JOURNAL

OF THE

FORESTRY COMMISSION.

No. 11 : MARCH, 1932.

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EDITORIAL.

THE intimation that Sir John Stirling-Maxwell is about to retire from the Commission will have been received with genuine regret by every member of the staff. His term of office as Chairman has been of short duration, but he has been a member of the Commission since it was formed. His knowledge of forestry and his unflagging interest in the work and in the welfare of everyone concerned have been a source of inspiration and of confidence.

Resignation of Chairman.

Sir John Stirling-Maxwell will be succeeded in the Chair by Sir Roy L. Robinson, who as Technical Commissioner and Vice-Chairman has already had heavy responsibilities. His selection is a tribute to his consistent application to those matters which beset the men in the field. As the first Rhodes Scholar in Forestry and as one who has never been induced to veer from the subject since he became a graduate, his promotion and the honour conferred upon him by the King are both subjects for congratulation.

Appointment of New Chairman.

The resignation of Mr. L. S. Osmaston caused a vacancy at the New Forest to which Mr. David W. Young was transferred. Upon leaving the Forest of Dean Mr. Young was succeeded by Mr. W. L. Taylor, previously Acquisitions Officer for England and Wales.

Changes in Divisional Staff.

In England and Wales, Mr. C. A. Connell was appointed to the New Forest Division on the 14th August, 1931, and subsequently transferred to Division 5; Mr. R. G. Sanzen-Baker was appointed to Division 4 on the 17th August, 1931; Mr. D. C. D. Ryder, No. 5 Division, resigned, with effect from 31st March, 1932.

Districts.

In Scotland, Mr. J. Maxwell MacDonald became District Officer, Dumfries and Galloway, under Mr. J. M. Murray, in the South-Western Division on 7th September, 1931, and Mr. David Spraggan was promoted District Officer the following day. He took up duty at Strome Ferry in the Northern Division at that date.

Reduction of Forestry Grant.

The unfortunate reduction in the Fund necessitated by the national financial situation has been the cause of disappointment in many quarters. The need for economy and for a close examination of all expenditure has to be recognised. It is anticipated that planting will proceed at the rate of about 20,000 acres per annum under the reduced grant so long as the operations can be carried out at the lowest possible cost.

Home-Grown Timber Committee.

The Forestry Commission recently set up this Committee to investigate the possibilities of improving the markets for home-grown wood. Mr. F. G. O. Pearson, 55, Whitehall, London, is Secretary, and any member of the staff who desires to make suggestions on the subject ought to communicate at once with him. The time is approaching when the Commission's plantations will have to be thinned, and serious consideration must be given to the disposal of the early thinnings. This is one of the most urgent problems now confronting the Commission.

Magazine of the Dean Forest School.

With commendable enterprise the students at the Dean School have produced a magazine of considerable merit and have given it the name of "Deansday Book." As explained in the opening notes of the magazine, the promoters hope thus to strengthen the links which bind student to student and to chronicle events otherwise so easily forgotten. Appropriately enough, Mr. C. O. Hanson gives a most readable account of the history of the School from the time it was started in 1904 up to the outbreak of war. Other contributions are by the students themselves. To Mr. J. Rowland is due the credit of editing this interesting publication, admirably produced and embellished by an artistic cover.

To Contributors.

Some of the matter published in the Journal is of such general technical interest or is so composite in character that considerable space has to be devoted to it; other subjects, however, can be dealt with much more briefly. This has to be pointed out because, each year, papers belonging to the second category are submitted which certainly would have been better if the writers had stuck more closely to the point. It should be remembered that a short statement is usually quite as effective as a lengthy one, and the aim should be to convey the sense in as few words as possible. This suggestion is not intended to discourage contributors, but increasing demands are being made on our space and articles have sometimes to be discarded because they are too long or too difficult to read. The pruning of over-sized Douglas fir is nothing compared to the treatment that has to be applied editorially to a good deal of the material received. This should not be necessary.

Contributing Divisions.

For next Journal the Divisions upon which dependence for matter will mainly rest are New Forest, Dean Forest and Division IV in England and Wales, and the South-Western Division in Scotland.

PLANTING OF SPRUCE SEEDLINGS.

By A. P. Long.

In these days, when all thoughts are turned to economy, any means which will lead to ultimate saving is worthy of the closest examination, and, of all recent developments, perhaps the most promising is the use of seedlings in the formation of plantations.

Hitherto transplants have been in vogue, as it has been considered essential to use plants possessing size, a good fibrous root system and hardiness. In this view, (1) size reduces weeding costs and danger from frost, (2) a good healthy fibrous root system enables a plant to become established readily, since such a system can make the best use of the small quantities of food available in the comparatively poor soil into which it is planted, and (3) hardiness enables the plant to withstand rigours of climate during the first few years when it is temporarily in check. The production of transplants is an expensive process, costing three to four times as much as the raising of 2-year seedlings. Hence, if seedlings can be used, without suffering serious disadvantages in growth or in piling up the costs of establishment, there is a big field for economy.

There are two lines of approach to this question: (1) the raising of seedlings having the characteristics stated, and (2) the elimination of those factors which adversely affect smaller and less hardy seedlings. Now, the production of seedlings comparable with transplants will demand a totally new nursery technique involving such factors as intensive manuring, much wider spacing in the seedbeds than is now customary, or, alternatively, artificial hardening by the application of potassic salts, and in the long run it may well prove to be almost as expensive as the current method of transplanting. Thus our greatest hope lies in the elimination of adverse factors.

Taking the three specified requirements in transplants, we observe that the disadvantages attaching to lack of size may be overcome by such means as cultivation, turf planting and efficient drainage, whilst the provision of a well-aerated soil medium, either by deep cultivation or turfing, surmounts many of the objections to the use of a sparse root system. The third factor, viz., means of guarding against climatic effects, is worthy of closer examination, with special reference to turf planting.

In earlier work with seedlings it was found that 1-year seedlings from beds of average density planted successfully, whereas 2- or 3-year seedlings from similar beds suffered severe losses unless the season were eminently favourable. The explanation suggested is that our 1-year seedlings are hardy, whilst 2-year seedlings, grown at the same density, nurse each other so effectively that they become "half-hardy"—to use a well-known horticultural term—and acquire all the inimical features of soft tissues which render them unfit for exposure. If this is agreed, the use of 1-year seedlings should be successful with adequate cultivation. Unfortunately, some species, notably the spruces, are too small as 1-year seedlings for

effective handling and, moreover, the cultivation of spruce ground is either quite out of the question or impossibly expensive. Consequently our ultimate object with spruces is to find a method of using 2-year or older seedlings grown under normal nursery conditions.

If it is correct that losses in 2-year seedlings are primarily due to half-hardiness and if hardening in the nursery is inordinately expensive, our only hope is to provide sufficient shelter to encourage gradual hardening in the forest. Clearly it is impracticable to provide an endless series of artificial shelters for individual plants, and yet an equivalent effect can be secured by making full use of the turf itself by deep planting.

The old German method of planting spruce on mounds and all recent work on the superficial planting of these species are based upon the fact that spruce roots definitely require air for their proper development in the initial stages. This is particularly well shown in newly-planted turfs by the action of young rootlets in ascending in the turf to escape the moist and unventilated layer formed by the conjunction of the ground and turf vegetation. It might seem that deep planting in turfs is therefore a direct negation of this principle, unless we regard the peat or vegetative turf as a fibrous muff which, on exposure, becomes well drained and well ærated so that, although offering very considerable resistance to winds, it does not exclude air, but permits its gentle percolation. Actually, there would appear to be no other explanation of an experienced fact that small plants may be so deeply planted in turfs that only the tips of the terminal buds are visible, and yet apparently suffer no inconvenience whatever. Unquestionably a weathering turf is better ærated than even the upper layer of a compact soil in a wet climate, and deep planting on turfs does not appear to involve any inconsistency. Thus the turf provides (1) an efficient medium for the development of rootlets and (2) a shelter, permitting gradual hardening of the plant. But we may go even further, for although a turf is porous, it does not permit sufficient light and air to allow the buried lateral branches of a deeply-planted tree to develop ; in other words, the turf artificially prunes an enclosed plant and reduces the proportion of shoot to root, a factor which is generally acknowledged horticulturally to be of great benefit to a newly-planted subject.

On these grounds deeply-planted seedlings should be more successful on turfs than shallow-planted ones, and results in the field during the P. 31 season support the conclusions reached. These results should not, however, be regarded as conclusive, as they relate to one season only and need fuller confirmation. During P. 31 some 25 acres of Sitka spruce 2-year seedlings were planted on turfs in Division II. The dibble method was used, and in this a hole is made in the centre of and right through the turf with a blunt-pointed dibble. The turf is partially turned over as though it were a hinged lid, the plant is threaded through from the top, and when all the roots have been spread out on the underside the turf is lowered to the ground and the plant firmed by closing the hole with, preferably, the heel. In passing it may be added that this method ensures that the whole weight of the turf keeps the root system in position,

a feature which has proved itself so far to be the most efficient method of preventing frost lift. Some seven hundred measurements were taken of seedlings planted at different depths in the turfs at Gwydyr and Clocaenog forests. The figures representing the first season's growth have been plotted and the striking results obtained are shown in the diagrams. (*See accompanying graphs.*)

The curves of the two sets of readings show several features in common.

(1) Maximum average growth was obtained from seedlings planted to such a depth in turfs that not more than 1 in. of shoot was exposed above the turf. Actually the greatest individual growth was produced in each plot by seedlings planted with their terminal buds level with the surface of the turf, being $8\frac{3}{4}$ in. at Clocaenog and $7\frac{1}{2}$ in. at Gwydyr.

(2) A striking fall in the average growth occurred amongst seedlings with $1\frac{1}{2}$ in. of shoot exposed, and this fall is progressively accentuated as the height of planting increases. This is well shown in the following table, which gives for each half-inch gradation of planting height the average growth of seedlings and percentages of the total average growth produced by each class or gradation :—

Height of plant above turf surface at planting.	Gwydyr.		Clocaenog.	
	Average growth of class.	Percentage of total average growth.	Average growth of class.	Percentage of total average growth.
Inches.	Inches.		Inches.	
0 • (level)	3·4	21·5	3·3	16·5
$\frac{1}{2}$	3·0	19·0	3·6	18·0
1	2·4	15·2	3·3	16·5
$1\frac{1}{2}$	1·7	10·8	2·6	13·0
2	1·4	9·0	2·1	10·5
$2\frac{1}{2}$	1·2	7·5	1·7	8·5
3	1·0	6·3	1·4	7·0
$3\frac{1}{2}$	0·9	5·7	1·1	5·5
4	0·8	5·0	0·9	4·5
By grouping.				
0 to 1	8·8	55·7	10·2	51·0
$1\frac{1}{2}$ to $2\frac{1}{2}$	4·3	27·3	6·4	32·0
3 to 4	2·7	17·0	3·4	17·0

At Clocaenog seedlings planted with more than 4 in. exposed showed the same downward tendency, with the exception of one tree only in the 6-in. class, which made a growth of 1·5 in.

(3) The death rate in the plots was extremely low, being nil at Gwydyr and 2·6% at Clocaenog, so that little information has been gained in

respect of the influence of depth of planting upon survivals. In the Clocaenog plot no death occurred amongst seedlings with less than 2¼ in. exposed, whereas half of the failures were found in the 2¼-in. and 2½-in. classes.

(4) The Gwydyr seedlings were planted during the fortnight ended 10th January, 1931, and there followed immediately a period of about three weeks of severe frost. The planting at Clocaenog was carried out during the fortnight ended 11th February, 1931, after which there was no prolonged frost. Both forests experienced a spell of drying winds in the following spring, so that the climatic difference between the two plots was the presence or absence of frost, and this difference has found expression in the curves, first, by greater height growth generally at Clocaenog, and secondly, by the flattening out of the Clocaenog height curve in seedlings of the 0 to 1-in. classes. It is an axiom that tender species benefit from shelter, and it follows that when frost is absent the beneficial effect of shelter is not so great as it would be if frost had to be guarded against. Our theme is "the deeper the planting the greater the protection offered by the turf," and again this view is supported by the flattening at Clocaenog, which indicates that, in the absence of frost, the beneficial effect of the turf is not so marked as at Gwydyr, where frost occurred. The Gwydyr curve further suggests that the baneful effects of frost have been almost eliminated by planting so deeply that the terminal bud only is exposed at the turf surface.

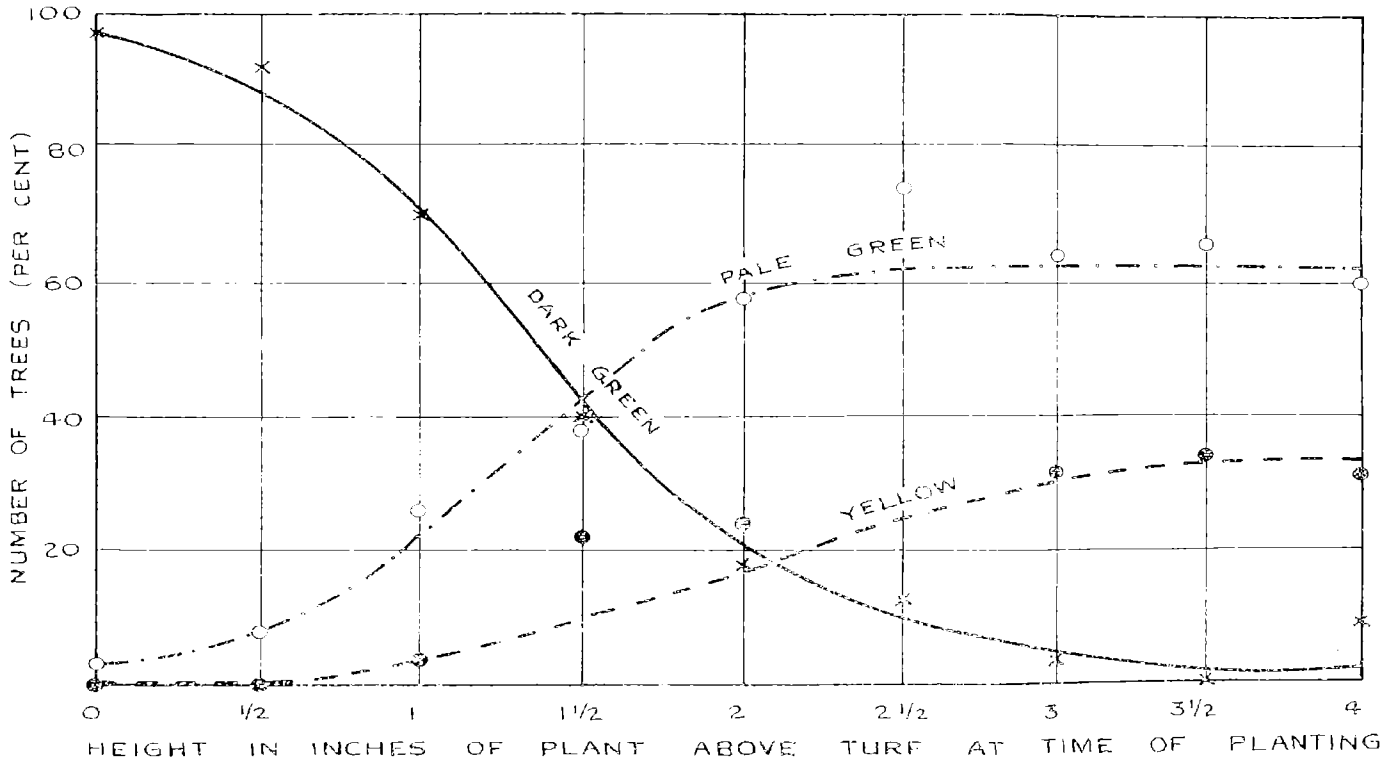
(5) So far we have only dealt with height growth, but vigour also is important. A good indication of the vigour is the colour of the shoots, and at the same time that growth measurements were made each forester independently described every seedling according to one of three colour categories, deep green, pale green or yellow. The number of trees of each colour was ascertained and is expressed in the following table as a percentage of the total trees in each class :—

Height of plant above turf at planting.	Gwydyr Plot. Percentages of—			Clocaenog Plot. Percentages of—		
	Dark green.	Pale green.	Yellow.	Dark green.	Pale green.	Yellow.
Inches.						
0 (level)	97	3	—	93	7	—
½	92	8	—	86	14	—
1	70	26	4	86	12	2
1½	40	38	22	76	19	5
2	18	58	24	77	18	5
2½	13	74	13	69	25	6
3	4	64	32	36	28	36
3½	—	66	34	22	33	45
4	9	60	31	44	22	34
4½				—	—	100
5				20	20	60

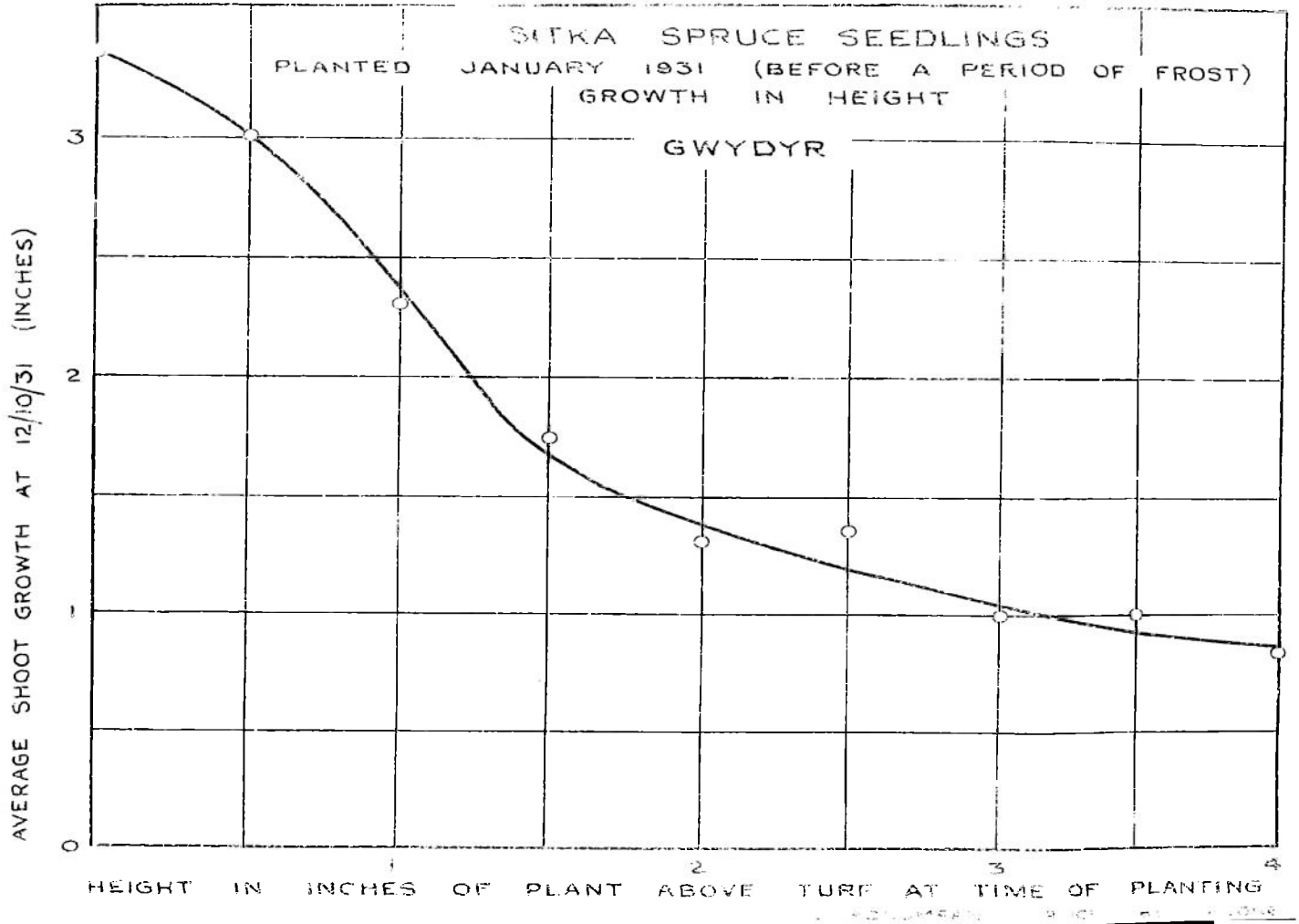
SITKA SPRUCE SEEDLINGS

VIGOUR OF GROWTH AS REPRESENTED BY COLOUR OF THE SHOOTS

GWYDYR



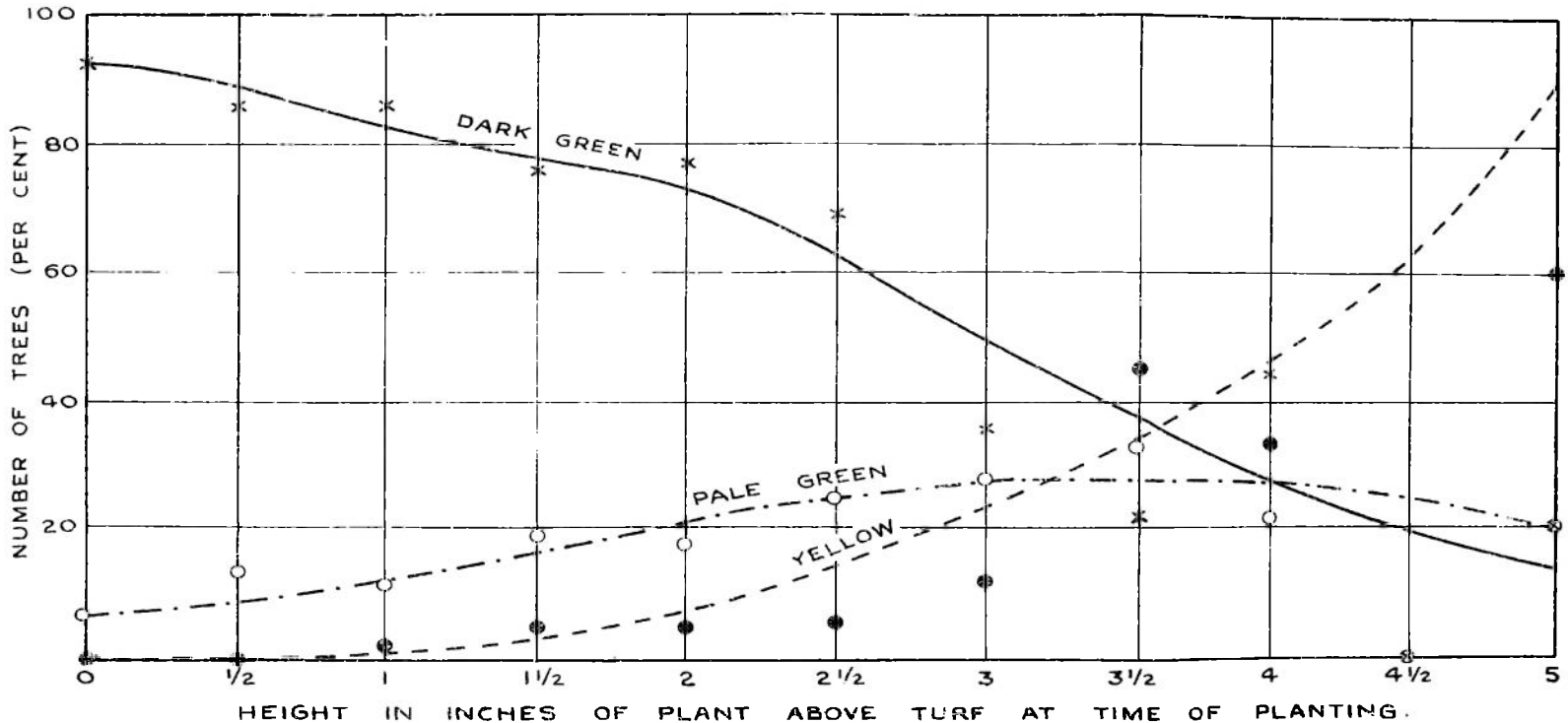
(TO ACCOMPANY ARTICLE BY A P. LONG)


SITKA SPRUCE SEEDLINGS
PLANTED JANUARY 1931 (BEFORE A PERIOD OF FROST)
GROWTH IN HEIGHT
GWYDYR
AVERAGE SHOOT GROWTH AT 12/10/31 (INCHES)
0
1
2
3
1
2
3
4
HEIGHT IN INCHES OF PLANT ABOVE TURF AT TIME OF PLANTING

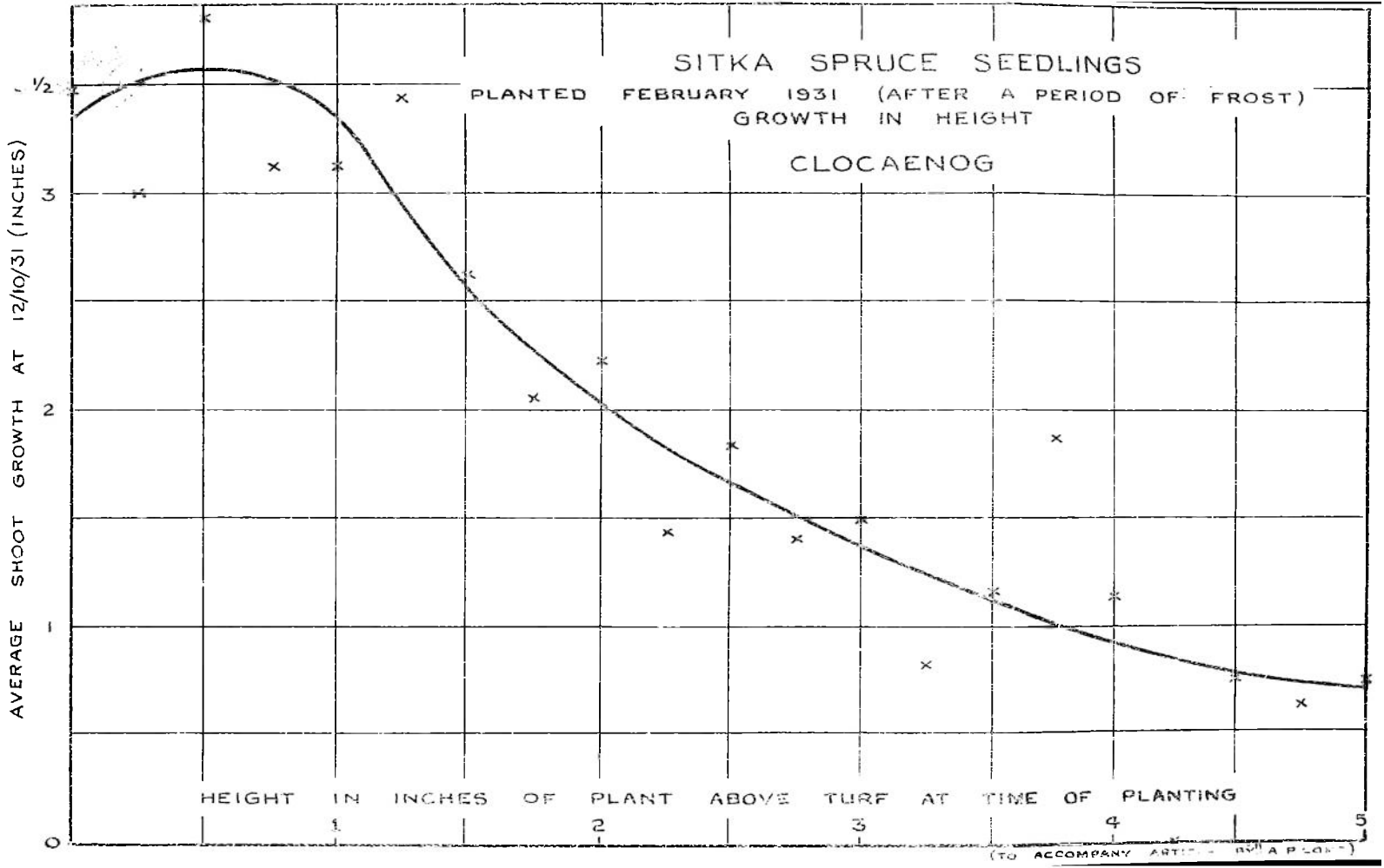
SITKA SPRUCE SEEDLINGS

VIGOUR OF GROWTH AS REPRESENTED BY COLOUR OF THE SHOOTS

CLOCAENOG



(TO ACCOMPANY ARTICLE BY A.P. LONG)



(TO ACCOMPANY ARTICLE BY A. P. [illegible])

The results are seen to follow exactly the same course as the height growth figures, viz., the deepest-planted seedlings have the most vigour, as represented by colour of shoot, and the shallowest have the least vigour. This is even more clearly shown by the average curves obtained by plotting the figures in the table.

The form of growth is equally striking in the different classes, the deeply-planted ones have generally produced vigorous leaders and laterals, whereas the shallow plants have often merely flushed and generally there is not so great a development of leader or last year's laterals, and it is very exceptional to find any development of laterals on the current year's shoots.

These features are well indicated below, being the shoot growth of three typical trees as measured from photographic enlargements :—

Height of plant above turf at planting.	New growth P. 31 (leader and laterals).	Extension of P. 30 laterals.	Total shoot growth. P. 31.
Inches.	Inches.	Inches.	Inches.
$\frac{1}{2}$	17·0	3·3	20·3
1	4·9	6·7	11·6
$3\frac{1}{2}$	0·9	5·0	5·9

Summary.

The results of the first season's growth of Sitka spruce 2-year seedlings on peat or vegetative turfs lead to the following conclusions :—

(1) Such seedlings raised under normal nursery conditions can be planted successfully.

(2) Deep planting is most beneficial, producing a better and more vigorous growth than shallow planting, and the optimum depth would appear to be that which allows not more than $1\frac{1}{2}$ in. of shoot exposed above the surface of the turf.

(3) Deep planting also affords the best means of overcoming frost-lift and holds out a prospect of enabling seedlings to be planted at any time during the planting season without fear of damage from frost or dry winds.

ATTRACTIONS OF BENMORE.

By H. WATSON.

In this short note I will endeavour to avoid the forests and planting areas which surround here stretching both north and south for many miles, and try to describe the exceptional and varied collection of shrubs and conifers to be found in close proximity to Benmore House—now Benmore Forest School and Hostel.

Immediately in front of the house is an undulating lawn, whose remarkable greenness is accentuated by the contrasting darker shades of the towering Sequoias and fringe of Douglas firs. At the foot of this stretch can be seen, among commoner trees, *Torreya californica* and *Cephalotaxus drupacea*. Nearer the house stands a magnificent *Rhododendron arboreum* over 20 ft. in height, which in May bears hundreds of vivid red blooms. Not far from this are two fine "Pink Pearl" rhododendrons and other hybrids. As regards rhododendrons, there are now over 200 different species planted out, and no words can adequately describe the riot of colour produced by these and by the azaleas during the months of May and June. The first rhododendron to flower is on the west drive. It starts flowering in January, and its red flowers light up the sombreness of the Scots pines and cypresses which flank this avenue.

To the east of the lawn lies the shrubbery. This was formed by Mr. H. G. Younger, the generous donor of the estate to the Forestry Commission, and who still retains a lively interest in his shrubs. At the entrance to the shrubbery are two fine specimens of *Desfontainea spinosa* and *Tricuspidaria lanceolata*. It would take the full capacity of the Journal to describe the numerous species which make up this interesting collection, and I will content myself with a list of the more important trees and shrubs to be seen there and which may be of interest to you :—

Magnolia glauca.
,, *parviflora.*
Xanthorhiza apiifolia.
Drimys aromatica.
,, *Winteri.*
Trochodendron aralioides.
Cercidiphyllum japonicum.
Hypericum patulum.
Stachyurus præcox.
Plagianthus Lyallii.
Abutilon vitifolium.
Ptelea trifoliata.
Euonymus latifolius.
Rhamnus Purshiana.
Acer Lobelii.
,, *insigne.*
,, *rufinerve.*
Acer striatum.
,, *tataricum.*
Rhus Osbeckii.
Piptanthus nepalensis.
Sambucus canadensis.
Viburnum cassinoides.
,, *Davidii.*
,, *Henryi.*
Abelia chinensis.
,, *triflora.*
Dipelta floribunda.
,, *venticosa.*
Lonicera pileata.
,, *sempervirens.*
,, *tatarica.*
Olearia stellulata.
Vaccinium ovatum.

