Memo No. 25/35.

FORESTRY COMMISSION.

Progress Report on Research. March 1935.

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1. Staff. The personnel have not changed to any great extent. Mr J.M. Ross was employed for a few weeks on a special investigation at Rendlesham during the summer of 1934. This man was later appointed District Officer on Probation. In November 1934 Mr R.G. Sangster was engaged as a temporary assistant to the Research Officer for Scotland, this was by arrangement with the Colonial Office and it is understood that this man will shortly have to be released.

2. Nursery Investigations. Work in 1934.

In the previous year the principal subjects of investigation were weed control, stratification of seed, method of covering small seeds, and date of sowing. These were continued in 1934 and in addition experiments were carried out on density of sowing, and on the use of organic substitutes for farmyard manure or leaf mould as a means of maintaining the fertility of nursery soils.

(1) Weed Control. Experiments were continued in Kennington Nursery Oxford and in a number of nurseries in Scotland. At Kennington chemicals only (Sulphuric acid, Sodium chlorate, and Aluminium sulphate) were used, but in Scotland blow lamp treatments were also included. At Kennington, where the drought was acutely felt, Sodium chlorate, which was very successful the previous year, greatly reduced the germination of the tree seeds. This chemical appears altogether too liable to cause serious damage to be safe in general practice. Sulphuric acid was again generally successful, weeding times were reduced to from one tenth to one half that of the controls and germination was not substantially affected. Except at Benmore the

blow lamp gave disappointing results and the conclusion was that it was only likely to be worth using where the weed growth is very strong. Summing up the work to date on weed control with chemicals, Sodium chlorate is too risky and none of the other salts tried seems likely to be both effective and reasonably safe. The best substance is undoubtedly sulphuric acid applied at a strength of 1 part of acid to 90 parts of water, at the rate of 1 gallon per square yard of seed bed, and sprayed on five to seven days after sowing. It must be observed that Sulphuric acid cannot be recommended for indiscriminate use because light sandy soils are unsuitable and very special precautions must always be taken to ensure that the acid is applied at the correct strength, but it is considered that the method is well worth a more extended trial in selected nurseries in the west and north of the country.

(2) Stratification of Seed. This experiment was continued for the third year at Kennington with Douglas fir seed and there were two sections, in one of which the seed to be stratified was mixed with sand and placed in earthenware flower pots buried to ground level in the nursery soil (Shallow Treatment). In the other section (Deep treatment) the mixture of seed and sand was placed in flower pots which were buried to a depth of 18 inches below ground level. The results were as follows, expressing the number of seedlings produced in terms of the yield from the dry stored seed as = 100.

	Shallow Treatment of Stratification.	Deep Treatment of Stratification.
A. Seed dry stored sown in Spring	100	100
B. Seed sown in Autumn	600	600
C. Seed stratified in sand at end of January and sown in Spring.	920	920

Stratification has improved the yield nine-fold compared with the standard method of spring sowing and is a significant improvement on autumn sowing. There was no difference between the shallow and deep

methods of stratification. Stratification of stored seed of Douglas fir has now been put into general practice in Divisional nurseries with satisfactory results.

(3) Method of Covering Small Seeds. The 1934 experiments with types of covering afford an excellent illustration of the necessity of repeating a method over several seasons before arriving at any definite conclusions. In 1933 the Scottish results were in favour of covering with fine sand as compared with either nursery soil, medium sand or coarse sand. This year there were some violent dry wind storms shortly after sowing and the wind took sand and seed and strewed them over the adjoining countryside. Then again birds were a nuisance as they singled out the sand-covered beds to dust in and did a good deal of damage. The upshot was that in one nursery (Inchnacardoch) the outturn was reduced in the beds covered with fine sand to only 20 per cent of that of the control. Elsewhere there was no corresponding disaster but the sand coverings did not lead to any really substantial increase in yield. The average outturn, using medium and coarse sand, was only 10 per cent greater than in the control plots covered with nursery soil (species European larch and Sitka spruce). Birch and alder, however, reacted in the usual way to sand covering and yields were increased from five to nine-fold.

The experience this year with coniferous seeds was undoubtedly exceptional, but it serves as a warning against the use of very fine sand in exposed nurseries.

(4) Date of Sowing. It is generally known that early sowing is advantageous but there are sometimes difficulties connected with tilth and in a large nursery the ground required for seed beds may be under lines which cannot be cleared in time for sowing early. However the results outlined below suggest that it is worth while making every effort to secure early sowing.

Three species were used. Japanese larch, Sitka spruce and Pinus contorta. The dates of sowing were March 22nd (Early Sowing) and May 8th (Late Sowing) 1934. Seed was sown in drills and

sand used for covering the seed. (Note, the use of coarse dry sand for covering very largely overcomes the tilth difficulty as seed can be sown under conditions which would be impossible if the seed had to be covered with the ordinary nursery soil.)

The following are the provisional results.

Germination.

	Early Sowing	Late Sowing
J.L.	General on April 26	Sporadic on June 27
S.S.	do on May 9	do on June 29
P.C.	do on May 9	do on June 30

Thus both early and late sowings took about the same time to germinate (from 6 weeks to 2 months). It must be remembered however that 1934 was a drought year and the dry spell set in about the end of April. In a normal season the late sowings of Japanese larch and Pinus contorta would have germinated more quickly. In this case the seedlings from the early sowings had about 2 months longer growing season than those from the late sowing.

Production per lb of seed.

	Early Sowing	Late Sowing	Ratio Early sowing to late sowing.
J.L.	45000	12000	4 : 1
S.S.	83000	7000	12 : 1
P.C.	67000	3000	22 : 1

The date of sowing has thus made all the difference between success and virtual failure, as far as yield of seedlings is concerned. The season of course was exceptional but it is evident that early sowing is a very efficient means of insurance against failure in a drought year.

The results are amply borne out by the experience of other sowings in Kennington nursery, any seed sown before about the middle of April did well while all the May sowings were very poor.

Size of Seedling.

	Early Sowing		Late Sowing	
	Maximum in.	Average in.	Maximum in.	Average in.
J.L.	6	3½	2	1 ½
S.S.	3	1½	1½	¾
P.C.	3	1½	1½	¾

The early sown seed which was got in under favourable conditions produced seedlings which were able to establish themselves before the drought set in and produced not only many more but also much stronger plants than those from the late sowings. The former can be lined out at one year while the latter are too small to handle.

(5) Density of Sowing. Density of sowing experiments were carried out in both countries and were based on the new thinner standard densities recently laid down. The germination varied considerably in the different nurseries but a useful series of plots has resulted and we can count on obtaining some quite definite evidence when the seedlings come to be lifted and graded.

