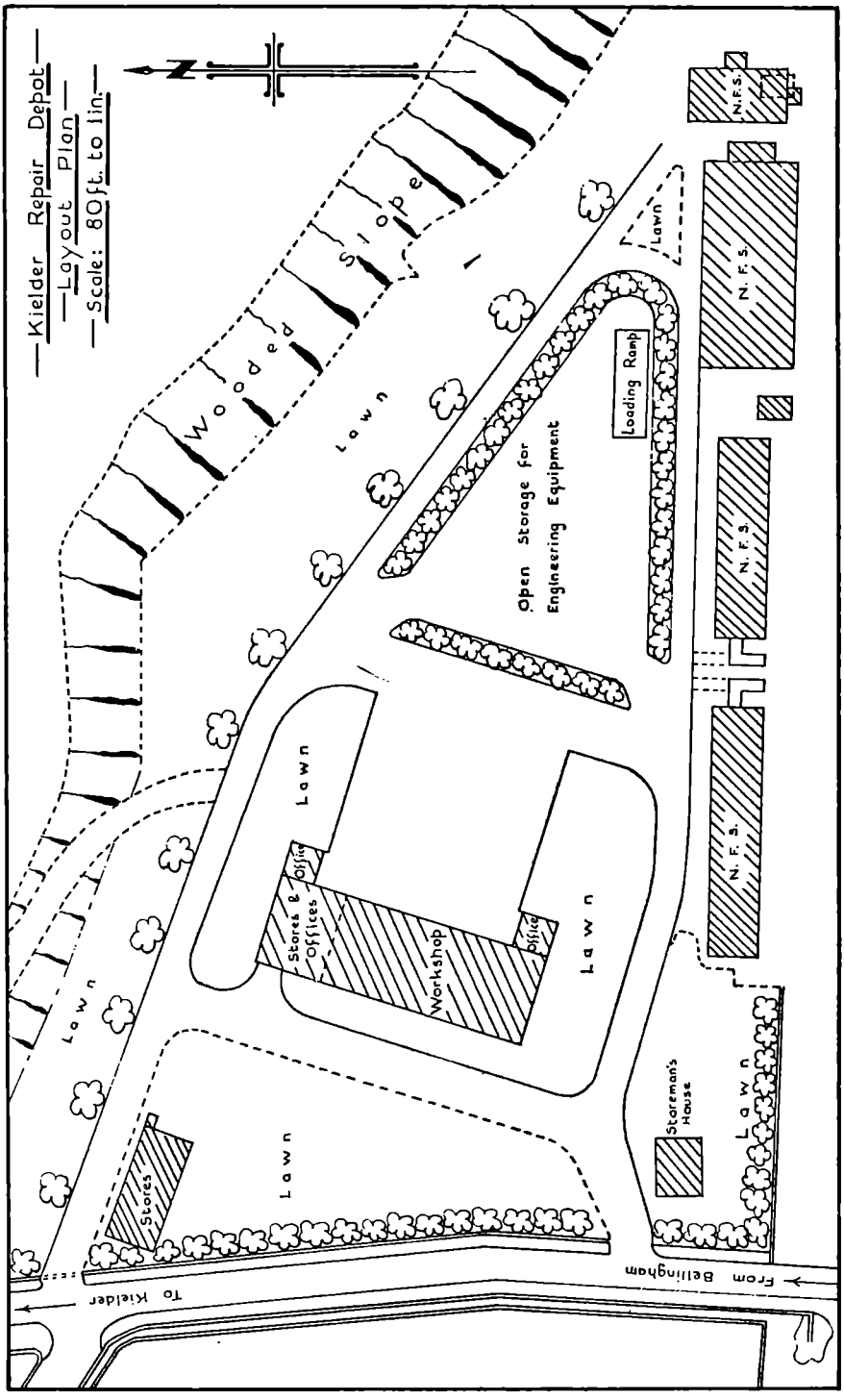
Nissen huts, Romney huts, brick huts—all were present in a haphazard collection in various stages of disintegration. In wet weather they appeared to sail serenely in a sea of mud with escorting squadrons of old baths, plough parts, etc.

To lead up to the present-day conditions it would perhaps be useful to give a brief outline of the history of the camp site, particularly to those unfamiliar with the Border Area and Kielder Forest in particular.

Kielder Camp as such was originally constructed by the Ministry of Labour as a rehabilitation centre, the inhabitants of the camp being employed on the first forest roads constructed in the area; at least records indicate that this duty was listed in their works; there is, however, no tangible evidence of their efforts in this respect.

At the outbreak of War in 1939 the labour camp was closed temporarily, but was later occupied by a company of Newfoundlanders employed in the area on timber production; the remains of the timber chutes used to move timber to the river can still be seen at Ridge End. The building which is at present used as a Civil Engineering Store accommodated a section of the next occupants of the camp and was used as an armoury and a guard room for the Royal Navy, who used the camp as a detention centre or "glass house" sailing under the name of H.M.S. *Standard.*

On the cessation of hostilities a Forest Workers' Training Scheme was commenced and the camp was used for this purpose until it was eventually taken over by the Y.M.C.A. and run on behalf of the Forestry Commission as


Kielder Repair Depot
Layout Plan
Scale: 80ft. to 1in.
N
Wooded Slope
Lawn
Lawn
Open Storage for Engineering Equipment
Loading Ramp
Lawn
N.F.S.
N. F. S.
N. F. S.
N. F. S.
N. F. S.
Lawn
Stores & Offices
Office
Workshop
Office
Lawn
Lawn
Lawn
Stores
Storeman's House
Lawn
To Kielder
From Bellingham

a hostel for European Voluntary Workers employed on both forest work and road construction.

When, subsequently, the forest village of Kielder was constructed the need for a hostel disappeared and from 1953 onwards the Camp has been used largely for workshops, offices and storages with four buildings occupied by the Northumberland County Council Auxiliary Fire Service as a weekend training centre. The building which, until it was recently demolished, was used as a workshop, originated as a garage, later became a gymnasium in H.M.S. *Standard*, again became a garage until June 1949 when it was finally established as a workshop. It can be seen that the Camp has had a lively and chequered career and one hopes that a period of stability will now attend its maturity.

The valiant band of men who worked to maintain a large fleet of mechanical plant in reasonable condition were fighting a losing battle against the appalling conditions in the Camp and it became apparent in 1961 that immediate action was necessary. The writer was instructed to prepare plans for submission to the Director for the complete clearance of all existing hutments on the site and for the construction of a new Depot.

Some two years prior to this, the task of re-designing the Depot had been entrusted to a firm of architects in Newcastle who had submitted some extremely attractive drawings, but who had also caused palpitations and some sharp intakes of breath at the Conservancy Office by enclosing with the drawings an estimate of cost amounting to something in excess of £40,000. As the natural course of events these plans were carefully filed away and the matter referred back for further consideration.

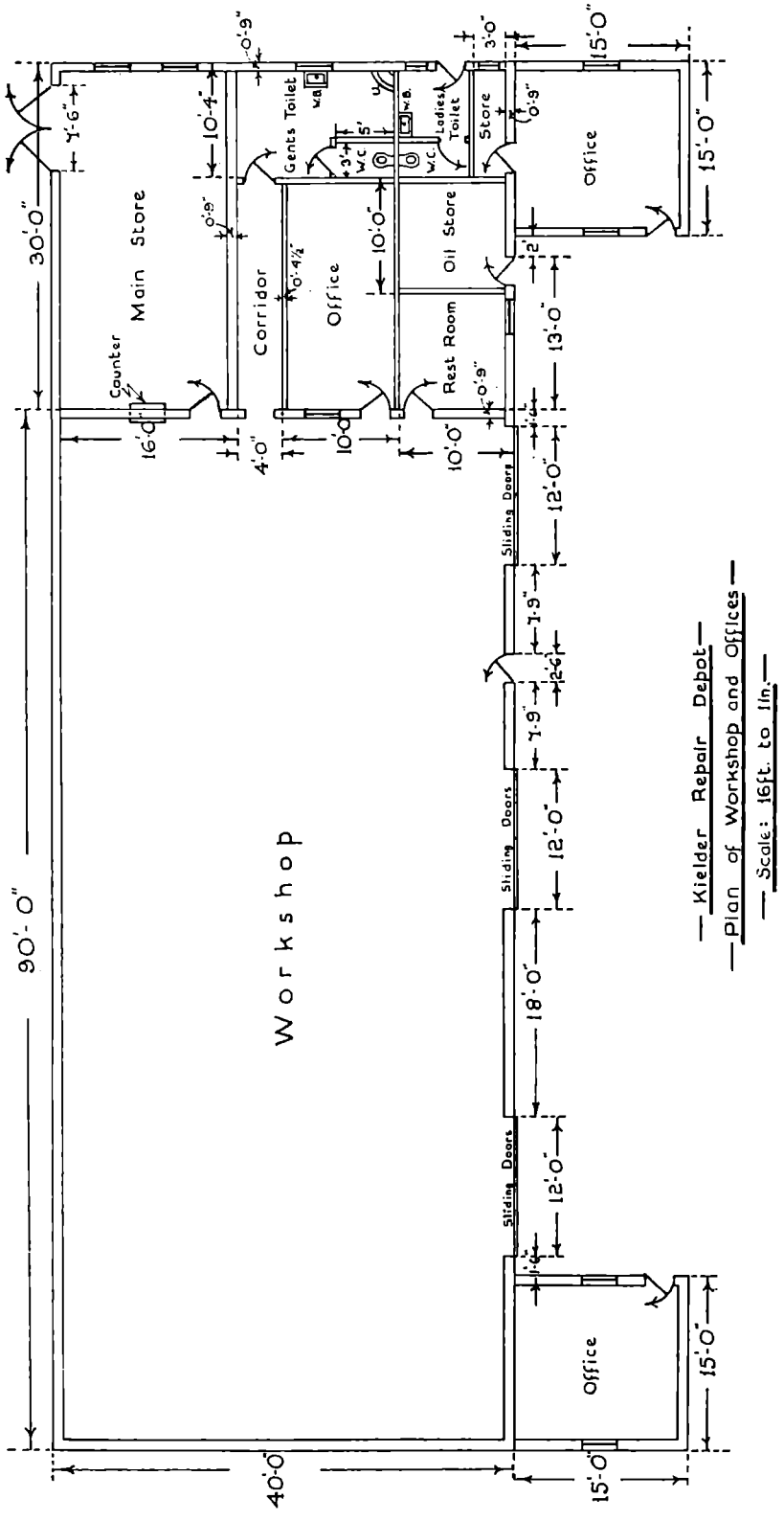
Since the Depot is responsible for the repair and maintenance of a large fleet of mechanical plant and vehicles, it was obviously essential to have an efficient workshop unit with an organisation adequate to cover inspections, routine maintenance and emergency repairs. This necessitated a re-planning of the central area so that the greatest functional efficiency could be obtained whilst, at the same time, securing an aesthetic appearance which would blend with the natural beauty of the surrounding forest.

Plans were prepared, the estimated cost being £14,000, including a contingency item and based on the premise that only the specialist erection would be done by contract, the main burden of work to fall on the Kielder Engineers' Section and to be carried out by direct labour. The predominant feature of the design was the new building which faces to the rear where all the vehicles are effectively screened from the main road. The building has green lawns planted around three sides and a ring road in the Camp area is also surrounded by grass to give a parkland appearance. Ornamental and flowering trees are to be planted around the perimeter road and in front of the building in the Spring of 1964 to show that science can make a happy bed-fellow with nature.

In order to achieve reconstruction without dislocation of work it was necessary to plan the operation so that all the new construction should be completed before any demolition of offices or workshops, and the transfer of staff, became necessary. In addition electricity supply and water supply had to be connected to the new buildings before terminating supplies to the old ones.

The type of building selected was a precast concrete portal-framed structure, built up from floor level with concrete blocks to a height of 7 feet 6 inches, with asbestos cement cladding forming the upper part of the walls and also the main roof sheeting. The dimensions of the main workshop are 90 feet long by 40 feet wide, the height to the eaves being 13 feet 9 inches. The layout of the various offices, stores and workshop is shown on page 152 and the general layout of the Camp area on page 150.

Around the main ring road and the two cross link roads traffic can circulate


Kielder Repair Depot
Plan of Workshop and Offices
Scale: 16ft. to 1in.
Workshop
Main Store
Counter
Corridor
Office
Gents Toilet
Ladies Toilet
W.C.
W.B.
Oil Store
Rest Room
Store
Office
Office
Sliding Doors
Sliding Doors
Sliding Doors
90'-0"
30'-0"
40'-0"
15'-0"
15'-0"
16'-0"
4'-0"
10'-0"
10'-0"
12'-0"
12'-0"
18'-0"
12'-0"
13'-0"
15'-0"
10'-4"
7'-6"
3'-0"
0'-9"
0'-4½"

freely within the whole Camp area, and radii of kerbs and bends have been carefully set out to conform with turning circles of the largest vehicles likely to use the roads.

The three main 12-foot-wide double doors open at the rear of the building on to a large concrete forecourt which enables vehicles to be washed at a special washing point or parked whilst awaiting admission to the workshops. Electrical pumps for fuel oil and petrol, with underground tanks, are to be constructed in the near future on the edge of this forecourt.

Behind this again is the Civil Engineer's hard standing which is to be surrounded by boulevard trees along the road side verge and which will effectively screen the stock piles of concrete tubes, plant and stores from the road. In from the main road all that will be seen eventually is the main building itself. A large loading platform and ramp has also been constructed on the hard standing area which can be reached either from the ring road or the hard standing.

The following features of the Depot may be of interest and assistance to those engaged in designs of such structures in the future:—

Heating. Design temperatures for the heating system were based on 55°F in the workshop and stores and 60°F in the offices and rest room. Two air changes an hour were allowed for in the workshop due to losses occurring from the doors being opened from time to time. The heating system is by oil-fired central heating, the power unit being a 26K Britannia boiler manufactured by Messrs. Ideal-Standard Limited and rated at 241,000 British Thermal Units per hour. The oil burner in the boiler is fitted with an immersion thermostat, a control box, a photo-electric cell and a time switch.

The main heating effect is achieved by a double bank of 4 inch diameter pipes with 9 radiators set at strategic points, each with a control valve and a regulating valve. Heat losses from the asbestos cladding has been prevented by using the "sandwich" technique in which a 1-inch layer of Polystyrene or mineral wool filling is laid between the two asbestos sheets, reducing the thermal conductivity figure to a μ of ·19.

In the appalling severity of 1963 winter weather a temperature of 0°F was recorded at Kielder (32° of frost) and in order to prevent serious damage to the heating system following freezing of the fuel oil in the tank in extremely low temperatures, an insulation layer of Polystyrene covered by a waterproof bitumenised felt has been fitted to the tank and feed pipe.

Lighting. Excellent lighting conditions have been achieved in the workshop by incorporating on each slope of the ridged roof a continuous length of 5-foot deep *Filon* translucent sheeting; in addition, a 5-foot deep sheet of similar translucent material is fitted to the back face of the building throughout its length and single *Filon* sheets between the main doors on the front face.