Arbutus Menziesii.
Leucothoë racemosa.
Oxydendron arboreum.
Zenobia speciosa.
Andromeda polifolia.
Enkianthus campanulatus.
,, *cernuus.*
Dabœcia polifolia.
Genista ætnensis.
Notospartium Carmichaeliae.
Prunus Yoshino.
,, *serrulata.*
,, *serotina.*
Exochorda macrantha.
Eucryphia pinnatifolia.
Pyrus Sargentii.
,, *Toringo.*
,, *rivularus.*
Crataegus Arnoldiana.
,, *crus-gallii.*
,, *punctata.*
Photinia variabilis.
Stranvœsia Davidiana.
Amelanchier alnifolia.
Escallonia "Donard Seedling."
,, *edinensis.*
,, *exoniensis.*
,, *rubra.*
Fothergilla Gardenii.
Corylopsis pauciflora.
,, *spicata.*
Hamamelis japonica.
,, *mollis.*
,, *virginiana.*
Kalmia glauca.
Ledum latifolium.
Forsythia intermedia.
,, *viridissima.*
Syringa yunnanensis.
Fraxinus Mariesii.
,, *Paxiana.*
Fontanesia Fortunei.
,, *linearis.*
Phyllyrea angustifolia.
Osmanthus armatus.
,, *Delavayi.*
,, *Forrestii.*
Buddleia Colvilei.
,, *variabilis.*
Lomatia ferruginea.
Ulmus campestris.
Zelkova crenata.
Pterocarya stenoptera.
Myrica cerifera.
,, *asplenifolia.*
Betula utilis.
,, *Maximowiczii.*
Alnus fruticosa.
,, *incana.*
,, *sitchensis.*
Eucalyptus Whittingehamensis.
,, *coccifera.*
Leptospermum lanigerum.
Corokia cotoneaster.
Cornus capitata.
,, *Kousa.*
Griselinia littoralis.
Davidia involucrata.
Carpinus Betulus.
Corylus Colurna.
Quercus castaneaefolia.
,, *coccinea.*
,, *Libanii.*
,, *Lucombeana.*
,, *Mirbeckii.*
Nothofagus procera.
,, *antarctica.*

CONIFERS.

Pinus Armandii.
,, *Banksiana.*
,, *contorta.*
,, *densiflora.*
,, *montana.*
,, *muricata.*
Pinus parviflora.
,, *pungens.*
,, *koraiensis.*
,, *rigida.*
Picea asperata.
,, *Breweriana.*

CONIFERS—*continued.*

Picea Engelmanni.
,, *jezoensis.*
Abies concolor.
,, *faxoniana.*
,, *grandis.*
,, *lasiocarpa.*
,, *numidica.*
,, *recurvata.*
,, *sibirica.*
,, *squamata.*
,, *Veitchii.*
Pseudotsuga macrocarpa.
Taxus cuspidata.
Cupressus macrocarpa.
Fitzroya patagonica.
Sciadopitys verticillata.
Picea likiangensis.
,, *Omorika.*
Tsuga brunoniana.
Arthrotaxis laxifolia.
Ginkgo biloba.
Prumnopitys elegans.

On leaving the shrubbery we find ourselves on the banks of the River Echaig, which flows through the policies from Loch Eck to the Holy Loch —an arm of the Firth of Clyde. A few steps take us to the main drive, which runs east and west. At the east end it joins the main Dunoon to Arrochar highway. On either side of the avenue is a row of very fine specimens of *Sequoia gigantea* interplanted with many varieties of rhododendrons. At both ends of the drive are luxuriant plants of *R. arboreum*. Other interesting large conifers near and adjoining the avenue are *Abies nobilis, A. magnifica, Picea jezoensis, P. Morinda, Pinus austriaca, P. cembra, P. radiata, Cedrus atlantica* and *Cryptomeria japonica*. To the north of the main drive is a pinetum. The conifers there are nearing maturity, and the Sitka spruce show prominent buttressed roots. Here also there are signs of good natural regeneration. A very impressive "aisle" of *Abies nobilis*—90 feet high—is flanked by mossy paths, on either side of which are tall Himalayan cedars (*C. deodara*) and monkey puzzles (*Araucaria imbricata*), also *Juniperus recurva*. Incidentally, ripe seed has been obtained from the araucarias. This path leads to the "Pond," the surrounds of which are now clothed with many species of *Deutzia, Diervilla, Berberis, Cotoneaster* and *Pernettya*. Patches of various Chinese primulas and *Meconopsis* have also been planted out. In summer the vista from the fountain end is superb, leading as it does in the far distance to the steep slopes of rocky Inverchapel. Before leaving here a look round shows us among other trees *Cupressus macrocarpa, Abies Nordmanniana,* and *Chamaecyparis nootkatensis,* also the commoner broad-leaved trees—copper-leaved beeches and scarlet-flowered chestnuts. On a wall near here *Berberis Darwinii, Azara microphylla, Staphylea pinnata,* and *Cydonia japonica* are thriving.

Near the pond is one of the garden gates by which we can enter and pass to the centre walk between fine yew hedges. It would take too long to describe the contents of these five acres; suffice it to say that innumerable species of flowering shurbs are there—also a wall garden and the old winter garden with ericas, bamboos, primulas, and a showy *Magnolia stellata*. Near the main entrance is a wall on which are growing very fine specimens such as :—

Aristolochia Sipho.
Berberidopsis corallina.
Solanum crispum.
Wistaria sinensis.
Vitis coignetiæ.
Arbutus Unedo.
Schizandra Henryi.
Correa alba.
Magnolia conspicua.
Buddleia globosa.
Sophora tetraptera.
Choisya ternata.

In front of the greenhouses, which are not heated now and have less hardy shrubs in them, the following species are doing well :—

Hydrangea paniculata.
Liriodendron Tulipifera.
Rosa Moyesii.
Itea ilicifolia.
Lithospermum scoparium.
Pieris floribunda ; and
Veronica species.

On leaving the garden, and facing us is the " Wild Bank " with more fine rhododendrons—especially the yellow *R. campylocarpum*—azaleas and shrubs like small trees are *Pittosporum tenuifolium* and *Olearia macrodonta.*

From there we can take to a path along the slope towards the Arboretum. All along this trail are rhododendrons and azaleas in profusion, and behind them and in the Arboretum we will see fine specimens of the following trees :—

Abies pectinata.
,, *Pindrow.*
,, *Pinsapo.*
,, *cephalonica.*
,, *Webbiana.*
,, *Nordmanniana.*
,, *Lowiana.*
,, *concolor.*
Picea orientalis.
,, *nigra.*
,, *excelsa.*
,, *sitchensis.*
Larix europaea.
,, *leptolepis.*
Sequoia gigantea.
,, *sempervirens.*
Pinus sylvestris.
,, *Strobus.*
,, *excelsa.*
,, *radiata.*
Tsuga heterophylla.
Pseudotsuga Douglasii.
Chamaecyparis Lawsoniana.
,, *nootkatensis.*
,, *pisifera.*
Thuya plicata.
,, *occidentalis.*
Thuyopsis dolabrata.
Cotoneaster frigida.
Acer palmatum septemlobem.
Crataegus Carrierei.
Chamaerops Fortunei.

Clumps of interesting natural regeneration of *Tsuga* and Douglas fir are to be found here.

Returning from the Arboretum one passes alongside the River Masson, through the Golden Gates and up the west drive to Benmore House. Of interest near this avenue are *Abies amabilis, A. brachyphylla, A. Veitchii, A. recurvata, Picea asperata, P. Omorika, Pinus Armandi* and *P. Peuke.*

What an impossible task I have set myself to picture in words the beauties and attractions of Benmore. It simply must be seen to be

appreciated. You, the readers of this Journal, who, as foresters usually have to work with only a few species of trees, is it not your duty to brighten up your areas a little more with patches of colour ? Here at Benmore you can see species which might suit your very district and enable you to experiment with a few clumps.

If you feel you want to see Benmore, just write to the Assistant Commissioner (Scotland), 25, Drumsheugh Gardens, Edinburgh, and ask for the Hostel Prospectus. If you pay us a visit, we will do our best to make these unappealing technical terms represent to you living things of exquisite beauty.

UNOFFICIAL NOTES OF A SHORT OFFICIAL VISIT TO SCOTLAND.

By A. G. Herbert.

On three occasions I have had a respite from my job of scribe to the Forestry Commissioners in order to have an official glimpse at some of their broad acres. My first visit was to Thetford Chase. Everyone visits Thetford. My second was to the old Crown Woods in England's most attractive county, which happens to be my own. My third visit, which proved even more interesting than the others, was in June last to some areas in the South-Western Division in Scotland, starting through the usual channels, *i.e.*, the offices of the Assistant Commissioner and the Divisional Officer.

In considerable trepidation I entered 25, Drumsheugh Gardens, where, it is alleged, a maximum of work is done with a minimum of staff. I braced my nerves to reply to the question, what about it. Fortunately, the Treasury investigator had recently visited that office and had been suitably impressed by what was going on, as I was. So I got off lightly, the only thing thrown at me being a statement of everyone's duties and a table showing the Assistant Commissioner and his descendants with lines showing the collateral connection of individuals in different branches. I had a glance at the records kept of feus, stipends, valuation rolls and other horrors unknown in our Whitehall office. In Drumsheugh Gardens they are mere Child's play. When I was doing my best to appear intelligent during an explanation why certain debits are treated as credits I was rescued by the Assistant Commissioner, who with the Divisional Officer took me off in his car to Queensferry. There we crossed the Firth of Forth alongside the wonderful bridge, the repainting of which is perpetually proceeding.

After passing through Dunfermline, lunch on the roadside was made memorable by the fact that I was with two Scotsmen who had not a corkscrew between them. And so to Tulliallan Nursery, attractively situated on sloping ground, where the very satisfactory results of Forester Simpson's enthusiasm are clearly to be seen. I understand the seed-beds, transplant lines and land under green crops cover 250,000 square yards; 1,265 lbs. of seed were sown there last spring. Among other "things seen" were records kept in the same orderly manner as the nursery, cones in their bins, a rototiller at work, and the former uncrowned King of St. Kilda, a tall picturesque figure with long white beard, who looks as if he might be rather a firebrand; also his dog with its teeth ground down in accordance with the custom of that island. Here I also saw the effective results of ground treated with the following mixture, compared with that treated with "adco," viz.: Ground limestone, 6 cwt., and sulphate of ammonia, 1½ cwt., in 5 tons of herbage, resulting after regular watering in 15 tons of manure.

Next morning I went with the Assistant Commissioner to Glasgow and "doon the wa'er," *i.e.*, across the Clyde from Gourock, south of

which can be seen the well-kept property of the Chairman of our Scottish Consultative Committee. Thence by car along the side of Holy Loch, with part of Benmore Forest to the right and Bryant & May's plantations on the left. In the Loch a number of unemployed liners are laid by, a depressing sight.

Entering the one-time Golden Gates of Benmore House, I saw some of the forest apprentices at soccer practice, and I was pleased to hear that the School has the best team in the district. Their quarters are excellent, with the exception of the small gloomy playroom. The erection of a recreation hut is under consideration and ought to be proceeded with if the little-used billiard room in the Hostel part of the House cannot be used for the purpose by converting one of the windows into a door for the admission of the apprentices. Their healthy and smart appearance much impressed me.

Then into the garden and grounds. Well, I have read about them, but they should be seen. The main features are the rhododendrons in bewildering variety and the great size of the trees; in particular an approach avenue of Thuya alternating with rhody bushes and a dark cathedral-like Douglas fir avenue leading nowhere in particular. I did, however, feel that the garden would be immensely improved for the layman, but perhaps not for the botanist, if the beautiful surroundings could be made more visible by the cutting of vistas. Few members of the public appear to visit the garden, but perhaps that is due to the fact that a visit entails banging a saxpence.

A short walk took us to a steep path rising alongside a small but entrancing rocky stream overhung by trees and ferns. The path ends at a locked Rest House erected to the memory of Sir Isaac Bayley Balfour. At this point a splendid and satisfying view appears of parts of Benmore Forest and the surrounding hills, a view reminiscent of some parts of Switzerland. Puck's Glen is free to the public, but there was little sign of their visits in the way of litter. The Assistant Commissioner threatens, however, to erect a tea house at the entrance.

Sunday morning it poured. The School Instructor took us in his car to the Bernice part of the forest. The track up the west side of Loch Eck seemed to be more a pond than a road. Mr. Watson wished to demonstrate that for such travelling the mileage allowance was insufficient, warned us not to sit over the defective spring, and stepped on the gas. He convinced me in a very short distance and I was glad to survive the ordeal.

We walked through some spruce recently planted by the apprentices, much of it on mounds. It looked fine, but the Instructor modestly attributed this partly to the recent rain. The small groups of timber and of scrub here and there, the profusion of bluebells and the hawthorn blossom across the loch, all contributed to the beauty of the place. On the return I noticed Cruach Wood, about which a good deal has recently been heard at the office.

In the afternoon Mr. Gosling took us to the Forest Garden, which will be more interesting when the trees are more visible. I was given a

number of wrinkles to assist in the identification of species by sight, feel or smell, but I proved a poor pupil. On the return I saw the magnificent trees in the arboretum near Benmore House. A word of praise here for the comforts of the Hostel. Mrs. Mackenzie, no doubt regarding me as a delicate southerner, provided me with four blankets, a coverlet and a hot-water bottle.

Off the next morning up the east side of Loch Eck, from which we could see the various methods of dealing with scrub on the side visited the previous day, some of it merely ringed, some lightly thinned and some heavily. Forester Calder showed some excellent Sitka spruce in Ballemeanach Nursery. Then to Glenbranter House, most unattractive, and southwards past some well-sheltered poultry holdings into a delightful glen completely planted up by the Commission. There the trees will very soon block out the view; some, close to me, planted in 1927, seemed to have reached a surprising height.

Back to the road, south round Strone Point, and then north to Glenfinart. The Point, for some reason I could not fathom, has three piers within a mile or two of each other. On these I knew there had been very considerable expenditure by the Commission. Sight of the little jetties gave me quite a shock, as I had expected something like Southend or Brighton piers.

Entering Glenfinart Nursery, I was struck not only by the healthy-looking stock, but by the precision of the lines. These reminded me of a "Battalion in Mass," the lines on one side of each path being continued exactly on the other side. The edges of the beds consist of earth some 10 in. wide and 2 or 3 in. high, packed extremely hard; these not only add to the orderly appearance of the nursery, but prevent water from the paths flooding the sides of the beds.

Nearby was a good-sized building used as a bothy, which recently caught fire in the night. The men, having no means of extinguishing it, called from his bed Forester MacMillan, who proceeded with the herculean task of cutting this solid stone building into two parts, thus saving the larger part, which is in use as before, the rest being gutted. The holders' houses form quite a feature up this valley. One tenant had, I was told, seven head of cattle and some hundreds of poultry.

Next day I found myself with Mr. Home in Fife. We first went to a very dense plantation, not the property of the Commission, forty years of age, sold for immediate felling, the price being £5 an acre! Then to the Commission's small Carden Forest, where trespass is the trouble. On to Edensmuir Forest, which is practically all planted up and looks very well. After a visit to Forester Cameron's house I was shown P. 25 Scots pine precociously bearing cones. Although the railway line alongside Edensmuir is level, there is an elaborate system of fire lines. Within the fence is a space a chain or so wide, left fallow, then a wide clean fire line and two more cleared lines within the plantation. No fire, I was told, has ever passed the third line, although fires from sparks are numerous. Efficient certainly, but expensive. In France the Railway Company would have to pay a rent for that unused land, and also pay for the protective measures.

After a visit to the Torloisk area, where the Commission's plantations compare most favourably with adjoining private plantations, I proceeded south *via* Kirkcaldy, with its terribly smelly linoleum factories. South of Edinburgh swollen rivers and floods everywhere. Making a detour next morning, I noticed some fine-looking plantations on hilly ground near the railway. I thought they were private woods until the train entered the station, Dalbeattie.

And so to Closeburn Forest. Entirely different in character from what I had seen before, it has a charm of its own, with its rich green rolling hills, its stells, its owls, lapwings and curlews, " The Water of Ae " and other rushing streams, and the holders' houses with their panelled rooms, really plywood. Some of the ground is soggy and a considerable amount of mound planting of spruce is to be seen, but the changing species met with on a walk show that care has been exercised to give each part of the ground the trees which it will treat best. I noticed a larch planted in 1928 which stood 10 feet high. Mr. Fraser, who occupies the smallest forester's house in the country—this is now being remedied—was a most informative guide.

One of the strongest impressions left on my mind was the extraordinary kindness of Mr. Murray and the other officers and foresters I met in the way they appreciated that I wanted to see all I could and hear all about what I saw. As for the trouble Mr. John Sutherland took on my behalf, he could not have done more, and for that and his hospitality I am indeed grateful.

PROGRESS REPORT ON RESEARCH: JANUARY, 1932.

By W. H. Guillebaud.

Nursery Experimental Work.

In England and Wales the main line of investigation was on the factors affecting the germination of Sitka spruce. Owing to the tendency of the Kennington soil to cake the germination has often been poor, especially in the early sowings, while if sowing is delayed for the sake of obtaining a better tilth very small seedlings are produced. The experiments have chiefly dealt with method of covering the seed, using sand, humus and other materials, and also testing the effect of secondary covering with moss or branches of Douglas fir, which are removed as soon as germination begins. The wet spring and summer, together with the absence of any dry, hot weather, acted unfavourably from the point of view of showing up differences between the treatments, but in spite of this the improvement in germination produced by using coarse sand was very marked, *e.g.*, in Experiment 1 there was a yield of 155 seedlings per drill as compared with 97 seedlings in the control beds covered with nursery soil. In this wet season humus, when used as a cover, was prejudicial to germination. Secondary covering with moss or Douglas fir branches did not improve germination, but when humus was used for the primary covering the moss counteracted the unfavourable effect of the humus.

Other experiments on the out-turn of European larch, on the manuring of seed beds of common alder and birch with ammonium phosphate, on the lining-out of Corsican pine, and on the density of sowing Japanese larch, were carried out, but these have not yet been assessed.

In Scotland the subsequent development of rejected seedlings of European larch was studied. The results appeared to indicate that seedlings, culled on account of double tops or frosted shoots and line-out for a year, did not recover appreciably in the nursery.

Various covering materials used with seed of European larch gave inconclusive results. Use of moss as a secondary covering resulted in heavy losses from damping-off. A preliminary trial of granite chips as a covering material for Sitka spruce seedbeds has given promising results, the seed germinated earlier than in the controls and produced larger seedlings.

A preliminary experiment on the raising of large 1-year old plants of Corsican pine gave promising results. The seed was germinated in a cold frame and the seedlings pricked out, while still in the cotyledon stage, into boxes containing a compost of soil and Corsican pine humus to which a complete artificial fertiliser had been added. The method produced sturdy plants, a proportion of which will be planted out this season.

Manuring experiments on seedbeds gave wholly negative results, the only effect of the manures was to stimulate weed growth and so to add considerably to the cost of raising the seedlings. It appears reasonably certain that the size of seedlings of such species as larch and spruce does

not depend primarily upon the amount of available food material in the soil, but upon other factors, of which aeration is probably one of the most important. It is proposed to investigate methods of improving aeration in seed beds during the coming season.

The large-scale grading experiment was duly carried out at each of the costed nurseries, and transplants from each of the three seedling grades are to be put out in P. 32 in the following forests: Scots pine at Tentsmuir, Scots and Corsican pine at Thetford, European larch and Japanese larch at Fiunary and at Radnor. The experiment is being continued.

Plantation Work.

Peat Project.

England and Wales.

There is little to report at the moment, as most of the assessments carried out in the autumn of 1931 are still being worked up. A P. 30 manuring experiment at Beddgelert shows clearly the stimulus produced in the second year by applications of phosphate. The data are as follows:—

Treatments.	Total Height.	Mean Shoot Length, P. 31.
	Inches.	Inches.
A. Control	10·0	1·6
B. 1 oz. basic slag	11·6	4·8
C. 1 oz. ammonium phosphate	10·5	3·0
D. 2 oz. calcium phosphate	14·0	5·6
E. 2 oz. magnesium carbonate	8·8	1·3
F. 2 oz. calcium phosphate, plus 2 oz. magnesium carbonate	14·5	5·5

The interesting point about this experiment is that the 2 oz. of calcium phosphate has been more efficient than 1 oz. of basic slag. The magnesium carbonate has had no beneficial effect (at Inchnacardoch a response to magnesium was established), and ammonium phosphate has been less effective than basic slag.

At Hamsterley an interesting observation was made in one of the Sitka spruce plots in a P. 30 experiment, where an irregular patch of old heather was burnt in the year of planting. In this patch the surface soil conditions are very different from those in the adjacent area, where the heather was very severely burnt some years before planting. Samples were measured on either side of the margin between these areas, with the following results:—In the recent and lightly-burned area the mean height was 18·9 in. and the 1931 shoot length 7·3 in. In the area more heavily burned at an earlier date the mean height was only 8·1 in. and the shoot height 0·9 in. An average plant was lifted in each type, and it was found that in the first type the roots were very long, strong and spreading.

In the second type the roots were short and weak, half coming from the collar and half from the nursery root system. It is clear that the question of season and severity of heather burning is important in this area.

Scotland.

The most striking development on the scirpus types in the West is the falling-off in growth of the Sitka spruce in the older experiments and the marked improvement seen in the pines and in Japanese larch. Another year or two's growth is required before we can be certain whether the poor appearance of the spruce is mainly a seasonal effect or whether it is the result of the exhaustion of the basic slag dressings applied at the time of planting. It is perhaps significant that the diminution in length of shoot is confined to spruce plots which have been planted four years or longer, the 2- and 3-year old plots still show good growth wherever slag had been applied on planting. By contrast Japanese larch, *Pinus contorta*, Scots pine and mountain pine have all made excellent progress during the past growing season. Outstanding growth is shown by Japanese larch at Achnashellach, where 4-year-old plants slagged a year after planting are from 4 to 5 ft. in height and putting on leading shoots of 12 to 18 in. in length, while the unmanured controls are less than 2 ft. in height and growing at the rate of only 2 to 6 in. a year. At Glenrigh the oldest plots have now been planted eight years. Scots pine is decidedly the best of the species tried, though in view of the exposure and high rainfall it is doubtful if it will make much of a crop ; Japanese larch is growing, but has been badly knocked about by the wind ; Sitka spruce (direct planted) has failed. In a 5-year-old plantation in the same forest Sitka spruce are in check in spite of turfing and slagging, while Japanese larch are from 3 to 6 ft. high on the better ground, with many shoots of over 12 in. Scots pine also are very promising, with good colour and growth. At Inchnacardoch a P. 25 experiment on the turf planting of Sitka spruce on peat has proved disappointing. The plants were twice slagged, but though the plants showed the usual marked response to slag in the second year after treatment, they have gone into check again.

In the 5-year-old species experiment planted on thick turfs with slag, remarkable growth has been shown by hybrid larch and by Douglas fir. Two-year Douglas fir seedlings are now up to 3 ft. 6 in. in height and some of the shoots are over a foot in length ; examination showed, however, that the roots are still confined to the turfs. Of the spruces tried in this experiment *Picea Omorika* is much the most promising.

The most interesting new species at Inchnacardoch, tried first on peat in P. 30, is *Alnus oregona*, which has been planted in some of the groups with Sitka spruce. Basic slag was applied at the time of planting. The plants were 1-year 1-year and were 12 to 18|in. in height. Many of these died back to ground-level during the first year, but came away strongly in the second season. The tallest plant is now 4 ft. 8 in. in height, with a leading shoot of 30 in. An examination of the roots showed a vigorous development of strong lateral roots with many sinkers penetrating the

lower levels of the peat. Nodules were plentiful on the larger roots. On present indications *Alnus oregona* is a tree of great promise for planting on scirpus peat of the slope type.

Upland Calluna Soils.

Allerston.

The older experiments on ploughed ground show definite response of all species to applications of basic slag; this is most marked in the case of European larch, where the slag has made a decisive improvement. Sitka spruce and Japanese larch are growing well. Some experiments were carried out in P. 31 on the use of seedlings on ploughed ground. On the whole losses have been low, the chief exception being some overgrown Japanese larch 2-year seedlings, which suffered heavy losses. A feature of the experiments was the success of 1-year seedlings of Scots pine, Corsican pine, *Pinus contorta*, European larch and Sitka spruce, losses in which averaged less than 5 per cent., and the majority of the plants made excellent growth. These experiments have shown that, with proper lifting and packing, and rapid planting after the receipt of the plants, well-developed seedlings can be used with success, given a favourable growing season like 1931.

Hamsterley.

Experiment No. 1, P. 29, on moderately good but exposed Calluna moorland, shows a remarkable response by Japanese larch and European larch to applications of basic slag at the rate of 1 oz. per plant applied at the time of planting. The following assessment was made at the end of the P. 31 growing season :—

	Japanese Larch.		European Larch.	
	Control.	Slagged.	Control.	Slagged.
	Inches.	Inches.	Inches.	Inches.
Total height	5·2	13·4	11·1	18·4
1931 shoot length	1·4	7·1	2·0	5·1

The poor growth of the unmanured Japanese larch is curious; the slag has certainly proved its value on this ground.

Teindland.

The ploughing and group experiments, where the soil has been broken up by hand, are looking most promising. With the exception of *Thuya* all the species are growing well. Root development in the disturbed soil is good and the ploughing appears to have solved the problem of surface drainage in spite of the apparent impermeability of the tightly-packed subsoil. There are no accumulations of water in winter on any of the ploughed sections. Basic slag has greatly improved the growth of

all species, but some species, notably Norway spruce, are now beginning to develop quite normally on the unmanured but ploughed areas. *Pinus contorta* planted in P. 29 in groups and slagged have put on shoots this year up to 2 ft. in length.

Breckland Soils.

The birch and grey alder planted in P. 30 as nurses are growing satisfactorily and appear promising.

One-year and 2-year seedlings and 2-year 1-year transplants of birch were planted in P. 31 under different conditions, some under Scots pine of heights ranging from 4 to 10 ft. and some on cultivated ground ploughed by single furrows or completely turned over. On May 20th, 1931, there was a frost of 10° and severe damage resulted. An assessment of the beech planted under Scots pine gave the following data expressed as percentages :—

	Section I. Pine, 8–10 ft. high.			Section II. Pine, 5–8 ft. high.			Section III. Pine, 4–6 ft. high.		
	1-yr.	2-yr.	2-yr. 1-yr.	1-yr.	2-yr.	2-yr. 1-yr.	1-yr.	2-yr.	2-yr. 1-yr.
Killed by frost	3	0	2	5	6	21	16	6	40
Badly frosted	2	2	4	3	13	27	14	53	29
Frosted	5	5	4	14	29	20	24	26	4
Total frost-damaged plants	10	7	10	22	40	68	54	85	73

The data show how effective the shelter of the tall pine in Section I has been in protecting the young beech and also that, without such shelter, a late frost can cause very serious losses (21 per cent. of 2-year 1-year dead in Section II and 40 per cent. in Section III). The lower losses among the seedlings as compared with the transplants are difficult to explain. Under the smaller pine the 1-year seedlings have survived the frost better than the 2-year seedlings or the transplants.

Large and small plants of European larch, Douglas fir and beech, planted on single furrows and on complete ploughing, were also affected by the May frost, but the losses were not serious. It was found that the micro-topography of the ground and the character of the vegetation had had a more marked effect on frost damage than the ground preparation or size of plant.

Chalk Soils.

A further trial of nurse species was carried out at Buriton in P. 31. The wet growing season was favourable to establishment and all species took well except for birch, of which only 1-year seedlings were available.

The grey alder made excellent growth and seemed the most promising species as a nurse for beech. One-year beech seedlings from Kennington Nursery did better than 1-year 1-year transplants of local raising.

In order to test the effect of shelter a number of 1-year beech seedlings were planted under the shelter of hurdles, while a similar number were planted on open land adjoining. The percentage loss in the sheltered sections was 15 and in the open 10. Shelter is therefore not beneficial in a cool, wet growing season.

The Loams and Clay Soils (Hardwoods).

The season of sowing oak experiment was continued for the third year in succession and gave results of the same order as the two previous experiments. There was a germination of from 45 to 50 per cent. between January and the latter part of March. In April the germination fell to 24 per cent., but with a density of sowing of 15 acorns to the yard a sufficient stocking was obtained over most of the area. Birds were the chief cause of loss in the April sowing; owing to the late preparation the soil does not have a chance to consolidate before the acorns germinate, and the birds have easy access to the seed.

A 4-year-old method of planting oak experiment at Soudley in the Forest of Dean shows that on that soil (a good loam) the plants do not respond quickly to elaborate planting methods. The mean height of mattock planted trees was 28·7 in. as compared with 26·5 in. for carefully pit-planted trees.

A heavy dressing of basic slag (32 cwt. per acre) has not appreciably improved the growth of direct-sown oak. Mean height at end of three years: Control, 8·4 in.; manured, 9·0 in. Ammonium phosphate has been equally ineffective.

An experiment on the effect of hoeing 1-year oak seedlings and 1-year 2-year transplants at Soudley has given interesting results. The data are as follows:—

Mean height of plants (inches).

Seedlings.		Transplants.	
Hoed.	Not Hoed.	Hoed.	Not Hoed.
26·8	25·0	30·9	29·4

The effect of hoeing has been inappreciable, while the difference between the heights of the seedlings and the transplants is small compared with the relative age and cost of the plants. It may be observed that the plants grew very well in 1931, both seedlings and transplants putting on an average of 11 in. growth.

In a weeding experiment at Dymock, where the weed growth consists of tall herbs, the unweeded plants continue to grow better than the weeded.

Year.	Weeded.		Not Weeded.	
	Total Height.	Annual Growth.	Total Height.	Annual Growth.
	Inches.	Inches.	Inches.	Inches.
1928 ...	Area planted with 1-year seedlings.			
1929 ...	6·0	—	8·0	—
1930 ...	12·6	6·6	17·0	9·0
1931 ...	18·1	5·5	25·0	8·0

The unweeded plants are now 7 inches taller than the weeded plants, and can be regarded as fully established.

A good deal of perennial lupin has been sown in various experiments with the object of improving the growth of oak, ash and sycamore. The lupin has developed very irregularly except where basic slag has been added, and this manure is evidently necessary for effective growth. The lupin has so far not had much effect on oak and ash, but has made a great difference to the sycamore, *i.e.*, there are plants 3½ to 4 ft. in height among the lupin as compared with 8 to 10 in. in the control.

In P. 31 iron sulphate was tried as a flocculant on heavy clay soils, but does not appear to be effective.

The oak in the 5-year-old experiments at Alice Holt makes very slow progress. The average height is only about 12 in., though here and there individual plants are beginning to get away. Acorns sown in groups in this forest failed completely for the second year in succession owing to the activities of birds and mice.

Races of Trees.

European larch of 13 different origins were planted out at Radnor Forest in P. 31. An interesting point arose out of part of this work. Two-year seedlings of four lots of larch were raised in Kennington Nursery and in the Forest of Dean. On planting out, the following losses were determined at the end of the year :—

Origin.	Percentage Losses.	
	Forest of Dean.	Kennington.
Tyrol	5	14
Silesia	3½	14
Aberdeenshire	5	37
Morayshire	4½	16½

Similar results were obtained from the parallel experiment in Scotland, where the seedlings came from six nurseries and were planted in three different areas. Plants coming from Auchterawe gave markedly the best results, losses averaging only 3 per cent., while plants raised at Barcaldine showed an average loss of 17 per cent. The difference in death-rate between plants from the various nurseries is striking and indicates that the study of the connection between losses in the forest and conditions in different nurseries might give useful information.

In Scotland lots of Scots pine of different origin were planted out at Findon and of *Pinus contorta* at Teindland.

Sample Plot Work.

During the six months, March to October, 1931, thinnings and remeasurements were carried out in 17 sample plots, of which 9 were in England and 8 in Scotland. Three silvicultural plots in the Forest of Dean were established as permanent plots. Several weeks were spent in carrying out pruning experiments in the Forest of Dean.

The Sitka spruce plot, No. 41. at Dunster, Somerset, was measured for the fourth time. Data :—

Age.	Height.	Girth.	Number of Trees.	Volume (true U.B.).	Periodic Mean Annual Increment.
Yrs.	Feet.	Inches.		Cubic Feet.	Cubic Feet.
22	59	23	690	5,070	530

This is the fastest-growing plot in England.

The series of Scots pine plots at Bagshot shows an apparent improvement in current production with heavier thinning. The mean annual increment was as follows :—

Grade.	1921–26.	1926–31.
Unthinned (A.)	95	52
Light thinning (B.)	98	87
Moderate thinning (C.)	101	137
Heavy thinning (D.)	110	152
Crown thinning (L C.)	81	99

The fall in the rate of increment in the A and possibly also in the B plot is interesting, also the improvement in the C and D grade plots. The degree of comparability of these plots is, however, rather doubtful.

The very fine *Thuya* plot at Munches, Kirkcudbrightshire, was measured for the third time. The current annual increment is being well maintained, namely, 305 cu. ft. per annum for 1921–26 and 312 cu. ft.

per annum for 1926–31. The age is 29 years, height 41 ft., number of stems 1,750 per acre. girth 16 inches, and true volume under bark per acre 3,690 cu. ft.

Research Work at Aberdeen.

Revised manuscripts dealing with the work done have been received from Dr. Laing and Mr. G. K. Fraser. As regards current work, Dr. Laing is continuing his studies on the identification of fungi associated with tree roots and is making field experiments with manures and humus inoculations. Mr. Fraser has been working on the ecology of peat in the East of Scotland, but the areas available are small and very scattered. Some work has also been done on vegetation types under Scots pine in the valleys of the Dee and the Spey. The object is to link up the woodland types with the unplanted heath ground from which they are derived.

I visited in October, 1931, the Drumtochty peat experimental area with Dr. Laing and Mr. Fraser; the peat there is of a very different type from that in the west, being much more crumbly and easily weathered. Good results have been obtained by Dr. Laing by planting trees on reversed turfs placed in the surface drains instead of on the natural surface of the soil.