(6) Trial of Organic Manures. Owing to the difficulty of obtaining adequate supplies of broad leaf humus or farmyard manure for the purpose of enriching nursery soils in humus it was decided to experiment with other forms of vegetable matter which might be possible substitutes.

The following substances were used.

(a) Sorbex peat from Sorbex Peat Ltd. of 7 Queen St. London, E.C.4. Price from 10/- to 12/- per bale. Sorbex is a yellowish rather strawy material, only imperfectly humified.

(b) Moss Peat Mould from the London & Provincial Moss Litter Co. Ltd. of Argyll House Euston Road, London, N.W.1. Price about 7/6 per bale. This is a black crumbly material well humified.

(c) Peat from the Cwm Ddu bog on Beddgelert Forest. This peat was sent to the nursery in October 1932 for some stratification experiments and was kept stored in a box. It is a black amorphous

peat probably taken from some distance below the surface of the bog.

(d) Compost prepared from mustard grown in the nursery in 1933. Ammonium sulphate was used as the composting agent.

(e) Decomposed Weed Compost.

(f) There was the usual control which received no organic material.

All treatments were replicated. The beds were prepared in the usual way; no inorganic manures were applied; substances (a) to (d) were applied in the form of a 50 per cent mixture of the substance and nursery soil, the depth of the mixture laid on the bed excavated for the purpose being 4 inches. In the case of (e) the decomposed weed compost formed a layer on the bed 4 inches in depth (there was no further admixture with nursery soil.) Species Norway spruce, Sitka spruce, and Pinus contorta. Seed sown broadcast on April 24 1934 and covered with sand. Densities. N.S. 1 lb. to 400 sq. ft. S.S. 1 lb. to 800 sq. ft. P.C. 1 lb. to 600 sq. ft. The weed compost plots were sprayed with Sodium chlorate after sowing and tree germination was inhibited, results of this treatment are accordingly omitted in the following summary.

Production per lb. of seed.

	N.S.	S.S.	P.C.
Sorbex Peat	29000	86000	56000
Moss Peat Mould	29000	23000	15000
Beddgelert Peat	28000	35000	22000
Mustard Compost	15000	13000	5000
Control	21000	21000	11000

The highest production of all species has been given by the Sorbex peat which has increased the output of S.S. and P.C. by 4 and 5 times respectively, compared with the control. Beddgelert peat comes second with a decided increase in the yield of S.S. and P.C. but Moss Peat Mould has given as good results as Sorbex with N.S. It is curious that the mustard compost should have depressed the germination of all three species.

The improvement in the germination brought about by the peat substances is interesting because in such a dry season the addition of

so large an amount of organic matter might have been expected to upset the water relations of the soil instead of which it seems to have had the reverse effect, except in the case of the compost.

Size of Seedling.

	N.S.		S.S.		P.C.	
	Max.	Av.	Max.	Av.	Max.	Av.
Sorbex Peat	3	2	$4\frac{3}{4}$	$2\frac{1}{2}$	4	$2\frac{1}{4}$
Moss Peat Mould	$3\frac{1}{2}$	2	4	2	$3\frac{3}{4}$	$2\frac{1}{2}$
Beddgelert Peat	4	$2\frac{1}{2}$	4	$1\frac{3}{4}$	$4\frac{1}{2}$	$2\frac{1}{4}$
Mustard Compost	$2\frac{1}{4}$	1	$1\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{2}$	$\frac{3}{4}$
Control	$2\frac{3}{4}$	$1\frac{1}{4}$	$2\frac{1}{2}$	$1\frac{1}{2}$	$2\frac{3}{4}$	$1\frac{1}{2}$

Apart from the mustard compost all the manures have improved growth but there is evidence of differential response of these three species. Sorbex peat has given the best results with S.S. while N.S. and P.C. are both largest in the plots treated with Beddgelert peat. The differences between any of the three peats are not very great but taken in conjunction with the germination data it would seem that Sorbex peat and Beddgelert peat are rather preferable to the Moss Peat Mould.

The seedlings produced in the peat treated plots are sturdy and many of the plants are furnished with lateral shoots. The root systems appear well balanced and there has been a greater production of sub-laterals than in the nursery soil alone. The real proof - the development of the seedlings when lined out or planted out - is still to come but there seems no reason to anticipate anything but good results.

In the quantities used at Kennington either the Sorbex peat or the Moss Peat Mould would be very expensive on a large scale and it remains to be seen if smaller quantities can be used successfully, the lasting properties have also to be determined. A point to bear in mind with regard to the Beddgelert peat is that it had been kept in store for 18 months before use, raw peat straight from a peat bog might not give equivalent results.

So far as it goes the experiment is useful as showing that we

need not be solely dependent on green manuring, farmyard manure, or broadleaf humus as sources of humus for nursery soils.

(7) Investigation of Nursery Fertility. Manuring experiments planned in co-operation with the Macaulay Institute for Soil Research were laid down at four nurseries in Scotland. The first stage was completed when good green crops were dug in at all four nurseries. Seed will be sown this year and further assessments made on the seedling crops.

3. Programme of Nursery Investigations 1935.

The following is a statement of the major projects.

1. Manuring of seed beds and transplant lines of ash and sycamore.	Kennington, Nagshead, Scotland.
2. Season of Sowing E.L., J.L., S.P., P.C., S.S.	Kennington and 8 nurseries in Scotland.
3. Density of Sowing N.S., S.S. and J.L.	Kennington and nurseries in Scotland.
4. Stratification of Seed S.P., D.F., C.P., N.S., Birch.	Kennington.
5. Trial of Sorbex peat.	Detail experiments at Kennington and Auchterawe. Semi-field-scale trial in a number of divisional nurseries.
6. Undercutting C.P. seedlings.	Thetford.
7. Effect of root pruning and root arrangement on root development of lined out seedlings.	Scotland.
8. Density of bedding out N.S., S.S., S.P.	Kennington and Scotland.
9. Treatment of weed compost heaps.	Kennington and Scotland.
10. Spraying against Oak Mildew.	Kennington and Division 7.
11. Spraying against Meria.	Nagshead, Newton and Auchterawe.

4. Progress of Plantation Experimental Work.

(1) Peat Project.

