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IRISH FORESTRY

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The Progress of Deep Peat Afforestation in the North-West

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THE afforestation of deep peat is an aspect of forestry practice with which many foresters are perhaps not very familiar. As a soil-type it is regional in its occurrence and as such does not therefore come within the compass of every forester's activities. Literature on the subject has for the most part been devoted to description and interpretation of experimental projects on peatlands and moorlands. Such work as carried out by Steven (1929), Frazer (1933), Tansley (1939) and Zehetmayr (1954) has, however, proved invaluable in determining sound basic principles applicable to large-scale operational activity in the field. It may be of interest to many therefore to read of what progress has been made in this sphere and of what techniques are being adopted in order to ensure the successful afforestation of this difficult and, in a forestry sense, comparatively unknown soil-type.

The observations recorded here are based on a study of plantations laid down on the blanket-bog regions of south-west Sligo and west and north-west Mayo. The work encompassed by the study was initiated in 1952. In the meantime further areas have been developed annually. The 1952 plantings are now approaching the thicket stage. There is therefore available for study a complete series of age-classes throughout the establishment phase of the rotation. First-hand information on all relevant factors can be availed of to create a composite picture based on factual evidence. It is the primary purpose of the study therefore, to record all relevant data and facts for the purpose of creating such a picture. Having done so, it is further intended to present an interpretation of the significance of the facts observed and the data recorded in so far as they are considered relevant to the establishment of an appropriate sylvicultural technique for the future treatment of deep peat areas.

Peat Classification and Type.

The region as a whole, in which are located the following State Forests, Ballycastle, Glenamoy, Glenisland, Lough Talt, Nephin Beg and Nephin Mór, is characterised by the occurrence of vast expanses of peat of climatic origin. Adopting Frazer's classification it is predominantly of the "blanket-bog" type, with some local development of "basin-peat". In referring to classification, the following extract from Zehetmayr is considered particularly relevant. While referring specifically to north of England and Scottish Highlands it is very descriptive of conditions in the north-west and it is therefore quoted in full:

. . . . "There remains the blanket moss or blanket bog types which cover huge areas to a varying depth and which is the chief concern of this Bulletin. Within this type there are often local developments of basin peat, originally formed in lochans, lochs, or lakes which give rise to areas of deep peat varying in size from pockets a few yards across to great bogs hundreds of acres in extent. Also easily recognisable in blanket bog areas are the knolls typically underlain by moraine, but also on occassion by rock, where the peat rises locally and becomes thinner and tougher. Between these extremes lies peat neither basin nor knoll, which is divided in this work into slopes and flats, the distinction having considerable importance in forestry as effecting the drainage and the exposure. The phenomenon of flushing must also be mentioned here. If peat is traversed by drainage water the composition and vigour of the vegetation alter, even though the seepage water is extremely poor in nutrients. These five features of the blanket bog basin, knoll, slope, flat and flush are constantly referred to in the description of the experiments as a means of defining the site" . . . .

In the north-west the peat deposits vary in depth from 12 ins. to 18 ins. on the "knolls" to 24 ft. or more on the "basins" and "flats". They are predominantly pseudo-fibrous in character with the exception of the "knoll" peats which are distinctly fibrous, and some molinia flushes which may exhibit amorphous characteristics. In this predominance of the pseudo-fibrous form they do not conform with Frazer's classification based on the predominance of a particular vegetation element, viz. *Tricophorum*, pseudo-fibrous; *Calluna/Eriophorum*, fibrous; *Molinia*, amorphous. Many of the *Eriophorum* and *Molinia* dominated peats of the north-west have the distinct gelatinous consistency of the true pseudo-fibrous peat. It is worthy of note that it is on these pseudo-fibrous types that the maximum response to ploughing is evident. The *Eriophorum* dominated slope or flat is particularly noteworthy in this respect.

Vegetation.

The major vegetation communities are dominated by *Molinia, Calluna, Eriophorum* or *Tricophorum, Erica cinerea, Myrica gale, Juncus squarrosus, Erica tetralix; Narthecium* and *Carex* species are secondary constituents. There is local occurrence of *Juncus articulatus, Pteris aquilina* and *Sphagnum*. A characteristic of many of the north-west peats is the occurrence in varying quantities of *Schoenus nigricans*. It's significance as a constituent of the vegetation communities is not fully understood. Suffice to say, however, that where it is abundant the suitability of the site for Sitka spruce is considerably enhanced.

Nutrient Status.