In May, 1931, a visit was paid by Dr. Ogg, Dr. Ostwald and Mr. Fraser to the peat experimental areas at Inchnacardoch and Achnashellach. Dr. Ogg is the head of the Macaulay Institute of Soil Research and Dr. Ostwald the Director of the Experiment Station of the Swedish Peat Society, Jonköping. The opinion was expressed that, as compared with similar work on the Continent, very rapid strides were being made and that the methods now being developed were promising. Mechanical cultivation was suggested as a possible means of reducing costs.

Pruning.

A considerable amount of time has been devoted recently to the subject of pruning. Preliminary experiments were carried out in 1931 on Norway spruce, Douglas fir and Corsican pine in the Forest of Dean, the object being to determine the extent to which live pruning could be carried out without seriously checking growth and also to find out whether the scars occlude satisfactorily. Since then pruning tools of various types have been purchased, and these will be given a thorough trial in the Forest of Dean, New Forest and Alice Holt. Different tools will probably be necessary for different heights above ground, and where a satisfactory combination has been discovered trials on a larger scale will be carried out.

Meteorology.

The Forestry Sub-Committee of the Agricultural Meteorological Committee met during the summer in the Forest of Dean and a scheme of work was drawn up. A station has been set up at Nagshead and further stations are being established at Benmore and Thetford. In addition to recording temperature and rainfall, there is a complete series of soil thermometers as well as instruments for recording wind travel and sunshine.

Breckland Research Committee.

There have been no developments during the past year.

Mycology.

Research into Frost Damage.

A detailed report has been received from Mr. Day, including a large number of photographs illustrating frost damage produced on different species. The species divide into two groups, one including all the evergreen species (these are susceptible to winter frost damage), and the other containing all the deciduous species, which are resistant. As regards spring frost, owing to the ease with which the old needles are damaged, Douglas fir must be regarded as the most susceptible species. If this type of damage is ignored, it is scarcely more susceptible than Japanese and European larch, which come next. Then come Sitka spruce and early-flushing Norway spruce, and lastly, as comparatively hardy species late-flushing Norway spruce, oak and beech. The position of the last two species is not what would be expected (especially beech), and it is possible that some factor, not reproduced in the refrigerator, may affect them outdoors more than the conifers and so increase their relative susceptibility. It is hoped that further experiments will throw light on this point.

Much work has been done on the abnormal anatomy of stems injured by frost. It has been shown that frost damage is often responsible for the formation of cankers. It is possible for severe frost in March to damage or even kill the cambium, often on one side only of the stem, and so give rise to cankers. The forester is inclined to ascribe all damage of this sort to attack by parasitic fungi, but it is clear that in very many cases frost is the primary cause and not the fungus.

Oak-rot Investigation in the Forest of Dean.

Work started in May, 1931, when a forester was placed in charge of the field side of the investigation. Seventeen areas were selected, distributed so as to cover the range of soil conditions as completely as possible. One hundred trees are to be felled in each area, the logs cross-cut into short lengths, and the location and amount of rot in each log determined. Eight areas were completed by the end of the year. The data have not yet been worked up in any detail; this is being done by Mr Day at Oxford. A preliminary examination shows that the percentage of entirely sound trees varies from 25 to 72 per cent. in the areas cut to date, the average being 53 per cent. There is a considerable range in the severity of attack; as might be expected, the rot appears to be most serious where the oak is of poor quality as regards rate of growth.

Dutch Elm Disease.

The fourth annual survey was carried out by Mr. Peace in September, 1931. The disease had been recorded for the first time in the counties of Monmouth, Huntingdon and Lincoln, bringing the total of counties infected up to 33; most of Wales and the whole of Scotland are believed still to be free. The disease continues to spread, slowly in some localities

and very rapidly in others. On the whole, it is more general and the number of cases much greater than last year. The most serious outbreak is undoubtedly that in the County of Essex, where, as distinct from other areas, the attack is more prevalent on large trees than on medium-sized or small trees. In places nearly 20 per cent. of the trees are dead, while another 50 per cent. are diseased.

Most, but not all, of the trees which " recovered " in 1930 still showed no signs of the disease this year. The few trees which had the disease in 1928 and showed no external signs in 1929 and 1930 are still normal. There appears to be every hope that these are now permanent recoveries. Recovery is relatively very infrequent in areas where the disease is severe. The wet summer does not appear to have mitigated the severity of the disease. The removal of infected branches has succeeded so far in a proportion of the small number of cases in which it has been tried. It has failed in other cases. It is only practicable in the case of specimen trees and where the disease is discovered at a very early stage.

More evidence was obtained as to the close connection between the elm bark beetle and the spread of the disease.

In the most severely affected districts the disease has definitely altered the aspect of the country owing to the numbers of dead and partly-dead trees. Elsewhere the disease is not really noticeable and the amount of damage done is negligible.

Meria laricis.

It is hoped that work on this fungus is nearing completion. A method of control has been devised which it is believed will be effective, and a circular detailing the method is being prepared for issue to the technical staff. The method consists in spraying the plants just before they begin to flush with a sulphur spray, followed by fortnightly spraying during the first part of the growing season with more diluted sulphur suspensions.

As regards the various factors affecting the intensity of *Meria* attack, it has been found that the disease is directly affected by moisture. The spores retain their vitality for 15 weeks if kept moist (at laboratory temperatures), whereas dry they die in a few hours. The correlation with weather in the field is not, however, always complete, other factors coming in to complicate the position. A still atmosphere is more important than high relative air humidity. No definite relation has been established between the incidence of *Meria* and frost damage. The disease can become epidemic without any aid from frost. Overhead shelter does not appear to lessen the disease, while side screening, which has the effect of hindering the free current of air, definitely increased it. *Meria* is nearly always more severe on 2-year seedbeds than on 1-year seedlings or on transplants. Lining out at one year is thus a useful aid in the control of the disease. It should be possible to keep an uninfected nursery entirely free from disease if there are no larch growing in the near vicinity and if no plants are imported from a diseased nursery for lining out.

Watermark Disease of Willows.

No further study of the disease has been made since the date of the last report. The Essex County Council have applied to the Commission for an Order compelling owners to destroy disused trees. The Order, which is to be administered by the County Council, is in course of preparation.

Chestnut Disease in the New Forest.

Considerable progress has been made in the investigation of this disease, which is causing the die-back of Spanish Chestnut in certain of the New Forest inclosures. A fungus of the genus *Phytophthora* has been isolated from diseased material and it seems highly probable that it will prove to be *P. cambivora*, which is the fungus concerned in "Ink Disease." Mr. Day suggests that resistant Japanese and Chinese species of *Castanea*, which are already being grown in France, should be introduced experimentally.

ENTOMOLOGY.

Pine Shoot Moth.

Dr. Chrystal has submitted a manuscript written by the late Mr. C. C. Brooks on his investigations in East Anglia; this is now being considered for publication. The paper throws a considerable amount of new light on the biology of the insect and on the incidence of damage and is a very thorough piece of work. More recently a detailed study of a block of P. 22 Scots pine at Swaffham has been carried out. The area was one which was very severely damaged by shoot moth a few years previously. It was found that there were 12½ per cent. of trees of good growth, unblemished by tortrix damage, and a further 33 per cent. of well-developed trees which had been only slightly damaged by tortrix and were making good recovery. When plotted on squared paper the distribution of the undamaged trees was seen to be rather irregular and in places there were gaps of considerable size, but if the slightly-damaged trees were included there appeared to be sufficient trees to make a satisfactory final crop, provided further damage does not take place.

Disbudding experiments were continued in 1931, but the results of the assessments are not yet available.

The past summer appears to have been unfavourable to the insect in East Anglia and the plantations have made a distinct recovery.

Defoliation of Oak in the Forest of Dean.

During the past year a further statistical examination of the population and mortality of the caterpillars in different types of woodland has been made. The winter moths were much less abundant than in previous seasons and occurred chiefly in the Highmeadow woods. In the pure oak of the Forest of Dean *Tortrix viridana* was the principal species and was the cause of local heavy defoliation, the damage being greatest in oak stands of feeble growth. The evidence from egg counts made late in the summer suggests that in 1932 the outbreak of *Tortrix* may be on a larger scale.

Much work remains to be done before the parasite relations can be elucidated. It is not certain how many of the parasites require alternate hosts and by what trees these hosts are supported. Mr. Brown considers that the biological niche, occupied in the early part of the year by *Tortrix viridana* on oak and by *Geometridæ* on deciduous trees in general, appears to be filled incompletely, if at all, during the latter part of the summer. The problem is evidently very complex.

Chafer Larvae.

Mr. W. F. Jepson, who has been investigating this problem with the aid of a grant from the Ministry of Agriculture, has made some progress in the control of chafer larvae in nurseries. It is understood that the work will be published shortly.

Timber Investigations.

An investigation on the preservative treatment of fencing posts (stobs) of seven different species will be carried out in 1932. Eight treatments are to be compared in addition to an untreated control. The posts are to be put out at Thetford, Clocaenog and Kershope Forests, and about 1,400 posts will be required for each of these areas. The preservative treatments of the posts and assessment of results will be the work of the Forest Products Research Laboratory.

ANCIENT MONUMENTS.

By R. H. Smith.

At intervals during recent months, certain of the population of North Wales have been living in a state of feverish excitement at the staggering news that a fresh " Roman Remain " has been discovered situated in some out-of-the-way place in the Forestry Commission's area. This thrilling news is usually followed without delay by the still more electrifying information that someone is coming up " to look at it." Who this " someone " may be is a matter of conjecture. But one pictures some rather irritable old archæological professor with steel-rimmed spectacles, armed with a garden trowel, an umbrella, and probably a lens. Make no mistake, we do not despise this intrepid explorer, we have a deep regard for his enterprise and enthusiasm, for he has a difficult task to perform, however good his steel-rimmed spectacles and his lens may be, as the reader will shortly understand.

How these " Roman Remains," presumably " stone " and not " bone," are discovered, is an unsolved mystery to the poor uninformed Forestry Commission employee who passes the " Remain " almost daily. Instructions may be issued to him that such-and-such an area must on no account be planted, and these are sometimes accompanied by a sketch, which in the circumstances is a wise precaution, for although occasionally an examination of the Ordnance map will reveal the word " Stones," more often there is nothing shown at all. In despair he proceeds to the sacred area in a valiant attempt to recognise the place indicated. After stretching his imagination beyond the limits of reason, he calls for another opinion—" There is a slight hump there, do you think that could be it ? " " No, I don't think so ; you see, it is so slight, but there is a stone here (excitedly), in fact, there are two ; this must be it. This is just the sort of place they would choose to make a camp. Do you remember we found three stones together at that other place, which were obviously the few remaining from a circle of them, because we found two indentations also, which may have been made by sheep, but were probably where stones had been ; anyhow, we will assume that this is the place." " Yes, I suppose this must be it ; we were lucky to find those two stones."

Whether these circles were erected as a memorial to themselves by the Romans, or were merely used to pen in goats, is not clear. Is the discovery of these often invisible remains the result of the workings of a superhuman imagination, or the revelation of some resurrected Roman spirit at a séance ? In either case the " someone " armed with his lens and his trowel is going to have his work cut out to locate and identify the Remains without a serious risk of ridicule and contradiction. It is thought that an aerial survey from about 4,000 ft. might be of assistance,

but no guarantee is given, although this method was successful in helping to locate a Roman Road recently in Ashdown Forest. Why not try it ? We do want to avoid disappointing the old Professor, especially if his object is to establish a National Park if sufficiently interesting revelations are forthcoming. I feel sure we could find all sorts of things to interest him in the formation of his park, particularly above the planting line. He should be in great demand when he does come.

R.E.A.S. SUMMER MEETING, 1931.

By H. J. WALLINGTON.

The meeting was held in the first week of September, with headquarters at Shrewsbury. On the first day an excursion was made to Lake Vyrnwy, which is the chief reservoir for supplying water to the City of Liverpool. The lake covers 121 acres, and is surrounded by approximately 4,000 acres of growing plantations ranging from 1 to 44 years of age. The Corporation have embarked upon an extensive afforestation scheme and aim at establishing a forest of some 5,000 acres on the catchment area. The land selected for planting consists of the slopes surrounding the lake and the numerous minor valleys radiating from the main valley. In some instances the planting limit reaches 1,500 ft. above sea-level, but this is only practicable where sufficient shelter is provided by higher ground beyond. The species which have proved most successful at Lake Vyrnwy are Douglas fir, Sitka spruce, Norway spruce and Japanese larch. Corsican, Weymouth and Scots pine have not done well; plantations of these species are heavily infested with the fungi *Brunchorstia destruens*. European larch, with the exception of a few isolated patches, has also proved a failure, larch canker being very abundant. Good crops of European larch have, however, been grown on this area in the past.

The inspection of the plantations commenced with a small mixed plantation 39 years old. Douglas fir had been planted in mixture with hard woods and had almost completely suppressed them. Next came a pure Douglas fir plantation 21 years old, planted at 4 ft. by 4 ft. and containing two sample plots, established to determine yield and best thinning methods. The plot on the higher side of the ride had been thinned according to a heavy low thinning, and the lower plot according to a crown thinning. The heavy low-thinned plot has now 600 trees per acre, against 946 in the crown thinning, whilst the total volumes of the two plots are 3,016 and 2,810 cu. ft. respectively. The plots were laid out when the plantation was 13 years old and the first thinning was given in 1926. There are many points for and against each method of thinning, but in the writer's opinion the main point to consider is the stability of the crop. The trees in the heavy low plot will obviously have a much better anchorage than the others and therefore will not be so liable to suffer from blowing, which appeared to be threatening the crown-thinned plot. The trees in the heavy low plot were of a much more uniform size than those in the crown thinning, and will, I believe, produce the better crop. The revenue from thinnings would be lost for some years where a plantation was heavily thinned at an early age, but this loss is compensated by the increased stability of the crop.

The next plantation was an even mixture of Douglas fir and Japanese larch, 23 years old, and contained another sample plot, where, by selective thinning, it is hoped to produce a true mixed crop. The Douglas fir were

being rapidly suppressed and were therefore favoured in the thinning. They had certainly responded well to the treatment given and, provided no damage from wind or snow occurs for a few years, they will undoubtedly take their place in the canopy once more. The route continued through a mixed plantation of Douglas fir and Norway spruce 42 years old, planted at 5½ ft. by 5½ ft., where the Douglas fir had outgrown and suppressed most of the Norway spruce. The estimated height of the trees was 65 to 70 ft. and the quarter girth at breast height 10 in. The side branches on the Douglas fir were persisting, and a discussion arose as to whether or not the trees should be pruned. Most of the members were in favour of pruning, but unless the trees are to remain to grow into really big timber I do not think it would be worth while.

Next came a small nursery, where, owing to the wet summer, growth was very poor. From the nursery a short walk brought the party to where Douglas fir thinnings were being cleaved into pales for making pale-fencing. This work is being carried out by Forest Products, Ltd., and the pale fencing is finding a ready market. Durability tests are being carried out, Douglas fir and chestnut being subjected to the same treatment, and if the result of the test is favourable to Douglas fir there is no reason why, in time, pale fencing made of this species should not take the place of imported chestnut fencing.

A drive round the lake afforded a good view of further plantations, especially some very nice 12-year-old Sitka spruce, which were showing annual growths of 3 to 4 ft. At the end of the drive another Douglas fir sample plot was seen. This was laid out in 1920 and the trees are now 32 years old. Thinning has been carried out regularly, and in ten years 360 trees have been removed, giving a volume of 1,700 cubic feet. There are now 388 trees in the plot and the height is 70½ ft., girth at 4 ft. 3 in. is 30 in., and the total volume per acre is estimated at 5,500 cu. ft.

The second day, which was unfortunately marred by very wet weather, was spent on the Plas Dinam Estate, where the forestry area extends to approximately 1,500 acres. The bulk of the plantations seen ranged from 10 to 25 years of age and were composed mainly of Douglas fir, Japanese larch and Sitka spruce. All the plantations are growing vigorously and have been extremely well managed. I think one could safely say that some of the finest plantations of Douglas fir in the country are to be found at Plas Dinam; growth is remarkably uniform and straight. The conditions generally on this estate are ideal for tree growth and the plantations are almost too good except to show what the different species are capable of doing under really good conditions. The soils vary in character from heavy clays and clay loams to brashy and gravel soil, with some areas of peat. The plantations are growing at altitudes ranging from 430 to 1,700 ft. above sea-level. Penrhuddlan Hill Plantation, at an altitude of 1,700 ft., was planted in 1905 in plots of Japanese larch, European larch, Corsican pine and, where moist, Norway spruce. The rate and vigour of growth of Japanese larch at this unusually high altitude is amazing, except where peat comes in, where growth falls off

considerably. The European larch were not very good and Corsican pine and Norway spruce no good at all at this height.

The third day, again a very wet one, was spent on the Powis Castle estate, where the morning was taken up with seeing some really magnificent specimen trees and in watching a timber-felling competition. In the afternoon the party was conducted over the castle and gardens. Of the many fine oak, chestnut, Douglas fir, larch and silver fir seen, the following are worthy of special mention :—The " Champion Oak," in 1909 the measurements were : height, 105 ft. ; girth, 23 ft. 6 in. ; contents, 2,026 cu. ft. The " Giant Oak," measured at the same time : height, 92 ft. ; girth, 26 ft. 6 in. ; contents, 1,925 cu. ft. ; and the " Red Rock Oak," measured in 1931, contains 667 cu. ft., and is still perfectly sound. There is also a Spanish chestnut with 408 cu. ft., apparently still sound. In Gwen Morgan Wood stands the tallest Douglas fir in England, a magnificent tree with a height of 168 ft., a girth of 11 ft. 7 in. and a volume of 516 cu. ft. The measurements of this tree in 1909 were : height, 138 ft. ; girth, 9 ft. 10 in. ; volume, 225 ft., and it will thus be seen that in 22 years this tree has increased its volume by 291 cubic feet. The age of the tree is estimated to be somewhere around 90 years. The tree carries a single stem to its full height.

The discussions throughout the meeting were many and interesting. The point which came up most frequently was about pruning Douglas fir, and this seemed a very vexed question among the members.

ALNUS OREGONA.

By W. H. GUILLEBAUD.

The majority of the north-west American forest trees are so well known in this country that it comes as something of a surprise to find that one which may have some value for certain of our conditions has apparently been rather overlooked. The species referred to is the Oregon alder. According to Sargent *Alnus oregona* ranges from Sitka in Alaska, where it often clothes mountain sides to elevations of 3,000 ft., southwards through the Islands and coast ranges of British Columbia, and through western Washington and Oregon, and the Cañons of the Californian Coast ranges, to the Santa Inez Mountains near Santa Barbara. It grows to its largest size (80 ft. in height and 10 ft. in girth) in the neighbourhood of Puget Sound, B.C., where it commonly fringes the banks of streams and grows in wet places. Sargent describes the wood as light, soft, brittle, and not strong. He says it is now largely used in Washington and Oregon for making furniture.

Morton and Lewis in their book on " Native Trees of Canada " (1917), state that *A. oregona* is the largest alder in Canada, frequently 40 ft. high by 1 ft. in diameter, but sometimes much larger. The trunk is usually straight and the branches slim. The wood is sometimes used commercially for interior finish, furniture frames, turnery and handles. It has a fine, even grain, and is fairly hard and strong. It is also said to be teredo-proof.

A third reference to the species is contained in the 1918 report of the Commission of Conservation, entitled " Forests of British Columbia." This states that in B.C. it frequently attains and sometimes exceeds a height of from 35 to 40 ft. and a diameter of from 12 to 18 in. It is a quick-growing short-lived tree, found usually on alluvial soils, along streams or moist hillsides, where the coniferous forests have been either destroyed or have not yet become established. As a rule it is associated with cottonwood or maple in a temporary type. The trunk is usually well-defined and clear of branches for one-half or more of its length. In dense stands, in which it is very frequently found, it forms long, straight poles. The wood is pale reddish-brown, light when dry and not strong. The grain is quite attractive, and it is said to be suitable for cabinet work. The chief use, however, is as fuel, for which it is excellent.

In Sudworth's " Forest Trees of the Pacific Slope " (1908) the climatic requirements are described as similar to those of Douglas fir and *Abies grandis*. It is the most tolerant to shade of the west coast tree alders, especially in youth. It occurs on the borders of streams and other moist bottoms, benches, and gentle slopes, in fairly well-drained, rich humous, rocky or gravelly soils. Abundant soil moisture and rich soil are requisite for the best growth. The wood is pale reddish-brown, brittle and light when dry. The cherry-like fine grain is attractive when finished, making the wood suitable for cabinet work. It will be observed that the authorities quoted differ to some extent as to the technical properties of the wood.

In 1928 a consignment of seed was procured from the coastal region of British Columbia near sea-level, and sown in a number of the Commission's nurseries in the spring of that year: further quantities were also sown in 1929 and 1931.

Nursery Treatment.—The small, light seed is very sensitive to caking and requires special care in covering to obtain good results. Experiments carried out at Benmore by the Divisional Staff and at Inverleith Nursery by Mr. J. Macdonald illustrate this point.

At Benmore 2½ lb. of seed of I. No. 31/30 were sown broadcast on two dates, and different methods of covering employed.

1. Sown May 28th, 1931.

(*a*) Seed sown and lightly patted down with a spade. Soil drawn on with a cuffing-board. Yield 21,000 plants per lb. Average height 1½ in., maximum height 2½ in.

(*b*) The soil was not patted down either before or after sowing. The seed was covered by riddling soil lightly over the bed. Yield, 41,000 plants per lb. Average height 3 in., maximum height 4½ in.

2. Sown May 19th, 1931.

(*a*) Soil not firmed, seed covered by riddling (as in 1 (*b*). Yield, 49,000 plants per lb. Average height 1½ in., maximum height 2½ in.

(*b*) Soil not firmed. The seed was sown on the surface and covered with moss only. Yield, 57,000 plants per lb. Average height 2 in., maximum height 3 in.

At Inverleith seed of the same Identification Number gave 4,000 plants to the pound when covered with sand, as compared with only 800 plants where the seed was covered with nursery soil.

Other yields were :—

Tulliallan Nursery (28/44) ..	31,000 plants per lb. All seedlings killed in first winter.
Glenfinart Nursery (28/44) ..	51,000 plants per lb. at end of growing season, 17,000 at end of second growing season, and only 5,000 when actually lifted as 2-year seedlings.
Kennington Nursery (29/35) .	1,100 transplants per lb.

It thus appears that the seedlings are liable to heavy mortality in the seedbeds. At Kennington there were many losses from drought in the dry 1929 summer (the beds were not watered). The Tulliallan losses were due to severe frost occurring during the winter months; the seedlings were killed in spite of being covered with lath-shelter. At Glenfinart, where the beds were protected with branches during the first winter, losses were also attributed to frost.

Growth in the Forest.

Plants have been distributed over 13 forests in Divisions 2, 4, S.W. and N., the soils including good mineral loam, chalk down, marshy soils, and both good and bad types of peat. Normal methods of planting have

been employed, except at Dovey, on a more or less grassy peat, and at Inchnacardoch, on fibrous *Scirpus-Myrica-Erica Tetralix* peat, where turf planting was adopted. The Inchnacardoch plants were manured with basic slag at the time of planting.

In both cases where it has been employed turf planting has given successful results. At Dovey (P. 30 planting) the height now ranges from 2½ to 10 ft.; according to the report, the best growth is near the drains and the poorest where the peat is deepest. The Inchnacardoch area has been referred to in the report on Research (*see* page 21), but it may be observed here that, considering the relatively bad type of the peat, the growth of the alder is distinctly encouraging, while the roots show a more vigorous development than those of any species hitherto examined on this class of peat.

As regards the remaining areas, where the alder has been planted direct, one or two cases of particularly good growth may be mentioned :—

(1) *Gwydyr.*—Elevation 200 ft., sheltered. Soil good loam, frosty. Average height when planted in P. 30 as 1-year 1-year, 30 in. Average height in October, 1931, 60 in. Maximum height, 9 ft.

(2) *Vaughan.*—Elevation, 900 ft. South aspect. Soil, 3 in., good loam over rubble. Average height when planted 15 in., average height in October, 1931, 47 in.

(3) Two-year seedlings were planted on a deep gravel bed at Glenfinart; with minor exceptions the crop is now uniform, the average height at the end of P. 31 was 6 ft., and the tallest tree 8 ft. 6 in. Several of the trees made a shoot of 4½ ft. in 1931.

On the other hand, on wet low-lying ground at Cannock, the plants were badly frosted, while unsatisfactory growth was reported from two areas at Gwydyr (in the one case the soil was a water-logged clay), on an exposed site at 1,100 ft. elevation at Cynwyd, and on peaty soil at Dovey. Plants put out in P. 31 at Bedgebury on loam, and at Friston on shallow soil over chalk, have taken well and made fair growth. At Friston the experiment was tried of cutting back a proportion of the plants to within a few inches of the ground; this proved quite successful, the plants so treated making considerably better growth than the others.

Henry remarks in "Trees of Great Britain and Ireland," that Elwes raised seedlings from trees planted a few years previously in Kew Gardens, and that they grew very rapidly on heavy soil at Colesborne, but being planted on a site very subject to late frost they had suffered on several occasions when the grey and common alders standing near were quite untouched.

In his report on the trees planted in Division 2, Mr. Long states that, owing to the early date at which the buds break the plants are especially

liable to damage by spring frosts, also that the young twigs are brittle, and so the species is unsuitable for planting on exposed sites.

Summary.

Alnus oregona can be readily raised in the seedbed provided care is taken with the covering of the seed. The 1-year seedlings have not proved hardy to exceptional winter cold. When planted on good soils and in sheltered situations the trees have made spectacular growth in the first two years; but several failures have been recorded where drainage has been poor, and also in areas subject to late frost. The silvicultural requirements of the species, in so far as we know them to date, evidently differ considerably from those of common alder or grey alder. At the same time, the wide natural range of *Alnus oregona* must be remembered. The seed employed in the Commission areas all came from the coast of British Columbia, and it is possible that seed from South Alaska would prove to be more hardy.

The future development of the plants put in on turfs on scirpus peat at Inchnacardoch is a matter of considerable interest. If the trees succeed on this ground it will open up a new prospect for the planting of the more difficult types of peat.

USE OF SEEDLINGS FOR TURF PLANTING.

By W. H. Guillebaud.

In a memorandum dated October, 1930, and headed "Turf Planting," the Technical Commissioner requested all Divisional Officers to carry out experiments on the turf planting of seedlings. There was to be no special selection of ground for the work nor was the planting to be done deliberately late in order to avoid the risk of losses due to freezing after planting. Controls were to be established with transplants and both Sitka and Norway spruce were to be used. Reports have been received from most of the officers concerned, and these are summarised below.

Sitka Spruce.

Twenty-eight separate lots have been reported on. Of these, seventeen are described as either satisfactory (actual data for losses not being provided) or the losses do not exceed 10 per cent. In six out of the remaining eleven cases the losses were between 10 per cent. and 20 per cent. In the five cases in which the losses were considerable an examination of the factors held to be responsible may be of interest:—

(1) *Salen.*—20,000 strong seedlings, 9 in. in height, were planted in February on a dry slope with bracken with some tufts of calluna. Losses were 21 per cent. There was heavy frost after planting and plants suffered from frost-lift.

(2) *Fiunary.*—10,000 good 4-in. seedlings were planted in the first fortnight in March on grass and rushes on a sheltered slope. Losses were 25 per cent. Nine days' hard frost, accompanied with east winds, followed on planting. A second lot of 10,000 plants put in on the same area in the second half of March escaped the frost and losses were only 5 per cent.

(3) *North Tyne.*—Four acres were planted early in the planting season with 3-year seedlings ex Chopwell. The soil conditions were very poor. Losses were 25 per cent. The plants suffered severely from frost and cold winds.

(4) *Kershope.*—53,000 3-year and 124,000 2-year seedlings ex Ireland were planted. The 2-year seedlings were partly first grade and partly second grade. They were planted on turfs in April and were not exposed to severe frost; there was plenty of rain after planting. The losses amounted to 30 per cent. in the exposed areas and 20 per cent. in more sheltered places. Many of the 2-year seedlings were unfit for planting, being drawn-up weakly plants with poor root systems. Losses were lower with the 3-year seedlings and on the better soils.

(5) *Rosedale.*—20,000 Grade I 2-year seedlings and 60,000 Grade II 2-year seedlings, both ex Dalby, were planted in November, December and January. Losses were 25 per cent. in the Grade I and 70 per cent. in the Grade II. The weather conditions after planting are not mentioned in

the report, but presumably there was frost subsequent to planting, as in other areas. On the same area 20,000 3-year seedlings ex Chopwell were planted. Losses in these plants were only 10 per cent.

In addition to reports received from Divisional Officers the fairly extensive experiments with seedlings carried out by the Research Branch have been reviewed. For the most part these have been carried out on very poor soils and under exposed and difficult conditions. Results as regards losses are quite satisfactory, failures very rarely exceeding 10 per cent., but on these poor soils growth is often significantly slower than that of transplants. An example may be given from Beddgelert, where the following measurements were obtained after three growing seasons :—

	Mean Total Height. Inches.	1931 Leading Shoot. Inches.
2-year seedlings	12·6	3·6
2-year 1-year seedlings ..	17·6	4·6
2-year 2-year ,, ..	21·6	6·1

It is probable that any difference in the initial rate of growth will disappear as the plants get older.

Norway Spruce.

Only eight records have been received ; of these six are quite satisfactory—losses 12 per cent. and under. The other two relate to plantations on clay soils at Yardley and Fermyn in Northamptonshire. Here the losses were 26 per cent. and 44 per cent. respectively for seedlings, as compared with 20 per cent. and 13 per cent. for transplants. The planting was carried out in February and March and a good deal of damage was done to the seedlings by late frosts.

The Larches.

Owing to shortage of seedlings little or no turf planting was carried out last year with Japanese larch. A good deal of planting was done with European larch seedlings, but mostly without turfing. Results on the whole were very satisfactory. Losses were moderate to low and growth generally good. Some outstanding results were obtained with 1-year larch seedlings planted on ploughed ground at Allerston and also in the Northern Division. At Allerston the seedlings used came from Kennington Nursery, where they were raised in boxes, some of which were filled with ordinary nursery soil, while others received special treatment, *i.e.*, addition of humus or artificial manure. The plants so raised were very strongly developed, averaging from 3½ to 5 in. in height. At the end of the first year in the field the mean height was nearly doubled and some of the plants made over 6 in. of growth.

Summary.

The results of the past season's trials with the turf planting of spruces suggest that success depends to a considerable extent on the observing

of certain precautions. In the first place, the quality of the seedlings used evidently plays a very important part. Experience showed that where Grade II seedlings were planted separately from Grade I of the same batch of plants, the results of using the second grade were unsatisfactory. Unless the seedling is well furnished and adequately rooted it does not appear to stand the shock of moving to moorland conditions. Secondly, seedlings have not the same resistance to severe cold and drying winds after planting as transplants ; many of the losses were due to this cause. Late planting is the simplest way of obviating this source of loss, but it is not always convenient. The partial burying of the shoot in the turf was found to give excellent results in Division 2. This method may prove to be the best solution, but more extensive trials are required. Thirdly, where a choice exists, seedlings should be given the better soils and less exposed sites.

AMOUNT OF WEEDING NECESSARY FOR HARDWOODS.

By W. H. Guillebaud.

Messrs. Young, Taylor, Felton and Steven were asked to express their views as to the amount of weeding required by oak, ash and beech respectively when planted on certain vegetation types. The types specified were :—

(1) Coarse grass—*Aira caespitosa, Calamagrostis*, etc.
(2) Coarse grass with thorns and briars.
(2) Coarse grass with thorns, briars and brambles.
(4) Soft grass—*Holcus, Agrostis*, etc.
(5) Strong brambles.
(6) Thin coppice.
(7) Tall herbaceous weeds, such as *Epilobium*, St. John's Wort, etc., with or without coppice.
(8) *Bracken.*

The views may be summarised as follows :—

(1) *Coarse grass.*—Small plants require weeding for the first two seasons, but after that can usually be left alone.

(2) *Coarse grass with thorns and briars.*—Oak and beech require weeding late in the year for the first two years and then can be left until there is risk of damage to the leading shoots by rubbing. A single hard cutting back of the thorns will then usually suffice. The treatment of ash depends on the size of the plants ; with strong plants little weeding is necessary.

(3) *Coarse grass with thorns, briars and bramble.*—The unanimous view was held that weeding is necessary until the leading shoots are free of the bramble runners.

(4) *Soft grass.*—There was a divergence of view, depending probably on the different types of grass which officers had in mind. The general view was that the grass must be prevented from falling over the small plants and burying them in the winter. It would be sufficient if the leaders were kept free and the grass cover lightened to prevent smothering.

(5) *Strong bramble.*—It was agreed that fairly drastic weeding was essential with the object of keeping the leading shoot clear. It is often better to pull the bramble aside than to cut it with a hook.

(6) *Thin coppice.*—With regard to beech the view was expressed that the shade would be beneficial and should be maintained until there was evidence that the plants were suffering from excessive shade, when a weeding should be carried out. Mr. Felton would give oak and ash a light weeding in the second year after planting with a final cutting back to free the leaders when the young trees have got well away. Mr. Young stressed the importance in this and other types of weed growth of

encouraging root growth during the first two years by giving the plants plenty of light and so would cut back the coppice in the first two summers after planting. Dr. Steven considered that it was important to prevent ash from being overgrown in early youth, as the result was crooked growth, which would impair the value of the timber.