In the summer a good deal of time was devoted to the recharting of the vegetation on the Lon Mor experimental area. The effects of drainage are interesting, deep draining alone has produced virtually no change in the vegetation but the more intensive the shallow surface draining the greater the effect and it seems that it is the outturned turfs rather than the drains themselves which bring about the change. The general effect of intensive drainage has been to increase the vigour of the heather and bog myrtle which are now much more prominent than they were before the bog was taken in hand. Simultaneously there has been a great reduction in the amount of sphagnum.

The position on the Scirpus peats has not greatly changed. On the Lon Mor the Sitka spruce, where planted at normal spacing and drainage, show no signs of emerging from the check into which they fell after the initial slag stimulus was exhausted. On the other hand some of the very intensively drained, close spaced and manured plots are maintaining their growth quite satisfactorily; in one 6-year old plot of Sitka spruce (No. 74 P.29) canopy is already beginning to form (plants 4 to 5 feet in height).

Japanese larch and Pinus contorta are still thriving at Inchnacardoch as also are the Alnus oregona.

At Achnashellach Experiment 9 P.28 the Japanese larch continues to make good growth, some of the slagged plants are now as much as 16 feet high though the average is a good deal less than this.

Both at Inchnacardoch and Achnashellach most of the recent experimental work has consisted in laying down blocks of Japanese larch at not unduly close spacing (4 feet), and manuring with basic slag or Semsol. In course of time these should indicate whether a first crop of Japanese larch can be economically established on the better types of Scirpus ground, that is primarily the sloping ground excluding the deep bogs.

Beddgelert is looking very promising and there has been no falling off in the height growth of the spruces. Some Pinus contorta have been blown over in the winter gales but on the whole this species is standing well.

At Smales Farm on Kielder Forest, there is a P.29 experiment in which various mixtures of Pinus contorta and Sitka spruce were tried. In addition to pure plots of each species there are plots with 25, 50, and 75 per cent of the pine, the balance being spruce. The species were planted on thick turfs, one ounce of slag being applied to each turf at the time of planting. The principal vegetation type may be described as Calluna-Scirpus-Molinia-Eriophorum but there are frequent patches of a better type, Molinia-Aira-Calluna-Vaccinium on which the spruce have grown much faster. The following is the latest assessment.

	Sitka spruce		Pinus contorta	
Type.	Height in.	Leading Shoot in.	Height in.	Leading Shoot in.
Call./Sc./Mol./Erio.	26	4.9	19	5.1
Mol./Aira/Call./Vacc.	47	13.4	18	4.8

The underlying idea in this experiment was that the spruce would be likely to check more than the pine on such a heathery vegetation and that the pine would function as a nurse killing down the herbage and ultimately providing better growth conditions for the spruce. It now looks as if this was not likely to be realised as on the one hand the spruce have not checked substantially even on the poorer ground - an average shoot of 5 inches after 6 growing seasons on this type of ground is quite good. On the other hand the pines have been kept cropped back so hard by black game that they are now substantially behind the spruce, especially on the better peat. Unless the spruce go into check, which seems improbable, any nursing will be done by them and not by the pines.

In general Sitka spruce is growing remarkably well on what appeared originally very poor ground and there can be no question that it is the correct species for this type of land. There are poor

patches but the tree seems to respond well to basic slag applied at time of planting and we are carrying out some top dressing experiments this year to see if the check can be overcome by subsequent manuring

(2) Upland Calluna Soils.

Scotland. Sitka spruce planted in P.28 on ploughed ground at Teindland and top dressed with basic slag a year or two after planting fell off markedly in growth this season; shoot growth in P.34 was only 2 to 3 inches, whereas in previous years 6 to 10 inches were put on annually. The two dry seasons of 1933 and 1934 may have contributed to this result. Pinus contorta in the same experiment are maintaining their growth well while more recently planted and manured Japanese larch, alder and birch are flourishing on ploughed ground. Whether in the long run any species will succeed better than the pines remains to be seen.

England and Wales. The experiments at Harwooddale are distinctly promising. It seems clear that the trees will respond to soil cultivation though it is not yet so certain whether application of basic slag is also essential. Scots pine planted three years ago in dug-over slagged groups put on shoots of nearly $6\frac{1}{2}$ inches in 1934 and appear very vigorous.

At Allerston 100 plants of horse chestnut were planted in P.34 on ploughed ground, there were no failures and the plants have made fairly good growth putting on shoots of 3 inches and up to a maximum of 7 inches. Other species planted experimentally last year include Douglas fir, Alnus oregona, Picea omorica and Picea asperata. There was a good take except in the case of the P. asperata.

Of the earlier experiments on ploughed ground the most interesting is No.6. P.28 where tractor ploughs were used which turned over a shallow furrow. Here Sitka spruce, which for some years made good progress, have checked badly as at Teindland. The most improved species is Corsican pine which has made great strides in the last year or two and is now growing strongly. The seedling plots of Scots pine,

Pinus contorta and Sitka spruce on the deep ploughing did well last season and give every appearance of making successful plantations.

There is little change to report on the Calluna ground at Hamsterley, growth is slow and none of the species appears wholly satisfactory.

At Clocaenog, Sitka spruce planted in P.32 on a thin Calluna-Molinia peat is growing well. The unmanured control sections are slightly poorer than the slagged plots but the differences are not very great; even without manure there are individual plants with shoots of from 8 to 10 inches. Growth is best where there is most Molinia.

(3) Dorset Heaths. Experimental work at Wareham Forest has developed along three lines: (1) Direct sowing of different species of pine, (2) Trial of 'exacting' species, eg. Douglas fir, Sitka spruce, and Japanese larch, on the drier soil types and (3) Comparison of one year seedlings of pines and other species with the corresponding transplants. Superimposed upon all three lines of investigation is the effect of phosphatic manures - basic slag, Semsol, and in some cases also bonemeal. The direct sowings have given the usual rather variable results. In the oldest experiment, P.32 Pinus contorta, P. radiata and P. pinaster are all good in the plots which received bonemeal (50 per cent of the contorta are 12 inches in height and over) and rather better than those that were slagged.) Corsican is poor where bonemeal was applied but good in the slagged plots. The only species to make fair growth without the aid of manure is pinaster.

In the following year (P.33) pinaster and radiata have done the best and even the unmanured plots are quite promising; contorta are backward as are Scots and Corsican, though all three species show some response to manuring.

The P.34 sowings suffered from drought, especially where the soil was very flinty, and the result has been a rather patchy germination. P. radiata have given a marked response to bonemeal and it would seem that this may be a better manure than basic slag for applying to direct sowings on Wareham soil.