Artificial lighting consists of mercury vapour strip lights, 16 in number in the workshop and as required in the offices and stores. The electricity supply is 240 volts and is on single phase supply only.

Accommodation. The Repair Depot as a unit now houses the Foreman Mechanic with his staff of mobile mechanics, fitters, storeman and clerk, the Superintendent of Works with his office staff and the Head Forester and clerk. Accommodation was, therefore, detailed as follows—main workshop, main store, gents' toilets, ladies' toilets, rest room, oil store, miscellaneous store, tyre store and three offices.

Two of the offices are set against the face of the main building as lean-to structures in order to provide space for extension for further offices should this ultimately prove to be necessary.

The timber beams forming the roof supports over the office and store accommodation have been made sufficiently strong to bear a considerable weight, and the complete tyre stock is now stored in the large first floor accommodation which is sealed off by a light concrete block wall and is reached from the ground floor by the timber staircase. A cantilever landing has been fitted adjacent to the door of this tyre store so that a lorry can reverse into the workshop and carry out direct unloading to the landing deck,

In both sets of toilets W.C.'s have been provided and wash basins have been fitted with *Sadia* electric water heaters.

A large concrete forecourt has been provided in front of the workshop in the centre of which is situated a washing point under a hydrant cover where vehicles may be washed and the mud washings swept away easily. The ring road and cross link roads have been constructed in tarmacadam with 12 inch by 6 inch concrete kerbs, and to prevent damage to the tarmacadam surface a 12 foot wide strip of concrete has been laid to enable tracked vehicles to cross to the forecourt without touching the tarmacadam.

Storm water drainage and foul sewers had to be laid in separate systems, the former draining away to a ditch which eventually discharges to the river North Tyne and the latter to a new septic tank which, in addition to coping with the effluent from Commission property, had to have sufficient capacity to deal with the A.F.S. buildings which house up to 20 men at weekends.

An inspection pit 30 feet long by 4 feet 6 inches wide, fitted with steps and bulkhead lighting, has also been constructed and can deal with any type of vehicle. In order to prevent infiltration of water from the wet peat sub-soil in the area a *Pudlo* lining was given to the internal wall faces and to the base of the pit.

Décor. A number of external finishes were considered before finally selecting *Sandtex*, a new product of the Blue Circle Cement group of companies, which by virtue of its powers of adhesion and its toughness enables it to provide a water repellent and weatherproof finish for many years; it is also resistant to acidic pollution and mineral oils.

A trial panel indicated its attractive appearance and externally the asbestos cladding and the roof cover were spread with the textured version, which in appearance is similar to the Tyrolean finish, and the concrete block work was painted with the matt version.

The colour selected was dark green whilst window frames, door jambs, etc., have been painted in cream to present a contrast. Internally, a pale green *Snowcem* has been used to paint all walls and to give lightness to both workshop and offices and stores.

The net result of the whole is an airy, pleasant building which blends harmoniously with the surrounding forest particularly as the grass swards are now growing and further softening the outlines of the structure.

Civil Engineering Work. All the fill for the bases and sub-grades of buildings, roads and hard standings has been supplied by gravel extracted by our own excavators in the nearby River North Tyne, and transported by our tippers to the site and there consolidated on the underlying peat with bulldozers and various types of rolling equipment. For the tarmacadam surfacing on the road works a *Blaw Knox pavier* was hired from a local contractor and operated by our own men.

The original design, Bills of Quantities and estimate, together with subsequent direction of policy, was carried out by the writer, site supervision by the Area Civil Engineer and Superintendent of Works, and the complete constructional work was done by a small band of men for whom none but the highest praise

is due. These men were ordinary forest workers in the engineering gang who, though completely out of their depth as far as skilled trades were concerned, have nevertheless demolished buildings safely, constructed high quality concrete with expansion joints, applied specialised finishes with the *Sandtex* spray equipment and laid kerbs and channels on horizontal and vertical curves and also used specialised hired equipment on road construction to a high standard which would satisfy the most critical Borough Engineer.

One sees frequently nowadays criticisms of the British working man, but for skill, versatility and cheerfulness in the face of considerable difficulty one could not have wished for a better group of men than that which worked on this reconstruction project and they should feel proud of their achievements.

Therefore, Gentlemen, to all of you who in the past have travelled to Kielder on duty or on inspection of its moody magnificence, no more the suppressed shudder, the averted eye as you pass Kielder Camp—the news, on a par with the relief of Mafeking, is that Kielder Camp has been reborn—make it your rendezvous next time you pass this way!

APPENDIX A

Major Items of Equipment serviced by Kielder Repair Depot

Crawler Tractors	10
Lorries (Platform and Tippers)	40
Excavators	3
Wheeled Tractors	5
Land Rovers ..	20
Vans	11
Motor Cycles	7
R.M. Powered Maintenance Grader	1
Rollers (grid, powered vibratory) ..	6
Compressors and Concrete mixers ..	8

Plus numerous items of timber conversion machinery, cultivation machinery, trailers, pump, saws, etc.

SHIPS LAUNCHED AT BUCKLERS HARD, NEW FOREST, 1745–1812

Contributed by
B. GALE

Ship	Date	Builders	Guns	Tons	Remarks
Surprise	1745	Wyatt & Co.	24	—	
Scorpion	1746	,,	18	—	
Woolwich	1749	,,	44	—	
Mermaid	1749	Henry Adams	24	—	
Lion (Transport)	1753	,,	4	—	
Gibraltar	1756	,,	20	—	
(Lighter)	1757	,,	—	56	
Coventry	1757	,,	28	—	
Thames	1758	—	32	—	
Levant	1758	—	28	—	Designed by Sir Thomas Slade
Hannibal I	1759	—	—	—	
Hayling Hoy	1760	H. Adams	4	—	
Europe	1764	,,	64	—	
Hannibal II	1772	—	—	—	
Greyhound	July 1773	H. Adams	28	—	
Triton	Oct. 1773	,,	28	—	
Thetis	Nov. 1773	,,	32	—	
Experiment	Aug. 1774	,,	50	—	
Vigilant	Oct. 1774	—	64	—	
Hound	Mar. 1776	—	18	—	
Pelican	Apr. 1777	—	24	—	
Romulus	Dec. 1777	—	44	—	
Hydia	Apr. 1778	—	24	—	
Garland	Jan. 1779	—	28	—	
Pandora	May 1779	(Sunk in Pacific 1791)	24	—	
Brilliant	,, 1779	—	28	—	
Zephyr	,, 1779	—	14	—	
Agamemnon	Apr. 1781	—	61	—	Commanded by Nelson. Wrecked off River Plate 1809.
Gladiator	1782	—	44	—	
Heroine	Apr. 1783	—	32	—	After sailing 168 nautical miles in 15 hours from the Lizard captured a French frigate of 40 guns.
Indefatigable	Nov. 1783	—	64	—	
Sheerness	July 1787	—	44	—	
Illustrious	,, 1789	—	74	—	
(Lighter)	Dec. 1789	H. Adams	—	119	
Beaulieu	May 1790	,,	36	—	

Ship	Date	Builders	Guns	Tons	Remarks
Santa Margarita	Apr. 1795	H. Adams	36	—	
Cerebus	Sept. 1794	,,	32	796	Cost £12.10.0 per ton
(Lighter)	June 1795	,,	—	90	Cost £10.10.0 per ton
Bittern	Apr. 1796	,,	16	395	Cost £13.10.0 per ton
Boadicea	,, 1797	,,	38	1038	Cost £15.10.0 per ton
Snake Brigantine	1797	,,	16	380	Cost £11.17.6. per ton
Abundance (Store Ship)	Sept. 1799	,,	24	673	Cost £14.10.0 per ton
Spencer	May 1800	,,	74	1901	Cost £20.0.0 per ton £38,021.1.3
L'Aigle	Sept. 1801	,,	36	—	
Starling, Snipe, Vixen (Gun Vessel)	1802	,,	16	184	Cost £18. 0.0 per ton
Euryalus	June 1803	,,	36	—	
Swiftsure		,,	74	1702	At Trafalgar. Cost £35,787.17.9
Sabrina	1806	,,	16	—	
Hussar	1807	,,	38	—	
Victorious	1808	,,	74	—	
Hannibal III	1810	,,	74	—	
Vengeur	1810	,,	74	—	
Repulse					
Revenue cutter	1818		—	—	Probably last Govt. vessel.

Merchant Vessels

Columbus (West Indiaman)	Sept. 1795		—	338	Cost £2,873 — £8.10.0 per ton.
Princess Mary (East Indiaman)	1796		—	465	
Heart of Oak (Coaster)	1800				
Endeavour	1800				
Active	1800				
Neptune	—				
Hard Privateer	—				
Mary Ann	—				
Henry	—				
Nelson	—				
Bee	—				
Lady Hannah Ellis	—				
West Indiaman	1812		—	400	

Australia — A large three masted vessel. Last ship to be launched.

A 74-gun ship was usually 30 months on the stocks; A ship of 1,300 tons burden required more than 2,000 average oaks, ie., 2,000 loads or 100,000 cubic feet, 100 tons of wrought iron and 30 tons of copper.

WHY TRAIN DELAYS?

Translated by J. R. Aaron from "VOLKSBLATT" 6.9.63. Page 3 (Austria)

At the height of the holiday (travel) season the Austrian State Railways have been subject to delays greater than ever before experienced. Repeated sins of omission is the material reason. The situation in the Oberbau area is particularly precarious.

As early as spring it was observed that countless concrete sleepers on different stretches of the railway, that were laid only one or two years ago must be replaced, because they had begun to display extensive fissures. The question arises, what would have happened to these vulnerable sleepers if last year's heavy frosts had been followed by a hot summer, such that many thousands more would have been damaged and neither the sleepers nor the manpower would have been available to replace them?

The man in the street is asking himself why should Austria, which is so rich in woodland, have introduced concrete sleepers as early as 1953 when their development is still in its early stages, while countries poor in wood such as England, Belgium and Holland and U.S.A. have not yet made up their minds?

A conviction in the permanence (indestructibility) of concrete sleepers—which has now been debunked—was no grounds for taking such a great risk. Similarly in Germany they are having second thoughts, because the proportion of orders for wooden and concrete sleepers has moved from 1 to 1, to 2 to 1 in favour of wood.

PARDON ME, BUT YOUR SLIP IS SHOWING
or
LEAVES FROM AN AUDITOR'S NOTEBOOK

By

W. O. WITTERING

Work Study Section, Thetford Forest

Having read Bill Reynolds' article in the 1962 Journal explaining how he became an auditor, a twinge of nostalgia attacked me and I am prompted to put down on paper some of the lighter happenings that befall an auditor in the course of his duties. One cannot tour Great Britain at the expense of the Forestry Commission for over five years checking accounts, stores, produce etc., without amassing some tales worth telling. So, at the risk of ruining my farewell speech when I retire, here are some of them!

Being appointed an auditor and issued with a Letter of Authority signed by the Controller of Finance was a rather frightening prospect to the raw recruit that I was in 1955. Prior to that, Fate had carefully steered me clear of all forms of accountancy. The Chief Auditor was, however, aware of my lack of knowledge in this respect for he made quite certain that I was not let loose on my own among the accounts until I had completed nearly three months training.

Eventually the great day came and I was instructed to proceed to Glasgow to carry out the first audit for which I was to be solely responsible. After nearly five days of searching bewilderingly through masses of payment vouchers, receipts, transfer advices, sales invoices, etc., etc., I suddenly realised that I had

discovered my first audit 'query'. "They cannot possibly have an answer to this one", I thought. I had in my hand a voucher for the purchase of seaweed! Further inspection showed that it had been charged to the 'Horses-Upkeep' account. Brandishing the voucher, I jubilantly marched into the Accounts Section. At that time, the Accountant was none other than the late Bill Stewart, a very experienced man and more than a match for the new (but keen) auditor. "Why are you purchasing seaweed and charging it to the horses account, Bill?" I asked. Bill Stewart sucked hard on his pipe and after barely a moment's hesitation, back came the answer: "Well you see, they are sea-horses!"

To the uninitiated, accountancy often seems drab and boring probably because they do not understand it. A lot of the time, this is so, the operations do tend to repeat themselves, but here and there the odd invoice crops up which makes the whole thing seem worthwhile. A Scottish Conservancy once paid squirrel bonus to a Mr. Fox; Headquarters bought some 'inferior-lined binocular cases'; South Wales paid out "money for old rope" (to tie up transplants with, of course). The latter conservancy also paid a plumber to 'search for leeks'; very appropriate I thought!

The duties of an auditor are wide and varied. Officially they are usually described as "Safeguarding the Forestry Fund" or "Enabling the Director General to sign the Commission's Account" etc. Scrambling over a pile of tramrails at Cairnbaan Camp in the pouring rain, it is extremely difficult to see the connection between trams and safeguarding the Forestry Fund but my second visit to this part of Argyll brought home to me the hospitality afforded to visitors to the Highlands. Having written to the same hotel at which I had spent two nights on my previous visit two years earlier, I was beginning to get a little worried as I had had no acknowledgement of my letter. Eventually, I decided I had better phone them to make sure that accommodation had been reserved for me. In a rather hurt voice, the hotel receptionist explained: "But *you* do not need an acknowledgement Mr. Wittering, you have stayed here before."

From Cairnbaan, I proceeded to Glenbranter where, among other things, my duties included checking the stock of explosives. I contacted the forester whom I found still laughing to himself as a result of a happening concerning one of his hired haulage contractors. The forester had found him cursing and swearing at his horse and on seeking an explanation, he was told that the horse had been pulling thinnings up a slope which had proved too steep for it, so the contractor decided to tie her to a tree while he manhandled the poles himself. "What did she do?" the contractor asked in a rather hurt voice, "while I was doing her work?" "She trod on my flask and ate my sandwiches".

On my second visit to the Forester Training School at Faskally, I witnessed another example of the Highland way of life. I called at the Bank of Scotland in Pitlochry for a statement of account which was duly handed to me, and just as I was leaving I asked the clerk if perhaps he would like to see my letter of authority. Back came the inevitable reply, "That's all right Mr. Wittering, you were here last year".

A trip to Benmore School was always most enjoyable if not at times hair-raising. The ride up from Dunoon was in single-deck buses which had been retired from plying their trade somewhere in England, and to save the need for a conductor, the pane of glass behind the driver had been removed so that he could turn round and take the fares while driving flat out at 20 miles per hour. On the way back from Benmore once, my colleague and I picked up the Tighnabruiach/Glasgow boat at Dunoon and sat in the refreshment room next to a Canadian couple. The gentleman of the visiting party had managed to board the boat at Tighnabruiach without surrendering his tickets and insisted that we take them so that we could use them the next time we rode from

Tighnabruiach to Glasgow. It was impossible to convince him that it was not a route for commuters.

Humour comes to the fore inside the offices as well as in the "field". In one conservancy office. a pleasant little girl asked the visiting audit staff if they would care to join others from the office who that afternoon were to be blood donors. Before we could reply she added: "But there, auditors don't have any blood, do they?"