(7) *Tall herbaceous weeds.*—It was generally agreed that this was the most favourable type of vegetation. Weeding would only be necessary in the case of small plants and very rank growth of the weeds, and then usually only the first year. Dr. Steven favoured a first weeding about August to allow the shoots to ripen off before the winter.

(8) *Strong bracken.*—Opinion was unanimous as to the necessity for weeding plants under dense, strong bracken. Short, thin bracken was considered favourable and not to be weeded.

Summary.

As a general outcome the enquiry favours weeding during the first year or two on practically all types of herbage, weeding then to be stopped except on certain types, notably bramble and strong bracken, which require regular annual weeding. Subsequent weeding on most of the types can be confined to one, or, at the most, two cleaning operations, carried out, where necessary, when the young hardwoods show definite signs of getting away. This procedure, if carried out, would result in considerably less weeding than has been the practice hitherto in most of our hardwood areas.

SALE OF SURPLUS LAND AND BUILDINGS.

By E. Wynne Jones.

In any undertaking a reserve is new capital. The formation of a reserve is a sound practice which no business corporation can afford to neglect, least of all those who have capital commitments upon a long-term basis, for unless there is a fund which can be called upon in time of depression and economic distress to tide over a difficult trading period, confidence (the soul of all business) will be lost, and maybe many years of diligent labour undone.

Speaking broadly, reserves may be of two kinds—(*a*) stocks and shares and (*b*) commodities. It is the latter with which we are concerned, and in the circumstances that have arisen out of the present national crisis it is opportune, or so it would appear, that a part of the Commission's reserves are in the form of landed properties, a proportion of which, in spite of economic conditions, can be realised, as I shall hope to show, with little or no devaluation.

Doubtless the comment will be made, following a financial crisis and sterling depreciation, that the property market is too depressed, and that the selling price of the Department's surplus property will inevitably suffer, but these contentions will be found untrue if re-sales are restricted to properties *in possession;* that there is reason for this optimism will be seen if the results of the fall in the value of the pound, in so far as property values are concerned, are followed to logical conclusions.

During the past few months we have seen a fall in the value of investments or, at any rate, we have become accustomed to witness depressed prices, due in part to the fall in gilt-edge securities, but more briefly accounted for by the disturbance of public confidence, and if we examine the market prices of Government stocks and property investments (such as freehold ground rents) we find that, over a period of years, the rise and falls bears a marked relation. This can readily be understood when it is realised that the rate of interest paid by gilt-edged securities largely influences the rate which an investor in landed property is willing to accept; also, when the prices of Government Funds are low, loose money is likely to be attracted from landed investments and invested therein.

Recently there has been a marked diminution in the amount of business done in real property deals for investment purposes and " prices " are down. Recovery will wait the return to more stabilised financial conditions, and it will therefore be appreciated that any of the Commission's properties which are let for a term of years or even a yearly tenancy cannot wisely be offered for sale in the existing circumstances, unless it should so happen that an occupying tenant is himself keen to buy. With land and houses held *in possession* by the Forestry Commission the position is different; they are by nature a commodity, and commodities *within* the country have in the past few months shown a general, or fairly general, rise in price, and, to carry the argument further, sterling depreciation has resulted in a rise in the cost of imports, including

building timber and other materials, while, if the purchasing power of the pound is reduced (as it has been) the nominal price of property will be increased. We may also look to the *rentier*, who, fearing a diminution in the value of gilt-edge securities, may desire to transfer his money into something more tangible where the value to him will not be influenced by economic conditions; what more natural than he should choose a property for his own occupation, where, whatever happens, he will not lose his own rent?

It would not, therefore, seem to be illogical to arrive at the conclusion that the selling price of the Department's surplus lands and houses in possession has not suffered in conjunction with the depression in investment prices, and the best procedure to be adopted in order to be able to handle the new capital remains to be considered: —

(*a*) Divisional Officers might be asked to submit a list of those properties in possession which, in their opinion, could be usefully disposed of, stating also the approximate values given in the original acquisition report. Before proceeding further, the provisional sanction of the Commissioners to the proposed sales or any of them could then be sought. From that event onwards it would be advisable for all preparations for the sale and subsequent negotiations to be in the hands of a single person.

(*b*) The surplus property would require to be surveyed and valued in detail, special attention being given to lotting in order that the property be sold to the best advantage, and any special stipulations in regard to the sale carefully framed. The valuation would require to be balanced against the general circumstances. In the case of agricultural land an estimate should be made field by field, increased or decreased from a standard according to the quality and conditions, with an addition for the buildings and dwelling-house, if any. The nature of the soil, how the fields lie towards the sun, the general compactness of the area, water supply, accessibility and proximity to transport or towns, prospective building value, cost of maintenance, repairs, etc., are all items which would require to be taken into consideration, while a true judgment of the yield which a property should produce, coupled with an estimate of demand, is essential. It may well be that a surplus asset may have more than one basis of value, but in the sales now in review the point to be kept in mind is the finding of a purchaser *for occupation*, and the value will be influenced largely by anticipated demand.

(*c*) The private treaty sale particulars having been prepared and approved by Assistant Commissioners, small block advertisements could be inserted in the local papers. In this connection each advertisement might, for reasons of policy, have at the commencement, " H.M. Forestry Commission invite offers for the undermentioned property, which has been found surplus to requirements." Expenses of advertising could be limited to, say ½ or 1 per cent. on asking prices, according to the value of the property.

(*d*) Except in difficult cases, local agents or auctioneers should not be instructed, but this should not prevent remuneration by way of commission being paid where a sale effected is directly attributable to an agent.

(*e*) As soon as an acceptable offer is received and provisional acceptance given, the sanction of the Commissioners should be sought at the earliest possible date by submission of the standard disposal report. Contracts should always be exchanged with the least possible delay.

(*f*) Sales in any one district should be strictly limited. If this is done it is unlikely that the first cost of new acquisitions will be in any way prejudiced.

If, as appears probable at the time of writing, the acquisition programme is to be curtailed by reason of public economy, and the sound work of the Commission seriously prejudiced thereby, there would seem to be no valid reason why new capital should not be found through the channel which I have attempted to indicate, but provided always that H.M. Treasury will concur in the loss of one acre of agricultural land in order to provide for (shall we say) five additional plantable acres.

NOTES ON QUEEN CHARLOTTE ISLANDS.

By A. D. Hopkinson.

About sixty miles from the coast of northern British Columbia lies a chain of islands called the Queen Charlotte Islands. They are mountainous for the most part and have a mild maritime climate, not very dissimilar from the west coast of Scotland. Dense coniferous forests clothe practically every part of the islands, with the exception of comparatively small areas of swamps or "muskegs," as they are called locally. The mountains, which rise to an elevation of about 4,000 ft., carry a close forest crop practically to their tops. Three species form the bulk of the forests, namely, Sitka spruce, red cedar (*Thuya plicata*) and hemlock (*Tsuga heterophylla*). Of these the Sitka spruce forms by far the most important species from a commercial point of view.

Nowhere does this species reach a finer development than in the Queen Charlotte Islands, where it attains a diameter of 6 to 8 ft. and a height of nearly 300 ft. after four or five hundred years of growth. Many trees of this age are perfectly sound when felled, but, of course, the old trees eventually decay and fall to make room for the vigorous natural regeneration which is nearly always present.

It must not be supposed, however, that there are complete stands of these giant trees. Trees of such great size only occur scattered through the forests singly or sometimes in small groups. Good mature trees run about 2 ft. to 3 ft. in diameter at breast height and have a total length of about 200 ft. These are common and form the most desirable type for exploitation. They are beautiful trees, straight and probably clear of all branches for the first hundred feet. But, then, how long have they been growing? Perhaps two hundred years or more! Little wonder such timber was eagerly sought after for aeroplane construction, when wood entered largely into their construction. Much was cut and utilised, but more was cut and wasted. However, nature quickly repairs the ravages of mankind on her forests in these islands, and it is only with great labour that small fields can be wrested from the all-embracing forest with its prolific regeneration.

Down by the seashore, if sand blows up from the coast, Sitka seedlings grow in it, the roadsides are thick with young Sitka and hemlock, and even the very gardens around the houses would be forests again if neglected for but a year or two. The forester in these islands has problems to face, but they are not our problems.

The forests of the Queen Charlotte Islands are dense. Here is no scattered growth of trees. Every particle of sunlight is absorbed by the trees and the ground vegetation lives in perpetual shade. So dense, in fact, is the growth that to penetrate into the forest is a slow and laborious task. One is continually climbing over fallen stems piled on top of each other, some sufficiently sound to bear one's weight, and on others, which appear the same under the all-covering moss, one sinks up to the knees in rotten wood. Again, one fights a passage through dense regeneration

and thickets of such woodland plants as tall bilberry, salal and devil's club, growing high above one's head. It is noteworthy how fertile a seedbed is decaying wood. Every fallen stem becomes a nursery on which grow hundreds of young trees, particularly Sitka and hemlock. No inorganic nourishment appears necessary for the first twenty years or so of life.

Now, what kind of soil produces such luxuriance in tree growth? The answer is that it is a forest soil and has probably been such for some hundreds of thousands of years. Therein probably lies the secret of its fertility. The subsoils, the mineral material underlying a foot or so of decayed wood and leaves, vary and are not very striking. Sandy loams occur, but also sour clays. It is only where drainage is insufficient and swamps occur that the tree growth falls away and does, in fact, in places become entirely lacking.

Besides the Sitka spruce are hemlock and red cedar, only slightly less magnificent in their proportions and all mixed in varying degrees according to the locality. The special functions of these species is for the former to maintain a dense undergrowth and for the latter to invade the swamps as far as tree growth can survive. Although of secondary importance, both these species have considerable commercial value. The hemlock is converted both into timber and pulp and the red cedar into baulks, shingles and telegraph poles according to their size.

What of the wild life? Numerous bears roam through the forests, feeding on bilberries and roots. Both the coast deer and elk have been introduced and appear to be succeeding. The rivers and lochs abound with salmon in numbers almost beyond comprehension, and valuable sea fish such as halibut form an important industry along the coast. Bird life is rich. The American eagle with its pure white head and tail is common and very tame, scarcely troubling to get out of one's way, particularly when gorged with salmon. Huge flocks of geese and wild ducks inhabit the marshes and estuaries, and these are reinforced by still greater numbers of their kind during the autumn migration. Ravens and hawks of various species are plentiful, and being so little interfered with have not yet come to fear man and avoid his presence. Of sea birds the most striking is the mure, a species of guillemot, large numbers of which are to be seen on the sea lochs. Withal the Queen Charlotte Islands are indeed a happy hunting ground for both forester and naturalist.

LOOKING BACK.

By M. E. W. Mackenzie.

Much water has passed under the bridges (and about half a million of money has changed hands in this Division) since I made my first acquaintance with Shrewsbury, nearly ten years ago. People and things, and even the town itself, have changed considerably since I first traversed the steep and tortuous streets of this ancient stronghold.

To one nurtured in a palatial edifice in Whitehall I found the two rooms comprising the Divisional Office rather shocking; no hot water, no messengers, no lift, no coal fires, no afternoon tea, no peace and very little staff. The rooms, situated in a main street, had a music shop below, a music school above, were within earshot of a church-organist and choir, and opposite to a singing school. This heavenly (or at any rate unearthly) environment was rather trying at times.

I found on my arrival that, thanks to the Geddes axe, I was the entire clerical staff and my range of duties was practically unlimited. Checking paysheets was relieved by spells at the typewriter, and retired Colonels and such like had a habit of calling to see the Divisional Officer in his absence. These people usually came in to pass the time, and as they were quite happy if they did the talking, I experienced no difficulty in sending them away contented, to dive once more into the accumulation. The arrears were always with us. At one time there were no fewer than four heaped tins of filing papers, and I am afraid we did not always quote references when replying to correspondence. But there were compensations. Had I not a room to myself; was I not second in command: was not the work new and varied, and correspondingly interesting? Moreover, the commercial activities of the Department, though on a small scale, were more in evidence. One did not write a letter commencing "Sir" and finishing up with "Your obedient Servant" for someone else to sign, and dealings with the public became more interesting and personal. In perspective it seems incredible how much effort was required to reduce and keep the arrears to manageable proportions, and at the same time to systematise the work and records. Nevertheless, these things were done and one does not regret the necessity because of the valuable discovery of all kinds of "short-cuts."

I think there were three forests in the Division on my arrival, but I am quite sure the monthly accounts took as much of my time in those days as they do now with more than a score of forests. During the first years we were continually asking for more staff (indeed, this habit seems to have persisted to the present day), and we were visited in turn by representatives of the Finance Branch, Assistant Commissioner's office and of the Treasury. Each visitor having done his duty, and made a suggestion or two, returned to London and apparently remembered Shrewsbury only as a spot on the map from which information was (sometimes) available. Each succeeding year, however, brought its improvements and additional time-saving ideas. Everything was in

turn scrutinised and revised. We benefited by other Divisions' " brain-waves," as I expect they did from ours. Anything that could be jettisoned was, so that, gradually, we were able to cope with the extra work resulting from a rapidly-increasing number of forests. A Divisional Code was prepared and circulated to foresters and foremen. This was fairly comprehensive and necessarily lengthy, but, because of the index provided, reference was an easy business. I think these bound Standing Instructions did more to ease the work than any other single act.

Changes in personnel have been frequent during the past decade. There have been three Divisional Officers and one district has had no fewer than six District Officers. Changes in Foresters, too, have been frequent.

With increased staff in the office (our pleas were sometimes successful) duties have now become more " cut-and-dried," and I am afraid that a certain amount of " red tape " has spoilt the charm of the good old days. But " good old days " always have had drawbacks, and, of course, romance increases with the distance. We still have arrears and reminders are our daily bread, but, if we have to exceed the official day, the extra time given is within reason. We have again been unlucky about staff, owing to the untimely activities of the Economy Commission, but this disappointment is almost balanced by the consideration (and valued assistance) of Headquarters in connection with overdue returns.

A Divisional Office job is not all beer and skittles, but it has compensations. To my mind (and I speak as a Londoner) the great drawback is the distance from town. After all, one has a private life, and a small provincial town is a poor substitute for the Metropolis. Promotions seem dead, but hope dies hard, and I am still looking forward with confidence to the day on which I shall be able to return with a wider experience of men and matters than I brought.

SUMMER PLANTING OF SPRUCE.

By J. W. ANDERSON.

As remarked elsewhere in connection with the turf-planting of seedling Sitka spruce of P. 31, the turfs were set out more closely in the rows than now appears to have been necessary. How to utilise some of these very promising plants, which were surplus to the area in question, was the problem. At first sight the obvious solution was to remove alternate turfs with the seedlings *in situ* to a new planting area, and this was actually done as a small-scale experiment, removal of the turfs taking place in August (12th–15th), 1931.

The thought of the long "carry" necessary in our case seemed to make this method too expensive for practical purposes, and the idea of "coring" the seedlings was the writer's suggestion of getting over the difficulty. It was thought that if some tool, acting in the same manner as an apple-corer, could be evolved, the "carry" would be simplified and the idea of later planting brought into the realms of possibility and practicability. A rough-and-ready sort of corer was made by converting a semi-spade into a circular spade having a constant diameter of 5½ in. Sharpened up, it answered fairly well, but on the whole left much to be desired.

Briefly described, the coring method of planting devised was as follows:—With a little circular wrenching disturbance as possible, a core with the seedling in it was cut from the seedling turf. When the tray (described later) was filled, these cores were removed to an area which had been turfed preparatory to P. 32 planting proper, the turfs actually having been cut and set out some three weeks prior to the date of our experiment. With the same corer a core was cut out of the centre of the necessary number of P. 32 turfs—this core being discarded.

A seedling core from the tray was then inserted, pressed well down so that the roots of the seedling came into direct contact with the moist and now decaying layer of vegetation. By footwork, similar to that pertaining in our planting of transplants and seedlings in turfs by dibble, cohesion between the foster-mother turf and the newly-inserted core was obtained. For the transport of cores a tray with inside measurements, of 28 in. by 56 in. was constructed on the lines of Scotch potato trays which allowed of 50 cores to the tray if carefully packed. The bottom of the tray was liberally covered with well-soaked sphagnum before packing took place, and, needless to say, no time was lost in placing the seeding cores on the moss after they had been cored.

The initial experiment consisted of 50 cores taken, as they came in the rows, from congested seedling turf area, *i.e.*, no selection of seedlings was made—with six whole seedling turfs, similarly taken, as control. Cores were cut and with the few control turfs were removed on 9.7.31. Rainfall for the previous 24 hours was 0·13 inches, while the recorded weather conditions at time of removal are a strong S.W. wind, muggy, with continued rain spit. The same "carry" was necessary throughout

all these coring and whole-turf removal experiments, and in the case of the one referred to immediately above (*i.e.*, the 50 cores) the cores were cut, carried, planted, control turfs carried and placed, and the whole protected by sheep-netting in one hour and a-half by two ordinary workmen, who did all the work necessary under the writer's supervision, *i.e.*, under general working conditions.

A shorter "carry" with a more efficient corer in use would give a cheapening in costs which might well make the whole idea useful and of practical value. It is readily admitted that the results to date cannot by any means be taken as conclusive of the proof of the pudding is not in the eating, but in the digesting, and though results are encouraging, they no doubt need the proof of another year's digestion before one becomes too sanguine. Details of the 50 cores and six whole-turfs used in the experiment cannot suitably be given here.

The general inference to be adduced, however, is that whereas the seedling cores generally improved in colour, the whole-turf seedlings deteriorated. It also seems worthy of note that in this, the initial trial of such a coring experiment, no actual death of a seedling in core has to be recorded.

It is unfortunate that a larger number of whole-turfs were not used as control and that only turfs happened to have been taken which showed what we now consider to be relatively "high" planted seedlings. Further, in comparing the colour of the controls as taken with the colour of the cores, all as at 4.11.31, it should be noted that in the instance of these controls the turfs were placed on green vegetation, *i.e.*, the rotted vegetation of the turf on top of a growing one. The writer imagines that some slight heating may have been set up—due to fermentation of vegetation, and ventures to suggest that, if this were so, the very slight rise in temperature in the new surroundings of the newly-removed active roots would be sufficient to cause this colour check.

Unfortunately, in the case of the larger experiment done in August (12th–15th), 1931, when some 800 cored seedlings and 800 whole-turf seedlings were removed, no records of growth and colour at removal were kept.

From their condition as at 4.11.31 it can be stated, quite fairly, that, generally speaking, the cores have the better colour, though, even then, the cores and whole-turf seedlings are definitely of a poorer colour than those done on 9.7.31. It may well be that the larger experiment was done too late in the season, and it would be very interesting and instructive to have a series of such experiments of intervals of, say, a fortnight, so that one could arrive at the latest date such removals would be profitable.

Having thus described the method and results to date, one may be permitted to suggest conditions under which they could be put into practice :—

(1) Unfortunately, it frequently happens that, for various reasons, the forester does not get entry into his planting areas until late in the season. Should there be a large amount of turf preparation for spruce planting, the suggestion is that, instead of increasing the labour force with raw, inexperienced turfers, a turf nursery be formed as adjacent to

the planting proper as obtainable. By turf nursery the writer means that the whole surface be cut into turfs, but suggests slightly larger turfs than usual, say, 18 in. to 20 in. square—surface measurement when up-turned. As the whole area is to be turfed, a cheaper rate seems feasible ? Instead of only planting one seedling in each turf, the further suggestion would be that the corer be lightly jabbed on surface, marking a future possible five cores to the turf. The planter would then dibble in five seedlings, *i.e.*, one in the centre of each marked possible core. Here, again, a cheaper rate than that which pertains in the field seems possible ? Should this method be worthy of adoption, there would then need to be no rush work to complete programme. The lateness of planting the turf nursery with seedlings would be governed by the season.

(2) Generally speaking, with large planting programmes to complete, beating-up is left until well on in the season, if not till after planting proper is completed.

Time is then generally short—yielding varied results ! Carefully-selected small parcels of land converted into turf nurseries would seem to open up possibilities, and if the "another season's digestion," already referred to, yielded satisfactory results, it would seem possible to do first weeding and beating-up at one and the same time. If ever the coring suggestions of the writer be adopted, he deprecates the idea of pulling the seedling too far through the turf, for the vary obvious reason that it will be cut when coring takes place. Selection of seedlings to suit the turfs would obviate this.

For a more efficient corer the writer suggests a circular spade on the lines of his converted semi-spade of 5½ in. diameter, with (*a*) the funnel in one piece ; (*b*) the funnel of thin, well-tempered steel, so that the cutting edge could readily be brought up to the required sharpness by file ; (*c*) the handle be centrally fitted, *i.e.*, be fitted to two short arms or brackets to top of funnel, making possible the necessary central pressure required for quick and harmless cutting of cores ; (*d*) a core ejector be fitted to the handle. The suggestion is that this might take the form of a rod (with spring) clipped to the handle. To the base of the rod a flat flange-like piece of metal be fixed so that, when spring was pressed down, the flange would automatically slowly eject the core cum seedling. For removal of trays of cores on a large scale one can visualise a cart on the lines of a baker's van, into which the trays would slide !

HEDGES IN NURSERIES.

By C. LAMONT.

There is no need to dwell upon the merits of species commonly used for hedges, as they are well enough known, but a few lines may be interesting about other plants tried in the Royal Botanic Garden Nursery, Edinburgh. *Genista virgata*, a native of Madeira, is one of the few shrubs from that island that is really hardy with us. Seedlings from seed sown in a frame or in open ground should be transplanted out at 1-year-old into the place where the hedge is required, as brooms do not care for moving when older. It is a fast grower and will form a hedge in two or three years' time. The silvery green of the young shoots gives it a very attractive appearance. Owing to the fast growth it is best pruned at least twice a year, and this heavy pruning keeps the hedge in fine shape. It spoils the flowering, however, as the flowers are borne on the young wood of the previous year. This plant makes a fine ornamental shrub. Other brooms may be tried and treated in the same way with good results, but I think *Genista virgata* will always prove the best.

Pyracantha also does well as a hedge plant, and the two I have in mind are *P. angustifolia* and *P. crenulata*. *Pyracantha angustifolia*, a native of W. China, will form a nice compact hedge, but it is rather tender, as the young shoots get cut back in hard frost. It recovers, however, when growth starts again and soon no trace of damage can be seen. *Pyracantha crenulata* is a native of Temperate Himalaya. It is said to be tender, but a form of this same plant found in China has proved to be quite hardy here, frost having no effect on it. It is more to be recommended than *P. angustifolia* because of its hardiness. It forms a fine hedge 6 ft. high. It has a fine bright green colour, whereas *P. angustifolia* is dull green, owing to the tomentose nature of the leaves and shoots. Both make fine ornamental shrubs when in fruit. The fruits are orange-yellow in colour, and those of *P. angustifolia* will hang on the bush till March. These shrubs may be propagated from seed or from cuttings taken in late summer.

Ligustrum ionandrum, introduced in 1910 from S.W. China, is one of the best privets for making a hedge. It will form a fine compact hedge up to 3 or 4 ft. high, and is one of the slowest growers in the *Ligustrum* family. It has small leaves and a very bushy habit, which makes it a first-class plant for a hedge if grown in suitable soil. It likes a light sandy loam and will not thrive on heavy clay, where frost always cuts it back, whereas on lighter soil only a few yards away frost has no effect. If a hedge is required up to 4 ft. in height, this is one of the best privets for the purpose so long as soil and aspect are suitable.

Ligustrum Delavayanum, also a native of China, was first raised in France from seed sent there in 1890. It makes a nice hedge, but is of a looser habit and has not got the firm appearance of *L. ionandrum*. It is very hardy and will stand plenty of pruning. Both these privets make fine ornamental plants and are easily propagated from cuttings.

PREPARATION AND SALE OF THINNINGS.

By R. H. Smith.

In the course of a very few years, say five, the Commission is going to be faced with the problem of tackling large areas of first thinnings from plantations planted round about 1920 and 1921, and in some parts of the country they may even have to be undertaken earlier. Some plantations of Douglas fir and Japanese larch are already forming canopy. This is not a matter which can be dealt with once and left for a few years; after the start is made there can be no stop, and the quantity to be tackled annually will be ever-increasing. This is really the beginning of the revenue from the capital sunk in the first planting and cost of maintenance in the Commission's earliest plantations. It is of the utmost importance that this matter should be given timely consideration, for at least three main reasons, which I will take in the following order :—

(1) The silvicultural improvement of the crop. Many of us have seen, at different times, plantations, usually of larch, absolutely ruined for no other reason than that thinnings have been neglected and the crop has been left to take care of itself, with disastrous results. Some trees naturally have been killed and their value as thinnings lost, and most of the trees have been drawn up into long, thin wands, striving to get their heads to the light. They have practically no crown, and therefore a very poor root development. To thin a crop like this is, to put it mildly, extremely difficult. The lighest thinning leaves horrible gaps and the remaining trees become whips at once, and the first strong gale tends to start them blowing. When they have reached this stage, unless the situation is very sheltered, they are almost beyond hope, because the lower part of the crown has been so terribly suppressed that it will take many years for any satisfactory development to take place, and during that period they are in constant danger of being blown and also being lashed by each other's crowns, and thus their development is delayed.

It is a lesson to anyone who has had to deal with such a plantation, which they are not likely to forget, and it is to be hoped that a repetition of these conditions will never be allowed to take place in any plantation established by the Commission.

(2) *The Sale of Thinnings.*—The disposal of thinnings, especially in out-of-the-way places, is going to be, and, in fact, is at present, in some areas a very serious problem. Some poles can be converted and used for estate purposes, such as gates and fence posts, and a few can be sold in small lots locally to farmers, rustic workers and private estates, but the majority have to be kept on hand for long periods. Timber merchants, for the most part, will not hear of buying "home-grown larch!" What is to be done? Haulage and railway transport add prohibitive costs. There must be markets for this produce in some parts of the country.

Would it not be possible to set up a "Disposals of Produce" department in London, through which advertising could be done (local advertis-

ing has been tried and failed), orders taken and contracts signed ? If sufficient quantities were available, and undoubtedly they will be, there is little doubt that railway and shipping companies would be prepared to offer special terms. The Forestry Commission could have their own lorry at each forest or each group of forests, and this would very soon pay for itself. By this means a number of truck loads could be sent at any time from, *e.g.*, North Wales to Shropshire, where, without having advertised in the proper way, the sale might never be effected.

All produce would be reported monthly to the " Disposals " department on a special form (here is further scope for the fertile brain in devising some new form printed on purple paper with a green border to differentiate from the existing shades !). In this way the department could be kept permanently informed of the existing stock at all forests.

(3) *The Organisation of the Work.*—Obviously, when large-scale thinnings start, the planting programmes cannot go on at anything like the existing rate without a large increase in staff. No doubt the increase will come gradually, and it is only desirable that it should be so, but thinnings are going to be extra work over and above all the present operations, and they are going to occupy much valuable time. The annual thinning programme in some districts, as they stand at present, may be anything upwards of 500 acres, and in later years as much as 1,500 acres and more of first thinnings, as well as second and third thinnings in the older areas at the same time. This immediately gives rise to the question, " Who is going to mark all these thinnings ? " Obviously the District Officer cannot do so, and in few instances will the Forester have time to do it. It will have to be undertaken by foremen and gangers specially trained for the job, whose work will be subject to frequent inspections by all officers, when advice and criticisms can be offered. The selection and training of these men is a matter which cannot go unheeded for more than a very few years more.

It is therefore evident from what little has been said that this problem of thinning plantations and marketing the produce is one of considerable magnitude and one requiring very earnest consideration and forethought.

UTILISATION OF THINNINGS.

By L. A. Newton.

One is constantly meeting with enquiries from well-meaning friends as to the Commission's intention with regard to the disposal of their thinnings. This is, in truth, a question which will soon become a very urgent one, and probably all the Commission's servants have given some thought to it. No apology, therefore, seems necessary for referring to the subject in a general way in the pages of the Journal.

Information is required regarding the acreages and species which are likely to require thinning in the near future. The assumption is that Douglas fir and Japanese larch may require a first thinning in, say, 1933, while the spruces and Scots pine will not need attention till about 1937. It is desirable, then, to tabulate, first, in only an approximate way, the information required under the following headings :—Firstly, the species, *e.g.*, Douglas fir ; secondly, the forest, with its distance from the railway ; thirdly, the acreage to be dealt with annually ; fourthly, the yield per acre either on a cubic content basis or, more probably, by giving the number of poles or bundles of poles of given sizes. These schedules would then require to be summarised for a whole district or country.

When these data are collected, the next information required is (*a*) the cost of felling, preparing and grading the produce, with delivery at the ride side, and (*b*) the cost of putting on rail.

In the Forestry Commission's Journal No. 7, p. 56, Mr. Edwards shows some costs relative to Tintern, and in No. 9, p. 32, Mr. Jones shows the receipts and total costs for Delamere Forest, but no detailed costings.

It is probable that, for Douglas fir poles, average 14 ft., with butts diameter 3½ in., the cost (*a*) is about 1*s.* to 1s. 6d. per score, and the cost (*b*) perhaps 2*s.* 6*d.* per score. These figures are given tentatively only and wide variations may be expected. The point is that an average figure might well be worked out for a district, a county, or a country according to the nature of the produce and its probable destination.

The next step would be to secure from the railways a clear schedule of freight rates for defined types of produce. The most convenient form would be a standard average rate to some important consuming centre. Information on motor transport rates would also be necessary. From this information it would be possible to state the quantity of a particular type and grade of produce available during any one year and its average cost on rail, or in Glasgow or other selected centre. From this could be easily deduced the average price at which the produce could be sold, either f.o.r. or in the consuming centre.

It is desirable here to point to three considerations. In the first place, thinnings are undertaken primarily to secure the health and well-being of the several plantations ; secondly, provided the Commission secure a profit over the whole of their thinning operations, a moderate loss in the case of some of the forests is immaterial ; thirdly, a sustained yield of thinnings is more likely to secure a reliable market than intermittent

offerings made whenever they are thought likely to pay. These points are emphasised because an individual officer may object that his forest is being submitted to a loss. He must realise that such a loss is of no consequence compared to the sale advantages of continuous supply.

So far we have discussed only the preliminary work necessary to obtain information regarding the produce for disposal and its cost price. By far the most difficult part of the problem remains. It is not proposed to foreshadow even in the most indefinite way the various uses to which this produce will be put. A number of possibilities will occur to everyone; any probabilities can be named by few. As soon as the data referred to above are available, steps might be taken to approach timber merchants, as well as all known users of timber. The plain facts, *i.e.*, quantities and costs, might be put frankly before them and, if necessary, published in the Press. The essential thing will be to mobilise thought on the subject.

It is inconceivable that in this industrial age the knowledge that a large quantity of material at practically waste prices is available will not be made use of for some purpose by somebody. The obtaining of low prices for the first year or two will be immaterial to the Commission. History shows that " waste products " whose availability has stimulated a " demand," become obtainable later only at prices which favour the producer.

PLANTING OF COPPICE AREAS.

By F. E. B. DE UPHAUGH.

Most of the woodland areas which have been acquired by the Commission in this district are composed of crops varying from a few standards per acre with coppice of different ages underneath, to what might be described as a highwood and consisting of poles of all sizes from hooping and cratewood size up to timber slightly too large for pitwood.

As far as reafforestation is concerned, these types of woodland naturally have both their advantages and disadvantages, which may roughly be summarized as follows :—

Advantages.

(1) Soil generally of the better class.

(2) Decreases the amount of beating-up required by careful selection of coppice for filling up blanks. Discretion must, of course, be used as to what percentage of conifer failures is allowable.

(3) Allows for shelter being left where necessary, either as belts, isolated trees or coppice according to the purpose for which it is intended.

(4) As a result of (2) and (3) the desirable introduction of hardwoods follows as a matter of course.

Disadvantages.

(1) General high cost of clearing, but dependent on the amount of saleable produce present.

(2) High cost of weeding, not necessarily of the stool-shoots, but of the weed growth, such as brambles, honeysuckle, foxgloves, etc., which generally appear after an area has been cleared.

(3) Occurrence of root fungi, which spread from the broadleaved stools to the conifers. The worst of these is, of course, the honey fungus, and in many areas is causing serious losses.

OPERATIONS.

Preparation of Ground.

There are two methods of clearing an area, namely, complete and partial clearance. Complete clearance means the cutting down of all trees and saplings, etc., on the area and leaving nothing standing. By partial clearance is meant the retention of a certain proportion of the old crop and may be roughly classified into three types as follows :—

(1) Selected belts of trees or coppice of, say, $\frac{1}{2}$–1 chain wide are left standing. The purposes are varied, *i.e.*, such as shelter belts, indication of compartment rides, amenity and game purposes, and fire protection. Generally they serve more than one purpose.

(2) Selected trees are left scattered over the area ; the number will vary according to circumstances. The main object of this type is protection against frost.

(3) The retention of one or more shoot on each selected stool, which again, of course, will vary according to circumstances. The writer has little experience of this method, but it should prove very useful in frost hollows and also on exposed areas. The shoots could later be cut out, if necessary, in the course of weeding.

Estimates and Costs.—Only the cost of preparation of ground as distinct from the preparation of produce will be considered. Often they are so nearly allied that it is hard to know where one ends and the other begins. When the men's earnings are not working out as they should, it is often difficult to judge where the error is, but in general it is in the rates for preparing ground, as the rates for preparation of each class of produce should not vary greatly.