The experiments with exacting species are still in the preliminary stage when it is uncertain what is going to happen; without basic slag all the species in the P.32 experiment look very miserable but in the slagged plots there are over 50 per cent of thriving plants, whether the growth of the latter will be maintained is perhaps doubtful. In P.33, in addition to the species already mentioned, Lawsons Cypress was included. This species has done remarkably well, the plants have kept their colour and put on shoots of from 3 to 12 inches. Having regard to the two dry seasons which the plants have survived it would seem that this species is a good resister of drought.

One year seedlings of Scots pine, Corsican pine, Japanese larch and Sitka spruce have been tried in successive seasons with rather moderate success; in P.32 Corsican pine losses were as high as 75 per cent and in P.33 all species except Sitka spruce suffered fairly heavily. Curiously enough the lowest losses in the seedlings were in P.34 although in this year the drought was particularly severe. The Japanese larch 1 x 0 were in two lots, large seedlings raised from early sowings in Kennington Nursery and small plants raised from the later sowing. Losses in the large seedlings were 4 per cent and in the small seedlings 13 per cent a result which throws an interesting side-light on the nursery experiment.

(4) Thetford Forest. The frost of May 26th 1954 combined with the drought has given yet another check to Experiment No. 8. P.30 on frost tender species, size of plant, and method of soil preparation. The effect of the frost varied with the topography, the frost level was about 15 inches above the soil but in hollows the level rose to 22 to 24 inches and in such cases large plants as well as small were affected. Of the species beech suffered most, then Douglas fir and then the two larches. In general the experience to date supports the use of large plants carefully planted in large screefs, but even so, open planting with frost-tender species at Thetford is a gamble and it seems much better to establish a preliminary shelter of pine.

The Experiments on the introduction of beech under Scots pine show that even this method is not a complete insurance against

failure, deer and hares can do great damage to the small beech and the pine canopy must be almost complete to afford protection against frost and drought. Experiment 32 P.33 is a case in point. Here the beech (seedlings and transplants) were introduced between rows of Scots pine only 3 to 4 feet in height. In the first year there were heavy losses in the beech due to frost and drought and in 1934 there were further deaths which bring the losses up to 30 per cent in the transplants and 77 per cent in the seedlings.

An investigation of pine plantations at Rendlesham which had been severely damaged by pine shoot moth brought out several interesting points. It was found that although there were insufficient undamaged dominants to make a complete final crop of Scots pine, there was a fairly adequate supply of slightly damaged trees, capable of recovery. Provided no further damage takes place the future of the plantations seems reasonably assured. An experimental treatment was carried out in a small plot, this consisted of a combination of thinning and pruning which greatly improved the appearance of the crop. The investigation confirmed the relative immunity of Corsican pine.

(5) Chalk Soils. The experiments at Buriton and Friston Forests have not been assessed this season.

(6) Loam and Clay Soils (Hardwoods). There is not much to say about the Northamptonshire experiments (Drayton, Fermyn, Oundle, Yardley etc.)

The ash plots at Oundle look fairly well but the development is curiously irregular. Oak plants apparently suffered from the drought and remained almost at a standstill throughout the growing season. Of the nurse species, Scots pine, Pinus contorta, and Lawson's Cypress all made satisfactory growth; alders, Thuya and Tsuga did badly. Stumping, tried with oak and alder, was unsuccessful.

The oak experimental plots established in P.27 at Alice Holt Forest were assessed in 1934 and showed very satisfactory progress. At the end of five years the plants averaged little more than 12 inches

in height, now they are from 3 to 5 feet high with occasional plants of over 6 feet.

A weeding experiment started at Alice Holt in P.30 with one year oak seedlings then 4 years planted has given interesting results. The vegetation consists of a rank growth of coarse grass, bramble, briar, blackthorn, with sallow and other coppice. For the first four years the plots were kept weeded but since P.30 one set of four plots was left alone while the other set of four was lightly weeded once each year.

The latest assessment carried out in 1934 when the plants were 9 years old revealed the following position.

	Total Height in inches.			Percentage of deaths since 1930.
	1930	1933	1934	
Weeded	11	31	37	3
Unweeded	12	34	40	4

It is evident that the plants have grown just as well in the unweeded plots as in the weeded while the figures for percentage losses shows that there has been no fatal smothering by the weeds. The plots included different original spacing distances and a detailed classification of the unweeded plots was carried out. The following table shows the percentage of living plants in each of the categories A. to F.

		4' x 1' spacing. per cent.	4' x 2' spacing. per cent.
A	Trees in brambles and briars with their heads well above the weed growth.	64	74
B	Trees in brambles and briars with their heads below the weed growth.	22.5	18
C	Trees growing in the midst of oak, hazel, or chestnut coppice and with their heads well above it.	1	0.5
D	Trees growing in coppice and being smothered by it.	4	0.5
E	Trees growing by the side of coppice but their heads free.	4.5	1
F	Trees growing by the side of coppice and being smothered by it.	4	6

The total percentage of oak plants above weed and coppice growth is 69.5 in the 4 x 1 spacing and 75.5 in the 4 x 2 spacing. On the assumption that none of the trees at present under the weed growth succeeds in getting through there is still a stocking of about 7500 plants per acre in the 4 x 1 spacing and 4000 plants in the 4 x 2, which should be ample for all purposes. It may fairly be concluded that weeding during the last five years was unnecessary, but it must be remembered that the plots were all weeded for the first few years and that the vegetation was not of the most smothering type. From other similar experiments it appears that the most dangerous forms of weed growth are oak coppice, and strong bracken.

In the Forest of Dean the ash hoeing experiment in Nagshead Inclosure was badly frosted in May 1934 but the trees made a fine recovery and are now, 3 years after planting, from 6 to 8 feet in height. in three out of the four plots, having grown over two feet in 1934. The controls, with the exception of one plot on a specially favourable site, did not put on more than 5 to 6 inches during last year.

(7) Origin of Seed. Some recent German papers on the behaviour of European larch of different seed origins, stressing in particular the superiority of the Silesian or Sudeten origin, have raised again the question as to the best source from which to obtain seed for this country. A survey of the oldest of the larch race areas has been made to see if these throw any light on the problem. The two principal areas are at Radnor and Drummond Hill. At Radnor the larch of Scottish origin is greatly superior to the continental larch. The best of the Scottish lots averages 8 feet in height (age 7 years) and is growing strongly while the poorest is a plot from Swiss (Munsterthal) seed which average only $2\frac{1}{2}$ feet in height. The Silesian larch plot is better than the Swiss but inferior to any of the Scottish lots.

In another series of plots in the same forest but a year younger, only continental lots were used and of these the Silesian is definitely the best.