Tea, the staple beverage of all Civil Servants including auditors is sadly mishandled in the various Commission offices. Some boil it to death, others serve it without sugar; at one repair depot it used to be ladled from a bucket into a variety of cracked and handle-less cups. Imagine our joy when in one office an attractive draughtswoman (she was a blonde too, Bill!) asked if the auditors would care for coffee instead of tea. "I make it with milk", she added. Our rejoicing came to an end on the Friday when we were each presented with a bill for 4s. 6d.!

During a visit to one official port-of-call, chickens were running about all over the place and while we were sitting at the table discussing various topics with the officer concerned, my colleague discreetly attracted my attention and motioned me to look under the table. There I saw that a pullet had perched on his foot and gone to sleep. Such are the ways of showing contempt for auditors!

As you can see, auditing with the Commission is not just a matter of putting blue ticks on paper, it is almost a way of life. Certainly my five years were some of the most interesting I have spent with the Commission.

FISHERMAN'S LUCK

By

R. J. JENNINGS

Head Forester, Forest of Dean

In the shelter of the larch woods of Dovey Forest on a warm midsummer evening the figures of a man and a boy moved along the grassy bank of the river where the shires of Merioneth and Montgomery meet.

No rain had fallen for many weeks and the water was low. Silent and sluggish it flowed with hardly a ripple over the smooth grey pebbles of the shallow bed. Down stream could be heard the clatter of hooves on stones as black cattle wandered towards the cool river to drink, swishing their long tails to whisk away the flies.

In his right hand the man carried a fishing rod. Eleven feet in length, made of split cane it was an expensive piece of tackle, cautiously he lowered the tip when passing under a hedge or tree. Over his left shoulder by a broad leather strap hung a canvas bag. In his left hand he held a thin nylon cast attached to an artificial fly made of horse hair, jay's feathers and gold wire. Quietly, gently he picked his way along a well-worn footpath by the edge of the river bank taking particular care where he trod. It was twilight and the stars would soon be showing.

The boy's load differed from the man's. With both hands over his right shoulder he held a landing net and from the cane handle, strung up by a loop of binder twine threaded through mouth and gills, hung a fat silvery sea trout. The boy was proud to be carrying it.

Presently the anglers halted. Here on a bend was a deep pool, years of winter flooding had eroded the soil and the far bank fell perpendicular to the

water. Slowly the man made his way down to the river holding his rod upright. He looked back at the boy, "I'm going to try here, lad" he said. Standing in the grass by the heap of tackle the boy could just discern the man in the failing light. "Can I come down with you?" he said. "Yes, bring the net and keep quiet", "Where shall I put the fish?", "Lay it on the stones down by the water". Walking over the wet gravel to the river edge the boy did as he had been told. Pulling the loop of string from the landing net he laid the sea trout on the damp pebbles. The fish weighed nine pounds. He rubbed his wet, slippery hands on his trouser legs leaving a trail of shiny scales behind. "It's a good fish, dad" he said, "Do you think we shall catch another one?" The man did not reply but raised his rod and with carefully timed swings cast his line across the pool.

Although he could not see the water on the far side the angler knew exactly where his flies were dropping. He had fished this water for many years. With his father a water bailiff he had as a boy helped to clear the pools of tree stumps and sunken obstacles for the Fishery Board. He cast right out under the opposite bank where he knew the fish would be lying. Letting the fly sink almost to the bottom he worked it in slowly with his left hand, pulling it along a yard at a time, but although the lure passed by many fish it did not tempt one. The water was warm and airless and the sea trout ignored his flies.

Soon it was quite dark, the grass held dew and mist began to rise from the water. After a while the man moved away from the pool and, with the boy following, fished slowly upstream.

From a smooth slatey rock on the other side of the river below the pool a small grey furry animal slid gracefully and sinuously into the water, leaving in its wake a widely spaced chain of bubbles as it disappeared beneath the surface. After several seconds its round cat-like head appeared for a brief moment, then with a splash the creature dived again and swam rapidly across the river not surfacing until it reached the other side. For a while it remained motionless like a half submerged log, its broad flat tail lying on the sand and gravel of the river bed. Then it came out of the water, and after shaking itself and scratching its neck, ran along the bank of the river, pausing now and again to sniff suspiciously at wet depressions in the sand and mud where the strong scent of a human foot tainted the familiar smell of grass, water weed and rushes. Suddenly becoming conscious of an attractive appetising smell it made a sharp whistling sound, and ran excitedly along the stones with nose in the air until it came to a fat sea trout lying by the water. Without hesitation, and again making a whistling sound, it sank its sharp teeth into the broad back of the fish in front of the dorsal fin. Then holding the trout firmly on the ground with its front paws it began to enjoy a meal. Very soon the whole backbone of the fish lay exposed.

One hundred yards upstream the anglers heard the whistle of the animal as they made their way to another pool. "What's that noise, dad"? asked the boy, "*Dwrgi*, lad" the man replied as he drew in his line, "Otter, never catch anything when they're about, spoil the fishing they do". He came up the bank from the water's edge swearing quietly to himself.

The moon shone from behind a cloud, a bat twittered overhead and the cattle stood knee deep in the river.

As it sat licking its paws the otter was suddenly startled by the sound of voices and the vibration of human footsteps coming along the bank towards it. With a rapid twisting movement it slipped into the river. A splash and it swam under water towards the opposite bank.

Back now at the bend in the river, about to dismantle his rod, the man stood at the water's edge. "Get my torch out of the bag" he called, "one more cast and we'll pack up and go home." His reel clicked and once again the tapered

line was whipped across the river and the fly drawn across the bottom. Three times the man shortened the line then suddenly his rod was wrenched violently and nearly pulled from his hand but quickly recovering his grip he struck upwards aware by now of a tremendous struggle on the line. "Quick son, quick" he shouted, "bring the net, I'm on." Changing the rod over now into his left hand he attempted to reel in, lowering the rod top slightly as he did so, but there was no give, a jerking twisting motion, a splash in the middle of the river, a whine of the reel and twenty yards of line went hissing through the water almost cutting his fingers. "Hurry lad" he said, "by heck he's a big one". Again the rod was snatched violently, another boring pull on his rod and once more a splash in the river. The man held his rod firmly, determined to give no more line, he was elated but puzzled at the behaviour of his catch, no fish he had hooked had given him this kind of a fight. Once more he tried to reel in some line and draw the catch towards the bank but the resistance was too much. He knew that to exert more pressure would result in a break, it must either be the nylon or the line, "Take your time" he said to himself, "and hold him, this fish will be a record for the river". There was a splash, a swirl and the line began to give; slowly, slowly he reeled in his line, soon he knew he would have his catch within reach of the landing net. He smiled with satisfaction. "Bring the torch and the net" he said to the boy, "I think we've got him now" The boy came down to the river from the bank above. "Shine the light down. here on the water" the man said "he's coming quietly". A thin beam of light from the torch was directed on to the water, both anglers saw a broad black back turn quickly beneath the surface, there was a sudden commotion in the water, a splash; the line was strained to breaking point and then hung loosely in the river by the man's feet. "Diawks" he said, "he's broken me", "he's gone, did you see his back, like a dog wasn't it?" He examined his line by the light of the torch. "See" he said "nylon broke just by the hook", "pity eh? My, he was a whopper!" Disappointment showed in the man's face as he packed up the tackle.

The mist rose from the water, the ripples on the pool died away and the anglers started slowly for home.

Upstream on the other bank an otter's head broke the smooth surface of the water, a pause and the animal made its way over the pebbles and along the grassy bank. Making a sharp whistling noise as it ran it turned into a ditch and disappeared into a hole under the roots of a fallen poplar.

The otter had a full stomach. It had fed well on a fat sea trout that it had found lying down by the water's edge. Shortly beforehand it had been alarmed by a strange drag and a pulling force on its back leg that had for several minutes prevented it from swimming on its usual coarse across the river. It had been very scared too by a sudden flash of light that had shone brightly in its face. The creature's wet smooth coat glistened in the moonlight. It limped slightly as it ran and its foot was sore, for between the pads of its toes caught in the loose skin was an artificial salmon fly made of horse hair, jay's feathers and gold wire. But it would not hurt for long as the barb had broken off as the animal ran along the stones and soon the hook would come free.

Down by the river's edge by the light of an electric torch a man and a boy were examining a sea trout. The man held it up by a loop of string through its mouth and gills and cursed under his breath as he looked at the fish which had most of the flesh stripped away from head to shoulder. The white back-bone showed down to its tail. The lad seemed perplexed. "But what did that to it, dad?" he asked. A whistling cry came from the river. "Flaming otters" said the man angrily, "Spoil the fishing"!

THE INNOCENT IN PARIS

By
D. HEALEY
Information Officer

The Commission's decision to send me to Paris to look at the International Machinery Exhibition provided the first opportunity in 16 years to leave the homeland on official business. The French, quite rightly I am sure, claim that this long-established annual Exposition is the biggest of its kind in the world and the purpose of my visit was to see what could be "picked up" in the way of new techniques in the public presentation of agricultural and forest machinery and how these could be adapted for use in the arrangement of our own forest machinery exhibition, which has been held on three occasions and is now on the way to becoming an institution. The visit was certainly fruitful and has been the subject of a special report elsewhere, so that it is unlikely I shall dwell upon it at any length in this article, if at all. Rather would I set down a few impressions of my stay in the most elegant of all cities.

I had not been to Paris since before the war. Consequently, on leaving the Gare du Norde my joie de vivre was abounding; quotations and clichés came to mind, not least pleasurable being the old couplet: "*Paris, elle est une blonde qui plait tout le mond.*" And then as I climbed into a taxi en route for my hotel (near the Arc de Triomphe, 28 NF room and private bath, with *le petit dejeuner*, such as there was of it, thrown in), I murmured; "Paris in the Spring: *c'est la vie.*" But this was really tempting providence for when the time came to pay the taxi driver I realised that an obsequious clerk in a Piccadilly bank (who ought to have known better if his professed knowledge of foreign travel was anything to go by), had endowed me with nothing smaller in the way of French currency than a 50 franc note. Now here there is a tip for any other would-be innocent abroad in Paris, and it comes from one who was transfixed by the strangest and most remarkable mixture of sentiments ever to appear, I am sure, on a human face. Had the Bastille still been standing that taximan would have had me in some rat-infested dungeon for at least *une semaine*, which would indeed have been unfortunate, since the Agricultural Exhibition only lasted that long. The moral, clearly, is—if you're going to Paris, use the Métro as often as you possibly can but in any case make sure you've got plenty of small change with you.

There was little time for sight-seeing and in any case my seniors must not be given the impression that dalliance was possible. Most of what I did see was by street light and floodlight, of which there was plenty. But I was struck by the "face-lift" which is now being given to several parts of Paris, in particular to the districts much visited by tourists. All this, I was told by a chatty gendarme who could speak my language with much greater facility than I his, was thought to be at the specific instance of President de Gaulle. And pleasing indeed is the effect in, for example, the Place Vendôme which, as seasoned travellers will know off the cuff, as it were, is occupied very largely by luxury shops, banks and hotels of varied architecture which "pays for the painting". Without attempting to convey an aura of historical erudition to which I am not in the least entitled, I would remind readers who have remained with me so far that the Place Vendôme is notable for its famous colonne, which is surmounted by a statue of Napoleon. The Place was constructed in 1685 by Louis XIV as a monument in his own honour and since then it has seen human emotions displayed in many forms. During the Revolution nine heads of victims of the guillotine were set on spikes in the Place, so that it became temporarily known as the Place des Piques. In May, 1871, the original colonne was pulled down with ropes before an audience of many thousands. It was re-erected in 1875, and the 375 sheets of bronze

which encase its 155 feet appear as one and give the impression of a solid mass of metal.

But I am digressing and must return to the more immediate past. There was a fair sprinkling of British farmers at the Agricultural Exhibition; one or two with whom I talked had already set about finding the cheapest way to see much of Paris by night, thus debunking the view held by some people that our agriculturalists, individually, are sufficiently financially solvent as to be able to make a take-over bid for the Folies Bergère. So together we set off one evening at 9.15 with the immortal Messrs. Thomas Cook as our hosts. Now this is something to be recommended, since the very reasonable fee was inclusive of transport and wine and champagne at all the places visited, as well as the entry charge. First, the major floodlit buildings and then a barnlike structure I know not where in which we encountered and (it must be said) encored some spectacular can-can and Apaché dancers, to say nothing of a solo dancer whose act can hardly be described in the sober pages of the *Journal*. Next, a visit to the Latin Quarter where students—so-called—showed us how the latest ballroom dances should be performed, surprisingly enough in ah atmosphere as respectable as any created by Victor Sylvester. Onward, and upward, in the social scale to the Eve Paris for a couple of hours or so to witness entertainment provided for the tired business man, and finally, as the *pièce de résistance*, to the famous Lido for a quite spectacular cabaret. And so *se concher*, after being obligingly dropped at the door of one's hotel at the hour of 4 a.m.

"The French love this sort of thing," said an attractive French woman journalist I met at the Exhibition as, in the shadow of one of the stands, she moved purposefully towards me. Which, as Damon Runyon would have said was startling more than somewhat. She was, however, merely determined that I should wear the extremely well made, though rather ornate, badge provided by the exhibition organisers for the *visiteur étranger*. Having so to speak been suitably decorated with the badge of office I had reason to be grateful. My visit to Paris took place during the period of lightning strikes by various public organisations in support of that currently in progress by the French miners; it was also a time when, for political reasons, the police were out in strength. And this little insignia did, in fact, serve in a way as an open sesame and also secured for me, I am sure, a considerable measure of the pronounced politeness which is so marked a quality of Parisians (my taxi-driver excepted). For instance, I returned one evening by Métro from the Exhibition to the Gare Etoile at the height of the rush hour which, incidentally, seems rather later than our own in London. Between stations the train suddenly ground (as only the Métro trains can grind) to a halt and out went the lights, the electrical people being determined to make a gesture on behalf of the miners. This could have been decidedly unpleasant, since the train remained in the bowels of the earth for nearly half-an-hour and the situation inside my carriage could only be described as having a marked semblance to the Black Hole of Calcutta. But that little badge did the trick—it had been noticed by those standing closest to me, and they, to a chorus of "*Pardonnez-moi, monsieur*" removed their feet from on top of mine and elbows from my ribs in efforts to alleviate the plight of *le visiteur* who, with this latest development, was seemingly plumbing the depths of human discomfort and misery. Indeed, a gendarme next to me immediately threw his arm across my chest and grasped the handrail, thus creating for me a little oasis in which I could at least breathe.

The Métro, of course, I found unchanged as visitors over many decades must have found it. For me there was still a naïve pleasure in reading those large notices "*Défense Fumer et Cracher*" in the carriages for somehow, I suppose, they flattered in that anyone should think me a sufficiently virile character as to be guilty of *crachant* in public places. I applauded the notices which required

the young to give up their seats to wounded soldiers (a reminder of the long Algerian war, as well as former campaigns) and the old and, throwing all pretences to vanity to the four winds I must say I tried to cash in where the latter provision was concerned—though, very surprisingly, to no avail. As for the carefree disregard of public safety in pneumatically closing the doors but leaving them otherwise unlocked—I marvel that, despite the prominent injunction "*Danger de Mort*!", there are not at least a dozen deaths a day on the Métro.