Estimation of costs and selection of correct piecework rates under this head are perhaps the most difficult that one has to deal with—partially on account of the weather in the autumn, which is the period at which most of the clearing is done, but mainly on account of the difficulty of judging the areas. No two areas are alike, and the variation within the area are often great. The only sure method of being able to fix a fairly accurate piecework rate are observation and experience. A forester may be absolutely sure of himself on his own area, but might be absolutely at sea when asked to name a rate on another forest where he has had no experience of adjoining falls. There are two ways of fixing piecework rates for an area to be cleared, namely (1) vary the piecework rate according to the difficulty of each patch within an area, and (2) fix an average rate for the whole area. The first is, perhaps, the ideal method, but No. 2 has generally to be adopted, although it may lead to uneven, fortnightly earnings. This can to a great extent be minimized by giving each man or gang an easy and difficult patch during the fortnight.

Costs vary temendously from, say, 30*s.* to 60*s.*, but a general average appears to be about 45*s.* As a rule, the more produce there is on an acre, the cheaper the cost of preparation of ground will be. This is not on account of preparation, produce being made to pay in part for preparation of ground, but because on a well-stocked area there is less useless produce to clear and less crown to the trees, and consequently less lop and top to burn up.

Weeding.

I understand that the method of coppice weeding varies greatly from Division to Division, but that employed in this district is roughly as follows :—

Initial Weedings.—The principle is hard weeding over a period which varies from two to three years, according to the age of the stools and consequent strength of the coppice growth, weed growth such as brambles, etc., quickness of the getting away of the trees, and the success of the first planting. The writer must in this article restrict himself to the actual coppice, regardless to other growth, which may necessitate extra weeding.

The objects of initial weeding are :—(1) To reduce the vitality of the stools so as to allow the conifer crop to get away and beat the coppice growth in subsequent years, and (2) to prevent actual damage to the conifers and which may occur through lack of light, whipping by coppice, damping-off, etc.

Consequently, initial weedings should be hard and right down to the stool except under exceptional circumstances, such as in frost areas or where it is intended to fill up blanks, when selected stools or shoots can be left. Good plants and early and careful beating-up are essential if high weeding costs are to be avoided in coppice areas. Further, it cannot be too strongly stressed on the men that on no account are trees to be planted too close to the stools. This may result in an extra weeding. Special care has to be taken when the men are paid by the thousand. Close stools may mean the planting of up to 200 trees per acre.

In each year one or two weedings are necessary, but the second weeding is often necessitated by the weed growth and not the coppice growth, which, perhaps, could be left until the following year and consequent saving of the cost of one weeding. Discretion in this matter often means the saving of money.

Subsequent Weeding.—At the end of the second or third year the trees should have got away and have their heads well above the surrounding coppice. If this satisfactory state continued, no further weeding would be necessary. Generally, what occurs is that the coppice catches up the weaker trees and a further selective weeding is necessary. For this job good men should be chosen and the exact amount of work requiring doing made absolutely clear to them. Otherwise, instead of costing from 3*s.* to 6*s.*, they will cut the coppice as for an initial weeding, with consequent high cost, and wind throw may occur. The object of this weeding is :—

(*a*) To free all trees that are being whipped by adjoining coppice.

(*b*) To cut back coppice where it is at the moment overtopping or likely to overtop the neighbouring conifers. A good rule is to cut back the coppice to a height of the bottom of last year's shoot of the adjoining conifer. If it affects two or three conifers, then it must be cut back to meet the demands of the conifer most likely to be affected, and it naturally follows that in most cases this is the smallest one. Each area and each species have to be treated on their merits, and it is not within the scope of this article to go into the matter in detail.

(*c*) To cut any honeysuckle that may be entwined in the trees or in the neighbouring vegetation. In this district honeysuckle is becoming a very serious menace, and in some places is already affecting 10 to 15 per cent. of the trees, and will probably necessitate going through plantations which are out of weeding as far as the coppice is concerned. If honeysuckle is cut out during the coppice cutting, it may be checked sufficiently long for the conifers to form canopy and kill it out by lack of light. I have had no experience in the matter, so cannot give an opinion.

It appears to the writer that there is no operation where the discretion of the forester is more needed. Close observation of older plantations adjoining may give the clue as to how much weeding is really necessary, both in initial and subsequent weedings, and consequently much money may be saved. But, in conclusion, it must be remembered that saving in the cost of initial weedings may in the end lead to much higher costs in subsequent weeding, and perhaps in an extreme case the spoiling of the whole plantation ; only by full knowledge of the area can it be decided for what period initial weedings must continue.

SITKA AND NORWAY SPRUCES AT KERRY.

By F. C. Best.

Owing to the rarity of mature Sitka spruce grown under forest conditions, any information on the growth and behaviour of this tree is probably of value.

At Kerry forest there is a 63-year-old spruce wood of over 100 acres, situated on a south aspect on damp but sound land at an elevation of between 1,300 and 1,550 ft. At one part of the wood, where extensive windfall has taken place, there are a number of single Sitka spruce scattered among the Norway spruce.

The following table compares seventeen Sitkas with the same number of Norway spruces selected as average dominant trees :—

Over-Bark Girth at Breast Height.

Sitka Spruce.	Norway Spruce.
Ft. In.	Ft. In.
4 3	3 7
3 3	3 0
3 11	2 9
4 2	2 11
4 0	2 8
3 3	3 1
3 8	3 2
3 6	2 10
4 9	3 8
4 10	3 4
4 10	2 10
4 9	3 7
4 8	3 9
4 4	3 1
2 9	2 9
3 9	3 5
4 6	3 0

Not many Sitka spruce seem to have been blown, though there may be more lying among the chaos of fallen timber. It is, however, obvious that the proportion of exposed standing trees to fallen trees is very much higher in the case of Sitka than in the case of Norway spruce, from which it seems justifiable to assume that Sitka spruce is a far more wind-firm tree.

The form of the Sitka is inferior to that of the Norway. The branches of the former are more persistent and larger, and some trees show obvious signs of the loss of leaders in recent years. That there is no appreciable difference in the height of the two species is surprising, but the explanation lies in the fact that the Sitkas have suffered from continual windbreak to the leading shoot and have been unable to attain the height they would have reached in a pure Sitka crop.

It is significant that though the Sitka have failed to rise above the canopy level of the Norway spruce crop, yet the Douglas fir, of which

there is a number scattered throughout, have usually managed to raise a somewhat scraggy wind-blasted top six or more feet higher.

Sitka spruce appears to retain undeveloped shoots and dormant buds low down on the stem even under normal canopy and when exposed by the removal of the surrounding crop these tend to develop. Another point of interest is that, in spite of the presence of a few hares, rabbits, trespassing sheep and cattle which stray into the wood, which is unfenced, quite a number of seedling Sitka are springing up under the old trees, whereas on this particular area natural seedlings of any other conifer are extremely scarce.

From the above observations the following points arise :—(1) Compared with Norway spruce, Sitka is a wind-firm tree. (2) Its recuperative powers are good ; it forms a new leader very readily and responds, when opened up to light, by additional foliage growth. (3) Natural regeneration from Sitka spruce may sometimes be possible. The facts all confirm the use of Sitka for shelter belts.

There appears to be one drawback to planting this tree on exposed areas for timber production, and that is its liability to loss of leading shoot. This can also be seen in any of the young woods of 15 ft. or more in height on windy situations in Wales. Its great power of turning one of its side shoots into a leader minimises but does not do away with this disadvantage, which must result in loss of form and height growth. As this tree is so largely used for planting higher ground, accurate information as to the probable extent of such damage would be useful.

BEATING-UP.

(*Memorandum issued to Technical Officers, November*, 1931.)

(1) I have observed during my summer and autumn inspections a good deal of bad or indifferent beating-up work. The explanations offered have sometimes been based on supposed Commission instructions and sometimes on what I consider to be faulty silvicultural considerations.

The question was discussed at the meetings which I have recently had with the Scottish and English Divisional Officers, and I undertook to get out a note for circulation.

Standing Instructions.

(2) As regards standing instructions, I have been unable to trace anything on Headquarters files, but I agree with the impressions of Divisional Officers that something may have been laid down in the early years of the Commission. If so, such instructions may be regarded as cancelled and the position is as follows :—There is now in force no statement from Headquarters which lays down how or when beating-up is to be done. It is the duty of the men in charge of forests to establish successful plantations at the minimum cost ; as regards beating-up, they have the same freedom of action as with the rest of the work.

Cost of Beating-up.

(3) Beating-up undoubtedly figures too largely in our accounts and tends to become a deadweight on the whole of our planting operations. It appears from our costing data that a beat-up plant costs on the average five times as much, from start to finish, as an initial plant. For P. 29 the *labour* costs of initial planting was 28*s*. per acre, *total* beating-up costs (including additional weeding) were about 33*s*. per acre. If by so doing we could obviate all beating-up it would pay us on those figures to go so far as either :—

(*a*) to double the cost of labour in planting ; or

(*b*) to plant approximately 50 per cent. more plants in the first instance.

It will be clear, therefore, that the problem of beating-up is worth the most careful investigation.

Causes of Failures.

(4) The necessity for beating-up failures arises, of course, from a variety of causes. Some of them, such as faulty initial selection of species, the use of unsuitable nursery stock, unsuitable planting methods, and bad planting and failure to weed, are (or ought to be) within the control of the supervisory officers ; others, mainly climatic, may from time to time upset the best-regulated plans. It is probably true to say, however, that the bulk of the failures occur from causes which are avoidable and must in future be avoided.

It is clearly the duty of local officers first to study closely the causes which give rise to failures under the specific conditions with which they are dealing and, secondly, to avoid the repetition of processes which they know will lead to failures.

Major Errors.

(5) Without attempting to catalogue the errors which I have noticed, I may say that the most frequent, *in point of time*, is to leave beating-up too late. One effect is to prolong the weeding period unduly, thus running up the total cost of establishment to an excessive figure. Another, when left very late, is to make the beating-up of no real use in the development of the crop. The other extreme, beating-up too soon, is rarer. It is commonest with the spruces (foresters being apt to overlook the strong recuperative powers of Norway and Sitka), with which a double crop is occasionally the result.

(6) The most frequent error in *point of species* and *type of plant* is to beat up with slow starters and small plants. The cost of weeding may become prohibitive and in the long run many of the plants may never develop sufficiently (owing to the rapid growth of the original plants) to play any effective part in the canopy. Also it is not realised sometimes that the growth of the weed species, such as birch or singled coppice shoots, may be legitimately used to complete the crop.

(7) It seems to me that many errors would be avoided if a little more silvicultural imagination were displayed in arranging beating-up work; if one would ask and answer the question, "What will the two constituents of the crop (the originals and the beat-ups) look like in, say, five years?" An estimate of the height and side growth of the original trees (and weed species) on the one hand and of the height growth of the beat-up on the other, will enable such a picture to be drawn.

Necessary Properties of a Beat-up Plant.

(8) So far as one can generalise on the whole question, it would appear that a beat-up plant should be either :—

(*a*) as quick and preferably a quicker starter than the original species, or

(*b*) a good shade bearer.

The longer the beating-up is left and the quicker the original trees are in starting the more important do these two considerations become.

(9) Considered in the above light, it is possible to construct a beating-up procedure. I have done this in the appended statement, but preface it with the warning that it is quite impossible to substitute such a table blindly for the experience and judgment which ought to be brought to bear on each specific case.

General Remarks.

(10) The wider the initial spacing the more important does timely beating-up become. The perfect plantation of a single species is not

easy to attain if the first planting is not a perfect success, and an effort to attain it may lead to unwarranted expenditure. Sporadic failures present in some cases a desirable opportunity of getting a mixture of shade-bearing species (such as beech) into the original crop.

SUMMARY.

(11) The first objective to aim at is the avoidance of beating-up. If such factors as hurried work, the use of unsuitable plants and so on are likely to lead to avoidable failures, then the work must be postponed to the next season.

Failures, however, are inevitable. They should be replaced so soon as it is certain that they do actually exist and that their distribution or numbers justifies beating-up.

A beat-up plant must be such that it will require a minimum of attention after planting and will play a useful part in the development of the crop. It must consequently be a first-class plant in itself, it must either be a quick grower or a shade bearer, it must be well planted, and it must be so located with reference to its neighbours and to coppice and weed growth that one year's or at most two years' weeding will afford it room for full development.

R. L. R.

(*For Appendix, see following pages.*)

APPENDIX.

Original Crop.	Beating-up Procedure.
Scots pine. (Moderately quick starter.)	With 4 ft. 6 in. spacing *sporadic failures* might be left until the crop is 4–5 ft. high and replaced where conditions are suitable with beech (experiments are tending to show that 1-year seedings may be used for the purpose); where conditions are unsuitable for beech J.L. may sometimes be used. *Extensive failures* to be beaten-up forthwith with S.P.
Corsican pine. (Slow starter.)	*Sporadic failures* as for Scots pine. *Extensive failures* forthwith with C.P.; if delayed, it may be necessary to use a quick starter (Scots pine or *P. contorta*), or with long delays (and otherwise suitable conditions), J.L. or Dg.
European larch. (Moderately quick to quick starter.)	*Sporadic failures* as for Scots pine (with beech). *Extensive failures* with E.L. if next year (*note* plants bitten by game frequently come away from buds near the collar); if delayed with J.L. or Dg. The spruces as a rule are useless for the purpose.
Japanese larch. (Quick starter.)	*Sporadic failures.* With beech in due season. *Extensive failures.* With J.L. forthwith or with Dg. (where suitable). It is very bad policy to delay beating-up J.L. A good deal of delayed beating-up has been done with Sitka; this is extremely doubtful policy unless there are sufficient Sitka present to form the final crop; even so the Sitka can be preserved only by early removal of the J.L.
Douglas fir. (Quick starter.)	*Sporadic failures.* With Douglas or J.L. *Extensive failures.* With Dg. (preferably) or J.L. if suitable Dg. lacking. In certain places, Dg. has been planted in damp or soft ground. Beating-up with Sitka may be advisable in such cases in order to make the crop more stable against wind.
Norway spruce. (Very slow starter.)	Generally beating-up can be delayed. As a rule, no living tree should be replaced as the species has remarkable recuperative powers. *Sporadic failures.* Can be beaten-up with beech (on suitable ground) or with Sitka, when the crop is getting well away. *Extensive failures.* Should be replaced with Norway (assuming that the first choice was correct) on turves. *Note.*—Much of the existing N.S. which requires beating-up is on Calluna soils, in which case, S.P. is a suitable species to introduce.

APPENDIX—*continued.*

Original Crop.	Beating-up Procedure.
Sitka spruce. (Moderate starter.)	Beating-up can be delayed but not so long as with Norway. The same rule as with Norway applies to replacing living trees. *Sporadic* and *extensive failures* with Sitka on turves or occasionally (on firm ground) with Dg. or (on damp ground) ? with *Tsuga*. *Note.*—On Calluna soils (*cf.* N.S.) *P. contorta* can probably be introduced with advantage.
Broadleaved species, oak, ash, beech, sycamore. (Slow starters.)	In general the unsatisfactory condition of plantations is not due so much to failures as to check in starting. It is a waste of money to replace such checked plants, which can be best got away by nursing, whether with natural growth or by conifers.

TURF PLANTING AND THE USE OF SEEDLINGS.

(Extract from memorandum issued to Technical Officers.)

USE OF SEEDLINGS DURING THE PLANTING SEASON, 1930/31.

Bearing in mind that no preferential treatment was deliberately given to seedlings as opposed to transplants, the results on the whole have been very satisfactory.

Sitka Spruce.—With certain exceptions, the experimental planting of Sitka seedlings on turfs appears to have been a distinct success. Out of 32 returns for which definite figures have been given, 20 show losses of 10 per cent. or fewer, and of these 10 were below 5 per cent. Where heavy losses occurred these are attributed to one or more of the following factors, of which (1), (2), (3) and (4) appear to be the most important :—

(1) Early planting followed by severe frost.
(2) Use of too small plants.
(3) Use of weakly badly-rooted plants—too dense in the seed bed.
(4) Exposure.
(5) Bad soil conditions.
(6) Turf planting on mineral soil.

Norway Spruce.—There are few returns for Norway spruce, but there has been general success apart from certain trials on heavy mineral soils in Northamptonshire, where seedlings have been markedly less successful than transplants.

European Larch.—One-year seedlings have been used with great success in experimental planting on ploughed ground at Clashindarroch and Allerston.

Two-year seedlings have done well in seven out of nine trials. In two cases they are described as better than the transplants.

Japanese Larch.—Very few trials, owing to lack of seedlings ; successful on turfs in Division III in those trials where strong seedlings were used ; on experimental planting at Beddgelert on turfs and at Allerston on plough losses were heavy, but the plants were too big ; results good at Dymock (direct planting).

Mr. Long has conducted some interesting experiments on the deep planting of spruce seedlings on thin turfs. He found that excellent results are obtained in the first year if seedlings are threaded through the turf from the top, a hole being made with a dibble, and left so deep that only the top inch of the shoot shows above the turf, the roots being spread on the natural surface below. In this way frost lifting was obviated ; there were no ill-effects from drying winds and growth was improved. An account of these experiments is published in this Journal (*see* page 5).

Growth of Spruce Seedlings Planted in Earlier Seasons.

There is little doubt that if spruce seedlings survive the first growing season they develop as well as, if not better than, transplants except perhaps on the poorer types of peat. In some of the earlier trials seedlings and transplants were planted alternately in the lines, and it is now impossible to tell from a casual inspection which plants were seedlings and which were transplants.

Extension of the Use of Seedlings.

During the current planting season in each Division a *minimum* of 20 acres is to be *turf-planted* with spruce seedlings (Sitka and Norway) and 10 acres with larch seedlings (European and Japanese). The following procedure is to be followed :—

With the Spruces.

(*a*) Grade I plants only to be used ; both 2-year and 3-year if available.

(*b*) Planting should be started late—after there is any risk of the turfs freezing —and continued at intervals well into the growing season.

(*c*) The plants should be handled with care at all stages.

(*d*) Thin turfs should be used where possible. If thick turfs have to be used the plants should not be perched on the top, but either deep-planted or planted on a step on the side of the turf sheltered from drying winds.

With the Larches.

(*a*) Grade I plants only to be used ; both 1-year (which appear to have given the best results on ploughed ground with European larch) and 2-year.

(*b*) Planting should *not* be late.

(*c*) The plants should be handled with care at all stages.

(*d*) Ploughing, if convenient, may be substituted for turfing.

It is important that these experiments with seedlings should be linked up with the following :—

(*a*) Normal use of transplants.

(*b*) In the case of spruces, turf planting of Grade II seedlings which were directed to be bedded-out in connection with last year's experiments.

CONTROL OF *MERIA LARICIS*.

(*Mycological Circular No.* 5, *issued to Field Officers, January*, 1932.)

This fungus attacking European larch is now recognised as one of the most serious nursery diseases in this country; the damage caused takes the form of a browning of the needles, which eventually are shed. It is seldom fatal, but owing to the crippling effect of persistent defoliation, it greatly increases the proportion of culls.

The damage done may be distinguished from that due to frost as follows:—*Meria* starts at the middle or the end of the needle and spreads down it, whereas frost kills the whole needle at once. *Meria* seldom attacks the needles at the extreme tip of the shoot, whereas that is the part most affected by frost; needles attacked by the fungus are less shrivelled than those killed by frost, even when they are completely browned.

Reinfection takes place in the spring from those needles still attached to the plant, and probably also from needles lying on the ground. The disease is generally worst in a wet season, and in a dry year may practically disappear quite early in the season.

Damage is usually most serious on seedlings in their second year, the 1 + 1-year lines being less attacked. In a wet summer beds of 1-year seedlings may be badly damaged. Older nursery stock and larch in plantations are often attacked, but the damage done is seldom considerable.

Preventive Treatment.—It is important in connection with spraying to recognise the two stages that occur in the development of the buds of larch in spring. The buds first show green at the tips, sometimes as early as January, and this condition may persist for several weeks before the second stage (the elongation of the needles) commences. Strong sprays should not be used after the commencement of the second stage.

The following provisional spraying recommendations can be made. Seedbeds of European larch in their second year should be sprayed at the end of February or at the beginning of March, before the second stage of bud development has commenced, with a solution of 15 gallons of amberene in 100 gallons of water, to be applied at the rate of 50 gallons per 1,000 sq. yds. of bed. This should be followed, at the end of March and thereafter at fortnightly intervals, with a spraying of 2 gallons of amberene in 100 gallons of water, or of 1 lb. of liver of sulphur in 14 gallons of water; whichever is used should be applied at the rate of 40 gallons per 1,000 sq. yds. of bed.

Amberene can be purchased from Messrs. W. J. Craven & Co., Ltd., 48, Port St., Evesham, at 5*s*. 6*d*. per gallon. Liver of sulphur, if not obtainable locally, may be bought from Messrs. Craven, and the cost should not exceed 1*s*. 6*d*. per lb. for fairly large quantities. A guarantee that it is manufactured with potash and not soda should be procured. Both substances mix readily with water, but care should be taken to

stir the solution thoroughly before spraying. The nozzle of the sprayer should be held close to the plants and spraying should be done as far as possible on dull but not wet days as on sunny or windy days liver of sulphur may scorch the needles.

Usually four of the weaker fortnightly sprayings will be required, but under reasonably dry conditions, and in the apparent absence of the disease, there should be no need for more. If, however, *Meria* damage reappears, spraying should be resumed at fortnightly intervals. Even in a damp season the treatment need not be continued after the middle of August, as defoliation after this date is not of great importance

Where 1 + 1-year larch are in close proximity to seedlings which are being sprayed, the fungicide should also be applied to the transplants, as otherwise the latter may become a source of infection to the beds.

So far as is compatible with other considerations, lining-out should be done at the end of the first year as the incidence of the disease on the lines is almost invariably less than on the beds.

Care should be taken to avoid sending infected larch to uninfected nurseries and, as far as possible, any new nurseries should be stocked with larch raised in them from seed.

The circular printed above represents the provisional results of investigations carried out by Mr. T. R. Peace in the laboratory at Oxford and also at Nagshead Nursery in the Forest of Dean. The results obtained have received confirmation through valuable work done independently at Seaton Nursery, where the essential features of Mr. Peace's method of control, namely spraying with sulphur compounds in early spring followed by summer spraying have been practised successfully for the past three seasons. The details of the Seaton method have been communicated by Mr. J. F. Annand and Mr. J. A. Lamb in the following notes.

Preventive and remedial Measures adopted against *Meria* on Larch in Seaton Nursery.

The method adopted in this nursery is by spraying liver of sulphur on the larch seedlings and transplants. Quantities are as follows :— 1 lb. of liver of sulphur (potassa sulphurata) to 14 gallons of water. This solution is applied through a " Mysto " knapsack sprayer. The first spraying is carried out in March on the seedlings or transplants which have been left over from the previous season in the beds or lines. This early spraying is to prevent the *Meria* from functioning in the dead needles thrown by these remaining plants. The second spraying is carried out immediately growth commences, and the treatment is continued at regular intervals of 4 weeks throughout the season—last spraying being done at the end of September or beginning of October. This method has been practised here for the past three seasons and has

been found quite effective. The losses from *Meria* in recent years have been almost negligible. The chief cause of the losses on the larch in this nursery is by early frost in autumn before plants are ripened, or late spring frosts when plants have already commenced growth, and chiefly the latter. The cost of the potassasulphurata is 1*s*. 6*d*. to 1*s*. 8*d*. per 1 lb. It is made up into 1 lb. bottles and this makes it very convenient for use. One gallon of this mixture is sufficient for 15 lineal yards of bed (4 ft. wide) equal to 20 square yards of bed. Spraying should be done on a dull day. There is danger of scorching the needles on sunny or dry, windy days.

No recent actual tests with controls have been made for some years as the liver of sulphur treatment was found the most satisfactory when various mixtures were tested. One reason for the success of the spraying with this mixture probably is that it has a decided beneficial manurial effect on the larch plants. The potash in the compound is readily available as plant food.

J. F. Annand.

Effect of systematic Spraying.

During the past season systematic spraying of all larch plants was carried out at Seaton Nursery, the first spraying being done in first week of March, second spraying during week commencing 23rd March, and further sprayings at regular intervals of 4 weeks throughout the season, the final spraying being carried out during week commencing 5th October.

The spray consisted of potassium sulphide (liver of sulphur) dissolved in water, the proportions being 1 oz. of this substance to 1 gallon of water, this being sufficient for about 16 lineal yards of seed-beds (4 ft. wide), and sprayed through a 4-gallon knapsack sprayer.

In previous years Bordeaux mixture had been used, and the results were not so satisfactory. The strength of this solution was gradually increzeased but this resulted in the plants being burnt, and losses were still traceable to *Meria*.

The solution of potassium sulphide is quite easily prepared, it is simply produced by adding the proportion of substance to the quantity of water which the container holds, this is then strained into the sprayer, no sacein or other " spreader " is required.

The results at the end of the season were very satisfactory, and the cost I think justified—various plants (seedlings and transplants) were forwarded to Dr. E. V. Laing at Aberdeen University for examination, the result being negative as no trace of *Meria* could be found.

This may be due to the nature of the season, yet it is possible that if nurserymen practised a systematic spraying with potassium sulphide their losses would be considerably reduced, if not entirely eliminated, and as larch planting is an important part of re-afforestation the cost of such spraying appears to be justified. Potassium sulphide costs about 8*d*. or 9*d*. per 1 lb.

J. A. Lamb.

THOUGHTS ON ECONOMY.

By G. B. Ryle.

Again for the second time in our short career we have been hit by the implement of our own profession—the axe. The first blow, the Geddes axe, though it fell with severity was undoubtedly in the long run vastly beneficial to us as a Department as it stopped the combined evils of over-staffing, over-spending and self-satisfaction. In 1920–1921 we had 68 technical officers and a plantable area of 64,000 acres (with no holdings). In 1930 we had 70 technical officers and a plantable area of 310,000 acres and, in addition, work had been greatly increased by the forest workers' holdings policy. During the same period the clerical staff had been increased from 56 to 100. This is suggestive. One would have suspected that ten years' experience might have taught us to afforest with less clerical assistance per head of technical staff, but it is in fact the reverse. One would have thought that it was possible to plant 1,000 acres with very little more clerical work than is required for 100 acres, though the technical work involved must necessarily bear a fairly strict proportion to the acreage. Furthermore, these figures are not truly representative, for the technical staff has become increasingly overburdened with duties which are really of a clerical nature. The trouble cannot be that the clerical staff is failing to pull its weight for there is in fact a call for more clerical assistance as the present staff is getting overburdened. The root of the trouble appears to be that *somewhere* there is a demand for more returns, more new forms, more costing calculations and more reports than hitherto, with the result that the clerical staff has to increase more rapidly per acre of plantation than does the technical staff.

Paper records have superseded good plantations in importance. The May "axe" will not be entirely unbeneficial to us if this state of affairs is checked. Restriction to the simplest and minimum number of forms and returns need have no ill effect on the growth of plantations. Even costing statements might be axed with little disadvantage. The immediate costing figures as calculated by every forester when he prepares his Fortnightly Progress Report, are, when intelligently scrutinised, most valuable controls. Headquarters costings are necessarily too late to be of any use in controlling expenditure and are furthermore inclined to be unconvincing.

A forest nursery should be a small area set aside for the propagation of the greatest possible number of the healthiest possible plants. It cannot be advantageously converted into a mathematical playbox. Nursery records should not exceed in area one-tenth of the area of the nurseries concerned. It would not appear to be of vital national importance if our Headquarters was kept in complete ignorance of the area of paths (in sq. yds.) on each nursery as the technical staff is probably able to ensure that the paths do not assume excessive width.

The slowing down of acquisitions and building work will give all outside staff an opportunity to pay considerably more attention than hitherto to real forestry and undoubtedly many avenues for economy will be found thereby, not only in reduced expenditure but in improved results. If the greatest possible proportion of the May " cuts " is made in the pruning of non-essential clerical work and the least possible cutting is done by slowing down of the actual work on hand then this second " axe " may be all to the good.

REDUCING THE COST OF PLANTING

By A. F. JOHNSTON.

Foresters experienced in mound cutting for planting have no doubt found this item an expensive one owing to the time taken in cutting the sides of the turf drains and slicing out with peat knives, especially the former. To simplify this I had an implement made quite recently for the purpose. It consists of two circular revolving sharp-edged blades cut from two old circular saws, 2 ft. in diameter; they are adjusted on a stout iron axle 18 in. apart and are clamped either side by iron discs to ensure rigidity; running up from each side of the axle is iron framework extending 4 ft., on which two wooden handles are fitted similar to those on a plough; there are also two other iron cross members above the blades for the suspension of extra weight when in use.

In ordinary wet soils where mounding is necessary the implement cuts the sides perfectly, one man drawing it along, but in thick peaty fibrous molinia areas extra weight has to be added, and a horse is attached by a trace to the middle of the iron axle and a man steers it as he does a plough. Not only is this implement of use for mounding but also draining and cutting of turf for laying out lawns, etc.

Mound Planting.—During P. 31 I found that the best and quickest method of planting mounds, besides being more successful and economical, was by using the ordinary dibble or "dibber," the type one would use for planting cabbages. A clear round hole is punched through the mound so that the roots of the plant have sufficient room to drop through easily to the collar without cramping and afterwards firmed up in the ordinary way. The best size plant to use for this purpose is either a 1 + 1 or 2 + 1. If larger plants have to be used, difficulty will be found to insert the roots without cramping; a dibble with a thicker stem may be used so as to make a larger hole but it would be more cumbersome to use.

The advantages the above holds over the ordinary method with the spade making a cut-out in the side are mainly (1) the plants are much firmer and stand more erect, (2) they are free from frost lift, (3) the mound is less disturbed, (4) the spade cut does not open up in dry weather, and (5) the work can be done for half the cost.

Planting direct.—I have also experimented to find the best and most economical tool for direct planting (without mounds). This I found to be the ordinary type of planting mattock but with an additional thin sharp-edged flange fitted to the hoe blade side of the mattock at right angles, semi-circular in shape and approximately 3 in. wide in the centre, so that when the instrument is driven into the ground it cuts out the soil in the usual L shape, the side cut being vertical so that when the tree is placed against it the tree stands erect when firmed on one side. The advantage is an obvious saving of time and cost of operation. With the

ordinary type of mattock without the flange the L-notch is made by first using the axe and then the hoe side causing a double action, whereas with the type I mention there is only one action, which means that a man during a day's planting would do the same amount of work with half as many strokes. Another point is that with the ordinary mattock some men, when working piece-work and are not supervised closely, will only use the hoe side and place the plant against the sloping back so that when firmed the plant is not upright and will not have its roots properly distributed. With the L-shaped mattock a man cannot help cutting a clear L, and only need firm up on one side.

I might also mention the tool does not hinder the worker while screefing. The following figures show the differences in time I have taken to plant 100 trees on similar soils :—(*a*) with ordinary type mattock, 28 minutes ; (*b*) with new type (L-flange mattock), 20 minutes. This shows that the latter could be done for practically two-thirds of the price paid for that of the former.

SOIL FERTILITY IN NURSERIES.

By R. Shaw.

Now that planting is being carried on so extensively in Britain, one of the many points of importance to be considered is the establishment of a well-managed and well-stocked home nursery. As everyone connected with forestry will admit, the secret of success with plants is fertility of the soil. To attain this, the forester in charge of a nursery must pay particular attention to the soil treatment, with a view to ascertaining what food his plants require, and how he is to supply them with that food.

The plant food problem, however, is by no means as simple as one would imagine, and unless one is willing to give at least a little time and thought to it, one will not be proceeding upon the proper track to get the best results from one's nursery. If plants are to attain their maximum growth there must be furnished in the soil three plant foods in different fixed proportions, and these are nitrogen, phosphoric acid and potash. All soils capable of supporting plant life contain these, in varying proportions, but there is in soils besides, various minor elements of use to the plant as food.

In plant foods the first distinction to be made is that between available and unavailable; *i.e.*, between the foods which contain the elements in such a form that the plants can make immediate use of them, and foods which must undergo a change of some sort before the elements contained in them can be used by the plant.

Plant food, to be available, must first of all be soluble, and secondly, the elements in it must be in such form chemically that the plant can use it. It is therefore essential, when treating a nursery soil, that there should be a good supply of water to dissolve the food and carry it up to the plant through the rootlets and root-hairs; these having the power at all times of absorbing moisture. Too much moisture is just as harmful as too little, so the soil must be in a condition that any surplus water will readily percolate through it. Furthermore, the degree of fineness to which the soil has been pulverised has a great deal to do with the amount of plant food which will be released for the growing crop.

The soil constituents may be of a two-fold nature, inorganic and organic. The former being formed of the various minerals, while the latter are formed of decaying vegetable and animal matter. All soils are composed in varying proportions of stones, clay, chalk, sand and humus. Should a nursery soil be of a sandy nature it will be found that it is not suitable for the production of good plants, there being nothing of a feeding value in it. Yet when not too abundant, sand is very useful as it makes the soil warm and dry. A good supply of humus or good leaf mould is very beneficial to a soil of a sandy nature, as it increases its power to retain moisture. The humus also contains the elements of food required by the plants; it teems with bacteria which

help to break up the soil and change the various substances—which cannot be used directly by the plant themselves—into a form in which the plants can make use of them. Although a sandy soil has the advantage in that it encourages early germination of seed, owing to its being easily warmed during the day, it has the disadvantage of cooling rapidly at night, in which case young seedlings are liable to be damaged by late frosts.

