

Monday, 16th July

Maps $\frac{1}{4}$ " Sheet 3
 1" Sheet 56

After breakfast there will be an opportunity to visit shops at Pitlochry or the Blair Atholl Distillery by the kind invitation of Messrs. A. Bell & Sons. Members should be sure to assemble again at Fishers Hotel by 10.45 a.m.

HYDRO-ELECTRIC POWER - THE TUMMEL VALLEY SCHEME

The following notes have been supplied by the North of Scotland Hydro-Electric Board.

In the valley of the River Tummel in Perthshire is the greatest water-power development in Scotland.

The River Tummel and its tributaries are harnessed in six hydro-electric power stations with an installed capacity of about 240,000 kw. and an average annual production of 600 million units of electricity; further developments in preparation will add another four small stations and increase the total estimated annual output of the valley to 660 million units - a great concentration of power within easy reach of the geographical centre of Scotland.

Two of the stations were built before the war by a private company, the others are post-war schemes, built by the North of Scotland Hydro-Electric Board who generate and distribute electricity in the three quarters of Scotland north and west of a line from the Firth of Tay to the Firth of Clyde.

To the west, on the borders of the counties of Argyll and Perth, lies the desolate plateau of the Moor of Rannoch. The Board have under survey a scheme at Loch Laidon on the Moor of Rannoch which would control the flood waters flowing down the River Gaur to the Tummel Valley and would have an estimated annual output of 24 million units of electricity.

There is a dam at Loch Eigheach on the edge of the Moor. On the River Gaur, there is a generating station of 6,400 kw. capacity with an annual output of about 17 million units, fed by pipeline from the dam.

Downstream, on the shores of Loch Rannoch, is the Rannoch power station of 48,000 kw. capacity. It is part of the first stage in the water power development of the Tummel Valley and came into operation in 1930. The main storage is in Loch Ericht.

Downstream is the Tummel Bridge power station of 34,000 kw. which was opened in 1933. The main storage is Loch Rannoch.

The catchment area of the Tummel scheme, in addition to the 458 sq. km. of the Rannoch development, is 518 sq. km., 295 of which lie above 600 m. where there is snow from three to four months in the year.

In the large Tummel-Garry section there are three generating stations: Errochty (75,000 kw.), Clunie (61,200 kw.) and Pitlochry (15,000 kw.) with an estimated annual output of about 300 million units.

The highest reservoir in this section is the newly formed Loch Errochty, whose top water level is 329 m. above sea level. A tunnel six miles long leads the water down 186 m. to the Errochty power station on the north shore of Loch Tummel.

About two miles downstream from the natural outlet of Loch Tummel is the Clunie dam from which a tunnel two miles in length with a diameter of 7 m. conveys the water to the Clunie power station on the shore of Loch Faskally, a loch created by the building of the Pitlochry dam.

The Pitlochry power station is an integral part of the dam at the outlet of Loch Faskally. This was designed principally to even out the flow of water in the lower reaches of the river in spite of the varying discharges of the stations upstream. There are two automatic spillway drum gates at the dam, each of which has a span of 27 m. The operation of the Pitlochry station is carried out from the control room at Clunie.

The catchment area of the Pitlochry station is 1,828 sq. km. and most of the water in that area is used four times for the production of electricity as it flows down the valley.

The hydro-electric development of the Tummel Valley, a great tourist centre, has been carried out by the Board with special consideration for the preservation of scenery and of fisheries. The fish pass at the Pitlochry dam is one of the premier tourist attractions in this part of the Central Highlands. It consists of a series of pools rising in steps of 46 cm., each pool being connected by a submerged pipe. The fish are counted by an electronic counter and during the five years in which this pass has been in operation, over 5,000 salmon have gone up each year.

BROWN TROUT RESEARCH LABORATORY - Scottish Home Department

The Brown Trout Research Laboratory, Pitlochry, was established in 1948 to carry out investigations on brown trout in Scotland and to continue other freshwater fishery investigations, mainly concerned with salmon and sea trout, which had been in progress for many years previously.

In its work on brown trout, the laboratory is particularly interested in the biology of these fish and in methods of improving the productivity of waters containing trout. Studies are being made, for example, of all the aspects of spawning of trout and the development and behaviour of alevins and fry and of the effects of adding such nutrients as phosphate and nitrate to trout waters.