Came the day for the journey home. Leaving my hotel, with a heavy case, I set off to find a taxi, only to be bedevilled once more by one of those lightning strikes. Again the city's electricity supplies were cut off and, with the Métro out of action, it was impossible to obtain a taxi or get on a bus. So back to the hotel to plead with the porter to use his influence to find me a cab. To give the man his due he tried hard enough; five garages, when called by telephone, were unable to help and only after he had spent 20 minutes in the streets near the hotel was he successful. On receiving frantic waves from the door I rushed out of the hotel and clambered into the car, gratefully—all too gratefully—pressing my last few coins into the palm of the porter.

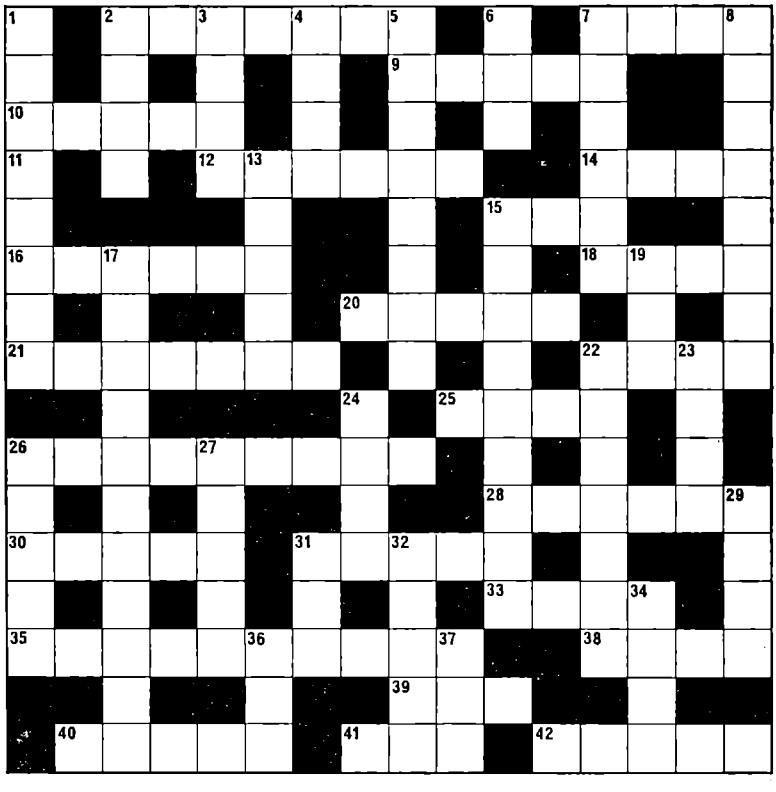
And so to the Gare du Nord, with just a minute or two to catch the train. I leapt from the taxi, reached for my wallet to extract some paper money. All I had left was—one 50 franc note! *La vie était très triste*!

FOREST CROSSWORD

by
J. R. AARON
District Officer, Headquarters

Down:

1. Grey or red?
2. Wooden door frame used at a jamboree.
3. The main idea.
4. A fox's home in a treeless part of Asia.
5. Descriptive of woodwool and certain breakfast foods.
6. She loves climbing.
7. Tea with the captain of the *Bounty* causes a disease.
8. A ray from a musical instrument for a strong timber.
13. Oral derision about a waterside tree.
15. Timber sold by the audit once method.
17. The approximate shape of conifers and poplars.
19. An alternative name for 30 across.
22. Warm the lady up for a moorland plant.
23. Fruit flavoured timber.
24. A forest mammal fond of parties.
26. Sad preparation of firewood (3: 2).
27. Useful for wreaths.
29. Only welcome on a compost heap.
31. A vestment made from *Abies alba*.
32. Scottish dances from a wood turner.
34. A unit of wire netting.
36. Forest tool favoured by Dr. Beeching.
37. Help!



Across:

2. Nuts to the ancient Romans, they are so often pickled.
7. A man leaves a type of saw for a shrub.
9. Bob leaves a type of spade for a poor home.
10. Elm as Julius Caesar knew it.
12. Does he use oak bark in six penny worths?
14. This cherry gets the bird from a strange animal.
15. Tree found in the Wash.
16. Infested foliage or exposed iron.
18. Atlanta peaches for measuring timber.
20. Timber used for Toynbee chairs.
21. Jack leaves the timber men and Bob leaves the sleepers for sawn wood.
22. A type of oak.
25. The foresters worst enemy.'
26. Old jokes by the blacksmith's shop.
28. Against rabbits?
30. Finnish University Town which exports timber.
31. Yes, from a greenwood tree.
33. Handy Eric changes colour.
35. Christmas tree (5: 5).
38. Kangaroo teeth marks at the bottom of the tree.
39. Cut branches from sloping ground.
40. Lacewood from a distant planet.
41. Were you one to start this puzzle?
42. Sullen timber extractor.

THE AFTERMATH

by

EUROS JONES

District Officer, South Wales

One long-dry spring, one day of days
The hot road shimmered in the haze,
Snake-like sped round the forest's rim
Which rose above it, cool and dim.

The questing sunbeams quivered down
The swordlike stems in blue-green gown,
And with the breeze that played beneath
Kissed drier still their bracken sheath.

A monster broke the sylvan still,
A four-wheeled demon, sleek and shrill,
And through its open window sped
A glowing object, not quite dead.

It lay awhile in yellowed grass,
The devilish breeze blew gently past,
Coaxing it, fanning 'til it grew
From spark to flame, and still it blew.

Aeons later the peace returned,
The mountain slopes no longer burned,
The fire was out, but Oh! the scene—
Just blackened stumps where trees had been.

Y GOEDWIG WLADOL

(THE STATE FOREST)

by

W. T. REES

Forest Worker, South Wales

Os gwerthwyd yr elltydd yn gyfan
O'r blaenau hyd waelod y fro,
Mae gobaith eto i fobl y lle
Gael boncyff ar dan gyda'i glo.

Os torrwyd y deri cadarnaf
Na wyr yr un henwr eu hoed,
Eto i lanw gwagle bob llaw
Fe blennir gymysgedd o goed.

Mae'r "Norway" yn harddu'r hen gribau,
A'r "Lawson" yn glasu y cwm,
A gwelir "Sitka" bigog ei brig
Yn gorchuddio'r hen foelydd llwm.

Pan syllwn ar dir ein hen dadau,
A chanfod yr harddwch yn wir,
Edmygwn ofal Llywodraeth gwlad
Am goedydd urddasol ein tir.

Translation.

From one valley's end to another
The woodsman has taken his toll,
But people therein can still gather
Some logs that will burn with their coal.

Though all the old oaks have been cleared—
Some older than mem'ry could tell,
To fill all the gaps thus created
Many new trees are set in the dell.

The "Norway" adds beauty to the slopes,
To the cwm the "Lawson" brings green
And the "Sitka" with needle so sharp
Now covers bare slopes with its sheen.

As we look at the land of our fathers
And see the fresh beauty now there,
Let us praise the Government's foresight
For our country's new woodlands so fair.

TO A WORN OUT R.L.R. PLOUGH DISCARDED AT LIGHTMOOR IN THE FOREST OF DEAN

by
R. J. JENNINGS
Head Forester, Dean

'Gainst the grey crumbling sandstone of the
Derelict shaft you lie an abandoned wreck
Worn out with work. No longer does the
Sunlight flashing on your burnished blade
Across the moor alarm the curlew, nor
Pointed brow churn up the earth and stone.
'Neath where your tired frame rests in
Charred ash and shale men too dug rock and
Earth in search of coal. Deep down in
Flooded tunnels ponies hauled and died.
Long since forgotten they now with you
Lie buried after toil in the forest.
Where the black crow mourns and the wind
Through the trees whispers a requiem.

THE CAMBIO DEBARKER: A WORK STUDY ASSESSMENT

By
N. DANNATT
Work Study Section

Notes on a visit to Sweden, September, 1963, to see Developments in Peeling and Extraction

Introduction

In recent years the costs of floating timber in Sweden has risen steeply and alternative methods of transport have been developed. At the present time about two-thirds of all timber, whether pulpwood or saw timber, is transported by lorries from forest to mill. In the past five years the quantity of timber so transported has more than doubled and it is expected that this trend will continue. The development of mobile peeling machines has overcome the difficulties of bark disposal and pollution, and increased the efficiency of road transport by eliminating waste. The increasing difficulties and costs of extraction from stump have led to the development of new techniques and machines. These developments, together with the increase in road transport, have led to an intensive road building programme which has the aim of bringing the lorry as near to stump as possible.

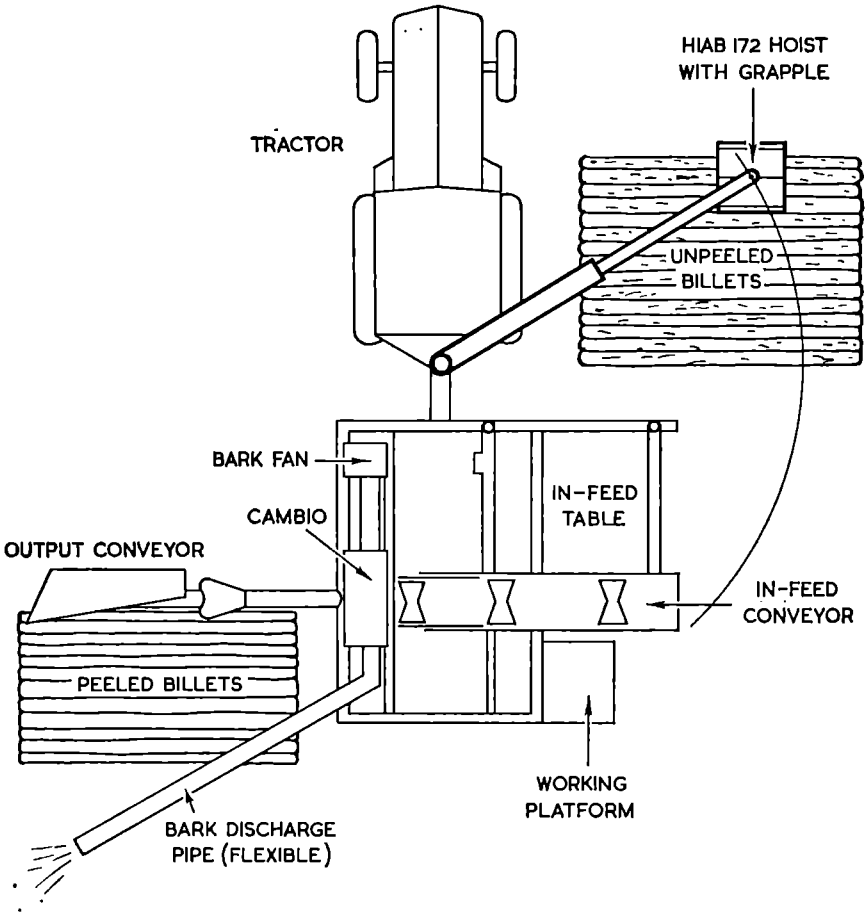
Peeling Developments

The Cambio 70–35 AC, is the standard peeling machine used in many pulp mills; it is used by Bowaters at Sittingbourne, in Kent, and the Wiggins Teape companies already use it at Sudbrooke in Monmouthshire and propose to use it at Fort William. The peeling principle is simple, a series of tools (3, 4 or 5

scrapers with 2, 1 or 0 knives) revolve at high speed; they are tensioned on strong rubber bands and press on the bark. The pressure of the scrapers and their speed separates the bark from the wood. Normally the bark is removed in small pieces about 1–2 square inches; if the bark is fibrous then a knife is added to prevent long strips of bark forming which tend to block the machine. The peeling tools revolve at about 400 revs./min. and the feed speed of the billets through the machine is between 100 and 150 feet/min. Essentially the machine is designed to peel a continuous length of timber and the aim is to feed billets end to end to achieve maximum output. The secret of good peeling is to have the scrapers correctly sharpened and tensioned. The scrapers, and knives, have

TRAILER-MOUNTED MOBILE CAMBIO PEELING MACHINE

LAYOUT PLAN



(See also photo in central inset)

an additional sharp bevelled edge, the "climbing edge" with which they "climb" from the square-cut end on to the unpeeled surface of the billet.

Three types of mobile Cambio barking machines were seen; all were designed to peel the standard 2 metre and 3 metre lengths of pulpwood.

Tractor-Mounted Cambio

When the trend of peeling in the wood became evident the Cambio manufacturers mounted their standard peeling machine between the rear wheels of a tractor. This combination was equipped with hydraulic lifting arms on the off side to feed the machine. The first man in the team rolls the pulpwood billets down on to bearers, into a position ready for the infeed (machine) operator to roll them on to the arms. The infeed operator operates a lever to lift the arms to engage the billet in the infeed rollers of the Cambio. The billet passes through the Cambio and is stacked by an operator at the outfeed side. This machine is widely used along forest roads but the low stacking height limits the quantity of timber which can be stacked along a given length of road.

Trailer-Mounted Cambio

The "Korsnas" paper company sponsored the development of the trailer-mounted Cambio to overcome the limitations of the tractor-mounted machine. Normally the two-ton Hiab No. 172 with a grapple is mounted over the rear wheel housing of the standard Swedish agricultural tractor similar to our Fordson Major; the tractor is the power unit for both crane and Cambio. This machine is more flexible than the first development and is also designed to work along forest roads. The billets pass from one side of the road to the other through the peeling machine, see the diagram on page 170.

Lorry-Mounted Cambio

This is the most recent development and the major difference is that, while for the first two systems the billets pass on a straight line from the unpeeled stacks through the machine to the peeled stacks, in this system the billets are peeled on an axis which is at right angles to the stacks of unpeeled and peeled billets. Because of this feature the lorry-mounted Cambio can work in a more confined space and is used in Sweden to work along public highways. The lorry usually employed with a heavily reinforced chassis is either the standard Volvo or Scania-Vabis with about a 120 h.p. engine. The hydraulic crane commonly chosen is the Hiab Elefant—the 176, with pulp grapple. With this set-up the crane places unpeeled billets on the infeed table, then lifts the peeled billets from the "bucket" at the outfeed end and stacks them, see diagram on page 176.

Operating Team

The basic team of men for all these combinations is three. One man feeding the billets from the infeed table into the machine, another operating the crane and the third stacking the peeled billets. In the original tractor-mounted system the first man in the team places the billets in a position ready for the infeed operator. This system is obsolescent and is being augmented by separately mounted hydraulic cranes, which eliminates the physical effort of the first man and enables the machine to remain in one position for a longer time because of the greater reach of the crane.

The key man in both the trailer and lorry-mounted machines is the crane operator, followed closely by the infeed operator. The third man who adjusts the peeled billets and generally makes the piles tidy is not absolutely essential.