A clay soil in a nursery is always wet and cold, retarding active vegetation in spring. Like sand, clay alone possesses very little plant food, but owing to the many impurities in clay soils plants are able to obtain some food. Here again a supply of humus is beneficial; for, although humus has a great water absorbing capacity, it is at the same time a very porous substance. To improve the physical condition of a clayey soil, an addition of any material of a gritty nature is required, while an addition of lime helps to liberate any inert material and renders the clay particles less sticky.

Chalky or limy soils tend to dry very much in summer, and are very expensive to keep clear of weeds, but, like the clay soil, if leaf mould or humus be added to it, it is rendered less tenacious. Soils of a peaty nature are perhaps the most difficult to treat, as the amount of humus they contain is very great. To improve such soils anything of a gritty nature should be added, sand being very good. An application of lime is also good as it helps to sweeten the soil. Peaty soil in a nursery—unless a very sandy peat—produces a poor root system.

When applying farm-yard manure to a nursery soil, this should be done very carefully as it must not be done too heavily; forest trees as a rule requiring very little. Always apply that which is well rotted, as well-rotted farm-yard manure is perhaps the best of all manures as it contains all the elements for plant nutrition. It is a lasting manure and builds up a soil to a "high condition." Its physical action is good, as it adds to the water holding and absorbing capacity of the soil. It restores humus stock and improves the texture of the soil; in sandy soils it gives cohesion and a good water retaining power. When added to clayey soils it loosely binds the particles making the soil more porous and friable. The quantity to apply varies according to the nature of the soil. If the nursery soil already is in "good heart" about 16 tons per acre should maintain its fertility. If, on the other hand, the soil be in a poor conditon, twice the amount may be used with advantage. Farm-yard manure should never be applied directly to young trees of any kind, but should be applied at the time of fallow or cleaning crop.

Another very good system of keeping up the fertility of the land is by green crop manuring—a term applied to crops which are grown for a summer and then cut and dug in, *e.g.*, yellow lupines, buckwheat, vetches, mustard, lucerne, and red clover. A green crop is almost as valuable as farm-yard manure although the latter should so far as possible be the basis of all manuring. Lupines and vetches should be mown, and dug or ploughed in when they commence to flower, and being succulent plants they decay rapidly, thus supplying food and keeping up a store of

valuable humus. When the amount of humus is increased care should be taken not to destroy it again. A very common way of doing this is by applying quicklime to a sandy soil, which turns up the humus. In the soil there are found various bacteria which have the power of making use of the free nitrogen of the air and bringing it into combined form, probably nitrates. If we examine the roots of any leguminous plants we find them covered with small wort-like nodules, which contain bacilli, which, along with the other bacteria in the soil, convert the nitrogen gas of the atmosphere into a form which may be used as food by the plants to which the nodules are attached, the host plant itself supplying them with the necessary food for their development.

Every well-managed nursery should have a compost heap, from which source the soil can be rendered very fertile at very little expense. The compost heap generally is composed of gathered-in leaves, path edgings and any waste vegetable matter that may be lying in the nursery, also, hedge clippings should be burnt and the ashes added to the heap. The heap should be allowed to remain for several months, because during decomposition a fair amount of nitrate of potash may be formed, which is a very valuable and good fertiliser. A further source of obtaining potash very cheaply is from wood ashes, and foresters in charge of nurseries, should reserve all the wood ashes that may be made, for by so doing they need never buy expensive potash salts. These ashes, however, should never be used on stiff or heavy soils, because they would only render such soils more sticky; but, for the improvement of sandy or chalky soils, they prove to be beneficial. In preparing seedbeds wood ashes may be applied at the rate of 8 oz. per sq. yd. of seedbed. There are various phosphatic fertilisers the forester may use, and of those the most common in use are: basic slag, superphosphate, bone meal, Kainit, and muriate of potash. Basic slag should be applied some time in autumn or winter at the rate of 4 cwt. per acre, and should never be mixed with sulphate of ammonia or guano.

Bonemeal may be applied directly to seed beds, for being a slow acting fertiliser it must undergo various changes in the soil before it is of any use as plant food. Apply at the rate of 2–4 oz. per sq. yd.

Kainit may be applied at the rate of 4 cwt. per acre during autumn, and also muriate of potash, although slightly less in quantity. Avoid mixing with any nitrate.

Perhaps the most important of soil improvers is lime, for unless the soil contains a sufficient supply of this material, insect trouble, or perhaps disease, may make its appearance in the crop. The duties lime performs are many, but perhaps the chief of these is that of liberating potash and sweetening the soil by neutralizing the acids that may be present in the soil, by the decomposition of humus already in the soil. Lime should never be applied with farm-yard manure. When such plants as dock and spurry make their appearance in a nursery it is a fairly sure sign that the soil requires lime. Never apply lime to a light soil, as it causes too rapid oxidation of organic matter. Nurseries situated near the coast may obtain, very cheaply, a good source of carbonate of lime from the pulverised sea-shells.

The preparing of the soil in a nursery should be done very carefully and effectively. The soil should be turned over as soon as it is fit to work so that it may benefit by frosts, and there may be no delay in lining out operations. Care must be taken that the work is not done while the soil is wet and sticky since this may cause injury in many ways. The depth to which soil should be turned over is determined by the condition of the soil itself. A pretty safe general rule to follow is, to turn the soil over as far down as the subsoil, and to thoroughly pulverise to a depth of 4-5 inches by harrowing or raking. All weeds must be carefully removed, also large stones.

All plants require food for their growth and development, and unless the food they require is obtained, only poor, starved and stunted plants may be looked for. It is therefore essential in treating a nursery soil according to its needs, to have it in a condition such as will promote the growth of healthy fibrous roots.

Given a good root system and well-developed foliage, plants will produce maximum results. The forester or nurseryman who understands what his crops require, why they need it and how to supply them with what they want has acquired knowledge that will be of life-long value.

MISCELLANEOUS NOTES.

Use of Potassium Permanganate against "Damping-off."

In the spring of 1928, Mr. L. B. Stewart, of the staff at the Royal Botanic Gardens, Edinburgh, recommended me to use a simple recipe against "damping-off" fungi, which I have since tried on nursery seed-beds with apparently successful results. As it is extremely simple and relatively cheap, details may be of interest:—

Dissolve one ounce of crystals of potassium permanganate in two gallons of water and apply the solution to the seedbeds from a watering can through a fine rose, preferably one throwing the liquid upwards and held close to the bed. The permanganate not only acts as a preventive when applied just before germination, but will also destroy the fungi after the seedlings have germinated without harming the young plants in any way, even if strengths of solution above that recommended are used.

For a first application on soil being used for seedlings for the first time, or where a severe attack is experienced, it is recommended to water at the rate of two gallons per three square yards of bed. It is advisable to water the beds at weekly intervals until the danger period is over, and in these later waterings the solution should be applied at half the above rate, namely, one gallon per three square yards.

The potassium permanganate costs in small amounts about 1*s.* 4*d.* per lb. and can be obtained of any chemist. The crystals dissolve rapidly and they store well. Purchase of sufficient crystals to last during the season and storage in jars is recommended. The cost of the material for the first application comes to about 2*s.* 8*d.* per 100 sq. yds. of 3½-ft. bed, and for later applications half that cost.

Last spring at Kennington, Oxford, we watered all seedbeds in the manner described and had no traces of "damping-off" fungi any where, although losses in the previous season were fairly heavy and although last season was one which specially favoured the "damping-off" fungi. The potassium permanganate is thus worth further trial, and from a cost point of view might be compared with other substances used, such as cheshunt compound.

M. L. Anderson.

Holly.

It seems to me that attention should be drawn to the danger of over-cutting berry-laden holly in the New Forest. Individual hollies being unisexual, it follows that the female trees only are in demand on account of their berries and may be unduly pruned or broken. In order to keep a check on the proportion of each kind, I am having groups of trees here and there examined (30 or 40 in each place) when in flower about the end of April, and the numbers counted respectively of male, female, bisexual and flowerless trees. The male or staminate flowers bear yellow anthers; the female flowers have a pistil with four lobes, and only the bisexual flowers have both anthers and fully-developed pistils.

Mr. Dallimore, of Kew Gardens, has been kind enough to supply the following note :—

"Individual trees of holly are definitely male or female, with the reservation that occasional female flowers may occur on male trees, occasional male flowers on female trees, whilst flowers with both male and female organs are sometimes found. So far as my observations go, the abnormalities rarely occur at the proper flowering time, but are more or less confined to those flowers that appear out of season. It is really better for practical purposes to regard all trees as being either male or female. There are well-known instances where female trees ripen a good crop of fruit when standing some distance away from a male tree. In such cases the percentage of matured seed is very low.

"It is quite likely that severe cutting of berry-laden branches will reduce the average crop of berries, for severe pruning tends to the production of vigorous young growth, which never fruits so freely as older wood. The production of berries is influenced by the weather at flowering time, whereas an individual rarely bears more than two heavy crops of berries in succession, and in many cases a very heavy crop is followed by a very light crop or no berries at all. Several successive heavy crops has a very enervating effect upon the health of a tree.

"Amongst naturally regenerated holly trees there is usually a preponderance of male trees. In order to improve the percentage of female trees in woods and other places, it is a good plan to cultivate an area of seedling trees in nursery quarters until they flower, then select the females for planting amongst established male trees and use the male plants for hedges. This necessitates nursery culture for four or five years with transplanting every second year. If not regularly transplanted, many losses will occur when the trees are moved to permanent places. Definite steps should certainly be taken to check indiscriminate cutting of berried branches." D. W. YOUNG.

PRECOCIOUS GROWTH.

There has been abnormal development of the terminal buds of *Pinus radiata* (*P. insignis*) this spring in the south of England. Already in the third week of February new growth 5 inches in length had been produced. Mr. Dallimore, of Kew, commenting on this, says that the phenomenon is probably due to the mild, wet weather of last summer, and the lack of proper ripening. At Kew, some plants of *P. radiata* in the nursery, produced young needles on the very long new shoots before the end of February. D. W. Y.

SALE OF CHRISTMAS TREES.

Having had to find a market for a number of Christmas trees at Chopwellwood Forest, I have naturally been interested in the prices, supply and demand for these.

Living only a few miles out of Newcastle, I quite expected to find a ready market there and good prices obtainable, but such was not the case. On every hand I found the market literally flooded with Dutch and German trees which had been bought at ridiculously low prices. Rooted trees, 2 ft. to 3 ft. high, I was told, had been bought at 2*d.* to 2½*d.* each, while tree tops, 8 ft. to 10 ft. in height, were only costing 7*d.* to 10*d.* each. In the latter case, of course, one can understand the seller being willing to accept a low price, for, being cut off during felling or thinning operations, the material would otherwise be left to waste in the forests. Only in one instance did I find a buyer who stuck to the slogan "Buy British," and he appeared to be doing a good trade. The regrettable part is that the public do not participate in the low prices of these foreign trees, the retail prices charged being precisely the same as for British.

I might add that I find an excellent local market here for the tops of spruces, chiefly Sitka spruce, which very often has a double leader, one of which must be removed. By delaying this operation until just before Christmas I can readily obtain 3*d.* each (wholesale) for them as Christmas trees, which, after covering the cost of dragging them out, leaves quite a substantial profit. W. HODGSON.

GERMINATION OF SYCAMORE SEED.

Those connected with forestry, especially nursery work and seed sowing, may be interested to hear of a little experiment which was tried at Chopwellwood regarding the duration of the germinating power of sycamore seed.

As a bumper crop of seed one year is often followed by a scarcity the next, the object of the experiment was to see if seed collected during a good year could be held over for the next season, thereby regulating the yearly supply of sycamore plants.

During the autumn of 1929, 155 lb. of sycamore seeds were collected in Chopwellwood and stored on a dry loft floor. In March, 1930, one hundred of these seeds were tested between sheets of blotting paper and the germination proved to be 87 per cent. 150 lb. of seed were sown in the nursery and proved at stocktaking time to have produced 150,000 plants or 1,000 plants to the lb. Then in March, 1931, one hundred of the stored seed were again tested between blotting paper precisely as before but the germination proved that the seed was useless.

The remaining 5 lb. of seed which had been stored for the first year on the loft floor and for the second year suspended in a sack in a dry building, were sown in the nursery under conditions as near as possible to the previous year, but here again there was no germination whatever, which proves that sycamore seed loses its germinating power during the first season and is useless for keeping overyear.

W. H.

Forestry Commission Forms.

To the forester just commencing service with the Forestry Commission probably one of his greatest difficulties will be to remember the many different forms which have to be filled in and the various dates on which these forms must reach the Divisional Office. For the guidance of some new starter the writer would like to say that he overcame the difficulty by using a simple table in the form of a calendar with a space for each day of the year, also a column each for fortnightly and monthly returns. Entries are made on the days on which the different forms have to be rendered to the Divisional Office, new forms and times being filled in as they occur. Mounted on cardboard and hung in a prominent place the table shows at a glance what is required day by day.

W. H.

Safety First.

The forest ladder will be much safer if the top rung is replaced by a length of chain: the chain prevents rolling when the ladder is leant against a tree or pole.

J. Rowell.

Pine Sawfly.

In June, 1929, there was a severe attack of caterpillars of the pine sawfly (*Lophyrus pini*) in a plantation of Scots pine, average 6 to 10 feet in height, and I adopted the following method as a means of combat which proved to be both effective and economical.

I collected pieces of well-seasoned larch, Scots pine, spruce, hazel, etc., of about 1½ in. diameter. These were cut into lengths of 6 in., and the ends of each bored with a half-inch wood bit making a 2-in. hole. In the hole I placed twelve to eighteen strands of tying wire and in some unravelled ply wire, the strands being about 8 in. in length. These were wedged in by a small wood peg, the whole complete formed a wire brush. The same were used by giving a short sharp tap on the infested branches.

This operation was carried out three times with a lapse of six days between each; the reduction in numbers on each occasion was very noticeable. No caterpillars were seen after the third operation, and although the weather subsequently was favourable for further attack none occurred.

H. Laney.

Fire Beaters.

To foresters who are not adequately equipped with fire beaters, I would advise them to look up the nearest marine store dealer, where for very little they might obtain a quantity of old spades, shovels, etc., or should he have none on hand, arrange with him to collect them. I have obtained numbers in this way and found that such tools riveted to a good larch pole (without bark) about 2½ in. in diameter, make excellent fire beaters and are lasting. The length of handles should vary according to the weight of balance for easy working, and it is therefore advisable to rivet the pole in the tool first before reducing its length by cutting.

H. L.

Weeding Nursery Lines.

The practice used in weeding nursery lines with the Dutch hoe where soil conditions are not of the best might call for special notice, both from the point of view of cost and the damage done. In the writer's nursery where the soil is moderately heavy and stones prevail the following method has been tried with success.

During fine weather when the soil was suitably dry to a depth of about 1½ in., cultivators with prongs fixed in a triangular form and at a correct angle were drawn through the lines at a depth of from 1 to 2 in. The result was that instead of weeds being cut off or buried to grow again as is often the case when using the Dutch hoe, they were drawn out by their roots, stones were brought to the surface and the surface soil was left more loose. This tool is easily used and no damage is done to the young plants. The cost of weeding is much reduced and plants which have received this treatment appear to thrive much better.

H. L.

Direct Sowing.

Volumes have already been written on this subject and it has been agreed that direct sowing in this country is not a great success. The following are a few facts relating to the sowing done on the Ringwood area from P. 26 to P. 29. The method used in P. 26 and P. 27 was that of removing a square of peat to a depth of from 2 to 6 in. and to sow the seed in the pit thus made. Except on well-drained spots such pits are full of water for practically the whole of the winter and during wet periods in summer also. Consequently when frost occurs the seedlings are covered with a film of ice. At the present time, many of these seedlings are no bigger than they were the first year, although most of them are living. In P. 28 it was decided that the pitting method be dropped and the seed sown direct on the ground surface with no more preparation than to make a scratch sufficiently deep to allow the seed to be covered. The result is that P. 28 sowing is far ahead of P. 26 and P. 27, and quite a number of the seedlings are up to 10 in. in height. Where wet spots were encountered the area was turfed as for mound-planting and the result here is even better, the seedlings on the mounds are now up to 20 in. in height. This all proves that the soil needs aerating. All through the sown areas are small well aerated spots of ground and here the seedlings are getting away.

The P. 29 area contains a gravel pit and on the disused portion of the pit *Pinus radiata* (*insignis*) are flourishing, some of them being 20 in. high, whilst those on adjoining unbroken land are standing still and look thoroughly miserable. It has been proved that where the seedlings are standing still the soil is lacking in mycorrhiza and should be inoculated, but it is my contention that if the physical condition of the ground is all wrong the mycorrhiza inoculation would do little if any good. In my opinion the unsatisfactory results obtained from direct sowing on the

Dorset heaths is almost solely attributable to the bad physical condition of the soil, and now that this is being partly put right by means of tractor ploughing, I see no reason why direct sowing should not be successful.

H. J. WALLINGTON.

A MIXED CONIFER PLANTATION.

The following are brief notes on a 12-year-old plantation near Carno, Montgomeryshire. The situation is an exposed hill-top, sloping gently to the south and east at an elevation of 1,200 ft. The climate is moist, rainfall unknown, but probably between 50 in. and 60 in. per annum. The soil is 7 in. dark loam on a compact subsoil of red-yellow clay loam. The vegetation consists mainly of fine grasses, bracken and gorse.

The plantation is composed chiefly of Norway spruce, Scots pine and Corsican pine, but the following small plots of regular mixtures are worthy of note :—

A.—J.L./C.P. 50 per cent. mixture in alternate rows at 4½ ft. spacing.

Form.—J.L. : Wind bent and with a slight tendency to corkscrew stems. C.P. : Straight and well shaped.

Height.—J.L. : 21 ft. C.P. : 16 ft.

Current height increment.—J.L. : 18 in. C.P. : 15 in.

B.—J.L./S.S. 50 per cent. mixture in alternate rows at 4½ ft. spacing.

Form.—J.L. : Same as in *A*, but more branchy. S.S. : Leaders have suffered from whipping by J.L. branches. Some have double leaders due to breaking of leading shoot.

Height.—J.L. : 19 ft. S.S. : 16 ft.

Current height increment.—J.L. : 18 in. S.S. : Variable, average about 20 in.

40 per cent. of the S.S. has been suppressed by the J.L.

C.—N.S./C.P. Two rows C.P. to one row N.S. at 4½ ft. spacing.

Form.—N.S. : Those in the canopy of good form. C.P. : Good.

Height.—N.S. : 10 ft. C.P. : 15 ft.

Current height increment.—N.S. : Variable, average about 20 in. C.P. : 16 in.

65 per cent. of the N.S. has been suppressed.

D.—N.S./S.P. 50 per cent. mixture in alternate rows at 4½ ft. spacing.

Form.—N.S. : Good. S.P. : Poor.

Height.—N.S. : 10 ft. S.P. : 13 ft.

Current height increment.—N.S. : Variable, average about 20 in. S.P. : 15 in.

50 per cent. of the N.S. has been suppressed.

Unfortunately, there are no plots of these species planted pure for comparative purposes. The Japanese larch grows too fast for the

Corsican pine, which looks like being swamped in time, and it starts much too fast, on this area, for Sitka, but such Sitka as do get through will probably overtop the larch, suppressing the ones immediately round about, resulting in a widely-spaced crop of rough Sitka with Japanese larch filling up the gaps.

Sitka spruce seems to be much more liable than Norway spruce to have its leader damaged by whipping and rubbing, and even with the protection of a nurse crop of larch the leaders suffer from wind break. It seems that Sitka is most likely to be more successfully raised as a pure crop without the addition of a nurse crop of any kind.

The C.P./N.S. mixture seems to be a bad one and, as a means of raising spruce, the N.S./S.P. mixture has little to commend it. The Scots pine would require to have early and careful thinning, and even then it is hard to imagine that the result could ever be as good, under these soil and climatic conditions, as Norway spruce raised in pure formation. It is dangerous, where trees are concerned, to draw conclusions too readily, but as local information is scanty it is as well to make the best use of what is available.

F. C. BEST.

CHECKED SPRUCE.

A successful method of dealing with checked spruce in Vaughan Forest is described below. The spruce had previously remained with growth completely checked since they were planted " on the straight " in 1927.

In 1931 turfs were cut, 12 in. square, with the plant in the centre ; the turf was then lifted, care being taken not to injure the roots, and placed on the higher side of the hole. The operation was a simple one, yet it has proved very satisfactory. There is a marked difference in the plants now as compared with last March, before the operations were commenced. The principal advantages of the method seem to be :—

(*a*) The cost per acre of lifting is less than turfing and replanting.

(*b*) Where plants are dead, the turfs can be inverted, it being no trouble to find them when beating-up.

(*c*) When in doubt about turfing a piece of ground, the forester can risk planting without turfs, knowing that, if it is not a success, he can rely on this method to put matters right.

(*d*) The work can be carried out, if necessary, during the summer months without loss in plants thus helping the forester during a slack time.

H. WILLIAMS.

STORES UPKEEP.

Now that economy has to be studied so carefully, a few notes on the upkeep of stores from a practical point of view may be useful. Most of the wooden parts of tools can be made in the forests. Where there are coppice woods some ash can generally be found suitable for making handles for axes, mattocks, sledge hammers and mauls. Handles for all

these tools are easy to make, and the only tools necessary are an axe and drawing knife. The prices charged by carpenters and iron stores range from 1*s.* to 2*s.*, and very often the only advantage they have over the home-made article is the smooth finish. The best ash for handles is the size that will split into four to six. The butt length is the toughest and makes the best axe handles, whilst the second length usually has the straightest grain and make good mattock handles.

Wooden mauls, when used on steel wedges for splitting stakes, wear out rather quickly, but when the wood is produced and dressed in the forest the cost of ringing and burning the handle hole is cheaper than having wedges dressed. The usual charge by blacksmiths for the above is about 2*s.*, providing the rings are in good condition. The best woods for mauls are yew, crab and thorn. The two last are easiest to obtain, as they appear in some coppice areas too profusely from the preparing-ground point of view. Suitable trees can be put out during clearing, then the sections suitable for mauls can be sawn out and stored away to season with the bark on.

Rakes for nursery work can also be made cheaply out of a piece of ash and some rails. The ash should be about 2 in. by 1 in., and the length anything from 1 ft. 6 in. to 2 ft. 6 in. This is long enough for a single handle. Ordinary wire nails of 5 in. or 6 in. make good teeth. The hole for the handle should be bored through first with a 1-in. bit at an angle. The spacing for teeth is then marked off and bored through with a bit about a sixteenth smaller than the nails. The holes should be bored through from the bottom side and should be made at opposite angles, so that on the top side they are staggered. This reduces to a minimum the danger of splitting. After driving the nails through, the teeth can all be set to the same sweep with a hammer. All the above can be done during wet weather, especially at nurseries where there are huts, and it will also be found that the workmen will take more care of tools when they have to help to repair them, and there will be fewer tools out of commission because of broken handles. W. G. Roberts.

Wind-blown Douglas Fir.

Is there no alternative to leader pruning? I think there is. Wind-rocked Douglas fir are chiefly the spindly plants and overgrown, stocky trees stand up much better and do not sway so much. My endeavour therefore has been to obtain a stocky tree and to do this in the nursery. Sometimes there is a surplus of Douglas fir left over in the nursery, 2 + 1 plants for example; if left they will be 2 + 2, and if up to the average, might be anything from 2 ft. to 3 ft. high next year, the majority of them tall and spindly. To prevent this the best thing to do is to disturb the roots, for this purpose the plants are merely loosened with a fork and raised slightly and the trees immediately firmed again. This impedes the growth, it can be done twice in the growing season, the first time in March or April, the second time to be found by experiment.

Another plan is to lift alternate rows, this encourages side branches and stops height growth. I have seen both tried with success and especially the first method in regard to hardwoods, and great improvement was observable in the following season. With excessive height growth stopped the trees are able to stand up to gales much better and we need not have mutilated or distorted trees in our plantations.

R. Fraser.

A few Points on Forest Shelter.

The ultimate fate of many areas taken over for afforestation is difficult to forecast. Of the many dangers which beset them wind is one of the worst. The question of shelter is always sure to arise especially if the area is comparatively flat, for in such cases belts, unless mature, are not very effective. Unfortunately, land acquired is not handed over with all one's silvicultural problems already solved, the areas have usually been clear felled and are barren of everything useful to a forester. On conifer areas a point often forgotten is that the main object should be the second rotation.

After dealing with main shelter belts, compartment boundary shelter is worth consideration, but very little can be done here unless the area is stocked with existing coppice. In all cases, irrespective of species chosen for planting, all established coppice not more than 6 to 8 years old should be left to fill the normal 30 ft. compartment width. This is absolutely necessary for complete success, for when large areas are suddenly and completely cleared the whole nature of the land is changed. This is especially evident during the critical period in spring following planting when the areas are usually subject to drying northern winds. A certain measure of protection against fire is also obtained, for even in the wider fire belts a good growth of coppice is definitely more useful in practice than an open space which has to be burnt yearly. With careful treatment during thinnings secondary belts can gradually be cleared without any ill effects to the plantations. Protection in the plants' early life is often carried further by planting in drifts where coppice exists. If main shelter is not already provided this is not altogether advisable, for I find that if a mixture is not employed or the planting distance does not allow sufficient space for, say, twenty per cent. of the coppice to grow up with the species planted it has a detrimental effect. It does not encourage the young planted trees to grow strong root systems. Again, you are faced with the problem of checking your coppice. This must be severely cut back not later than the second year following planting. Even so in cutting back the coppice it is not always advisable to treat the whole compartment, but to leave, say, every 100 yards, 6 rows of coppice slightly checked until the following year.

On an area where there is little protection available and a mixture is not employed, a point often forgotten is a suitable plant-spacing. A good example is Douglas fir. It is a species to which one cannot apply a definite planting distance because same is governed by conditions which

do not apply to all forest trees. Only in the most sheltered positions should 1,200 plants per acre be used, and even here I do not see any sound reason why such close planting should be done unless it be to avoid beating-up a fifteen per cent. failure and, unfortunately, plants do not die in sympathy with even spacing, consequently a comparative small loss has often to be beaten up. It has been proved that Douglas, like many other species, can develop a fair root system if not grown too closely which also advantageously affects the leader indirectly. This result can most satisfactorily be obtained by correct planting distance. There are arguments we know which favour close planting, but with Douglas fir especially the disadvantages of wider spacing are not felt to any appreciable extent. I see no reason why a spacing of 8 ft. × 8 ft. should not be adopted especially if the area is thickly stocked with coppice stools.

A. E. JOHNSON.

FROST DAMAGE TO BEECH ON DOWNLAND.

The satisfactory planting of beech on chalk downland is a problem especially on those parts that are bare of vegetation. As the result of recent observations a fact is made clear which will render the establishing of beech still more difficult. I refer to the late frosts which I find are more severe than one would expect to find on open ground at 600 ft. elevation. On 4th May last we experienced a sharp frost, and on going round, I found the young leaves of the beech were almost black. This was in a P. 28 planting and the plants that had suffered damage were those we used for beating-up in P. 31, as most of the original plants had already lost their tops, down to the level of the grass around the screef, within about 4 to 6 in. of the ground this lower part remaining healthy. On the patches that had no grass growth very few of the original plants were alive at all. I think the fact that where there is grass growth the plants are alive at the base proves it to be frost damage. If the sun was to blame for it one would expect to find the whole tree dead.

S. E. PHELPS.

SALCEY: WEEDINGS OF YOUNG OAK PLANTATIONS.

These observations refer to the weeding of oak plantations directly following planting and for the few years afterwards. In this area only one weeding was found necessary in the season directly after planting and this was left until late in June before commencing and then only a light weeding was carried out. What was done was just to open out the heads of the trees and to leave the weeds which consisted mainly of long coarse grass in between the rows as side shade for the oak. In a portion of one compartment practically all the weeds were cut back, leaving the oak quite open and exposed to the full rays of the sun, and in this case quite a number of the trees began to droop rather badly, causing growth to be checked for quite a while. Whatever weeds grow after such a

weeding should not be sufficient as a general rule to interfere with the late growth of the trees even in a wet season and they should act as a protection for the trees from frost during the winter season. In this area the trees used for planting were quite small, being 1-year seedlings.

H. C. DYER.

WIRE-NETTING FENCES.

On the erecting of netting fences where the boundaries are irregular, as is often the case on old forest areas, if the top wire is to be kept taut, it is necessary to put in a strong post at every angle. The custom has generally been to sink a post about 2½ ft. or 3 ft. into the ground and putting a wooden strut jutting out into the inner side of the bend. A simpler and more effective method is to drive a strut stake in at these angles and tie back with strand wire to an old stem; if a stem is not available a short stake driven firmly in will do as well. Straining posts set in every 250 or 300 yards can be tied back to an old stem and need not be let in deeper than 2 ft.; the wires do not give and the top wire is kept taut indefinitely, which is essential in a district that is regularly hunted by fox hounds.

Gate posts set in the line of fence can be tied back by a wire to an old stem. The same way this obviates the necessity of putting in a strut jutting into the gateway that may get pulled about by carters or timber hauliers.

Old gates that have got shaky by being partially decayed and drag on the ground when opened, can be made useful for years longer, by running a double wire from the head to the heel, just above the top rail, and twisting it taut, and another wire from the top of the heel to the lower end of the head, care being taken to ease the head of the gate up out of the square before fixing, as it is sure to sag a bit. R. BUTLER.

FORESTERS' OBSERVATION RECORDS.

Those of us who have lived and worked in forest areas for quite a number of years have no doubt come across many things of interest yet have not taken the trouble to note them. How often does one hear of a new record of insect attack or fungal disease only to remember that one saw it years before, and did not draw attention to it. I rather think that the reason for this inaction lies in the fact that there was and still seems to be no definite medium whereby a forester whose time is more or less spent in the forest may have his information transmitted to the proper recording quarter.

Have we not a duty as a Government Department to gather all information possible relative to the forest and its inhabitants? By so doing might we not act as a clearing house for the sciences which deal with these subjects? I would suggest that each forester should enter in his diary anything of interest which he sees whilst inspecting his area, *e.g.*,

harmful insects, with observations on their mode of attack and results therefrom ; deaths of trees and causes ; dates of leaf flushing ; condition of weather during planting, etc. The greatest amount of really useful knowledge will only be achieved through the forester's own initiative. where no rules and regulations are laid down as to subjects or procedure. The habits of a vole, for example, may seem so commonplace that no thought of writing down his observations occurs to him. Yet who knows but that what he has seen may have far-reaching effects in the handling of the problem. By all means encourage the forester and give him the chance to submit his observations either to his Divisional Officer or to the Research Officer who in turn could "sift the wheat from the chaff," and publish the result firstly in our own Journal. H. WATSON.

PRUNING OF PLANTATIONS.

Two articles which have appeared recently in the Swedish Forestry Journal *Skogen* are of interest in view of the increased attention now being paid to the subject of pruning. Both writers stress the importance of pruning but recommend different ways of carrying out the work. One (Wesslen) uses a blade apparently about 4 in. long, set at right angles to the pole, with which he hooks the branches down, using a downward stroke of the tool. The other, Löf, employs a sharpened pruning spade with a straight edge, and the branches are cut with an upward blow. Wesslen prunes his trees to a height of 20 ft. to 25 ft., while Löf does not reckon to prune higher than 16 ft. The cost per tree, according to Wesslen, amounts to 0·7*d*., and according to Löf to 0·3*d*. to 0·5*d*. Both writers prune only selected trees—from 150 to 250 trees per acre, and the pruning is not carried out until the trees are 30 to 35 years old.

Calculations of profit are as follows :—

(1) Wesslen assumes a rotation of 85 years, the stems to be pruned when 35 years old. Cost of pruning per tree amounts in 50 years at 4 per cent. compound interest to 6·6*d*. Assuming a 10 per cent. loss of efficiency, *i.e.*, some of the stems will be damaged, the cost increases to 7·3*d*. On the average at 85 years the trees will give a butt log of 18 ft. × 11 in., with a volume of 11·88 cu. ft. The cost of pruning will be equivalent to 0·7*d*. per cu. ft. As the prices for plywood, veneer, etc., exceed normal prices by from 40 to 50 per cent., the pruning should certainly be profitable.

(2) Löf reckons an average cost of 0·4*d*. per tree or 11*s*. to 12*s*. per hectare. If the trees stand for 30 years after pruning, the costs, at 5 per cent. compound interest, amount to 47*s*. to 53*s*. per hectare. Assuming that in 30 years the pruned stems attain a diameter of 8 in. at a height of 17 ft. and that some knots will be apparent in the centre of the stem which will reduce the quality of that portion to second class, then at least 80 per cent. of the middle cut should be of first or second class and the remainder third class, while 80 per cent. of the outer portion of the logs should be first class.

It is calculated that on a butt of 17 ft. by 8 in. the increase in value as a result of pruning will amount to 1*s.* 5*d.* Pruning costs at 5 per cent. amount to 1·7*d.*, so that there is a net gain per hectare with 250 such stems of £16 2*s.* 0*d.* (£6 10*s.* 0*d.* per acre).

W. H. GUILLEBAUD.

KILLING WEEDS BY SPRAYING.