At Drummond Hill the Scottish lots are again the best, Silesian and French origins come next and are about equally good, plants from Tyrolese seed are the poorest both in vigour and form. These plots are now nine years old. In the younger plantations at Drummond Hill, Clashindarroch and Lael (3 and 4 years old) there are as yet no well defined differences between the various lots, almost all are healthy and vigorous. So far then as our evidence goes larch from Scottish sources is the best and after that the Silesian. It would perhaps be premature to condemn the alpine larch out of hand on such relatively scanty data, but on the whole it is supported by experience in the Divisional plantations.

The Scots pine proveniance plots are both numerous and well distributed over the country but they are too young to give much information at present. In course of time we should have a very interesting series of plantations.

5. Summary of Plantation Experiments planned for 1934/35.

(1) Peat Soils. It is proposed to top dress with basic slag some patches of checked spruce on bad vegetation types at Kielder and Beddgelert Forests.

Further comparative trials with basic slag, Sensol and mineral phosphates will be carried out at Inchnacardoch on spruces and Japanese larch.

Two experiments have been laid down at Inchnacardoch, one on slope peat and one on basic peat, to determine the possibility of establishing a crop of Sitka spruce by repeated applications of phosphatic manures. The effect of flushing Scirpus peat with water from a neighbouring burn will be tested at the Forest of Ae.

(2) Upland Calluna Soils. Some small-scale manuring experiments have been planned at Teindland and a few miscellaneous species such as Pyrus intermedia and Cotoneaster Simonsii are to be tried.

The effect of different intensities of drainage will be tested on hard Calluna knolls at Benmore and a series of manuring

and cultivation experiments is to be carried out on the same type of ground in a number of forests in Scotland.

At Allerston seed of various pine species will be sown on beds prepared on ploughed moorland and manured with hop compost prepared by Dr Rayner. (Last year this compost produced excellent seedlings of Scots and Corsican pine at Allerston.)

At Harwooddale a semi-field-scale trial of a special planting method will be carried out using Scots pine and Japanese larch as the indicator species.

The chief experiments at Clocaenog deal with intensity of drainage and comparison of basic slag and Semsol applied to Sitka spruce and Japanese larch.

(3) Dorset Heaths. No experimental work proposed.

(4) Thetford Forest. Planting of seedlings and transplants of beech under Scots pine.

(5) Chalk Soils. Trial of Alnus cordata and Tilia parvifolia. There is a small stock of plants of these species in the nursery and it is proposed to try them on chalk soil.

(6) Loams and Clay Soils (Hardwoods). At Tintern Forest semi-field-scale experiments on the hoeing of ash and sycamore will be carried out, also trial of ash plants of different ages and sizes.

In the Forest of Dean, method of planting Douglas fir, and direct sowing of walnut.

(7) Origin of Seed. Plants from seed of three origins of European larch raised in four nurseries in Scotland are to be planted out at Laanachan, Clashindarroch and Drummond Hill Forests. This is a repetition of a larger experiment started in 1929 and is intended to act as a check on the latter.

Small lots of different origins of European larch, Scots pine, Pinus contorta, Mountain pine and Norway spruce are to be planted out in various forests.

(8) Root Arrangement. A series of experiments on the effect of root pruning and root arrangement upon the subsequent development of seedlings and transplants of larches, pines, and Douglas fir will be carried out in a number of forests in Scotland.

6. Progress of Special Investigations.

In recent years work on plantation experiments has steadily diminished allowing more time to be given to other investigations; these are briefly summarised below.

(1) Grading of Seedlings. A comprehensive experiment on the grading of seedlings was started four years ago in six Divisional nurseries. Each year from 30,000 to 50,000 seedlings of each of a number of species were lifted, put into three grades, and each grade lined out separately. At the end of one year the plants were lifted and graded and selected species put out in the forest, Scots pine and Corsican pine being planted at Tentsmuir and Thetford and European and Japanese larch at Radnor and Fiunary. The experiment is giving quite conclusive results. In every species the lining-out losses have been lowest in the Grade I seedlings and highest in Grade III (Grade I being the strongest seedlings and Grade III the culls), on the other hand in the forest the differences are much less striking and as far as establishment is concerned transplants from Grade III seedlings are little inferior to those from Grade I. Whether there will be substantial differences in subsequent rate of growth remains to be seen.

(2) Use of Seedlings for Turf Planting. Since the Forest Year 1931 a series of Divisional Experiments on the use of seedlings for turf planting has been carried out annually in all Divisions. There have been about 350 separate experiments in which nearly 2,000,000 seedlings have been planted. The principal species were Norway and Sitka spruce but considerable numbers of European and Japanese larch also were used. The seasons have been on the whole unfavourable but

in spite of this a very fair measure of success has been achieved with the spruces. The broad conclusion is that while spruce seedlings are less dependable than transplants, they can be used without undue risk as a substitute for transplants provided certain precautions are taken as to quality of plant, choice of site, and methods of transport and planting and provided also that weather conditions are not exceptionally unfavourable. Larch seedlings have not been successful, possibly Dr Laing's researches at Aberdeen may throw some light on the causes of failure.

(3) Beating-up. The problem of avoiding unnecessary beating-up largely turns on the development of the plants among which the beat-ups are to be introduced. Rate of height growth, spread of lateral branches and height of maximum branch spread above ground are the most important factors, and during the past two years a large number of measurements have been made in plantations on different soil types. The data have been worked up and tables produced showing for each species and soil quality (as determined by vegetation type) the development of the plants in height and branch-spread during the first 12 years after planting. The tables and general conclusions have been issued to all technical supervisory staff in the form of a Silvicultural Circular. A diagram based on the table for Japanese larch has been prepared by Mr F. Scott to illustrate the dangers of delayed beating-up, this also is being generally circulated on the instructions of the Technical Committee.

(4) Root Investigations. A considerable number of roots of spruce and other trees planted on poor peat types have been examined by one of our Research Foremen. The results throw useful light on the action of basic slag on root development and on the response of the trees to turf planting. It is hoped to write up this work at an early date.

Roots of plants growing on ploughed moorland have also been examined and the investigation is still in progress.

Preliminary studies of older trees (birch and Scots pine) growing on leached soils have shown that where there is no pan in the way birch can send its roots down to a great depth (9 feet) and so can utilise the lower layers of the soil. Where there was a thick iron pan the roots of neither birch nor Scots pine were able to penetrate it.