However, additional money is paid to ensure that the peeled billets are stacked to assist subsequent lorry loading. In some cases the peeled billets are stacked with stickers (peeled billets) to assist seasoning. After seasoning the pulpwood billets are loaded on to a lorry equipped with a Hiab Elefant and grapple and trailer. Thus the minimum team is two men, but if tidy stacking is necessary the third man is required.

Outputs and Costs

No outputs or costs were obtained for the obsolescent tractor-mounted machine.

The trailer-mounted Cambio with crane, tractor, etc., cost approximately £7,500, and outputs ranged from 3,000 to 4,500 H.ft. per eight-hour shift.

The lorry complex cost £7,500 with an old chassis and reconditioned engine, but £10,000 with a new lorry. Outputs ranged from 2,500 to 4,000 H.ft. per shift.

The contract rates quoted for both these machines were the same in spite of the 10–15% greater output from the trailer-mounted Cambio. The rates were about 3¾d. per H.ft. O.B. and include all machine costs, overheads, etc. Of this cost, about one-seventh, i.e., ½d., was paid for the additional work of stacking peeled billets to assist subsequent loading and to accelerate seasoning. Cost of hand peeling is 6d. per H.ft. O.B.; thus the saving is 33⅓% or 2d. when using the mobile Cambio. No accurate cost of peeling at the factory was obtained, various estimates ranged from 2d. to 3d. per H.ft. O.B. These mobile machines are sometimes worked for two shifts per day and achieve an annual throughput approaching 1½ million H.ft. Most of the machines are designed to peel standard 2 metre and 3 metre lengths of pulpwood but with minor modifications longer lengths can be accommodated.

Hiab Developments

The Hiab firm manufacturers two types of hydraulically-operated cranes, one using a cable through the arm for lifting, and the other using rams in the arm for lifting. When first designed these cranes were not intended for forest work, but operators fitted them to both tractors and lorries. When the Hiab engineers became interested in this development and began to look at forestry problems, they quickly discarded the cable type of crane and the smaller "hydraulic" crane and concentrated on the larger "2-ton" model. The result, called by some the "Forest Crane", is the Hiab Elefant No. 176 for which hydraulically operated grapples were developed at the same time. These grapples have jaws which are about 2 feet 6 inches wide and have a catchment area which varies from 0·33 sq. ft. to 8·07 sq. ft. depending on the product to be handled; the jaws are opened and closed by a single hydraulic ram and the whole grapple is turned by a "Hydraulic Rotator" which has an operating arc of 230°.

This combination of crane and grapple can be operated by one man and is the standard equipment for timber-carrying lorries; it has recently been mounted on tractors for extraction.

Lorry-Mounted Crane

The Hiab Elefant with grapple appears to be the standard equipment for the timber-carrying vehicles in Sweden. These large powerful lorries carry about 15 tons of timber; they tow a trailer with a capacity of about 10 tons, making a total pay load of about 25 tons. Three makes of lorry were seen, the Volvo, Scania-Vabis and the Mercedes; they all had a rating of about 120 h.p.

Because this crane is expensive it was thought that one crane could either be interchangeable between lorries, or be mounted on a separate vehicle to load several lorries, but it soon became evident that difficulties of the crane being in the right place at the right time more than offset the additional cost of one crane per lorry. These cranes can be mounted directly behind the lorry cab or on the end of the lorry platform, or on the trailer, depending on road width. One very important feature of the increase in road transport is the attention paid to forest roads, the roads are being made so that there is ample stacking space for produce. Along narrow roads with room for one vehicle the Hiab crane must be mounted on the tail end of the lorry, or near end of the trailer, so that both parts of the vehicle can be loaded from the one position. If the crane is mounted behind the lorry cab the trailer is loaded by either the lorry moving to a position between it (the trailer) and the stack, or making the trailer pivot about the coupling to reduce the distance to the Hiab; for both these loading positions side stacking places are necessary. It appears that the mounting most favoured is directly behind the cab; when mounted in this position the crane and grapple are folded over the cab during transport.

Tractor-Mounted Crane

Concurrent with the development of the lorry-mounted crane came the development of tractor-mounted cranes. It appears that the tractor is rapidly taking the place of horses in Sweden and so new equipment has been developed which achieves greater output to offset the additional capital expenditure.

The basic equipment is a normal agricultural tractor (Bolinder-Munktell), similar to our Fordson Major, a two-ton hydraulic crane with grapple, and a trailer. The tractors have been modified in several ways to adapt them to forest conditions; some have the typically Scandinavian half band (track), others have larger front wheels, and others have rear wheels with larger and wider rubber tyres. These modifications are made to increase the traction in soft forest conditions and to give added stability when using the crane.

The crane is mounted over the rear axle housing and sometimes the framework extends to the front of the tractor to carry a counterweight. Two types of crane are fitted, the 172 with the short boom and the 176 (Elefant) with the extended boom; each is equipped with a grapple; the crane controls are situated in the tractor cab.

The trailers have a capacity of about 10 tons, and like the tractors there are variations in design. Some have two large hydraulically powered wheels, others have two bogies of four free running wheels. These different designs serve the same purpose, that is to give a larger bearing surface to the wheels and thus facilitate movement over soft ground.

This equipment requires a careful logging plan to achieve the maximum output. Racks are made about 1½ chains apart and each rack is about 12 ft. wide. The feller stacks the 2 metre or 3 metre length pulpwood at rackside ready for the subsequent extraction. For an average extraction distance of about 200 yards, this combination of machines has a turn round time of about 1 hour for a 10-ton load, which gives an output in an 8-hour day of about 2,000 H.ft. These figures relate to highly skilled operators; an indication of their rate of work is the speed of unloading from the trailer on to an adjacent stack, which was observed to be 1 ton per minute. The cost per H.ft. using the equipment was claimed to be 3½d. including machine and overhead costs. The comparative cost of the old method, by horse, in the same conditions was claimed to be 4¾d. This is a saving of 26% or 1¼d. per H.ft. But to achieve this saving some £4,500–£6,000 of capital must be spent on the machines.

These tractor developments have taken place within the last two or three

years and as a result a new crane has been designed; it will be similar to the No. 172 but embody the best features of the No. 176 and the outer boom will extend hydraulically.

Application to British Conditions

Peeling

Delivery of a trailer-mounted Cambio for the Brandon Central Depot at Thetford Chase Forest in East Anglia is expected before the end of 1963. This machine will peel pitwood poles ranging in length from 15–25 feet, and the annual throughput should be in the region of ½ a million H.ft. O.B., plus up to 150,000 H.ft. O.B. of stakes and woodwool material. This machine will fully mechanise the peeling in Thetford Forest.

Careful consideration should be given to these machines, especially when long haulage distances are contemplated; or where there are weight restrictions on roads. These machines could be used increasingly as new chip and paper mills are built to cope with the growing supply of timber. The lorry-mounted Cambio would seem particularly suitable to many of our hilly regions with their narrow roads.

Hiab Cranes

A Hiab Elefant (No. 176) with the large pulp grapple has been used successfully for nearly two years in the trials for the Scottish pulp project. The crane is mounted on to a 12-ton Bedford articulated lorry. A Number of two-ton Hiab's No. 172 have been mounted on 5 and 7 ton Bedford platform lorries in the past 4 years; these cranes have been used successfully with a selection of tongs and slings for loading logs and shorter pulp/chipwood material. When using these accessories a mate is necessary in addition to the crane operator. To reduce the labour content and costs, two grapples have been tested in Thetford during the past few months. The trials have been successful. The small grapple, with a catchment area of 0·33 to 1·6 sq. ft., is the best tool for logs, while the larger grapple, with a catchment area of 2·2 to 5·9 sq. ft., is the best tool for the shorter chipwood/board mill material. (The largest grapple 2·2 to 8·1 sq. ft. may be even better.)

A tractor-mounted one-ton hydraulic Hiab, the Bimbo No. 292, is being tested. This crane has a limited capacity which is reduced considerably by a grapple, and it has a limited reach. Whilst a useful tool in some conditions, it is expected that the two-ton model will be of much greater use in the forest.

Two tractor-mounted two-ton cranes are being ordered by the Forestry Commission; a No. 176 (the Elefant), mounted on a Fordson Super Major tractor, will be used to feed the trailer-mounted Cambio at Thetford Forest. A No. 172 crane, mounted on a Fordson County Super-4 tractor, will be used in the development work for the Scottish pulp project either as an independent loader to load lorries, or with a trailer as an extraction vehicle in the flatter areas.

Thus the Swedish developments are being applied to British conditions. The indications are that the lorry-mounted peeling combinations will be the best for most of our forests, but the trailer complex should also have a place. The larger two-ton crane, the Hiab Elefant, will probably be the best tool for mounting on a lorry, but the shorter boom No. 55 will also have a place. The No. 172 and No. 55 should be the best cranes for mounting on a tractor for most conditions.

The Pattern of Future Mechanisation

It would appear that the trend will be towards greatly increased capital expenditure on machines for forest operations. Outputs will be high and costs will be similar to, or lower than, present manual methods. More mechanical peel-

ing will be done at roadside. Double drum winches and tractor mounted cranes with trailers will be the standard extraction machines, and large-capacity lorries served by independent loaders or carrying their own cranes will be the major timber transport vehicles of the future.

THE CAMBIO DEBARKER: AN ENGINEER'S VIEWPOINT

by

W. C. ANDERSON

Directorate Mechanical Engineer, England

Equipment seen in Sweden:
Korsnas Type Cambio Debarker, Model 70-35 a.c.

The above machine is produced in Sweden by Soderhamns Verkstader A-B, Soderhamn, Sweden. This firm manufactures the Cambio debarking unit, basically designed for fixed installation.

The Cambio is mounted on a trailer by another firm who thus produce under an agreement with Soderhamns, the so-called Korsnas type Cambio 70-35 AC debarker. This firm is Soderlund & Lendstrom A-B., Mek. Verkst., Gavle, Sweden, who are specialists in the manufacture of trailers. They mount the Cambio on a trailer and provide the bark fan with ducting, a conveyor system designed to ensure that the logs proceed through the peeler in a horizontal manner (or along its axis of rotation) and the necessary drive mechanism from the tractor power take-off coupling gear to the peeler, fan and conveyor system.

Tractor

This must be within the 50–60 h.p. range, equipped with rear P.T.O., for driving the debarker and ancillary equipment on the trailer and with front P.T.O. with hydraulic pump, to operate the hydraulic hoist which will be a HIAB model 176 with grapple.

The tractor selected is a Fordson Super Major which is being suitably modified with sub-chassis, special front axle, etc., to accept the additional stresses it will be subjected to and to accept adequate ballasting to assist in its stability.

The Hoist is a HIAB model 176 (Elefant) which is being fitted to the tractor by the U.K. Agents for this hoist, Geo. Cohen & Sons, Ltd., London.

At a future date a *robust* cab for the tractor should be considered.

Other forms of Debarker seen and their comparison

Only equipment which embodied the Cambio was seen but even those who had no vested interests whatever in this expressed opinions that it was the best on the market. It was obviously widely used, especially by pulp mills.

Apart from several of the Korsnas types which were seen there were many stationary ones, usually in banks of 3 (or 4) and also in groups of up to 8—these were at mills.

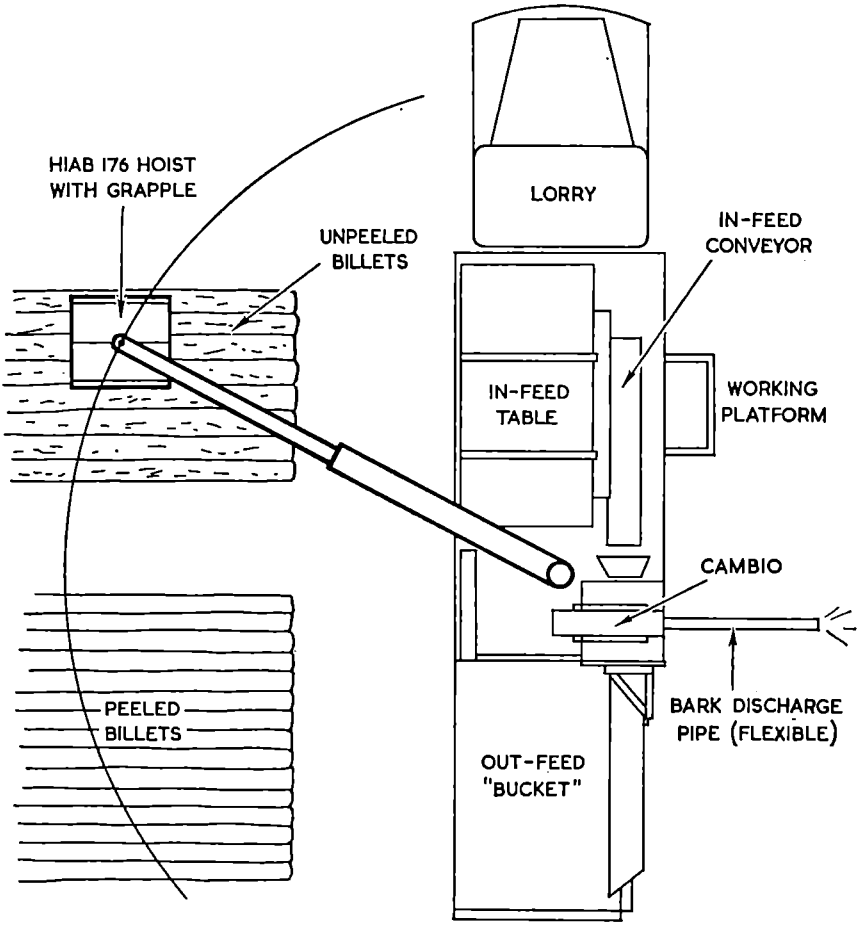
One of the old tractor-mounted units was seen but the "Korsnas" and the "Carlskrona Cruiser" type had apparently superseded this type.

The Carlskrona Cruiser is the truck-mounted version and referred to later in this report.

From discussions with the personnel concerned with these debarkers on

servicing, reliability and the expected lives of component parts, especially knives, it was ultimately possible to consider the spares list for initial importation with the machine.

LORRY-MOUNTED MOBILE CAMBIO PEELING MACHINE



(See also photos in central inset)

The Swedish Tractor

In Sweden the Korsnas Type Cambio is powered mainly by the Swedish "BM 350" wheeled tractor which is sometimes equipped with half tracks (B.M. = Bolinder-Munktell and is a product of the Volvo company).

A detailed specification of this tractor was not readily available and I did not attempt to get one as I would not recommend the import of this machine; there being no service facilities in the U.K., and I do not expect that there ever will be.

Baby Rolls

These are rolls fitted with the feed rollers on the Cambio to enable shorter lengths to be peeled (stakes); the peeling of such material will apparently be ultimately up to 20% of the material to be peeled.

Teams of Operators

Discussions and observations suggested that the crew to operate either of the portable units viz., Trailer type (Korsnas) or Lorry-mounted type (Carlskrona Cruiser) should be three. It is possible that sometimes this might be reduced to *two*. It was suggested that when peeling long lengths the butt end of one log might roll out of place on the stack and cause trouble that at least one extra man could deal with.