In an article in the *Revue des Eaux et Forêts* M. Paillié records some useful observations on the destruction of weed growth on forest roads and rides and in the nurseries by means of solutions of chlorate of soda. Over a period of ten years chlorate of soda has been used for treating roads and rides at Des Barres. At first a proprietary compound known as "*Mortherbe*" was also experimented with, but, results being approximately the same, recourse was had to chlorate of soda as being the more economical.

A solution of 16 grammes to the litre of water is sprayed over the roads and rides, whether shaded or not, at the rate of 1 litre of the solution to the square metre, this having been found to be the most effective application. Where the weeds are sparse the strength can be reduced to 12 to 15 grammes per litre, especially when the treatment has been repeated annually over a period of years. One application per annum, made under suitable conditions, suffices to kill all weeds on the drives for the season except where dense growth of couch grass occurs. Here a stronger solution of 20 grammes has been found necessary, and two applications are required to kill the weeds. The only species of weed partly resistant to this treatment is the creeping thistle.

Atmospheric conditions exercise considerable influence upon success or failure with chlorate of soda. Damp weather is preferable to drought, in which circumstance a heavier watering with the solution is necessary. On the other hand, the destruction of weeds is complete if a period (even only a few days) of drought or strong sunlight ensues after the dressing, while if the treatment is carried out in rainy weather or if there has been much rain in the previous 24 hours the result is not so sure. If the work is properly done the weeds turn yellow in a few days and in a fortnight they may be brushed away. With the price of chlorate of soda at 4·50 francs the kilogramme, the cost, including application, is from 9 to 10 centimes per square metre and is cheaper and quicker than manual labour.

Regarding the killing of weeds in nursery seed-beds by means of chlorate of soda, the results obtained are not so clear as with the roads and rides. A solution of 5 grammes to the litre applied in dry weather to 2-year-old bedded Norway spruce and Scots pine killed out the weeds for the season, but the plants suffered and losses resulted. The strength of the solution was then reduced to 3 grammes.

Applications of a 2-gramme solution have been made to seedbeds of silver fir, 27 days, and to Douglas fir, 40 days after sowing, at a rate of two-thirds of a litre to the square metre. The results have been good; weed growth has been markedly discouraged in comparison with control areas and the first hand-weeding, always a delicate operation among young seedlings, has been unnecessary. The areas treated have in the course of the year been much more free from weeds than the untreated beds, and it seems that in the case of the slower germinating seeds, treatment with chlorate of soda, before the seedlings appear, is cheap and harmless.

The writer terminates his paper with a word of warning concerning the influence of the nature of the soil upon the action of chlorate of soda, a matter which has not yet been closely studied.

W. L. TAYLOR.

VEGETATION TYPES IN DANISH BEECH WOODS.

In an important article by the well-known Danish forest authority, Dr. Bornebusch, it is stated that the Danish beech woods can be placed in three groups as regards vegetational types, namely :—

(1) Types in which the flora is composed of calciphilous plants or of those which prefer neutral to slightly acid soils.

(2) Types in which plants less sensitive to acidity such as *Anemone nemorosa* and *Asperula odorata* are dominant and there is no mixture of lime-loving plants.

3. The type with *Oxalis acetosella.*

The first group, of which the characteristic plant is *Circaea luteliana*, occurs on the loams and clays of the marl soils with their high lime content. The *Corydalis* type occurs in beech stands over 30 metres high with deep soils, the principal species being *Corydalis cava, Anemone* and *Asperula.* The *Mercurialis* type, recognisable by the presence of *Mercurialis perennis, Anemone* and *Asperula*, corresponds to good beech sites, which are often moist and level. The general *Circaea-Asperula* type occurs frequently in the rather poorer beech stands of moderate quality, *Circaea, Anemone* and *Asperula* with some *Oxalis* are characteristic.

The *Primula* and the *Ficaria* type occurs on the brown, moist, level soils where the growth of the beech is unsatisfactory. The following plants are characteristic :—*Anemone nemorosa, Primula elatior, Circaea lutetiana, Ficaria verna, Aira caespitosa, Carex silvatica* and *Carex remota.* The *Anemone-Asperula* type occurs particularly on loamy sands and gravels, chiefly on soils where the influence of the deeper-lying soil, which is rich in lime, does not extend into the upper layers. The *Oxalis* type occurs in pure sands, where beech grows slowly. There is a marked tendency to the formation of raw humus, which may be encouraged by faulty treatment.

The various types change with the age of the stands. In the *Oxalis* type, for example, there is generally no vegetation; in open crops one finds *Agrostis, Holcus mollis* and *Veronica chamaedrys.*

The author deals at length with the raw humus which is a feature of Danish woods. This formation is due partly to the humid climate and partly to drying winds. The raw humus has different properties on the different types. The soil in the *Oxalis* type is easily podsolised, while that in the *Circaea* types is resistant to podsolidation.

As the vegetational types are an expression of the soil conditions, they are of importance as guides to the selection of species and to the method of cultivation. The *Corydalis* and *Mercurialis* types represent good beech soils on which a mixture with ash and other light-demanding broad-leaved trees would be suitable; the *Circaea* type, however, does not often have a sufficient depth of soil for ash, and on this type oak is to be preferred.

The *Ficaria* type is as a rule unsuitable for beech; oak does better and grows faster, but a mixture of oak and beech might be employed. The *Anemone-Asperula* type is good for beech. For mixtures, larch is preferable on high ground, although oak is also useful; ash should only be employed in fresh, low ground. Group mixtures of different conifers are also advantageous. On the *Oxalis* type the beech gives poor returns, while conifers and particularly spruce do well on this ground. Large areas of this type have been converted to spruce, one reason being that raw humus develops readily on this soil, making the natural regeneration of beech very difficult, while planting with spruce is easy and profitable.

On the types with *Circaea* young beech plants thrive very well in the shade of the older crop. On this type a slow natural regeneration is to be recommended as a heavy opening of the stand, or a clear felling leads directly to a strong growth of grasses which is injurious to the young growth. On the *Anemone-Asperula* type the growth of grass is not so strong.

A mixture of *Anemone nemorosa* with raw humus plants shows an unfavourable soil condition which has gone back from a mull to something between a mull and a pure raw humus. Where the *Anemone* is growing in raw humus it is undoubtedly a relic of better conditions; it invades a locality slowly and with difficulty, but, on the other hand, disappears slowly.

The contrary is the case with *Oxalis acetosella*. If wood-sorrel occurs on raw humus it is a sign of improving conditions. Raw humus plants as relics of earlier bad conditions often remain in a luxuriant carpet of wood-sorrel. This plant invades very quickly, its small seed being mechanically expelled, and it spreads in stands previously with no vegetation, where thinning has been carried out. Its appearance is a sign that the treatment is favourable and has been carried out with sufficient care, as too much interference in a stand, previously dark and dense, leads to an invasion of grasses. The wood-sorrel is thus a plant from which much can be learned as to the correct treatment of woods. The development of a nitrate-flora is a sign of soil invigoration, but the decomposition of the humus goes on very fast, and in some cases the nitrate plants are soon replaced by *Aira flexuosa*. J. MACDONALD.

Climatic Requirements of Douglas Fir.

The growing recognition of the importance of Douglas fir on the continent is reflected in the number of articles that are written about this tree in the German periodicals.

The latest of these, by Hans Schwarz, deals with the climatic conditions in the localities of optimum growth in north-west America—in the western parts of Washington and Oregon. The author finds that the following are among the climatic requirements :—Mean temperature, 50° F. ; temperature of the coldest month, 37·4° F. ; temperature of the warmest month, 62·6° F. ; number of months with temperature above 50° F., 5 to 6 ; absolute maximum, 98·6° F. ; absolute minimum, 1·4° F. ; mean frost-free period, 200 days ; sunshine percentage, 40 to 50 per cent. (30 per cent. in winter ; 50–60 per cent. in summer) ; mean wind velocity, 6·2 miles per hour ; annual rainfall, 55 in. ; rainfall from 1st April to 30th September, 11 in. to 16·5 in. ; days with ·01 in. or more, 160 ; days with ·01 in. and more (between 1st April and 30th September), 50.

The author concludes that in Europe the localities which most nearly satisfy these requirements are the southern part of Great Britain, northern France and the surrounding countries, including part of Germany.

J. M.

Germination of Seed of Rowan.

A paper by Professor Fabricius, of Munich University, gives an account of various researches carried out on the germination of *Sorbus aucuparia* seed.

In the first experiment the seeds were treated in various ways before sowing, being soaked in different liquids in order to find out which was the most effective in breaking down the hard coat of the seed. Among the treatments were soaking of the berries for 20 hours in water ; for 10 minutes in concentrated sulphuric acid ; for 30 minutes in 30 per cent. sulphuric acid, and also a treatment of 1 hour in 3·8 per cent. hydrochloric acid. On the assumption that when the fruits are swallowed by birds, the digestive juices act on the seed coat in such a way as to help germination when the seeds have been scattered, Fabricius arranged that certain lots of seed should be soaked in what corresponded to the digestive secretions of a bird. Thus, seeds were soaked for 6 hours in 0·4 per cent. hydrochloric acid, 0·4 per cent. pepsin, 0·2 per cent. pancreatin.

After treatment the seeds were sown in flower-pots in a mixture of two-thirds mull-earth and one-third sand. Forty berries yield on the average 100 seed. The author concludes that it is improbable that the germination is helped to any great extent by the digestive juices.

The author also carried out various experimental sowings of rowan in autumn, 1928, and spring, 1929. Among his conclusions are the following :—

Seed from some individual trees germinates better than that from others and seed from some localities is probably of greater germinative power than that from others.

Seed freed from the berries germinates much better than seed still enclosed in the berry, irrespective of whether the berries or the seed are fresh or dry. Freshly-gathered berries can be crushed by means of a fruit-press or may be mashed in water. Autumn sowing is preferable to spring sowing. The seed should be sown broadcast and lightly covered with sand or fine soil to a depth at the most of 1–2 mm. Autumn-sown seed need not be covered as the winter rains wash it into the soil. On the other hand, a thin covering of fine twigs is useful. J. M.

Halwill Forest.

Halwill Forest area consists of nearly 3,000 acres. It is situated in North Devon on a high tableland, ranging from 500 ft. to 800 ft. above sea-level. There is a heavy rainfall and the soil is mostly peat on stiff clay.

A certain portion of the land replanted was cleared during the war by Portuguese labour, the coniferous crop being sent to South Wales for the coal mines. Other areas which are carrying their first crop of forest trees were open moorland with many bogs. This forest was one of the first to try the experiment of planting on mounds, it having been found that with the ordinary method plants became waterlogged and their roots were killed by being planted in the clay. The first mounds were cut from peat in a very wet area, where ordinary planting had failed This was done with a Scotch rutting spade, the mounds being large and conical and planted with 2 + 2 Sitka spruce; another small portion being one row of mounds, one row screefed and one unscreefed. There were no failures on the mounds and growth was good even in the first year, and the colour of the plants was dark green. The screefed and unscreefed rows were very poor, with no growth, the colour yellow and many losses; the mounded Sitka spruce planted in P. 24 are from 8 ft. to 12 ft. high and looking very fresh. The mound method has now become general and is carried out by cutting drains and using the turfs for mound planting. Growth is somewhat erratic on areas where no trees have grown before; with no change in vegetation trees will be found in large groups, putting on 2 ft. to 4 ft. per annum, and only a few yards away similar groups putting on only as many inches.

On neighbouring farms also the soil varies greatly and the parts where corn and root crops fail to grow are known locally as "deaf soil," although they are similar to the productive areas in depth and appearance.

E. R. Smale.

Planting during Summer at Rheola.

An experiment was carried out at Rheola during the summer of 1930, the results of which may be of interest to other foresters. The object of this was to ascertain the possibilities of planting on mounds during the recognised " out of season " period. A plot of land of uniform quality was selected, and the whole area was mounded by the usual " mounds with drains " method in the month of April. The soil was 4 in. of peat over clay and carried a crop of thin molinia, scirpus and cotton-grass. The altitude was 1,000 ft. above sea-level.

A small portion of the area was planted during the latter week of each month, commencing in June, 1930, and continuing until March of the following year. The plants used were Sitka spruce 2 + 1, culls which had been re-lined out in an adjacent bed in April previous to the commencement of planting.

The results have been carefully noted, and I append the table (*see* page 103) which shows the results of each month's plot, together with information regarding the weather at time of planting and the consequent appearance of the plants on each plot at October, 1931.

The plots in order of merit may be placed as follows :—(1) June (2) July. (3) August. (4) March. (5) February. (6) October. (7) December. (8) November. (9) January. (10) September.

It is interesting to note that the best results are shown in the June, July and August plots, and that there is a marked falling-off in those for September, October and November, while the plots for January, February and March again show comparatively good results. I must say that the experiment was commenced with a certain amount of pessimism, but the results have after all been quite satisfactory. On the other hand, it must be remembered that the summer of 1930 was by no means a dry one, which would tend to give the plants a good start.

This does not necessarily prove that we shall at some future time find ourselves planting all the year round, but it appears to be possible to carry out the planting of small wet areas during the " out of season " months with a certain amount of success. P. Harrison.

Pruning of over-sized Douglas Fir.

It may be of interest to some of our foresters to read of the results of a small experiment carried out at Bruton Forest. The plantation in which the experiment was made was planted during P. 30. The age of the plants was 2 + 3, their average height 4 ft., and they were pit-planted in a fairly well sheltered position. The soil was greensand, fairly open and porous, but of good quality and covered with a heavy growth of bracken. The aspect was north and west.

In April, 1931, about 25 of these trees were leader-pruned down to the level of a suitable bud, and the average height at this time was 4 ft. 6 in. An equal number of trees in the immediate vicinity were marked at the same time, but unpruned. The new growth was first measured in July

TABLE REFERRED TO IN NOTE "PLANTING DURING SUMMER AT RHEOLA."

In Summer of 1930.			In October, 1931.		
Date when planted.	Weather at time of planting.	Number planted.	Total losses.	Approx. per cent. of failures.	Appearance of the plants.
1930.					
June 26th	Showery	147	1	1	Very good, 2½-inch shoot.
July 30th	Warm and showery ...	161	3	2	Good. Healthy colour.
August 28th	Very hot	195	4	2	Good, 1-inch shoot.
September 29th	Fine and warm	173	Nil	—	Poor colour.
October 28th	Raining	167	8	5	Good colour, ½-inch shoot.
November, 28th	Dry and cold	160	4	3	Fair.
December 30th	Very wet	169	2	1	Good colour.
1931.					
January 29th ...	Raining	185	6	4	Fair. Not good colour.
February 27th ...	Raining	228	2	1	Good. Healthy appearance.
March 27th... ...	Dry and frosty ...	233	11	5	Good colour, ½-inch shoot.
Total and average per cent. ...		1,818	41	2¼	

and the following were the measurements of the pruned trees : maximum growth, 11¼ in. ; minimum growth, 4½ in. ; average, 7 in. The trees were again measured at the end of the growing season, and the measurements then were : 26 in., 9 in. and 13½ in., respectively.

To compare growth, the unpruned trees were also measured at the end of the growing season. They were planted at the same time, and were of the same age, size, etc. Their measurements at the end of the growing season were : maximum growth, 42 in. ; minimum growth, 6 in. ; average, 27¼ in. The pruned plants were not selected for pruning, but were pruned in the rows as they were planted. The unpruned trees were also measured in the rows.

It will be noted that at the end of the growing season the average growth of the unpruned trees was a little more than double that of the pruned trees. Other observations are, that of the 25 pruned trees, one tree developed 4 leaders, one 3 leaders, 6 trees developed 2 leaders, and the other 17 trees one leader each. Where the leader was cut down near the branch whorls, there is a tendency for a side branch to take up the lead. Side branches in some cases put on nearly double the growth of the new leader. One tree had developed two side branch leaders, one of which was 26 in. long and one 23 in., while two other trees had side branches of 19 in. in length. The average length of new growth on side branches of the pruned trees was 16½ in., and the average length of new growth on side branches of unpruned trees was 15 in. The wounds are healing well, and none died back very far ; the trees are of good colour. In some cases the new leader has become quite perpendicular, and it is difficult to see that the tree has been pruned. In the unpruned trees there is not the same tendency to develop double leaders.

As regards weather conditions, the summer was an abnormally wet one and I think that the trees put on a little more growth than is usual during a normal season. I have watched the trees, both pruned and unpruned, after a heavy rain and on a windy day, and have noticed that the unpruned trees will bend more with the wind than the pruned trees. While the unpruned trees " swayed " from the level of the soil, the pruned trees swayed a little at the top and the main stem at the soil level appeared more steady. At the time of writing, it is noticed that one or two of the unpruned trees have " swayed," but the pruned trees seem firm and more stable.

R. E. Pallett.

Privately-owned Woods and their Improvement.

W. E. Hiley in his latest book (" Improvement of Woodlands ") has indeed set himself a problem in that his declared intention is to demonstrate to the average British landed proprietor that his uneconomic woodlands can be made to yield an increasing revenue without the expenditure of enormous capital at a low and long term interest.

That gross mismanagement quite apart from the practice of indifferent silviculture is the order of the day in the majority of woodlands is a fact demonstrated with typical clarity and outspokenness. A large proportion of the woodland owners of the present generation look upon their properties more in the nature of social amenities than as business propositions and those who perforce have to consider them in the latter category have found them to be such millstones that they have preferred to let things slide along in the old way rather than embark upon a business undertaking whose nature they do not properly understand. As a handbook on the management of British woodlands the text is excellent and unusual, but possibly the author has attempted to cram rather too much into a small space. It might have been better to deal with Silviculture and Management in two separate volumes.

Being almost the only English work which preaches forest economics as a practice instead of as a dry and unpractical theory, " Improvement of Woodlands " fills a long-felt want; the chapters on taxation and death duties are particularly valuable.

The silvicultural section contains a number of rather dangerous generalisations, but apart from this the notes are readable and refreshing. The chapter on the conversion of coppice areas is treated rather lightly and the possibilities of such woods being made to produce saleable small timber or pitwood are largely ignored. In the western portion of the country there are large areas of this type which are well capable of such conversion and in places that are not too far removed from colliery districts they can become profitable.

The book just falls short of success in dealing with the typical uneconomic woods the condition of which is originally set out to rectify, but as these woods are so multifarious in their types and differ so much in their requirements this criticism cannot be taken as definitely condemnatory. G. B. RYLE.

STROPHOSOMUS CORYLI.

Strophosomus coryli is similar in general appearance to the clay-coloured weevil (*Otiorrhynchus picipes*) which has recently proved locally troublesome in many places, but it is somewhat smaller, more rotund in shape and has a clearly defined dark stripe down the suture of the elytra at the base. This weevil has recently been found at Llanover where a localised patch of young Scots pine plants (P. 24) had been more or less denuded of foliage. The damage done corresponds to that caused by the heather beetle (*Strophosomus lateralis*) to which it is closely allied.

Fowler (in " Coleoptera of the British Isles ") gives hazel, oak and fir as the food plants of *Strophosomus coryli*. As a forest pest it is not likely to assume importance. The species is frequently extremely abundant in hazel coppice woods and it is possible that conifers planted in such places may be damaged. G. B. R.

Larch Thinnings in Okehampton Forest.

Even larch thinnings are not always easily sold and a certain amount of canvassing may be necessary to get anything like a fair price for the small material. The most saleable appear to be wireless poles, and the thinner poles for rustic fencing.

The larch plantation in question covers about six acres and is 28 years old. It was planted by the previous owner who when cleaning the ground for the larch left a few old oaks with large side branches and a few old silver firs probably as roosting places for pheasants. These older trees naturally killed the surrounding young larch and left blank spaces for several yards round the trees making a loss in sales from the financial point of view. After planting, the young plants were left to look after themselves, no weeding, cleaning or thinning being done for nearly twenty-six years with the result that every tree was covered from bottom to top with ivy, there being dead branches right to the ground, some small poles rotting as they stood, others drawn up into mere whips and the whole thing looking a poor sight.

During the last two years cleaning and thinning have been carried out, being done very carefully to prevent wind damage, as a small portion was blown over in the 1929 gales, leaving nearly half the area exposed to the south-west winds. Provided future thinnings are carried out carefully, however, it has every chance of becoming a good plantation.

The thinnings have been put into four different classes and sold at about 6*d.* per cu. ft. First-class poles of approximately 6 in. diameter and over have sold at 3*s.* each, quite a number being used for building small hay sheds. Second-class poles have sold at 1*s.* each, third-class at 6*d.* each, fourth-class (of 3 in. diameter and under) at 3*d.* each, and the small cleanings at 1*d.* per pole. A few of the poles have been cut to stakes and transferred to other forests, but have been valued at the same rate.

W. E. Jones.

The Newland Oak.

This famous old tree stands in the middle of a field on a farm belonging to the Newland House Estate. It is situated in the northern part of the Forest of Dean and within half a mile of Newland Church, one of the oldest churches in Gloucestershire. No one seems to know its age, but it must be several hundred years old. It is a pollard with a bole about 10 ft. high, but the stem is hollow. About twenty years ago, when the tree was 43 ft. in girth, every limb was alive and strong. To-day the tree is nearly 44 ft. in girth, but its fate seems to be sealed, for all the branches are dead with the exception of four, about 30 ft. in height, the top 10 ft. of which is dead.

This tree, like a good many more of these old ones, is a sessile oak, and is reputed to be one of the largest in the kingdom. Although it is hollow the outside shell is still unbroken, and to get inside it it is necessary to climb up to the top from the outside; the hollow is about 6 ft. in diameter.

W. E. Jones.

Converting Coppice Areas to Conifer.

Part of the P. 31 area at Caio Forest was an oak coppice felled in 1922 and 1923, and it was decided to convert this into a Douglas fir plantation. " Drifts " 8 ft. apart were cut through it and the Douglas fir planted as nearly as possible at 8 ft. × 8 ft., but closer in the more open spaces. Approximately 900 plants to the acre were used, and the labour charges for the first year worked out as follows :—

	Per acre. £	*s.*	*d.*
Preparing ground, *i.e.*, cutting " drifts "	0	9	0
Planting, 900 at 1*s.* 4*d.* per 100 . .	0	12	0
Weeding (some parts twice) . .	0	10	0
Total	£1	11	0

To this can be added haulage charges, etc., of roughly 3*s.* per acre.

During the weeding operations in P. 31 the oak coppice was opened out a good deal more and this year about 200 to 300 more Douglas fir are being planted to the acre, in some parts to form a denser crop. After next summer this area should not need a great deal of attention, as the trees should have had a good start by then and, if any failures occur, there is plenty of young oak coppice to fill up any gaps. Taking the whole of this area, there is only about 2 per cent. failures, but as large 2 + 2 plants were used it might have been more if we had not had a wet summer.

L. T. Edwards.

Marking of Tools.

There must be in many of the Forestry Commission's forests considerable losses of general stores, more especially where the public have access to the paths and roads adjoining the Commission's property, and theft cannot altogether be ruled out as the cause of many of these. The present method of marking is not entirely satisfactory. It is suggested that by marking the steel or metal of the implements at the makers or before issue, the tools would not be weakened and their identification and safety would be ensured at a very small cost.

W. V. Jackson.

Lifting of checked Sitka Spruce.

A quantity of suppressed Sitka spruce was lifted out of the forest in Bourne Wood during P. 31. These plants were planted in P. 29, but had not grown and were pale yellow owing to stagnation of their roots. The manner in which they were lifted was to cut the turf 16 in. × 16 in. × 6 in. to 8 in. deep round the plant and lifting the turf on to the side from which it was taken, leaving the plant unmoved in the turf.

These plants have now recovered much of their colour and in some instances have put on leading shoots of as much as 6 in. to 9 in. This surely shows that turf planting of Sitka spruce on soil even of heavy nature is better than planting them on the soil level. A. BIRKETT.

A USEFUL HINT *re* UNIFORM.

After receiving and wearing the uniform for a few weeks it was noticed that the breeches were being badly frayed at the knees by constant tearing of brambles and briars. To avoid destroying the breeches a pair of partly-worn horsehide leggings were taken to the cobbler and were carefully stitched on to the knees, thus making a pad about 6 in. to 9 in. high and 9 in. across the top of each knee. This has proved satisfactory and may be of use to others who have to work where similar high, rough vegetation occurs. A. B.

RIDDANCE OF RABBITS.

When fencing in rough areas where rabbits are numerous the following points should be kept in mind. Before commencing to cut down existing scrub or coppice over the whole area a fence line is cleared about 3–4 yards wide around the area and the fence erected right away. Then the preparation of the ground may be commenced. The reason for erecting the fence first is to enclose the rabbits so that by good warrening they can all be killed off. However, if the preparation of the ground is proceeded with in advance of the fencing, the rabbits soon know there is trouble brewing and clear away to the adjacent land, there to increase and cause continuous trouble by working along the line of fence.

When clearing the area for planting it is as well to leave a patch of 2–3 acres rough in the centre to permit warrening. When this is in progress stray rabbits on the area will welcome this hiding place and collect there. Thus after a short time warrening is confined to this small area, which with good dogs and ferrets is soon cleared of rabbits.

C. P. CARR.

Pinus insignis RAISED IN DIFFERENT TYPES OF HUMUS.

Pinus insignis seed was sown in twelve boxes measuring 18 in. × 24 in. × 6 in. The soil in six of them was a mixture of sandy soil and beech humus, while the other six contained a mixture of the same soil and *Pinus insignis* humus. All the boxes were given the same amount of water during the summer, but it is interesting to note that the seedlings in the beech humus mixture have made much more growth than those in the other type of humus, the former being 6 in. high and those in the

Pinus insignis humus only 3 in. Although the seedlings in three of each of the six boxes were lifted and pricked out as soon as germination was completed, and those in the remaining three boxes thinned out, there is hardly any difference on the average in size of the plants pricked out and thinned out. H. R. HALSEY.

EARWIGS ATTACKING SCOTS PINE SEEDLINGS.

Towards the end of September, 1931, it was observed at Seaton Nursery that some of the Scots pine 1-year seedlings had a brownish tinge. Closer inspection revealed that some of the needles were quite dead, whilst others were still green, and an incision on the stem between ground-level and " collar " gave the impression that the stem had been nipped. When pressure was applied the stem broke where this incision appeared. Apart from this incision, which was noted to be slight, and in some cases a slight swelling had formed round the incision, no other marks could be found. Traps were laid to catch any insects which might possibly have caused this damage, but none capable of doing such damage was captured. It was then decided that a portion of a bed should be dug up and the soil searched for any possible ground insect which was likely to cause the injury. The result of this digging was that earwigs (*Forficula*) were found to be numerous.

Experiments were then carried out at the nursery by Mr. W. B. R. Laidlaw, entomologist at Aberdeen University. The first experiment was the placing of seedlings which had already been attacked in pots, and earwigs also introduced amongst the plants. These were examined daily, but no further damage could be traced. The second experiment consisted of putting earwigs amongst sound seedlings which had also been potted. Within a few days it was found that these plants had been " nipped " ; this was confirmed by reports from Mr. W. B. R. Laidlaw. A rough estimate of plants attacked in this nursery would probably be 70 per cent., although the number of actual deaths was negligible.

It was thought that the earwigs had been so numerous owing to favourable conditions being found in the posts used for the protection of the Sitka spruce seedlings during the previous year. This, however, was not the case, as similar nipped plants were found in other sections in various parts of the nursery, where no posts or other suitable breeding places could be found.

Traps consisting of trusses of straw were placed on the beds and left overnight. These were collected in the morning and burned as, on examination, these traps were found to be holding earwigs.

A spray consisting of arsenic was used, but it is impossible to state the result of this as since then frost has been registered at nights, and this would suspend any activity of the earwigs.

It may be that the earwigs have been trying to climb up the seedlings and the slender stems were unable to bear their weight, and the stems

being soft resulted in the earwigs nipping the plants during the climb. Unless the trouble is physiological, which is possible, the earwigs are the only solution of the nipping. Practically all affected plants have recovered and no appreciable permanent damage is apparent.

J. A. LAMB.

FORESTERS' MEETING.

A contributor in the Journal of 1930 suggested that a meeting of foresters in each Division should be arranged once a year in the form of a tour over one of the areas. This was tried on a small scale in the North-eastern Division last year, and proved a great success. The tour was organised by the District Officer and attended by the foresters under him. It was very much enjoyed and appreciated by the participants.

The Midmar area was the first chosen scene for visitation, and the foresters met there on the morning of 30th September. The holdings were inspected, and the lay-out and well-kept gardens of these were remarked upon. A circular tour was then made of the planted area, and the species, growth, planting methods, weedings, etc., were all discussed and compared. An experimental plot on top of the hill at a height of 1,350 ft. was visited. This plot was established in order to give some indication of what species would be likely to succeed on the higher ground of this area, as the existing Scots pine trees were small, stunted specimens. It is rather early yet to give any definite results, but it was observed that, if anything, the spruces were the most successful. This concluded the tour of the Midmar area, and the party then proceeded to Kemnay, where the holdings were also inspected and the general lay-out of the area observed. As the Kemnay area is composed of diversely situated woods, and as time was short, it was only possible to go over a portion of the ground. Here again, however, the various details were discussed and compared. Two existing plantations of Scots pine of approximately 30 ft. in height were inspected, and suggestions made as to the necessary degree of thinning required.

At the close of the day the meeting was adjourned to the local hotel, where a very enjoyable and profitable evening was spent talking over forestry conditions in general, and the individual areas represented in particular. As the new forms of Plant Records were being introduced in this Division at the time, the District Officer took the opportunity of explaining all about them in detail.

It is intended, if possible, to make this occasion an annual one, visiting the other areas in rotation, and it is hoped it may be taken up on an even larger scale.

JAMES ALLAN.

RECORD BOOK.

I have found the keeping of a record book of value to me in the forest, and it will, I hope, be even more useful to my successors. I therefore

venture to suggest a similar procedure may be adopted by other foresters. At the commencement of the planting season the forester should prepare for himself an enlarged map of the area to be planted that season, marking out its rides, and inserting approximately, as they are planted, the various species. These maps if kept in the forest office will prove of great assistance in later years. In addition to these maps, an ordinary twopenny exercise book should be kept, using one page for each compartment. At the top of the page should be drawn a sketch of the compartment showing the various species. Underneath this should be recorded the age, number of plants used and relative acreage occupied by the various species in the compartment. In later years the same information regarding the plants used for beating-up the compartment should be inserted opposite the original species. Details of weedings, thinnings or other information could also be added.

This book if carried in the forester's pocket during inspections or tours of the area will usually provide all the information required by inspecting officers. It does away with the usual searching of office records, and the too often inaccurate searching of the forester's memory. The book will also prove of the greatest value to succeeding foresters enabling them to see at a glance what has previously been done in the forest. J. A.

An inexpensive Forest Gate.

A cheap, but effective, forest gate can be made for temporary fences in the following manner. Either Scots pine or larch thinnings can be used, and should be cut into the necessary lengths required. If a 10-ft. gate is desired then three poles of this length can be cut, also three pieces 4½ ft. and two pieces 5½ ft. The end poles should be at least 3½ in. in diameter. In two of these 4½-ft. poles a 1½-in. hole is bored with an awl at top, centre and foot of each. Into these holes are inserted the ends of the 10-ft. poles, which are then securely wedged or nailed. The third 4½-ft. pole is notched and nailed vertically across the three bars in the centre of the gate. The diagonal pieces 5½ ft. long can then be nailed on from the top of this centre pole to the foot of the two end poles. A double strand of No. 8 G fencing wire is stabled at the top of each end post, and drawn down to the foot of the opposite end post diagonally. By twisting the double strands together the gate is held securely. It can then be covered with mixed mesh netting wire and hung as follows. Under one end post a block of wood is inserted in the ground. In this block, and also in the gate post resting on it, a ½-in. wide hole is bored 3 in. deep. Into these holes is inserted a 6-in. iron rod (obtained by cutting the square head off a 6-in. bolt), and finally a piece of fencing wire is stabled round the head of both gate post and strainer. The gate will then swivel upon the iron rod, and swing easily to and fro. If the gate is barked and creosote or tar applied, the life and effectiveness of the gate are duly prolonged.

J. A.

Assistance of a Sketch Map.

It is the duty of every forester to minimise expenditure without lowering the standard of work. In both fencing and planting this is possible by eliminating all unnecessary transport charges. In fencing for instance, it has helped me considerably to draw a rough sketch map of the area to be fenced, dividing the line of fence into sections, and then conveying the approximate material required to each section. In the latter, in allocating plants for future planting, I invariably draw a sketch map of the area to be planted, filling in as accurately as possible for each small area the species and approximate number of plants required. On commencing planting I consult my sketch-map and then convey the requisite number of plants to their respective areas. George Murray.

Notes on the White Spruce (*Picea alba*).

The white spruce, although growing in comparatively small numbers in the north-eastern part of Scotland, has several qualities which give it a distinct advantage over the other coniferous species. The tree, which has a beautiful conical outline, has a heavy dark green slightly glaucous foliage, and is very suitable for ornamental planting in exposed sites. It favours a fairly deep, moist soil, but will thrive on the east coast on peat and in swampy places where the soil is of very poor quality and where other conifers would probably fail.

The quality, which is this species chief advantage, is that in the comparatively dry east coast climate it will thrive in the most exposed situations. White spruce can be seen standing in full foliage on the edges of plantations where other coniferous trees are warped and entirely defoliated by wind blasting.