Work on salmon and sea trout is particularly concerned with the freshwater phase in the life histories of these fish, but some work has been done on their movements in the sea, by means of tagging experiments.

THE WOODS OF FASKALLY HOUSE - The Forestry Commission

The policy woods extend to 75 ha., and consist mostly of overmature mixed conifers and broad-leaved species, or younger conifers.

Briefly, the objects of management are to produce an uneven-aged irregular structure on a group basis, with a continuous series of age and girth classes. Natural regeneration will be utilised and planting is to be used chiefly to introduce desirable species, especially for the purposes of improving the soil by introducing additional broad-leaved species.

To carry this out the area has been divided into six blocks and one of these will be treated each year during the conversion period of 120 years. This six year felling cycle allows twenty treatments of each block. Regeneration is to be carried out in small groups of up to 0.05 ha. Prior to any work being carried out in a block, a complete enumeration will be done, and subsequent enumerations at six-year intervals will give the increment from which the control of yield can be calculated.

The working plan has been in operation for only three years and will be revised in 1965.

FORESTER TRAINING SCHOOL

Chief Instructor: H. Cruickshank

Faskally House is used as a Forester Training School, one of five in Britain. At present 39 students are under training.

At the end of the two years' course, which includes both practice and theory, successful students are awarded a Forester's Certificate and are available for appointment as Assistant-Foresters with the Forestry Commission or on private estates.

Lunch will be taken at the School.

The bus will drive to Ledmore, which is two miles south west of Bankfoot, along the Tay Valley. On the way to Dunkeld, Craigvinean Forest (Forestry Commission) will be seen on the right across the Tay, with plantations up to 460 m. The forest extends to 1,805 ha. of which 1,320 ha. are planted. It is of interest that Craigvinean was the site of one of the first plantations made by the Dukes of Atholl in 1759. On the left the woodlands still mostly belong to the Duke of Atholl.

LEDMORE - The Forestry Commission

(1) The Seed Orchards. Research Branch, Genetics Section.

The principal object of this series of seed orchards is to produce seed of six origins of Pinus sylvestris and eight origins of Pseudotsuga taxifolia. Each P. sylvestris orchard (except that of Cawdor origin) consists of twenty grafts

from each of twenty clones and each P. taxifolia orchard consists of ten grafts of ten clones. All these clones are derived by grafting from Plus trees growing in outstanding plantations in Scotland.

Each of the P. sylvestris plantations represented suffered severe damage during the gales of January 31st, 1953 and these seed orchards will, it is hoped, by their production of seed serve both to perpetuate these good origins and provide the basis for the further improvement of P. sylvestris in Scotland.

The area of each P. sylvestris seed orchard is 0.8 ha. and of each P. taxifolia orchard 0.2 ha. The total area planted is 5 ha. and 1.6 ha. respectively. The spacing between the grafted seed trees is 4.5 x 4.5 m. The clones of grafted plants in each orchard are arranged in a balanced mixture whereby each clone has an equal chance of being pollinated by every other clone. It is anticipated that a thinning will be necessary and this is allowed for in the layout. The relatively warm, dry and sunny climate of Ledmore Nursery is believed to be favourable to the production of seed by both P. sylvestris and P. taxifolia. The soil is a medium loam derived from the Lower Old Red Sandstone formation and the nutrient status is good.

The isolation of the whole site from foreign pollination is probably good. There are no large areas of either species in the immediate neighbourhood. The isolation of each P. sylvestris origin within the orchard is accomplished by means of the P. taxifolia orchards in one direction and will be further improved by the introduction of seed sources of Tsuga heterophylla, Chamaecyparis lawsoniana and Thuja plicata in a direction at right angles to the P. taxifolia.

The propagation of the grafted plants began in spring 1953 and the majority of the rootstocks used were 1+1 and 1+1+1 transplants of P. sylvestris and P. taxifolia. The establishment of the seed orchard was begun in 1955 with the sowing of grass with a catch crop of oats (Avena sp.). The grafts were planted in April, 1956.