These three comprise the Hoist Operator who might also be the lorry or tractor driver; the Peeler Operator and a labourer. Of these three the most important is the Hoist Operator on whose skill the speed of operation depends mainly. The peeler operator is not really skilled; he simply pulls/guides the logs on to the conveyor which takes them through the debarker. The third man, a labourer, is useful for tidying up and straightening bundles or piles, etc. I think he might be required in the early stages at least until the minimum crew of two became familiar with operations.

In fact with long lengths of logs being peeled on the trailer type of outfit a fourth man might also be required initially. Every mobile unit seen had three operators.

Training of Operators and Maintenance Staff.

The operation of the equipment is comparatively simple provided the hoist operator has had some experience.

The maintenance staff will require some instructions and this can be most readily provided in the main by the use of films.

Soderhamns have a set of films covering six lessons on the operation and maintenance of the Cambio, the most important of these being:—

Lesson No. 2:—Replacement of fan wings, tool shafts and debarking tools.

Lesson No. 5:—Maintenance of Debarking Tools.

Carlskrona Cruiser

This is the truck-mounted version of the Cambio debarker and is the develop ment of Messrs. Svenson A-B, Valleverken, Jamjoslatt, Karlskrona, Sweden.

The Cruiser at present is designed to deal with up to 3-metre lengths and I suggest that it would not be worth while considering in its present form for dealing with (much) longer lengths, mainly due to the mechanical handling problem.

The hoist is placed amidships on the lorry chassis and it has to pick up timber—in "grabfuls" at centre of balance of each load. The deck on which the load is placed prior to being fed through the peeler must be at least long enough to contain the longest length to be peeled. This could be achieved by having a vehicle with a one-man cab—or simply a "four-wheel trailer" with a power unit for the items fitted to it. The trough, which overhangs the chassis to the rear, is designed to accept peeled logs and in same length as foredeck.

Advantages of the Cruiser

The main one is its ability to bark more efficiently at roadside than the trailer model, due to stacking ability by hoist. It also appeared to be rather

faster than the trailer type and of course mobility over longer distances would be very important as these peelers have such a high output that they have to move very frequently. For these reasons it appeared to be gaining popularity in Sweden where a mobile unit was required.

The position of the hoist, with the operator perched on a seat which rotates him with the load (as on the Massey-Fergusson digger) enables him to see his load at all times very clearly and to stack it more accurately and possibly higher.

Lost time of the Cruiser was put at 3%–10%.

In comparison with the Korsnas Trailer Type the axis of the peeler should be noted—on the trailer it is at right angles to the longitudinal of the trailer and on the lorry parallel to it.

HIAB Hoists and Hydraulic equipment

The address of this firm is Hydrauliska Industri A-B, Hudiksvall, Sweden.

The factory seemed to be concentrating on the truck- and tractor-mounted units which appear to be widely used in Sweden, especially with the hydraulic grapple introduced about 2 years ago—virtually every outfit working on timber appeared to be equipped with a hydraulic grapple—no slings!

Apparently quite a number of two-ton hoists are fitted to half-tracked tractors and sometimes (in more severe conditions) the half tracks, or bands as they call them, are replaced with full tracks over the tractor's pneumatic tyres.

Some loading/lifting techniques were indicated; one of the most important perhaps being to bring the load, by means of the hoist and using its grapple and hydraulics, into the side of the truck or tractor before lifting, i.e., always lifting a load at the shortest possible radius.

On extraction where tractors are moving a lot, stabilisers did not appear to be used a great deal (HIABs confirmed this).

On "semi-static" operations, such as with the trailer-type Cambio, stabilisers are required and will be fitted to the Fordson Super Major tractor for Thetford.

Device for Folding the (2 ton) Hiab 172 Outer Boom from Transport Position and Contrariwise

As I had heard comments on the physical difficulty of folding the outer boom of the Hiab (Two Ton) 172 into the transport position I asked Soderlund and Lindstrom and also Hiab about this. (The later model 172 and 176 hoists will be all hydraulic but we have a few of the older ones).

The problem is more apparent when a lorry is equipped with a head board or bolster of about cab height, the hoist being chassis-mounted behind the cab, i.e., between cab and head board. This was noted recently (August) when fitting such a hoist at Lightmoor Depot onto a 7½ ton Bedford truck. Consideration will be given to fitting hoists "inside" the head board in future as this could be a better idea although it produces other problems.

On Swedish trucks the hoist is usually stowed on a "shelf" built out over the cab and supported by struts on the front bumper.

Additional Items of Mechanical Plant or Equipment Seen

Trailers

When studying Hiab equipment in the field (at Strombacka) it was perhaps inevitable that some trailers should be seen in use. Two of these were most interesting in design.

Each of the trailers was said to be carrying about 9 tons of timber (Max.—

15 cu. metre at 600/800 Kilos/cu. metre, approximate 9 tons) and this down a slope of about 1:8, and sometimes greater, strewn with rocks, stumps, etc.

(**a**) The first trailer was supported on tandem twin bogie wheels. These were so arranged that the front wheels carried less weight than the rears, so inducing a tendency to climb; in consequence in this twin-wheel arrangement draw-bar pull peaks would be reduced allowing the trailer to be pulled by a smaller h.p. than might have been possible otherwise.

Tyre equipment on the trailer was 10·00 by 20 by 12 P.R. (Goodyear High-miler) and apparently this is a slightly larger size than had been used previously. The hoist used was the Hiab 172 (latest model) and "medium" size pulp grapple.

The tractor was a B.M. 350 (50 h.p.) on half tracks over pneumatics.

(**b**) The second trailer had a somewhat similar chassis to the first but had, instead of small tandem-bogey wheels, large wheels of same size as the tractor rear. The tractor had no front axle or wheels and so this was simply a four-wheel unit (similar to the Caterpillar DW21 scraper units.).

This was a new development and only in prototype stage.

A hydraulic motor was used to drive the rear wheels through carden shafts and pinions and gears.

The tyre equipment all round was 18·00 by 25 by 12 P.R. (Goodyear "Supergrip").

The hoist used was Hiab 176 and medium size pulp grapple.

I discussed the wheel arrangements with a most knowledgeable Swede and he mentioned that discussions and observations to date suggested that perhaps wheels of up to eight feet diameter should be used for some such extraction operations.

The way the timber was loaded and the design of the trailer chassis was particularly interesting.

In my opinion one of the most important points in these operations, and to quite a degree the secret of their success, was to ensure that the tractors could and would be driven at very low ground speeds.

A reduction gear box of possibly 6:1 ratio would be essential on—say—the Fordson Super Major wheeled tractor.

In winter conditions the trailers are, in many cases, obviously replaced by sledges.

Road Transport

All the timber which was being extracted at the time of this demonstration had been cut at stump to a standard length (3 metres apparently the usual) and so the mechanical handling was relatively straightforward and hydraulically operated grabs could be used to advantage. (This 3-metre length also suits the pulp mills, of which we saw three, and noted that they were very highly mechanised as regards wood handling).

The use of road transport had also developed quite a lot apparently in recent years and mechanical handling was enabling this to be more fully exploited. They said at present road transport moves about 60% of their timber and water the remainder, but that in two years or so it was expected to be nearly 100% road transport.

They explained that the maximum gross weight moved on a truck with trailer was 35 tons (which is of course greater than permitted in the U.K.) and this comprised a 50–60 cu. metre load.

Almost every lorry was equipped with a 2-ton hoist complete with grapple.

The vehicles were mainly the 150 b.h.p. Scania or similar Volvo, and were said to carry their timber loads over long distances.

It was explained that the lorries are loaded by (2-ton model) hydraulic hoists at the *rate of* 12 *tons in* 20 *minutes* and unloaded at 12 tons in 12 minutes (and that these were generous times!). However, this was for a rationalised product, viz. 3-*metre lengths.* There was also a bonus system of sorts in use on such operations.

Operators for Tractors and Trucks

It was explained that the authorities were happier now to agree to only one man working on his own and that with a hydraulic grab it was better and safer thus. They added that this eliminated the risk of a second man or mate being struck by grab, logs, etc., although they appreciated the fact that it would normally be preferable to have two men together in case of accidents. (Two teams could be used to solve this perhaps).

Obviously the regulations in Sweden are far from as rigid as in the U.K. but they thought they had a good training scheme which consisted of a nine-week course for operators at a forest school. I am not aware how successful this system is.

However, it is essential that under conditions such as were seen in Sweden, and with the equipment used, some attention must be given to operators' training to achieve *high productivity safely.*

CAGE TRAP FOR HARES

By

S. W. R. STEWART

Forester, East Scotland

1 Introduction

The sketch opposite is of a cage trap for hares designed by myself at Keillour Forest. It has been tried successfully at several forests in East Scotland.

2 General

The trap consists of an oblong enclosure with netting tunnels entering at both ends. The hare is encouraged to enter the trap by providing lead-ins to the tunnels. Once inside it will try to climb and burrow, but will not find the narrow entrances. The trap is normally erected on the inside of perimeter fences and is intended to trap hares already in the forest.

The advantages of a trap of this type are:—

(i) It is more humane than conventional snares and traps because the animal feeds on vegetation inside and suffers no harm until the trapper dispatches it humanely.

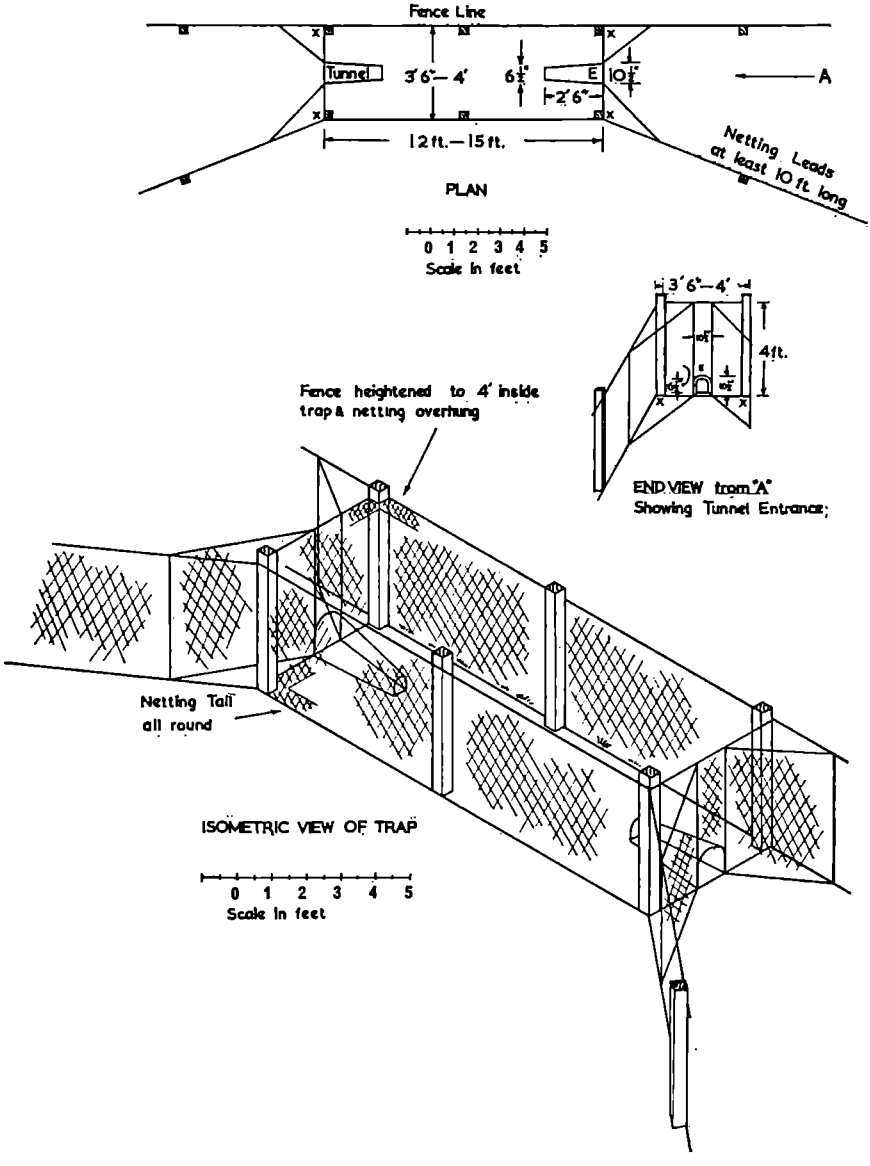
(ii) It is permanently set and can take hares for up to a week without inspection, so it saves labour.

(iii) Because the hare remains alive it is not attacked by crows or cats, nor spoilt by shotgun pellets and it should fetch a good sale price.

(iv) Hares can be enticed into the trap with bait (cabbage, turnip), in hard weather.

(v) Both animals and birds are caught in the cage but birds can escape if the roof is left uncovered.

CAGE TRAP FOR HARES



3 Construction

(i) *Materials.* Standard 18/19 g. rabbit netting, 8 g. wire, fence posts, staples.

(ii) *Height.* Sides should be at least 4 feet high. Hares will try to climb out so it is as well to have the sides overhanging.

(iii) *Dimensions.* 15 feet by 4 feet is about right. The length allows birds to take off easily. If the trap is made narrower it will tend to lead hares to the entrances. If made wider the hares are difficult to catch.

(iv) *Entrances.* Once inside, the hare will spend some time standing on the tunnel at E on the sketch. Funnels should be strongly constructed from two thicknesses of netting reinforced by 8 g. wire and pegged into position.

An alternative funnel-shaped entrance may be used. This should be circular in section, 10 inches falling to 6 inches and about 2 feet long. The entry should be 4½ inches above ground level. Both tunnel type and funnel entries seem to work equally well.

(v) *Lead-ins.* At least 10 feet long. Avoid sharp turns at X.

WINTER 1963 AT DARTMOOR FOREST: A FORESTER'S LOG

By

R. BULTITUDE

Forester, South West England

DECEMBER

Thursday, 27th. Min. 24° Max. 29° (F). Cold and hard frost with light/moderate E/NE wind. Very slight cover of snow in the morning. Snow falling by dusk. (Last day of Christmas Holiday for Dartmoor men).

Friday, 28th. Min. 25° Max. 33°. About 9 ins. of snow on the ground and still snowing. Moderate drifting in a few places and the Bellever–Postbridge road impassable. Take Land Rover via forest roads to Postbridge and on to Chagford (via Lettaford as Junston road blocked) to collect pay. Next to Fernworthy—driving a little difficult but possible to reach depot—Fernworthy squad had walked in. By mid-day snowing very freely; at 1 p.m. drive men back to Chagford, return to Bellever.

Saturday, 29th. Min. 27° Max. 32°. Strong E wind rising to gale in afternoon with blizzard conditions continuing until late evening. Postbridge, Princetown, etc., completely cut-off.

Sunday, 30th. Min. 26° Max. 29°. Warmer with moderate thaw conditions. Deep drifts in many places. Entry to yard at Bellever blocked by 8 ft. of snow. Where level, snow about 18 ins. deep.