This adaptability, combined with its very close style of branching, makes it an ideal species for use as a shelter belt round young plantations of conifers. During spring there generally occurs in this district a more or less heavy discoloration on the needles of pines and spruces, which it has been suggested may be due to salt-laden winds from the sea. The white spruce suffers little, if at all, from this cause, which fact would indicate that it may be safe to use this species in fairly close proximity to the sea. From a commercial standpoint the tree has one great disadvantage, and that is its comparatively slow rate of growth. From data collected in this locality it was found that the average contents of a tree forty years old was 12 cu. ft. However, it may be pointed out that these trees had not been given much advantage either from soil conditions or treatment during their life-time.

The timber is extremely tough, and a saw-mill company operating in the vicinity finds a ready sale for it when manufactured into fence posts, gate rails and fish barrel staves.

On the Forest of Deer a number of these trees were manufactured into fence posts five years ago. The trees were cut into 5 ft. lengths, then split with wedges into the requisite sizes. After pointing, the ends were charred by fire and then tarred. Now, after being in use five years, these posts are still as good as new, showing no indication of rot at the ground surface, as would have been the case had Norway spruce been used. In conclusion, it may be remarked that in this district, where European larch is extremely scarce, not being adapted to the prevailing conditions, the timber of the white spruce has to a great extent been used as a substitute and has given excellent results. A. Ross.

LIST OF TECHNICAL OFFICERS.

HEADQUARTERS.

At 9, Savile Row, London, W.1.
Story, Fraser, Education and Publications Officer.
Guillebaud, W. H., Chief Research Officer.
Sangar, O. J., Assistant to Technical Commissioner.

At Imperial Forestry Institute, Oxford.
Anderson, M. L., Research Officer, England and Wales.

Travelling Officer.
Macdonald, J. A. B., District Officer (Sample Plots).

ENGLAND AND WALES.

Assistant Commissioner's Office (55, Whitehall, London).
Pritchard, H. A., Assistant Commissioner.
Jones, E. W., District Officer (Acquisitions).
Pearson, F. G. O., Probationer District Officer.

New Forest (The King's House, Lyndhurst, Hants).
Young, D. W., Deputy Surveyor.
MacIver, L. E., District Officer.
Lowe, G., District Officer.
Yarr, W. J., Assistant to Deputy Surveyor.

Dean Forest (Whitemead Park, Parkend, Lydney, Glos.).
Taylor, W. L., Deputy Surveyor.
Forster Brown, W., Deputy Gaveller (Mines).
Popert, A. H., District Officer (Part-time Dean School).
Roper, J., Survey Clerk.

Division 1 (Chopwellwood House, Rowlands Gill, Co. Durham).
Hopkinson, A. D., Divisional Officer.
Ross, A. H. H., District Officer.
Batters, G. J. L., District Officer.
Dicker, A. C., Probationer Estate Officer.

Division 2 (15, Belmont, Shrewsbury).
Long, A. P., Divisional Officer.
Fairchild, C. E. L., District Officer.
De Uphaugh, F. E. B., District Officer.
Best, F. C., District Officer.
Smith, R. H., District Officer.

Division 3 (Beacon House, Queen's Road, Bristol).
Scott, F., Divisional Officer.
Ryle, G. B., District Officer.
Russell, W. D., District Officer.

Division 4 (55, *Whitehall, London*).
Felton, A. L., Divisional Officer.
Forbes, R. G., District Officer.
Stileman, D. F., District Officer.
Fossey, R. E., Probationer District Officer.
Sanzen-Baker, R. G., Probationer District Officer.

Division 5 (17, *Queen Street, Peterborough, Northants*).
Steven, H. M., Divisional Officer.
Muir, W. A., District Officer.
Connell, C. A., Probationer District Officer.

Schools for Forest Apprentices.
Broadwood, R. G., District Officer (Instructor).—Parkend, Lydney, Glos.
Watson, H., District Officer (Instructor).—Benmore, Argyle.

SCOTLAND.

Assistant Commissioner's Office (25, *Drumsheugh Gardens, Edinburgh*).
Sutherland, John D., Assistant Commissioner.
Cameron, J., Land Agent.
Newton, L. A., District Officer (Acquisitions).
Macdonald, J., Research Officer, Scotland.
Whyte, J. P. M., District Officer.
Webster, J., District Officer.

Northern Division (51, *Church Street, Inverness*).
Fraser, J., Divisional Officer.
Mackay, J. W., District Officer.
Beresford-Peirse, H. C., District Officer.
Oliver, F. W. A., Assistant to Divisional Officer.
Spraggan, D. S., District Officer.

North-Eastern Division (12, *North Silver Street, Aberdeen*).
Annand, J. F., Divisional Officer.
Bird, D. H., District Officer.
Cowell-Smith, R., District Officer.
Murray, D. V., District Officer.

South-Eastern and Western Division (25, *Drumsheugh Gardens, Edinburgh*).
Murray, J. M., Divisional Officer.
Whellens, W. H., District Officer.
Home, G., District Officer.
Gosling, A. H., District Officer.
Macdonald, J. M., Probationer District Officer.

Foresters.

England and Wales.

Name.	*Grade.*	*Name.*	*Grade.*
Division 1.			
McGlashan, J.	I	Gough, W. R. ..	II
Bewick, W. J.	II	Hodgson, W. ..	II
Laney, H.	II	Gilson, R. ..	II
Anderson, J. T. ..	II	Simpson, G. A. ..	II
Reid, D.	II	Liddell, J. ..	II
McNab, C.	II		
Division 2.			
Butter, R. ..	I	Brown, G. H. ..	II
Jones, H. W. ..	I	Cowe, J. F. ..	II
Shaw, J. L. ..	I	Inglis, A. ..	II
Anderson, J. W.	I	Lomas, J. ..	II
Fraser, R. ..	I	Edwards, D. T. ..	II
Roberts, W. G. ..	II	Jones, D. ..	II
Squires, C. V. ..	II	Smith, H. J. ..	II
Harris, W. A. ..	II	Wellington, C. R.	II
Harrison, Percy	II		
Division 3.			
Hall, W. J. ..	I	Pallett, R. E.	II
Williams, J. ..	I	Wild, P. ..	II
Wallington, A. W.	II	Harrison, P.	II
Hollis, G. W. ..	II	Caddy, T.	II
Pritchard, R. ..	II	Edwards, L.	II
Jones, A. H. ..	II	Wylie, N. A.	II
Weir, A.	II		
Division 4.			
Aston, A. S. ..	I	Cottenham, W. ..	II
Dyer, H. C. ..	I	Gulliver, G. H. ..	II
Nelmes, F. J. ..	I	Aston, T. H. ..	II
Simpson, A. ..	—	Phelps, S. E. ..	II
Richards, G. H.	II	Saunders, H. J.	II
Butler, R. ..	II	Kent, W. ..	II
Johnson, A. E. ..	II	McKenzie, C. ..	II
Division 5.			
Anderson, T. E.	Head	Johnson, H.	II
Tribe, W.	II	Everitt, F. W.	II
Hendrie, T.	II	Price, A.	II
Clark, J. S.	II	Parry, A. A.	II
Bewick, R.	II	Smith, J. J.	II

England and Wales—continued.

Name.	*Grade.*	*Name.*	*Grade.*
New Forest.			
Forgan, W.	Head	Blake, W. G. ..	II
Aston, O. R. T. ..	I	Gale, B.	II
Parker, F. H.	II	Colwill, S. W. ..	II
Adams, J. H.	II	Wallington, H. J.	II
Dean Forest.			
Smith, Frank	Head	Watson, F.	II
Humphries, W. J. ..	I	Lees, G.	II
Lewis, T.	I	Morgan, T.	II
Walker, A. E.	II	Williams, D. N. (School)	II
Christie, W.	II	Roberts, J.	II
Taylor, G. ..	II	Light, G...	II
Adams, I. ..	II		

Scotland.

N. Division.			
Anderson, W.	I	Macintosh, W.	II
McEwan, J. ..	I	Gunn, J.	II
Murray, W. ..	I	Kennedy, J.	II
Mason, W. ..	I	Cameron, R.	II
McClymont, W.	II	Stewart, P.	II
Mackay, K. ..	II	Mackenzie, J.	II
Macdonald, D. ..	II		
N.E. Division.			
Cameron, J.	Head	Clark, F. J.	II
Warren, A.	Head	Allan, J.	II
Sinclair, W.	I	Mackenzie, G. ..	II
Shaw, R... ..	I	Ross, A.	II
Lamb, J. A. ..	I	Allan, T. ..	II
Mitchell, F. M. ..	II	Kennedy, J. M.	II
Robbie, J. D. ..	II	Murray, G. ..	II
McConnell, J. ..	II	Mackay, W. ..	II
Corbett, J. ..	II		
S.E. and W. Division.			
Paterson, S. H. A.	I	Macmillan, H. ..	II
Simpson, A. N. ..	I	Ross, W. L. ..	II
Macintyre, J. F.	I	MacRae, M. ..	II
Cameron, Hugh	II	Grant, A. ..	II
Reid, J. M. ..	II	Drysdale, A. ..	II

Scotland—continued.

Name.	*Grade.*	*Name.*	*Grade.*
S.E. and W. Division—continued.			
Calder, J.	II	Donald, R. R. (School)	II
Fraser, A. M.	II	McDonald, J. D. ..	II
Graham, A.	II	Watson, J.	II
Kennedy, J. A. M. ..	II	Sinclair, L.	II
Cameron, Alistair ..	II	Ritchie, M.	II

Research and Experiment.

Gray, W. G. (Oxford) ..	II	Mackenzie, A. M. ..	II
Grant, A. (Edinburgh) ..	II		(Headquarters)
Brookman, H. A. (Edinburgh)	II	Maund, J. E. (Headquarters	II)

REGISTER OF IDENTIFICATION NUMBERS.

FOREST YEAR, 1931.

The order of arrangement is as follows :—

Serial number (preceded by the last two numbers of the forest year in which supplies were received); quantity; species; crop year; origin; vendor; purity per cent.; germination and fresh seed per cent.

31/1 5 lb.; *Fraxinus americana;* 1930; U.S.A. (Nottingham, Rockingham Co., N.H.); L. E. Williams Nursery Co.

31/2 10 lb.; *Pinus Laricio;* 1930; Cyprus (Troodos); Cyprus Government.

31/3 5 lb.; *Liriodendron Tulipifera;* 1930; U.S.A. (Philadelphia, Pa.); Conyers B. Fleu Jr.

31/4 1 lb.; *Larix leptolepis;* 1930; Japan (S.E. of Kiso district, altitude 1300–2200 ft.); gift from Mr. Murakami, Tokio.

31/5 3 lb.; *Acer saccharum;* 1930; U.S.A. (Rockingham Co., N.H.); L. E. Williams Nursery Co.

31/6 7 lb.; *Cupressus macrocarpa;* 1930; U.S.A. (Monterey, Northern California); Morris & Snow Seed Co.

31/7 6½ lb.; *Sequoia sempervirens;* 1930; U.S.A. (Fort Bragg, Mendocino Co., California, altitude 280 ft.); E. S. Mainwaring & Sons.

31/8 45 lb.; *Quercus Mirbeckii;* 1930; Algeria; gift from French Forestry Service.

31/9 782 lb.; *Quercus sessiliflora;* 1930; Germany (Brandenburg); Schultze & Co.

31/10 3,792 lb.; *Quercus pedunculata;* 1930; Holland (Wageningen–Arnhem–Dieren district); Nederlandsche Heidemaatschappij.

31/11 3 lb.; *Pinus Laricio* var. *calabrica;* 1930; Italy (Sila Forest, Cosenza, Calabria); gift from Mons. Luigi Storti.

31/12 1 lb.; *Pinus resinosa;* 1930; U.S.A. (Chippewa National Forest, Cass Lake, Minnesota, altitude 1,300 ft.); gift from U.S.A. Forest Service.

31/13 2 lb.; *Picea Engelmanni;* 1930; U.S.A. (San Isabel Forest, Colorado); Barteldes Seed Co.

31/14 10 lb.; *Abies concolor;* 1930; U.S.A. (Plumas Co., California, altitude 5,000 ft.); James Dodge.

31/15 78 lb.; *Abies grandis;* 1930; U.S.A.; Manning Seed Co.; 95; 35 + 5.

31/16 2 lb.; *Picea sitchensis;* 1930; U.S.A. (Brooklyn); Manning Seed Co.

31/17 18 lb.; *Carya tomentosa* (*Hicoria alba*); 1930; America (Northern Tennessee and Kentucky); O. Katzenstein & Co.

31/18 18 lb.; *Carya amara* (*Hicoria cordiformis*); 1930; America (Northern Tennessee and Kentucky); O. Katzenastein & Co.

31/19 2 lb.; *Picea sitchensis;* 1930; U.S.A. (Curry Co., Oregon, altitude 30–50 ft.); Long-Bell Lumber Co.

31/20 2 lb.; *Cryptomeria japonica;* 1930; Japan (Takahagi near Tokio, Ibaraki); gift from M. Fujioka, Tokio.

31/21 1¾ lb.; *Pinus desiflora;* 1930; Japan (Iwamurata near Tokio, Shinano); gift from M. Fujioka, Tokio.

31/22 2 lb.; *Abies nobilis;* 1930; Wales (Corris Valley); own collection.

31/23 10 lb.; *Larix europaea;* 1930; Silesia (Sudeten, altitude 1,700–2,600 ft.); Semenarsky zavod statnich lesu.

31/24 2,893 lb.; *Quercus sessiliflora;* 1930; Germany (Darmstadt); Heinrich Keller Sohn.

31/25 47 lb.; *Larix europaea;* 1929; Austria (altitude 660–1,640 ft.) J. Stainer; 86·9; 43.

31/26 2 lb.; *Pinus Murrayana;* 1930; Canada (Mt. Ida, British Columbia); Canadian Government.

31/27 3½ lb.; *Pinus Murrayana;* 1930; Canada (Clearwater River, British Columbia, altitude 1,200–1,500 ft.); Canadian Government.

31/28 3½ lb.; *Pinus Murrayana;* 1930; Canada (Columbia River, British Columbia, altitude 2,600 ft.); Canadian Government.

31/29 1,557 lb.; *Pseudotsuga Douglasii;* 1930; Canada (Lower Fraser River Valley, British Columbia, altitude 200–400 ft.); Canadian Government; 96; 84 + 3.

31/30 4½ lb.; *Alnus oregona;* 1930; Canada (Pt. Coquitlam and New Westminster, British Columbia); Canadian Government.

31/31 33 lb.; *Thuya plicata;* 1929; Canada (Lower Fraser Valley, British Columbia); Canadian Government; 97; 43.

31/32 ½ lb.; *Chamaecyparis nootkatensis;* 1930; Canada (North Vancouver City, British Columbia); Canadian Government.

31/33 24 lb.; *Picea sitchensis;* 1930; Canada (Queen Charlotte Islands, British Columbia); Canadian Government; 91·7; 84.

31/34 140 lb.; *Abies grandis;* 1930; Canada (Southern Vancouver Islands and Lower Fraser Valley, British Columbia); Canadian Government; 96·8; 31 + 11.

31/35 1 lb.; *Acer macrophyllum;* 1930; Canada (Lower Fraser Valley, British Columbia); Canadian Government.

31/36 53 lb.; *Pseudotsuga Douglasii;* 1929; Canada (British Columbia; Interior Wet Belt); Canadian Government; 98·5; 76 + 3.

31/37 331 lb.; *Larix europaea;* 1929; Austria (Inn Valley, Northern Tyrol, altitude 1,970–2,620 ft.); J. Jenewein; 92·8; 42 + 2.

31/38 42 lb.; *Larix europaea;* 1929; Silesia (Sudeten); H. Hanel; 81·4; 46.

31/39 5¼ lb.; *Alnus glutinosa;* 1930; Silesia (Sudeten); H. Hanel.

31/40 3 lb.; *Cupressus macrocarpa;* 1930; France; Vilmorin-Andrieux.

31/41 3 lb.; *Thuya plicata;* 1930; France; Vilmorin-Andrieux.

31/42 10 lb.; *Juglans regia;* 1930; France; Vilmorin-Andrieux.

31/43 6 lb. ; *Alnus glutinosa ;* 1930 ; France ; Vilmorin-Andrieux.

31/44 1 lb. ; *Pinus austriaca ;* 1930 ; Austria ; Vilmorin-Andrieux.

31/45 20 lb. ; *Sequoia sempervirens ;* 1930 ; Italy ; Vilmorin-Andrieux ; 98·4 ; 17.

31/46 2,091 lb. ; *Pinus Laricio ;* 1930 ; France (Corsica) ; J. Grimaldi ; 98·8 ; 44 + 5.

31/47 112 lb. ; *Alnus incana ;* 1930 ; Lower Austria (altitude 650–1,650 ft.) ; J. Stainer.

31/48 665 lb. ; *Picea excelsa ;* 1929 ; Austria (primary mountains, altitude 650–1,650 ft.) ; J. Stainer ; 99·5 ; 79 + 1.

31/49 4¼ lb. ; *Pinus Murrayana ;* 1930 ; Canada (East of Kamloops, British Columbia, altitude 1,310–3,450 ft.) ; J. Rafn.

31/50 2½ lb. ; *Abies nobilis ;* 1930 ; Denmark (Island Fyn) ; J. Rafn.

31/51 2½ lb. ; *Pinus ponderosa ;* 1930 ; Canada (Kamloops, British Columbia, altitude 1,150–2,950 ft.) ; J. Rafn.

31/52 11½ lb. ; *Pinus insignis ;* 1930 ; West America ; J. Rafn.

31/53 10 lb. ; *Pinus montana* var. *uncinata ;* 1930 ; Denmark (Jutland) ; J. Rafn.

31/54 2½ lb. ; *Acer campestre ;* 1930 ; Denmark ; J. Rafn.

31/55 5½ lb. ; *Tilia parvifolia ;* 1930 ; Bohemia ; J. Rafn.

31/56 5½ lb. ; *Sophora japonica ;* 1930 ; Austria ; J. Rafn.

31/57 19 lb. ; *Quercus coccinea ;* 1930 ; U.S.A. (Georgia) ; J. Rafn.

31/58 71 lb. ; *Quercus rubra ;* 1930 ; Germany ; J. Rafn.

31/59 1 lb. ; *Betula papyracea ;* 1930 ; U.S.A. (New Hampshire) ; J. Rafn.

31/60 5 lb. ; *Acer platanoides ;* 1930 ; Denmark ; J. Rafn.

31/61 5 lb. ; *Carya alba ;* 1930 ; U.S.A. (Georgia) ; J. Rafn.

31/62 19 lb. ; *Quercus palustris ;* 1930 ; U.S.A. (Missouri) ; J. Rafn.

31/63 1 lb. ; *Eucalyptus Gunnii ;* 1930 ; New Zealand ; J. Rafn.

31/64 2 lb. ; *Picea excelsa ;* 1929 ; Germany (Braunlage, Hartz Mountains) ; Braunschweig Forstliche Versuchsanstalt.

31/65 416 lb. ; *Pinus Laricio ;* 1930 ; France (Corsica) ; P. Spinosi.

31/66 1,404 lb. ; *Larix europaea ;* 1929 ; Switzerland (Münstertal, altitude 4,430–5,900 ft.) ; J. Roner ; 93·2 ; 48.

31/67 50 cones ; *Picea asperata ;* 1930 ; China (Wenchiren District of West Szechuan, altitude 5,250 ft.) ; gift from Memorial Park Commission, Peking.

31/68 3 oz. ; *Pinus densiflora ;* 1930 ; Japan (Sendai) ; gift from M. Fujioka, Tokio.

31/69 3 oz. ; *Pinus koraiensis ;* 1930 ; Japan (Korea) ; gift from M. Fujioka, Tokio.

31/70 4 oz.; *Pinus densiflora ;* 1930 ; Japan (Miyako, Iwate) ; gift from M. Fujioka, Tokio.

31/71 10 oz. ; *Pinus densiflora ;* 1930 ; Japan (Hirosaki, Aomori) ; gift from M. Fujioka, Tokio.

31/72 2 oz. ; *Picea Glehnii ;* 1930 ; Japan (" Hokkaido ") ; gift from M. Fujioka, Tokio.

31/73 1 oz.; *Picea jezoensis;* 1930; Japan (" Karafuto "); gift from M. Fujioka, Tokio.

31/74 2 oz.; *Picea jezoensis;* 1930; Japan (" Hokkaido "); gift from M. Fujioka, Tokio.

31/75 1 oz.; *Taxus cuspidata;* 1930; Japan (" Hokkaido "); gift from M. Fujioka, Tokio.

31/76 1 oz.; *Abies firma;* 1930; 1930; Japan (" Chiba "); gift from M. Fujioka, Tokio.

31/77 1 oz.; *Torreya nucifera;* 1930; Japan (" Chiba "); gift from M. Fujioka, Tokio.

31/78 2 oz.; *Thujopsis dolabrata;* 1930; Japan (Tanabu, Aomori); gift from N. Fujioka, Tokio.

31/79 1 oz.; *Thujopsis dolabrata;* 1930; Japan (Uchimappe, Aomori); gift from M. Fujioka, Tokio.

31/80 1 oz.; *Larix dahurica Turcz,* var. *corcana Nakai;* 1930; Japan (Korea); gift from M. Fujioka, Tokio.

31/81 1 oz.; *Abies sachalinensis;* 1930; Japan (" Hokkaido "); gift from M. Fujioka, Tokio.

31/82 10 oz.; *Chamaecyparis obtusa;* 1930; Japan (Kiso, Nagano); gift from M. Fujioka, Tokio.

31/83 3 oz.; *Chamaecyparis pisifera;* 1930; Japan (Kiso, Nagano); gift from M. Fujioka, Tokio.

31/84 9 oz.; *Cryptomeria japonica;* 1930; Japan (" Chiba "); gift from N. Fujioka, Tokio.

31/85 2 lb.; *Picea obovata;* 1930; Russia; gift from Russian Government.

31/86 507 lb.; *Larix leptolepis;* 1930; Japan; S. Ando; 94; 74 + 2.

31/87 502 lb.; *Larix leptolepis;* 1930; Japan; Shinano Shubyo Co.; 98; 56 + 3.

31/88 ½ lb.; *Pinus maritima;* 1930; France (Landes); Vilmorin-Andrieux.

31/89 1 lb.; *Pinus Strobus;* 1930; U.S.A. (Coast of Maine); Brown Co.

31/90 1 lb.; *Picea rubra;* 1930; U.S.A. (Coast of Maine); Brown Co.

31/91 1,008 lb.; *Pinus sylvestris;* 1930; England (East); own collection; 99·7; 95.

31/92 10 lb.; *Juglans regia;* 1930; France; J. Rafn.

31/93 2 lb.; *Larix leptolepis;* 1930; England (East); own collection.

31/94 1½ lb.; *Chamaecyparis Lawsoniana;* 1930; England (East); own collection.

31/95 1 lb.; *Picea Omorica;* 1930; Serbia; Sarajevo Forest Department.

31/96 513 lb.; *Larix leptolepis;* 1930; Japan; Yokohama Nursery Co.; 98·4; 49 + 1.

31/97 10 lb.; *Acer saccharinum;* 1930; U.S.A. (Philadelphia, Pa.); Conyers B. Fleu Jr.

31/98 3 lb.; *Acer rubrum;* 1930; U.S.A. (Philadelphia, Pa.); Conyers B. Fleu Jr.

31/99 10 lb.; *Pinus Laricio;* 1930; Cyprus (Troodos); Cyprus Government.
31/100 160 lb.; *Pinus maritima;* 1930; Portugal (Leira); gift from Portuguese Government.
31/101 2 lb.; *Ulmus parvifolia;* 1930; South Africa; South African Government.
31/102 8 oz.; *Nothofagus dombeyi;* 1930; Chile; gift from Chilian Government.
31/103 8 oz.; *Nothofagus procera;* 1930; Chile; gift from Chilian Government.
31/104 15 oz.; *Nothofagus obliqua;* 1930; Chile; gift from Chilian Government.
31/105 114 lb.; *Acer Pseudoplatanus;* 1930; England (North); own collection.
31/106 10 lb.; *Acer Pseudoplatanus;* 1930; England (East); own collection.
31/107 205 lb.; *Acer Pseudoplatanus;* 1930; England (South); own collection.
31/108 156 lb.; *Acer Pseudoplatanus;* 1930; England (West); own collection.
31/109 35 lb.; *Fagus sylvatica;* 1930; England (North); own collection.
31/110 975 lb.; *Fraxinus excelsior;* 1930; England (North); own collection.
31/111 1,255 lb.; *Fraxinus excelsior;* 1930; England (West); own collection.
31/112 4,444 lb.; *Fraxinus excelsior;* 1930; England (Midlands); own collection.
31/113 895 lb.; *Fraxinus excelsior;* 1930; England (East); own collection.
31/114 412 lb.; *Fraxinus excelsior;* 1930; England (South); own collection.
31/115 52 lb.; *Crataegus Oxyacantha;* 1930; England (North); own collection.
31/116 701 lb.; *Crataegus Oxyacantha;* 1930; England (West); own collection.
31/117 30 lb.; *Quercus sessiliflora;* 1930; England (Midlands); own collection.
31/118 30 lb.; *Quercus pedunculata;* 1930; England (West); own collection.
31/119 728 lb.; *Quercus pedunculata;* 1930; England (South); own collection.
31/120 130 lb.; *Quercus pedunculata;* 1930; England (Midlands); own collection.
31/121 26 lb.; *Aesculus Hippocastanum;* 1930; England (Midlands); own collection.
31/122 392 lb.; *Aesculus Hippocastanum;* 1930; England (West); own collection.

31/123 23½ lb.; *Castanea vesca;* 1930; England (South); own collection.
31/124 25 lb.; *Castanea vesca;* 1930; England (West); own collection.
31/125 920 lb.; *Castanea vesca;* 1930; England (East); own collection.
31/126 165 lb.; *Juglans regia;* 1930; England (South); own collection.
31/127 32 lb.; *Juglans regia;* 1930; England (West); own collection.
31/128 38 lb.; *Juglans regia;* 1930; England (East); own collection.
31/129 6,985 lb.; *Quercus Robur;* 1930; England (East); own collection.
31/130 100 lb.; *Carpinus Betulus;* 1930; England (East); own collection.
31/131 10 lb.; *Carpinus Betulus;* 1930; England (West); own collection.
31/132 22 lb.; *Betula* spp.; 1930; England (East); own collection.
31/133 15 lb.; *Robinia Pseudacacia;* 1930; England (East); own collection.
31/134 45 lb.; *Alnus incana;* 1930; England (West); own collection.
31/135 1,000,000 seedlings (2-year); *Picea sitchensis;* crop year unknown; origin unknown; Ministry of Agriculture, Northern Ireland.
31/136 50,000 transplants; *Picea sitchensis;* crop year unknown; origin unknown; English Forestry Association.
31/137 100,000 seedlings (3-year); *Picea excelsa;* crop year unknown; origin unknown; Liverpool Corporation (Lake Vyrnwy).
31/138 25,000 transplants (2 + 1); *Larix leptolepis;* crop year unknown; England (West); Llandinam Estates Co.
31/139 60,000 transplants (2 + 1, 2 + 2); *Larix leptolepis;* crop year unknown; origin unknown; English Forestry Association.
31/140 5,800 transplants (2 + 1); *Larix eurolepis;* crop year unknown; England (West); Llandinam Estates Co.
31/141 58,500 transplants (2 + 1, 2 + 2); *Larix europaea;* crop year unknown; origin unknown; Clinton Estates Ltd.
31/142 187,000 transplants (1 + 1); *Larix europaea;* crop year unknown; origin unknown; English Forestry Association.
31/143 72,000 transplants; *Larix europaea;* Crop year unknown; origin unknown; English Forestry Association.
31/144 50,000 transplants; *Larix europaea;* crop year unknown; origin unknown; Ministry of Agriculture, Northern Ireland.
31/145 90 lb.; *Pinus sylvestris;* 1929; Scotland (N.E.); own collection.
31/146 762 lb.; *Pinus sylvestris;* 1930; Scotland (N.E.); own collection.
31/147 2¼ lb.; *Pinus sylvestris;* 1930; Scotland (West); own collection.
31/148 25 lb.; *Pinus sylvestris;* 1929; Scotland (N.E.); own collection.

31/149 46 lb.; *Pinus sylvestris;* 1930; Scotland (N.E.); Capt. J. B. Dunbar, Pitgaveny.
31/150 68 lb.; *Larix europaea;* 1930; Scotland (S.E.); own collection.
31/151 436 lb.; *Larix europaea;* 1930; Scoltand (N.E.); own collection.
31/152 1¼ lb.; *Larix europaea;* 1930; Scotland (West); own collection.
31/153 14 oz.; *Tsuga Albertiana;* 1930; Scotland (S.E.); own collection.
31/154 12 lb.; *Abies nobilis;* 1930; Scotland (S.E.); own collection.
31/155 42 lb.; *Abies nobilis;* 1930; Scotland (N.E.); own collection.
31/156 91 lb.; *Abies nobilis;* 1930; Scotland (West); own collection.
31/157 2 lb.; *Picea sitchensis;* 1930; Scotland (S.E.); Col. W. S. Fothringham.
31/158 1 lb.; *Picea sitchensis;* 1930; Scotland (S.E.); own collection.
31/159 8 lb.; *Pseudotsuga Douglasii;* 1930; Scotland (N.E.); own collection.
31/160 1½ lb.; *Pseudotsuga Douglasii;* 1930; Scotland (West); own collection.
31/161 1 lb.; *Pinus montana* var. *pumilio;* 1930; Scotland (S.E.); own collection.
31/162 3½ lb.; *Thuya plicata;* 1930; Scotland (S.E.); own collection.
31/163 10 lb.; *Thuya plicata;* 1930; Scotland (N.E.); own collection.
31/164 19 lb.; *Thuya plicata;* 1930; Scotland (West); own collection.
31/165 12 oz.; *Chamaecyparis Lawsoniana;* 1930; Scotland (N.E.); own collection.
31/166 2 lb.; *Chamaecyparis Lawsoniana;* 1930; Scotland (West); own collection.
31/167 5 oz.; *Chamaecyparis Lawsoniana;* 1930; Scotland (S.E.); own collection.
31/168 4 oz.; *Alnus glutinosa;* 1930; Scotland (N.E.); own collection.
31/169 2 lb.; *Abies grandis;* crop year unknown; Scotland (N.E.); F. D. S. Sandeman.
31/170 1 lb.; *Abies grandis;* 1930; U.S.A. (Western Oregon); Long-Bell Lumber Co.
31/171 1 lb.; *Larix eurolepis;* 1930; Scotland (N.E.); Earl of Strathmore.
31/172 3½ lb.; *Larix* (? *eurolepis* or *europaea*); 1930; Scotland (S.E.); Col. W. S. Fothringham.
31/173 3 lb.; *Sequoia gigantea;* 1930; Scotland (S.E.); own collection.
31/174 9 lb.; *Abies Nordmanniana;* 1930; Scotland (S.E.); own collection.
31/175 5 lb.; *Abies pectinata;* 1930; Scotland (S.E.); own collection.
31/176 10 lb.; *Acer platanoides;* 1930; Scotland (N.E.); own collection.
31/177 2 lb.; *Pyrus Aria;* 1930; Scotland (N.E.); own collection.

31/178 80 lb.; *Fraxinus excelsior;* 1930; Scotland (N.E.); own collection.

31/179 20. lb.; *Quercus sessiliflora;* 1930; Scotland (N.E.); own collection.

31/180 107 lb.; *Acer Pseudoplatanus;* 1930; Scotland (N.E.); own collection.

31/181 40 lb.; *Fagus sylvatica;* 1930; Scotland (S.E.); own collection.

31/182 1703 lb.; *Fagus sylvatica;* 1930; Scotland (N.E.); own collection.

31/183 6 lb.; *Pyrus aucuparia;* 1930; Scotland (N.E.); own collection.

31/184 2½ lb.; *Abies amabilis;* 1930; U.S.A. (altitude 3,000 ft.); Long-Bell Lumber Co.

31/185 2½ lb.; *Abies amabilis;* 1930; U.S.A. (altitude 5,000 ft.); Long-Bell Lumber Co.

31/186 1 lb.; *Abies concolor;* 1930; U.S.A. (Sierras, North California); Long-Bell Lumber Co.

31/187 1 lb.; *Abies magnifica;* 1930; U.S.A. (Sierras, North California); Long-Bell Lumber Co.

31/188 2 lb.; *Abies lasiocarpa;* 1930; U.S.A. (Cascades, Washington); Long-Bell Lumber Co.

31/189 2 lb.; *Picea Englemanni;* 1930; Canada (British Columbia); Long-Bell Lumber Co.

31/190 1 lb.; *Pinus Lambertiana;* 1930; U.S.A. (North California); Long-Bell Lumber Co.

31/191 1 lb.; *Pinus Murrayana;* 1930; U.S.A. (Cascades, Washington); Long-Bell Lumber Co.

31/192 40,000 seedlings (2-year); *Larix europaea;* crop year unknown; Denmark; Howden & Co., Inverness.

31/193 4,500 transplants (2 + 1); *Pinus montana* var. *pumilio;* crop year unknown; Italy; Howden & Co., Inverness.

31/194 4,500 transplants (2 + 1); *Pinus montana* var. *uncinata;* crop year unknown; Italy; Howden & Co., Inverness.

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