Controlled pollination will begin about 1958 with the object of identifying these parent clones with high combining ability. Undesirable clones will be gradually removed from the orchard on the basis of both clonal and progeny trials and the gaps so created will be filled with the best of the remaining clones.

It is hoped that these seed orchards will begin to produce regular crops of both P. sylvestris and P. taxifolia seed for use in the nursery from about 1966. The grafted seed trees will be pruned and if necessary fertilizer and girdling treatments will be applied to encourage the regular formation of flower buds. The grafted seed trees will be allowed to reach a height of between 6 and 7 m. An annual production of between 10 and 15 kg. of seed per ha. from 1966 is the aim.

(2) Ledmore Nursery. The Forestry Commission. East Scotland Conservancy.

District Officer:	Mr. T.A. Woodburn
Assistant District Officer:	Mr. R.T. Larsen
Forester:	Mr. A. Rose

The farm of Ledmore (82 ha.) near Bankfoot, Perthshire, was acquired by the Forestry Commission in November, 1949, with the object of forming a second large nursery in the East Conservancy; the first being at Newton, near Elgin, in Morayshire.

In the spring of 1950 some 8 ha. of Ledmore were ploughed, cleaned and green-cropped. By 1951, however, the ground was still considered too dirty for large scale lining out, and it was not until 1952 that this nursery was brought into use. In that year 7 million seedlings were lined out. This year the numbers lined out are 6 million seedlings and in addition 2,250 kg. of hardwood seed and 18 kg. of conifer seed have been sown.

At the present time 18 ha. are under nursery. This area will be gradually extended to 30 ha. The balance of land has been transferred to Strathord forest or is to be retained under agriculture for the time being.

The Ledmore nursery is in charge of a Forester, and an Assistant Forester. The number of workers employed varies with the seasons, being highest during the spring and summer, when lining out and weeding make heavy demands on labour. At these times, about thirty workers, mostly women and boys, are on the payroll. During the autumn and winter months the staff drops to about twenty workers.

Shortage of labour has had a marked influence on our working at this nursery. It has led to the extensive mechanisation for which Ledmore has now earned something of a reputation.

(i) Layout of the Nursery. When Ledmore was acquired, careful consideration was given to the layout so that machines could be operated successfully and economically. As a result nearly every nursery operation is now mechanised either fully or in part.

Sections. These extend to not more than 0.8 ha. 110 m. has been found to be the most convenient length, especially for mechanical lining out. Odd corners and the margins of irregular shape have been utilised for the growing of hardwoods, poplar stoolbeds, ornamental and Christmas trees.

Roads. The roads through the nursery are 4 m. in width to facilitate turning of the tractors, other accessory roads being 3 m. Only one permanent metal road has been laid from the main entrance to the buildings, which are centrally disposed. All earth roads through the nursery are kept free of weeds by periodical runs with disc harrows.

Hedges. Only shelter belts and hedges against the prevailing wind have been planted. Cross hedges through the nursery would constitute an obstruction to machines and have been avoided.

(ii) Mechanical Equipment

The Lining Out Plough. This machine has been in operation in various versions since 1946 when the plough was modified to work with normal 3 m. transplant boards. Women and boys provide the bulk of the labour required. This plough can cope with large consignments of seedlings at short notice, with the result

that it has been possible to discontinue lining out in the autumn and confine it to the spring. With the help of two of these ploughs and by careful organisation of the available labour, 250,000 seedlings can be lined out per day at Ledmore at an average cost of under 4s. per thousand.

The strip method of lining out is now in use at Ledmore. With lines 23 cm. apart every sixth line is missed. This gives 90 cm. wide beds with 46 cm. alleyways in between. This method slightly increases the cost of lining out but is well worth the extra expenditure, since better quality transplants are produced and output is increased, due to the elimination of damage by weeding. Weeding and other operations may be carried out from the alleyways in wet weather when conditions would not permit this in normal lines of transplants. The strip method also allows the follow-through of other tractor-drawn implements such as the steerage hoe, the undercutter and plant lifter.

The main disadvantages of the older prototype plough in nurseries not previously laid out for mechanisation were its overall length and the fact that it was an old-fashioned "drag" plough. By shortening it, and fitting a three-point linkage for the "hydraulic lift" of a Ferguson tractor, the turning circle has been greatly reduced. It has also been modified to carry a fertiliser hopper with a chute which places the fertiliser at the bottom of the trench.