Monday, 31st. Min. 31° Max. 36°. Heavy sleet at first with slow thaw conditions. First part of morning spent digging way out of yard. Remainder taken up using Land Rover and squad to force track through forest roads. 4 p.m. before we reach Postbridge. Collect a "ration" of 12 gals. of paraffin from shop and a few stores, return to Bellever. During afternoon becomes colder with no thaw. On returning home learn that Mrs. Donovan (our part-time clerk) has become ill and is tending to go into diabetic coma; her doctor has telephoned detailed instructions as to treatment and has arranged for R.A.F. helicopter to collect her tomorrow morning if weather permits.

JANUARY

Tuesday, 1st. Min. 26° Max. 35°. Squad makes preparations for helicopter to land in field alongside hostel—digging letter "H" through snow and preparing "smokey bonfire". It is foggy at first but lifts by 9 a.m. Helicopter

(from 22 Search and Rescue Sqdn., Chivenor) arrives and lands, 10 a.m.; Mrs. D.—with label pinned on coat stating time and quantity of her last insulin injections—is carried out to aircraft and flown off to Exeter. Same machine had already left supply of bread at Postbridge; it also delivers 4 doz. loaves to us. Remainder of the day spent making a L/Rover route out of Postbridge towards Moretonhampstead—I choose this direction because conditions near Two Bridges and Princetown reported hopeless. By end of afternoon we have only managed to reach top of Merripit Hill. No thawing today.

Wednesday, 2nd. Min. 26° Max. 29°. A pair of old skid chains had been unearthed yesterday and adapted to fit the L/Rover and we put these on the rear wheels before resuming our route-making. The chains improve the driving considerably and we reach Postbridge without any of the usual shovelling and pushing; to my surprise I drive to the brow of Merripit at the first attempt. Parts of the road have been swept bare of snow but carry 3 ins. of hard ice, but there are many drifts and several are too deep to charge and have to be dug away. We reach Warren Inn about 1 p.m. so there is a warm place to eat our lunch. At Warren the drifts are considerable and it takes nearly two hours to cut a way through these. Nearer Bennet's Cross we find that all of the road ahead is full of snow for several hundred yards with none of it less than three or four feet deep. The landlord of the Warren had told us that a dozer was supposed to be approaching Bush Down so we walk on to look for it—visibility is less than 50 yards in the freezing fog. We find that a small dozer is making some slow progress near the top of the hill. A couple of newsreel cameramen had followed in the wake of the dozer and in spite of our uninhibited comments they insist on some shots. Further hand digging would now be fruitless and we return to Bellever.

Thursday, 3rd. Min. 28° Max. 33°. There was a further fall of snow during last night with a moderate E wind. Before setting out I phone Postbridge P.O. and learn that a traxcavator had reached the village from the Moretonhampstead side at about midnight and then retraced towards Moreton. Hoping to drive right on I set off with the L/Rover and squad but on reaching the open ground on Merripit find the road is blocked with fresh drifts. We start digging but blizzard conditions make this impossible so we return to Bellever. I am about to drive the L/Rover into the garage when my wife tells me that she had had a phone call to say that the traxcavator has again reached Postbridge from the Moreton direction. With two men (A/F Bill Trotter and Ganger Jan Newman) I set off again and in spite of fresh drifts drive through to Moretonhampstead and Chagford. I collect the pay and put up the packets in the bank while Bill and Jan obtain various supplies including 20 gals. of paraffin and a box of pills and medicines (the latter for Postbridge and Bellever). On the return journey we pick up 2 cwt. of coal and some other provisions in Moreton. It had been snowing continuously and we had doubts about our prospects of reaching Postbridge. However, in spite of continuous drifting on the high ground we were able to drive through—stopping at Warren Inn just long enough to hand in a parcel of food supplies given to us by the Moreton police. On Merripit Hill conditions were so severe that the L/Rover could barely force its way down in 2nd gear of the low range.

Friday, 4th. Min. 27° Max. 32°. Telephone inquiries show that following intensive clearing by several traxcavators 4-wheel drive vehicles can travel from Postbridge to Princetown and Tavistock. With two others, drive to Tavistock to collect further supplies—food, gas cylinders and 55 gals. of paraffin. About 7 p.m. a traxcavator arrives in Bellever having opened the Bellever road.

Saturday 5th. Min. 27° Max. 33°. I drive into Chagford to take child

(Andrew Trotter) to doctor; collect a few sundries inculding paraffin for Postbridge. Mail arrives—the first since 27th of December.

Sunday, 6th. Min. 25° Max. 32°. I stay put. Freezing all day with stiff E wind.

Monday, 7th. Min. 24° Max. 30°. Weather similar. Drive to Chagford to see Fernworthy squad and to collect last week's pay list. Road out to Fernworthy is still impassable and strong E winds are causing some fresh drifting.

Tuesday, 8th. Min. 23° Max. 30°. Weather similar with strong E/NE winds. Try to catch up on some office work.

Wednesday, 9th. Min. 16° Max. 28°. Drive to Moretonhampstead and Chagford for further supplies—especially paraffin.

Thursday, 10th. Min. 18° Max. 27°. Strong E winds; road on Buck Down blocked by deep drifts. Drive to Chagford via Runnage and Challacombe but going bad with fresh drifting in progress. Deal with pay and return to Bellever by same route.

Friday, 11th. Min. 18° Max. 28°. E/NE winds with gusts to gale force, but machines are keeping most roads open. Drive to Princetown to collect grocery supplies and some paraffin for Postbridge.

Saturday, 12th. Min. 17° Max. 28°. Wind has moderated. Fine and sunny but very cold. Bellever road still open but not passable for ordinary vehicles.

Sunday, 13th. Min. 16° Max. 29°. Three tons of coal delivered to Bellever by Royal Marines. Lorry ran into the ditch on Bellever hill, but to Marines' surprise the L/Rover was able to tow it clear.

Monday, 14th. Min. 18° Max 32°. Having learned that the Fernworthy road has been opened to some extent I try it with the L/Rover and by dint of digging reach the depot. Bellever squad commences brashing.

Tuesday, 15th. Min. 23° Max. 33°. Collect the Fernworthy squad at the top of Wage Hill and run them out to forest. They spend day digging to improve the access and clearing snow-break trees from the road. Slight thaw during the day.

Wednesday, 16th. Min. 22° Max. 34°. Same again. Snow falling by 4.30 p.m. and wind rising.

Thursday, 17th. Min. 16° Max. 33°. Some inches of extra snow but difficult to judge how much with wind at gale force from the E. Ground blizzards in many places. Bellever road is blocked again so drive to Postbridge on forest route. Moreton road and Runnage road impassable—so is Two Bridges—Princetown road.

Friday, 18th. Min. 16° Max. 22°. Weather similar. Bill Trotter and Jan Newman volunteer to walk with me to Chagford. We drive the L/Rover to the foot of Merripit. Less than perfect walking conditions, the E gale whipping up continuous ground blizzards and sufficiently cold to freeze the tears on our cheeks. As the deepest snow is on the road we walk near it on the moor; much of the snow is hard enough to walk over fairly well but sometimes it lets us through to our knees or our hips. We are glad to stop at Warren to thaw out. Near Chagford Cross a huge traxcavator is clearing the road, and we gather it hopes to reach Warren during the afternoon. We carry on to Chagford via Junston and over Meldon. Deal with pay at the bank and get a few shopping items (but nothing heavy!) and the usual Postbridge medicines. We have a lift with the garage jeep for part of the return journey—via Beetor Cross as far as Chagford Cross but the road is filling up so rapidly that it would be unwise for the jeep to go further. The return walk is a bit better with the wind at our backs. During the evening and night wind increases to storm force.

Saturday, 19th. Min. 18° Max. 24°. Gale force E wind all day increasing to storm by 4.30 p.m. with severe ground blizzards; snow streaming off Riddon Ridge blots out our usual view down the E. Dart valley. Most of day spent unsuccessfully trying to thaw water main where it crosses the stream to Nos. 9 and 10. Snowing hard by 6 p.m. but wind gradually moderating to force 5 during the night.

Sunday, 20th. Min. 18° Max. 24°. Spend most of the day in bed with severe cold.

Monday, 21st. Min. 16° Max. 28°. Remain indoors to shake off cold. Squad works at re-opening the forest route and Jan Newman thaws out the ram house and tries to free frozen main (it starts running again at about 6 p.m. —Jan had left a fire burning underneath it). Telephone inquiries suggest that the Postbridge–Princetown road is now open for 4-wheel drive traffic.

Tuesday, 22nd. Min. 16° Max. 26°. Drive L/Rover to Tavistock for supplies especially paraffin and methylated spirits. A small convoy carrying supplies including coal and gas cylinders (some for Bellever) reaches Postbridge in late afternoon. Forest track now very difficult going; it is dark before we reach Bellever.

Wednesday, 23rd. Min. 20° Max. 28°. We rendezvous in Tavistock with Halwill lorry bringing 4 x 4 Fordson with a fixed dozing blade. Escort the lorry to Princetown to unload the tractor in Princetown—Bernard drives it back to Bellever.

Thursday, 24th, Min. 18° Max. 27°. Traxcavator starts clearing the Bellever road in the morning and I decide to postpone pay day until tomorrow. Most of day on office work.

Friday, 25th. Min. 20° Max. 26°. Drive to Chagford to deal with pay. Collect further paraffin supplies. The traxcavator reaches Bellever end of afternoon and we are able to drive through to Postbridge.

Saturday, 26th. Min. 15° Max. 29°. Truck fuel and some other sundries from Postbridge to Bellever with L/Rover and trailer. Becoming warmer!

Sunday, 27th. Min. 26° Max. 38°. Slow thaw conditions.

Monday, 28th. Min. 28° Max. 38°. Bernard drives to Fernworthy with tractor to clear snow (the journey is via Lettaford as the Junston road is still blocked). Visit depot and find Nissen hut has collapsed under weight of snow. Slow thaw conditions during day.

Tuesday, 29th. Min. 31° Max. 34°. To Fernworthy with Bernard. Fernworthy squad snow shovelling and first aid to Nissen hut. L/Rover has plug trouble so I return to Bellever to find and fit new plugs. Bob Alpe phones to report tractor's blade unserviceable. Phone Foreman Mech. at Exeter and arrange for motor mechanic to come tomorrow. Bernard drives the tractor back to Bellever. Very slight thaw conditions during the day.

Wednesday, 30th. Min. 32° Max. 33°. Snowing hard with strong E wind by daylight. I decide to pick up the pay from Chagford today as it may be impassable tomorrow. Before setting off a new pair of chains is fitted to the front wheels of the L/Rover—the rear wheels are still chained. I am accompanied by Bill Trotter, Jan Newman and Ann Trotter (7 years old and needing medical attention after a fall). On the high ground drifting is already severe but we reach Chagford via Lettaford. Again the pay packets are put up at the bank and the packets for the Fernworthy squad are lodged with the bank for Bob Alpe's subsequent collection. A few supplies are collected and we hurry off for the return journey. On the Lettaford road we encounter Charlie Hill, a Chagford baker, who is hoping to deliver bread to Postbridge. He has no chance of driving through with his van so we offer to carry the bread with us

and several dozen loaves are transferred to the L/Rover. Beyond Moor Gate road conditions are distinctly bad and there is no sign of our original tracks. On Bush Down the road between the 8-foot snow banks is traversed by scores of drifts few less than bonnet high and several considerably more, but fortunately these ridges are all separated by a yard or two and to our surprise the L/Rover can charge through without being forced to a halt. At the Warren we stop just long enough to leave some loaves. When we reach Postbridge the Bellever road is almost impassable, but it is just possible to force a way through.

Thursday, 31st. Min. 22° Max. 32°. A few isolated snow showers and moderate NE wind. The Bellever road is now impassable—even the Fordson 4 x 4 cannot get through without a lot of digging. Whole day spent digging; by end of afternoon about half distance to Postbridge has been made good enough for L/Rover.

FEBRUARY

Friday, 1st. Min. 26° Max. 31°. High winds have cleared Bellever road entirely and it is no use to dig while ground blizzards continue. During afternoon helicopter delivers supply of pig food for Bellever Farm and also 4 dozen loaves.

Saturday, 2nd. Min. 18° Max. 30°. E gale throughout, heavy snow showers and continuous ground blizzards, drifting severe everywhere. Most of my time spent in attic with blow-lamp thawing frozen pipes—this chore has become all too familiar.

Sunday, 3rd. Min. 18° Max. 23°. Wind much lighter and much of day sunny; a lot warmer than yesterday.

Monday, 4th. Min. 12° Max 31°. Wind almost nil, but snow commencing about 7.30 a.m. continues all day. The Bellever squad is kept on indoor jobs, making fire beaters, etc.

Tuesday, 5th. Min. 28° Max. 31°. Snow almost continuous; in morning it is falling on a light S wind, but by mid-afternoon wind has backed SE and increasing to near-gale. Before dark, wind approaching storm force; snowing with ferocious intensity we have never seen before. Hostel warden, Jimmy Martin, has been in Postbridge all day (for some weeks he has devoted himself to the task of looking after the old folk in the village). About quarter to six in evening I manage to contact him by phone at the P.O. as I doubt if he can safely attempt to walk back to Bellever; it is arranged that I will stoke the hostel fires for him. The distance I have to go from home to the hostel is not above 60 yards but as soon as I'm outside I begin to wonder if I'll be able to get there. The snow is now waist deep everywhere and in two or three places it is up to my chest. The stoking job takes about 10 minutes but my tracks have vanished already when I flounder home again.

Wednesday, 6th. Min. 28° Max. 35°. In the morning, about 6.30 a.m., the snow turns to heavy rain which continues till 11 a.m. There is a great depth of snow everywhere and vast drifts; although the general level subsides a few inches while the rain pours down it is quite a business to move about anywhere. Bellever presents a curious picture as all the hedges and dry stone walls have disappeared under snow. The squad spends most of the day digging walking paths. During the afternoon we take out the Fordson (now minus the unserviceable blade) and manage to make a track from the yard to the forest boundary.

Thursday, 7th. Min. 36° Max. 40°. Rain during the morning and fog in the afternoon. Rapid thaw conditions. The Fordson, with the squad digging where

necessary, reaches Postbridge via the forest roads. Arrangements have been made for helicopters to bring supplies to Postbridge and the squad digs out a large landing space in a field near the bridge. I go exploring with the tractor which is able to force a trail to the foot of Merripit Hill. It is freezing slightly by nightfall.