(5) Season of Coppice Ringing. Although it was well known that coppice shoots peel or ring more easily in the spring than in the winter there was some doubt as to the length of the season of easy peeling. An investigation carried out in 1934 at Bedgebury and Lyminge Forests in Kent showed that the period of easy ringing was a comparatively long one, over 2 months in the case of most species, and that its start could be related roughly to the period when the white-thorn was about to flower and flower buds were beginning to show in the blue bells. In 1934 this corresponded to about the third week in April.

In 1935 it is proposed to investigate the case of peeling of conifer thinnings in relation to the season and in particular to determine whether poles felled in winter can be peeled more easily if they are left lying until the spring.

(6) Gorse-Heather Areas in Wales and South West England. A survey has been made to ascertain the part played by the Western Gorse, Ulex gallii, in causing the check of spruce and larch on land which has become invaded by the gorse. The conclusion reached was that soil factors were primarily responsible for the check of the planted trees and that the gorse was not a contributing factor of any importance. On the other hand the invasion of gorse is a great nuisance in practice owing to the increased amount of weeding necessary.

(7) Douglas fir in the Thetford District. The difficulty of establishing Douglas fir at Thetford, for which frost is chiefly responsible, has led to a study of the plantations of this species in the neighbourhood of Thetford. Most of these were apparently raised

in mixture with Scots pine which has provided the necessary shelter. The work will be written up during the summer.

(8) Studies of Plantations of Special Interest. The Research Officer for Scotland has made detailed silvicultural studies of the Crown Plantations in the Isle of Man and at Hafod Fawr in North Wales, and of Sir John Stirling-Maxwell's plantations at Corrour. Reports have been prepared on the first two of the above areas and these will be published in due course.

Mr Macdonald has also reported on an interesting high-lying plantation belonging to Sir John Ramsden on the side of Loch Ericht.

The next areas to be undertaken are Inverliever, and the Duke of Buccleuch's plantations at Moorburnhead.

(9) Metecrological Stations. Observations on the three stations at Benmore, Parkend and Thetford were continued. Except at Benmore the drought seriously interfered with the development of the young trees, the Thetford plots in particular suffering badly. The data are being worked up.

(10) Pruning. We are carrying out some detailed investigations on pruning in Division 7 in collaboration with the Forest Products Research Laboratory. Our side of the work consists in carrying out experiments on pruning at different seasons of the year, with various tools, and removing more or less of the living crown. In due course some of the stems will be sent to the Laboratory for examination.

In addition the Laboratory are making an examination of a number of Scots pine logs the object of which is to determine the effect of pruning at given stages upon the outturn of clean timber. Specimens of pruned logs of different species are also being studied to determine the normal rate of occlusion.

7. Measurement of Permanent Sample Plots.

The past year has been mainly occupied with the routine work of remeasurement, and 34 sample plots were dealt with. Only two new sample plots were established both of which were in Sir John Stirling-Maxwell's plantations at Corrour. The species were Japanese larch and Sitka spruce. The larch plot (27 years old) was growing at 1400 feet elevation and contained 1200 trees per acre with a mean height of 30 feet and volume of 1000 cubic feet (true measure) per acre. The stems are rough and rather crooked and a considerable proportion are forked. The Sitka spruce plot was at a lower elevation, 1300 feet, and on typical 'flush' peat. The age was 24 years, height 34 feet and volume 2300 cu. ft. (true measure) per acre. The stems are mostly straight and free from defects.

Of the remeasured plots the 41 year old natural European larch wood, Tom-an-Uird, in Strathspey deserves special mention. In appearance this is an excellent crop with straight stems and symmetrical crowns but the thinnings show that heart rot is prevalent, the majority of the stumps revealing serious decay. This is an instance of the liability of second crop larch stands in this country to attack by Fomes annosus. There are two plots here, one lightly and one heavily thinning. When first established at 31 years of age both carried the very heavy stocking of 1900 to 2000 trees per acre, in three thinnings these have been reduced to 340 trees per acre in the heavy (D grade) thinning and 680 trees per acre in the light (B grade) thinning. The stand is now 41 years old and the D plot with half the number of trees has only 20 per cent less volume than the B plot. This is a rather unusual case of recovery of larch as a result of heavy thinning after severe overcrowding. Other interesting plots are the two Douglas fir plots at Tortworth and the Sitka spruce at Dunster. At Tortworth the older plot has a mean height of 120 feet at 65 years of age and volume of 11000 cu. ft. per acre. The largest tree has a quarter

girth of 19½ inches and height of 136 feet.

The Dunster Sitka spruce was thinned and measured last year for the fifth time. The present age is 25 years and nearly 2000 cu.ft. per acre have been removed in thinnings since 1923. The development is shown in the following table.

Age	Main Crop.				Thinnings.		
	Mean Height. ft.	No. of Stems per acre.	Mean Girth. in.	Volume per acre cu.ft.	Number per acre	Height ft.	Volume per acre cu.ft.
13	33	1640	13	1650	10	16	-
16	42	980	16	2300	660	34	560
18	47	910	19	3550	70	38	90
22	59	690	22½	5050	220	48	600
25	67	550	25	5750	140	58	660

At the present time 38 per cent of the total length of the average stem is covered with living crown.

8. Botanical Research.

(1) Mycorrhiza Research - Dr M.C. Rayner. An article by Dr Rayner has appeared in the December 1934 number of Forestry in which the work to date is fully summarised. Copies have been circulated to the Commissioners, to the members of the Advisory Committee on Forest Research and to Technical Officers who are not members of the Society of Foresters.

Work on the action of organic composts is being continued; one of the complications is that the composts alter on keeping, and the effect seems to be that a stored compost has a greater manurial value than one freshly prepared. The reactions that go on during the process of composting are very complex, thus the nature of the source of nitrogen applied - e.g. whether dried blood or ammonium sulphate - has a marked effect upon the product.

Last year's field plots at Allerston produced interesting results, only one of the composts, that from spent hops, improved seedling growth of pines. This year this compost will be

applied on a sufficient scale at Allerston to raise several thousand seedlings and these will be compared with plants raised in ordinary nurseries.

(2) Dr E.V. Laing. Root development of European larch seedlings. This work is still in an early stage and there is little definite to report. Some observations on winter transpiration of larch plants may possibly be of practical significance. Dr Laing found that normally larch passes little or no water through its tissues during mid winter (November to January), but if a slight wound is made on the collar of the stem there is a quite active absorption of water. If these observations are confirmed they suggest the need of special care to prevent injury to the plant in planting. The immediate programme is to carry on the study of the periodicity of root and shoot growth in larch of more than one seed origin. Experiments on season and method of planting are in progress and the effect of abnormal root arrangement is to be investigated.