The "Ledmore" Six Drill Seed Sowing Machine and Grit Distributor. One of the lines which is being followed at Ledmore is the development of a plant suitable for the forest without the expense and loss of lining out. It is believed that such a plant may result from undercutting one-year seedlings, so producing what is termed a "one undercut one" or "1 U 1" plant.

It was with this in mind that the six-drill seed-sowing machine now in use was designed. This machine can sow seed thinly in drills so that after undercutting the conditions for growth are not dissimilar to those in transplant lines. The grit distributor is similar to those in general use, but it has been modified to confine the grit covering to the drills.

The "Ledmore" Undercutter. This twin-bladed undercutter has been designed to meet the conditions prevailing at Ledmore, but is of general application. It is fitted with two discs which travel on either side of the bed and two pneumatic depth-control wheels. Control of depth is a most important factor if the undercutting is to be properly done.

The "Gunn" Plant Lifter. The mechanical loosening of seedlings with this tool before lifting is now common practice in many forest nurseries. At Ledmore, however, it has been modified to lift transplants or drill sown seedlings by fitting four half-moon tines to the blade of the lifter. The tines travel between the lines of plants and break-up the surface soil, thereby reducing stripping of the roots to a minimum. Depth-control wheels have also been fitted to this machine.

The Steerage Weeding Hoe. This is an adaptation of an agricultural implement which has been modified to take "Planet Junior" attachments. Introduced to do inter-line weeding and cultivation, it straddles the beds and covers both bed and alleyway in one operation. It is also fitted with depth-control wheels. Although still in the trial stage, it has given good results and should play a big part in reducing the costs of nursery weeding.

In addition to these specially designed implements, the following types of agricultural equipment are used:

The Ferguson Single Furrow Reversible Plough. This is ideal for nursery work. It allows the sections to be ploughed both ways from start to finish leaving the surface level. It also saves fuel and oil since there is no running light when turning at either end of the sections.

The Oliver Single Furrow Plough with Sub-Soiler. When breaking-in new nursery ground which has previously been under agriculture, this is a useful, if not essential, implement. It breaks up the plough pan, penetrates into the cold sub-soil without bringing this to the surface, assists both drainage and moisture retention and builds up the soil texture desirable for nursery working.

Ferguson Ridgers. Used for ridging seedbeds in the autumn, these ridgers allow of early seedbed preparation, cultivation and sowing in the following spring. Without ridging, these operations would be unduly delayed.

(iii) General Notes

Maintenance of Fertility. Good husbandry and management is given first consideration at Ledmore. The history of each individual section is recorded in book form, giving for each Forest Year the soil analysis data and manurial prescriptions, the manure actually applied and the crops raised, so that chemical and physical irregularities may be observed and corrected. Strict rotational greencropping is adhered to, and normally one-third of the total nursery area is reserved each year for this purpose. After growing two successive crops of plants, organic and inorganic manures are applied according to prescription. Oats (*Avena* sp.) and tares (*Vicia* sp.) are then sown and ploughed in while still succulent in late July or early August. Once decomposition has taken place, the sections are ploughed back lightly in September or October to ensure a high concentration of humus in the top layers of the soil where it is needed. This method of cultivation also reduces the weed population by weathering, although actually there is no fallow ground. It is essential to make good the high degree of soil exhaustion (both physical and chemical) caused by the growing and removal of successive tree crops.

Whether this can be done by the use of artificial fertilisers only, or whether organic matter is essential, has been the subject of much recent research, and though artificial manures often give equally good results for a time, sufficiently long-term results are not yet available. Although the use of green crops is the common method of incorporating organic matter in Scotland, great use of compost has been made in some nurseries, and especially in England.

Weeding. Only in a rich, sweet, healthy soil can we grow good crops, which in turn produce shade and reduce competition from weeds. Special attention is paid to the necessity of reducing the weed population. It is hoped that, with the planting of shelter belts and hedges, and enclosure by the surrounding plantations, the nursery will eventually become protected from weed seeds blowing in from outside.

The bus drives back to Pitlochry by the same route. In the evening members will have the opportunity of going to the Festival Theatre at Pitlochry.