Friday, 8th. Min. 30° Max. 38°. I have arranged for Bob Alpe to collect the pay money in Chagford this morning and if possible to rendezvous at Warren Inn. He is to have at least two companions from the Fernworthy squad. The Fordson with Bernard's farm trailer and the Bellever squad travel up to Postbridge. The trailer is unhitched and left in Postbridge to be ready for carrying supplies to Bellever (when they arrive). With Bill Trotter and Jan Newman I drive the tractor to the foot of Merripit and we then walk up the Warren. The going is rather bad in the soft snow; mostly we sink to knee depth but now and then we sink to our waists. We reach Warren about lunch time; we are the first visitors since our last call on the 30th and I have brought some bread and groceries for them. A helicopter with animal feeding stuff arrives while we are there and makes a very neat landing on the road between two huge drifts; we help to unload before going on to the top of Bush Down. There is no sign of the Chagford party and at 3.30 p.m. we turn around to head back for Postbridge. It is almost dark by the time we mount the tractor and the going through the forest roads is rather slow; we reach Bellever about 7 p.m. During the day the Bellever squad have helped to unload five or six helicopters at the Postbridge landing place. On phoning Bob Alpe I learn that he and his companions had tried to travel via Junston and had found this quite hopeless and had then walked to Moor Gate via Lettaford and finally gave up the attempt at Challacombe Cross. It is arranged that he shall lodge the pay at the bank until next week.

Saturday, 9th. Min. 35° Max. 42°. Fog and sleet during the morning. I learn that a traxcavator had reached Postbridge from the Princetown direction last night and various supplies should come in by road during the afternoon. About 3 p.m. I drive the tractor up to Postbridge with Bill Trotter as helper. We collect various items including pig food for Bellever Farm. Again it is becoming dark when we start the return journey; Jimmy Martin joins us to lend a hand. Near the Cherrybrook ride the trailer leaves the road and after abortive attempts to dig it out we decide to unhitch. The groceries, etc., are transferred to packs and we drive on without the trailer; Jimmy rides astride the radiator to shine his torch on the track. Reach Bellever about 8 p.m.

Sunday, 10th. Min. 31° Max. 36°. Snowing at first with fresh SE/E wind. In morning go with Bernard and Jack Chalmers to collect trailer; manage to get it back on track and are able to deliver sacks of pig food. New snow fall about 4 ins.; there is some drifting.

Monday, 11th. Min. 28° Max. 32°. We succeed in towing the L/Rover to Postbridge behind the Fordson. The Moretonhampstead road is now open and I am able to drive to Chagford via Lettaford but the latter road is very difficult and we (Bill Trotter and Jan Newman are with me) have to do some digging. I meet Bob Alpe at the bank and deal with pay. We collect 70 gals. of paraffin and return to Postbridge via Moreton. In the meantime the tractor has towed the L/Rover trailer up to Postbridge; the paraffin drums are transferred to the tractor and we drive the L/Rover and trailer to Tavistock and collect 17 cwt. of coal. It is dark by the time we return to Postbridge so the vehicle and trailer are left in the village and we walk down to Bellever. Jack Chalmers has set about the job of making a large wooden sledge which can be towed by the tractor.

Tuesday, 12th. Min. 25° Max. 33°. Several empty gas cylinders are loaded

on the tractor and taken up to Postbridge. The tractor then returns to Bellever towing the trailer load of coal (this is urgently required: Bellever Farm has run out and two or three other people have very little). I drive to Tavistock and collect 10 gas cylinders, poultry food, and various sundries. When we return to Postbridge the tractor is ready with our "new" sledge and the supplies are transferred to the sledge. During the morning a traxcavator commences clearing the Bellever road.

Wednesday, 13th. Min. 28° Max. 34°. The weather forecast suggests further snow so decide to deal with pay. Drive L/Rover to Chagford with Bill Trotter. Before leaving Chagford we collect 55 gals. of paraffin. In Postbridge we unload the paraffin drums and drive on to Princetown where we are able to collect 5 cwt. of coal. On our return to Postbridge, tractor and sledge transport the fuel supplies and sundry other stores back to Bellever. Clearing of Bellever road is about half-way through by end of the day. By 7.30 p.m. it is raining slightly.

Thursday, 14th. Min. 23° Max. 34°. It is a good deal warmer and there is moderate rain until mid afternoon. Most of my day is spent in the office. The traxcavator reaches the top of Bellever hill.

Friday, 15th. Min. 36° Max. 38°. Rain showers and fog. The clearing of the road into Bellever is finally completed by mid-morning. I drive to Fernworthy to check on conditions; the road near Fernworthy has been opened by traxcavator this morning, but only as far as Metherall. Beyond this point the snow is still very deep with all the road completely filled. At the forest boundary the drifting has been considerable—the gateway and walls are completely buried under 8 feet of snow. Many of the roads near Corndon and below Shapley are still blocked and the only route open to Metherall is via the Wage Hill turning to Thorne and Hole farm.

Saturday, 16th. Min. 31° Max. 35°. Colder with freezing fog. As the Bellever road is not fit for most vehicles I visit Postbridge with L/Rover to bring in supplies which have been left there.

Sunday, 17th. Min. 27° Max. 30° A little sunshine at times, but cold.

Monday, 18th. Min. 20° Max. 31°. Transport the Fernworthy squad to Metherall. The deep snow is now very hard and walking is easy.

Tuesday, 19th. Min. 26° Max. 33°. Wind is causing slight drifting at exposed points. Transport Fernworthy squad.

Wednesday, 20th. Min. 25° Max. 29°. Mainly sunny but cold with fresh E wind. Transport Fernworthy squad again. Spend day checking snow-break damage in Cpts 12, 11, 15, 17, 18, 22, 30, 36 and 37. Yesterday's drifts on Bush Down and Bellever road are removed by snow plough.

Thursday, 21st. Min. 24° Max. 32°. Warmer after morning frost with moderate thaw in the day. Wind light NW. Again transporting men to Fernworthy.

Friday, 22nd. Min. 29° Max. 38°. Moderate snow shower in morning otherwise fine with a little sunshine. Thaw conditions. Transport squad as usual.

Saturday, 23rd. Min. 14° Max. 41°. Very hard frost at first. Slight thaw in the day.

Sunday, 24th. Min. 27° Max. 37°. Colder, dull with moderate E wind. Freezing all day.

Monday, 25th. Min. 24° Max. 30°. Very slight thaw after hard frost. Road conditions in most places are a good deal better but packed snow and ice remains in the side roads. Transport Fernworthy squad to Teigncombe.

Tuesday, 26th. Min. 26° Max. 35°. Fine and sunny but rather cold with stiff E wind. Spend whole day at Fernworthy assessing snow damage, meet District Officer during afternoon.

Wednesday, 27th. Min. 28° Max. 36°. Warmer with moderate thaw during day. Transport squad to Teigncombe.

Thursday, 28th. Min. 30° Max. 38°. Thaw continuing after morning frost. Transport squad to Teigncombe.

MARCH

Friday, 1st. Min. 30° Max. 38°. The roads are now sufficiently good to use the Morris van for the first time since before Christmas!

2nd to 7th. From now on there is rapid rise in temperature with very rapid thaw. On Monday, March 4th, a Council J.C.B. commences to clear the road into Fernworthy and has reached the depot by the afternoon of March 7th. It looks as if the '63 winter is over.

"ABOUT THREE YEARS FROM NOW WE SHOULD GET A FORESTER'S HOUSE!"

FORESTRY COMMISSION STAFF
At 1st October, 1963

Notes: The stations of individual officers are shown only where they are different to that of their main office. The list should *not* be read as a seniority list; it has been compiled from returns submitted by the various offices to the Establishment Section.

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TELEPHONE: REGENT 0221

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DEPUTY DIRECTOR-GENERAL:	G. B. Ryle, C.B.E.
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CHIEF ENGINEER:	E. H. Macmillen
MACHINERY RESEARCH OFFICER:	Shaw, R. G.
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PRINCIPAL EXECUTIVE OFFICER:	Cormack, W. M. (Controller of Finance)
CHIEF EXECUTIVE OFFICER:	Bradford, E. H.; Clark, G. H.; Lenman, J. P.; Shapcott, M. P.
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ASSISTANT ENGINEER:	West, R. W. (Alice Holt, Machinery Research)
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DIRECTORATE FOR ENGLAND

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ENGLAND, NORTH-WEST CONSERVANCY

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Cheshire.
Telephone: Chester 24006–7–8

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FORESTER

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ASSISTANT FORESTER

Birch, F. C. (Matlock); Birch, T. (Mortimer); Bowdler, A. C. F. (Cannock); Collings, P. J. (Sherwood); Corfield, J. S. (Grizedale); Dean, B. G. (Cannock); Hall, J. R. (Longtown); Hill, J. T. (Swynnerton); Hobbs, A. B. (Sherwood); Hutchinson, P. (Mortimer); Long, T. W. (Thornthwaite); McGowan, G. H. (Dalton); Morris, R. (Sherwood); Patten, B. D. (Kershope); Townson, P. (Grizedale); Ward, A. A. (Sherwood); Wood, D. (Grizedale).

ENGLAND, NORTH-EAST CONSERVANCY

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CONSERVATOR:	G. J. L. Batters
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DISTRICT OFFICER, II:	Chadwick, D. J. (Kielder); Earl, D. E. (Seconded to Govt. of Uganda); Hooper, H. J. (Estates); Hurst, R. T. (Wakefield); MacDonald, I. A. D.; Marshall, I. R. B.; Morgan, J. F. (Pickering); Oakley, J. S. (Seconded to Govt. of Uganda); Rix, A. (Durham); Walker, A. D. (Kielder)
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LEADING CIVIL ENGINEERING ASSISTANT:	Blankenburgs, V. (Kielder)
CIVIL ENGINEERING ASSISTANT:	Grant, V. (Bellingham); Simpson, J. P.
DRAUGFTSMAN (CART.):	Crofts, E. A.; Tattersfield, D. A.
HIGHER EXECUTIVE OFFICER:	Blott, J. C.; Fisher, R. H.

EXECUTIVE OFFICER

Chapman, J.; Iredale, N.; Mitchell, M.; Palmer, R.; Roscoe, K.; Wallis, Miss B. E.

HEAD FORESTER

Chisholm, J. D. (Redesdale); Fox, T. F. (Kielder); Gough, W. R. (Pickering); Hislop, J. J. (Wark); McCavish, W. L. (Kielder); Sharp, G. A. (York (East)); Simpson, C. N. (Kielder); Snowdon, L. (Allerston)

FORESTER

Adams, G. (Hambleton); Ainsworth, P. H. (South Pennines); Baird, R. L. (Fountains); Bardy, D. A. (Widehaugh); Bartlett, R. F. E. (Allerston); Bewick, T. (Widehaugh); Bolam, T. W. B. (Hambleton); Bowns, A. (Hambleton); Brown, W. C. (Harwood); Charlton, E. (Widehaugh); Collier, T. E. (Wark); Cumming, J. (Jervaulx); Dawson, K. J. (Selby); Edes, D. S. (Harwood); Fawcett, E. (Allerston); Featherstone, C. (Helmsley); Fowler, N. L. (Rothbury); France, J. (South Yorkshire); Gledson, J. G. (Rothbury); Hammond, D. (Wark); Harbin, W. B. (Wynyard); Hartley, A. (Knaresborough); Haw, G. (Widehaugh); Heaven, S. F. (York (West)); Hird, J. T. (The Stang); Hodgson, M. (Hambleton); Jane, T. A. (Kielder); Johnstone, T. (Hambleton); McGrath, T. P. C. (War Department); Marsh, E. W. (Redesdale); Marshall, J. A. (Hamsterley); Martindale, J. M. (Hambleton); Metcalfe, J. E. (Kielder); Moore, W. (Kielder); Moules, T. R. (Allerston); Parker, G. W. (Chopwell); Robinson, P. D. (Hamsterley); Salmond, M. P. (South Yorkshire); Scott, G. H. J. (Allerston); Scott, J. J. O. (Kielder); Scott, T. I. (Allerston); Stanley, W. E. (Allerston); Stephenson, F. (Hambleton); Stokoe, G. (Slaley); Straughan, J. G. (Wark); Straughan, W. (Redesdale); Tait, J. (Kielder); Taylor, C. E. (Hambleton); Telford, J. W. (Chillingham); Terry, T. N. (Allerston); Thompson, L. T. J. (Kielder); Turnbull, M. T. (Kielder); Webster, F. (South Yorkshire); Williams, K. D. (Hamsterley); Woodcock, F. A. (Kidland); Woodward, F. G. (Wolds); Young, J. P. (Wolds).

ASSISTANT FORESTER

Allen, M. J. J. (Seconded to Bangor University); Barry, G. N. (Kielder); Bartholomew, W. (Kielder); Bell, D. A. (Kidland); Clark, P. F. (York (East)); Davison, A. (Fountains); Elgy, D. (Wark); Featherstone, P. (Rothbury); Fisher, H. (Allerston); Giggal, D. F. (Wark); Griffin, C. R. (Kielder); Holden, R. L. (Rothbury); Howes, R. E. J. (Wark); King, C. J. (Kielder); Lancaster, R. A. (Allerston); Lee, D. R. (Jervaulx); Maughan, B. (Kidland); Mills, K. (York (East);) Pearson, A. A. (Kielder); Powell, D. E. (Seconded to War Dept., Weymouth); Priestly, T. J. J. (Seconded to N. F. Products); Richardson, L. (Wark); Simpson, G. (Allerston); Sivill, J. (Allerston); Spencer, J. B. (Hamsterley); Stanbridge, F. W. (Chopwell); Stockdale, B. R. (Allerston); Stonehouse, F. (Allerston); Stubbs, R. W. (Wynyard); Wilbert, G. N. (Kielder).

ENGLAND, EAST CONSERVANCY

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DIVISIONAL OFFICER:	Ballance, G. F.; Payne, S. R.; Snook, K. R. (Estates)
DISTRICT OFFICER, I:	Chard, R.; Harker, M. G.; Kennedy, J. N. (Ipswich); Mackay, D. (Aylsham); Pryce, T. S. (Estates); Searle, H. (Lincoln); Tilney-Bassett, H. A. E. (Thetford)
DISTRICT OFFICER, II:	Barrett, F. D. (Estates); Busby, R. J. N. (Princes Risborough); Christie, A. C. (Princes Risborough); Derrick, R. G. (Seconded to Sarawak); Foot, D. L. (Northampton); Horne, A. I. D. (Aylsham); Leefe, J. D. (Grantham); Muir, J. Laurie- (Bicester); Overell, P. A. W. (Thetford); Small, D. (Hitchen); Wildash, J. T. (Northampton)
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CONSERVANCY ENGINEER:	French, J.
MECHANICAL ENGINEER:	Cook, G. O.
CLERK OF WORKS (ESTATE):	Foote, J. (Rockingham); Holmes, W. (Thetford); Raisborough, R. (Aldewood)
DRAUGHTSMAN (CART.):	Chubb, Miss W. E.; Elliott, H. (Thetford)
HIGHER EXECUTIVE OFFICER:	Bowman, L. W.; Norton, J. F.

EXECUTIVE OFFICER

Folkes, K. A. B.; Kitteridge, K. E.; McIntyre, H. V.; Merker, P. A.; Threadgill, J. S.; Wild, A. H.

HEAD FORESTER

Button, G. H. (Swanton); Chapman, S. (Princes Risborough); Lawson, G. E. (Thetford); Poll, E. A. (Thetford); Redford, C. W., B.E.M., (Thetford); Wellington, C. R. (Aldewood).

FORESTER

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Answer to the puzzle picture on page ix: "What's going on here?":
A thinning, of course!

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