9. Research on Forest Soils.

During the past year a grant has been made to the Macaulay Institute of Soil Research near Aberdeen which will have the effect of giving us the services of Dr A. Muir, one of the staff of the Institute, who has already had much experience of field survey work. The intention is to study in the first place the soil conditions on heath or moorland ground where establishment has proved difficult. The surveys which will be carried out on these areas will provide valuable basic data as to the effect of tree growth upon the future development of different soil types. The first area to be studied is the Bin Forest in Aberdeenshire which includes some very poor ground on quartzite as well as land on a richer igneous type of rock. As a preliminary step Dr Muir has made a tour of the principal experimental areas in Scotland, in this way gaining a knowledge of a wide range of moorland soils.

It may be observed that the soil research work that the Macaulay Institute are doing touches on our problems at many angles and so the grant made by the Commissioners for specific investigations on forest soils has good prospect of being supported by purely scientific work in a number of directions. One of these deals with plant nutrition (manuring) and Dr Stewart who is in charge of the advisory work of the Institute is cooperating with us in some nursery manuring investigations. The Institute is also in touch with Dr Rayner's work on composting and the relation of compost treatments to mycorrhiza formation, while the humus investigations of Dr G.K. Fraser of Aberdeen University have a general bearing on the same problem. This worker has an interesting series of pot culture experiments, duplicated by field plots, which show the reaction of Scots pine to additions of the principal food nutrients (nitrogen, phosphoric acid and potash) over a range of soils. The purpling of the one year seedlings where there was a deficiency of phosphate was very conspicuous. This work will be continued and extended.

Dr Fraser has also been working on a classification of humus types, a tentative scheme has been drawn up and is being tested in the field. Progress has also been made with methods for estimating the major constituents of humus types.

10. Entomology.

Mr Brown's progress report is given below in a slightly abridged form.

"The Pine-shoot Beetle, Myelophilus piniperda. In the Autumn, typical specimens of Myelophilus damage to the leaders of Scots Pine were collected and examined, and compared with specimens of the kinks and forks which are so conspicuous in the stems of many of the standing trees. The chief malformations which the beetle originate are now familiar, but some ready means of distinguishing these from the analogous malformations occasioned by the attacks of

other pests (e.g. Evetria buoliana) is desirable. One interesting fact, which the search for specimens disclosed, was the relation between the severity of the deformation and the intensity of attack by the beetles. A single leader killed may be quickly replaced by a lateral shoot, with little distortion: but, in an intense attack, all the shoots in the top three or more whorls may be destroyed and a new leader is acquired only at the cost of a great, often permanent, bend; or, in some cases, forking ensues. Recurrent attacks aggravate a single one, because incipient new leaders are repeatedly destroyed. Similar rules govern the results of attack by the Pine-shoot Moth. It is proposed that longitudinal sections be made of some of the beetle kinks and compared with similar kinks caused by the Tortrix.

"In Bramshaw Wood a detailed examination has been made of the trees in nearly ½ acre of 25-year-old polewood, where the second thinning was in process of being made. Records were kept of all the slight and grave bends and of the forks and posthorns and of the height at which they occur: height and girth data were also obtained. There were abundant signs of damage by the Pine-shoot Tortrix and few certain examples of beetle damage: it is probable that the bulk of the injury was caused by the moth, as indeed one might expect in a wood of that age. There were also traces of Sawfly defoliation, which may in some cases have caused the death of leading shoots. The thinnings furnished material for the more exact study of the different types of injury, particularly in the crown. There were a few bud-whorls actually infected with the Tortrix. Although the worst damage by this insect occurred in the period from 1917-1920 when the plantation was about 8-10 years old, it is likely that there was a persistence or a recurrence of the outbreak, which caused some of the injury higher up. A large proportion of the trees had major blemishes.

This investigation is intended as the first of a series, which will embrace Pine-wood from the age of 20 years to about 60 years, and, if possible, the respective contributions of

Pine-beetle, Pine-Tortrix and other agents will be estimated.

"Control of Pine Weevil. An experiment in which different types of traps were laid down was carried out in Puckpits Inclosure in the New Forest during the summer. The experiment was planned by Mr H.S. Hanson. The most effective of the 8 traps tested was a bark trap consisting of two or three pieces of bark kept moist and in place by a sod of earth. As a sequel to this trapping experiment visits were made to Wangford Warren, Suffolk, and The Beacons, Tintern Woods, which were both burnt in the summer of 1933, to study the efforts being made there to keep this pest in check. At the Beacons, considerable damage had been done to the new plants and although intensive trapping had been resorted to, the stumps in part of the area harboured the grubs of the weevil in considerable numbers, and it will be necessary to continue control measures in 1935. Where the fire had consumed the humus layer, few grubs were found, and they appeared to be scarce, too, in the part where a special type of breeding billet had been laid down. In these billets, the grubs were very heavily parasitised by Bracon hylobii. On Wangford Warren, the total of weevils trapped and the population of larvae in the stumps were both relatively inconsiderable. Further experiments in the control of Hylobius are being planned for the coming season.

"The Pine-Shoot Moth. A preliminary study has been made of the parasites of this insect in East Anglia and of the part they play in eventually bringing the outbreaks under control. Sample collections were bred from four different localities in the Thetford district. In two 7-year-old plantations, near Lynford and Cranwich respectively, in which the outbreak was approaching its climax, the total degree of parasitism was similar: of the pupae, etc., collected, about 30% yielded parasites. In an 8-year-old plantation at Olley, near Thetford, where the attack was a little more advanced, 41% parasitism was recorded; and in a 9-year-old plantation near Foulden,

where the attack was just beginning to decline, the collection yielded 70% parasites and only 30% moths. Repetition of the assessments in the same areas for two more years is desirable, but the results so far obtained give some ground for the inference that the parasites play a notable part in suppressing the outbreaks. In the coming year, if time and opportunities permit, the parasitism in the New Forest will be compared qualitatively and quantitatively with the parasitism as observed in East Anglia.

"The areas in Compartments 66 and 67 at Wangford (S.P. P/26), where the disbudding was done in October, 1932, were visited again in October last. The recent progress of damaged and undamaged trees, in both control and disbudded plots, was observed and photographs of typical specimens were taken.

"The manuscript of the report on the survey in Norfolk and Suffolk and on the disbudding experiments has been prepared for publication.

"Oak Defoliation in the Forest of Dean. By means of egg counts in the case of Tortrix viridana and of examination of soil samples for the pupae of the Mottled Umber Moth, the present status of these pests was estimated at the beginning of October. The results confirmed the opinion previously expressed that the outbreaks of the Mottled Umber have practically died out and that the eggs of the Tortrix, though still plentiful, are in many areas notably scarcer than a year previously. Prophecy is dangerous where insects are concerned, but we may perhaps look next summer for a marked decline in the outbreak in many of the stands which were severely defoliated in 1932-34, to some degree counterbalanced by the development of a moderate attack in parts of the High Meadow woods. Some information has been collected on the bionomics of important parasites of the Tortrix.

"Control of Chafers. The disappointing results of the injections of Paradichlorbenzene against Phyllopertha in the Delamere Nurseries were confirmed during a visit in November. It appeared

that the chafers were killed only in the immediate vicinity of the injections and so that diffusion was very incomplete. How far diffusion is dependent on factors of weather and soil is not clear from the experience of previous investigators. Closer, smaller, injections would, no doubt, be more effective; and the cost of application is small in comparison with that of the chemical: but, in densely stocked seed-beds, very close injections would be difficult. With Phyllopertha, unfortunately, we cannot effectively apply chemicals before the ground is stocked, because this chafer has a one-year life-cycle and the grubs that do the damage in July-September derive from eggs laid in June. At any rate, the high cost of Paradichlorbenzene and the failure of these first experiments make further trial of it inexpedient at the present time."

One or two of the points dealt with by Mr Brown require to be slightly elaborated.

(1) Pine Beetle. This is a joint undertaking with the Parasite Laboratory at Farnham Royal in which Mr H.S. Hanson of the Laboratory has been studying for the past two years the insect and its parasites and predators. A large amount of data has been collected which so far seem to support Mr Hanson's original suggestion that this pest could be controlled to a great extent by providing conditions which favour the parasites and predators. The investigation is still in progress and an interim report is in course of preparation.

(2) Control of Chafer. For the last few years there has been a plague of the garden chafer, Phyllopertha horticola in many of the Commission's nurseries, Delamere in particular, and losses have been extremely heavy. This seems to be a relatively recent plague because Dr Munro in a report written in 1925 states that he was unable after very careful search to find any grubs of this chafer in our nurseries, at the same time he expressed his surprise that it should not occur as a nursery pest. Now it appears widely distributed in England. Experiments on control with soil insecticides have so far proved disappointing and a questionnaire has recently been issued to those in charge of all chafer-infested

nurseries in the hope that we may get some clue as to the factors tending to favour the spread of the chafer. It is an intricate problem because of the number of different species of chafer involved and the wide range of soil and climatic conditions.

(3) The Pine Shoot Moth. At the suggestion of the Director of the Parasite Laboratory arrangements are being made for the introduction from Austria of a supply of two parasites of the Tortrix larvae. These parasites play an important part in keeping the pest in check on the Continent but do not occur in this country. The parasites will be reared at the Laboratory and distributed in one or two severely infested plantations and it is hoped that they will become established under the new conditions.

11. Vole Disease.

Dr C. Elton of the Bureau of Animal Population at Oxford and Dr Findlay of the Wellcome Laboratory are continuing their investigations on the vole disease. The Commissioners are supporting this work by a grant enabling sufficient voles to be bred to carry on the research.

12. Mycology.

Elm Disease. Another annual survey was completed in the autumn. In spite of the two abnormally dry summers of 1933 and 1934 the position has not altered materially for the worse and over the greater part of the country the damage is not serious.

Meria laricis. The dry season kept the disease generally in check last year and there was little infection in most of the nurseries. Some further spraying experiments with the colloidal sulphur preparation Sulsol are to be carried out this year.

Damping-off of Conifer Seedlings. The work done last year again showed the value of pre-treatment of the soil with substances such as formaldehyde and cresylic acid. None of the treatments applied after the disease had appeared was successful, potassium permanganate giving negative results for the second year in succession. The work is to be repeated.

Heart Rot of Conifers. Material sent in from the Divisions has been examined and in almost every case Fomes annosus has been isolated. Other fungi recently identified are Stereum sanguinolentum and Phallicta squarrosa. The Assistant Mycologist is visiting areas where felling is in progress in order to supplement the information obtained from the samples sent in. Before attempting to investigate the disease we must know more about its distribution and incidence.

Poplar Canker. This disease is being kept under observations. It is apparently very widespread but confined to certain susceptible species of which the Black Italian Poplar fortunately is not one. Inoculation work is proceeding.

Ink Disease. Apart from Phytophthora cambivora two other species of the same genus P. syringae and P. cinnamoni have been found causing this disease, the former on beech in north Devon and the latter on sweet chestnut in the New Forest. The identifications were made by Mr Ashby of the Imperial Mycological Institute. Experimental inoculations have shown that all three species are capable of attacking either sweet chestnut or beech.

The progress of the disease in the New Forest has been checked, probably as a result of the dry summers.

Bat Willows. A considerable amount of time has been spent by Mr Day in writing various sections of the Bulletin on the Cultivation of Tree Willows, now in preparation.

Frost. Work on the influence of various factors accessory to frost as a cause of injury to trees has continued. It is hoped to complete the present series of observations at the end of this year. A good deal of attention has been given to the question of frost damage of European larch and several forest areas were visited in the summer. It seems possible that much of the die-back and unhealthy appearance of young larch plantations, which we have been inclined to ascribe to wrong seed origin, may be due to frost.

13. Utilisation.

The Forest Products Research Laboratory have started a large scale test of preservative treatments of railway sleepers manufactured from home grown Scots pine, Beech, and Douglas fir. The Railway Companies are co-operating in the project and have arranged to test the sleepers on their permanent ways. The Scots pine and beech sleepers were arranged for between the Laboratory and the Railway Companies but difficulties arose over the Douglas fir which the Companies were not anxious to include in the test. Eventually the sleepers were purchased by us direct from Messrs Paterson & Co. of Glasgow who had large supplies cut from timber grown at Durris. The whole of the sleepers have now been treated and delivered to the Railways.

Some slicing tests carried out by Messrs Paterson on Sitka spruce timber supplied from Benmore have given interesting results. 20 logs containing a little over 10 cubic feet quarter girth of timber yielded, after slicing, 9½ cubic feet of boards. Messrs Paterson reported that the boards dried flat, and were of excellent quality for ordinary boxmaking purposes, though somewhat inferior to Russian Whitewood. The latter is now imported for box making at 10d per cu. ft. for round peeled logs 6 ft. to 9 ft. long with an average diameter of 7½ inches at the small end. The firm stated that the boards were quite suitable for their ordinary purposes and that they could absorb large supplies if they were available at prices comparable to those of imported white wood used for the same purpose.