Analytical data covering the various peat types of the region are unfortunately not available. Table I below, indicating the chemical analysis of a pseudo-fibrous *Eriophorum/Schoenus* peat at Glenamoy, gives however, an indication of the trend of fertility in peat. For purposes of comparison, in Table II is shown an analysis of a "raised bog" *Polytrichum/Sphagnum* taken from a profile at Cloncreen, Co. Offaly. (Walsh & Barry 1958).

TABLE I

Depth (cms.)	% H_2O	pH	% N	% Ash	P(s) P.P.M.	Ca(s) *	K(s) P.P.M.	% Decom-position	Density grams/c.cm.
0–20 }	91.2	4.6	1.44	2.4	16	4	177	38	0.80
20–50 }					2	3	22		
50–100	93.8	4.5	1.20	1.2	4	4	50	47	0.91
100–150	93.0	4.6	1.08	1.2	0.5	3	33	46	0.91
150–200	92.5	4.8	1.00	2.6	0.5	3	56	44	0.90
200–250	92.2	4.8	0.84	2.6	0.5	3	83	38	0.87
250–300	91.0	5.0	0.72	2.6	0.5	3	61	59	1.04
300–350	90.1	5.1	0.76	12.6	0.5	2	45	57	1.03

TABLE II

0–20 }	93.7	4.5	1.36	1.9	17.0	4	130	14	0.40
20–50 }					7.5	5	88		
50–100	94.2	4.6	0.92	1.4	2.0	4	77	10	0.35
100–150	95.0	4.3	0.72	1.0	3.0	4	67	8	0.34
150–200	95.1	4.5	0.76	1.0	0.5	3	33	5	0.36
200–250	94.5	4.7	0.76	1.2	0.5	3	33	8	0.36
250–300	93.3	4.7	0.80	2.4	0.5	3	33	48	0.80
300–350	92.7	4.6	0.72	1.6	0.5	3	27	40	0.79
350–400	92.8	4.8	0.72	1.8	0.5	3	17	35	0.60
400–450	91.2	5.0	1.64	3.8	0.5	4	22	38	0.78
450–500	90.2	5.3	1.40	5.0	0.5	6	12	51	0.82
500–550	91.4	5.2	1.68	6.0	0.5	7	33	58	0.92
550–600	90.1	5.5	1.44	19.2	0.5	8	27	42	0.80

* Calcium Value 2 = 400 P.P.M.
" " 3 = 600 "
" " 4 = 800 "
" " 5 = 1,000 "
" " 6 = 1,500 "
" " 7 = 2,000 "
" " 8 = 2,500 "

By way of contrast the figures hereunder indicate the amounts of some of the major elements present in some Co. Sligo agricultural soils :

(a) pH 6.3

Calcium	5,000 lbs. per acre or	2,500 P.P.M. (value No. 8)
Phosphorus	30 " " "	15 "
Potassium	150 " " "	75 "

(b) pH 5.5

Calcium	5,000 lbs. per acre or	2,500	P.P.M.	(value No. 8)
Phosphorus	15 ,, ,, ,,	7.5	,,	
Potassium	300 ,, ,, ,,	150	,,	

(c) pH 5.7

Calcium	1,200 lbs. per acre or	600	P.P.M.	(value No. 3)
Phosphorus	3 ,, ,, ,,	1.5	,,	
Potassium	200 ,, ,, ,,	100	,,	

A level of less than 5 P.P.M. of phosphorus is regarded as deficient.

It is quite apparent even from a superficial study of the Tables that the nutrient status of the Glenamoy profile is extremely low in respect of the major elements necessary for plant growth. Nevertheless it is evident in the field that tree-growth amongst certain species will respond significantly to fertiliser application of as little as 1 cwt. per acre. As yet in field practice, fertiliser application has been confined to dressing with Phosphate (Ground Mineral Phosphate or Basic Slag). It is not unreasonable to hope therefore, that applications of other major and even minor elements can bring about equally significant responses and in the long run perhaps widen considerably the choice of species for peat afforestation.

Some aspects of the tabulated results as shown in Table I are worthy of further consideration :

(1) *Moisture Content:* It will be noted that to a depth of approximately 12 feet in the profile, moisture content is over 90%. This is a very significant factor in ground preparation. 90% Moisture Content is a stagnation level in which tree roots will not survive. Drainage therefore must be so intensive that moisture content in the upper layers can be reduced to a degree where healthy root growth and penetration can be promoted.

(2) *pH.:* Acidity level is not considered a very significant factor for species now in use on peat. Further investigation may indicate the desirability of liming in order to get satisfactory results with other species.

(3) *Nitrogen:* It will be noted that Nitrogen content is extremely low at all levels. This would seem to indicate that perhaps spectacular results could be obtained by adjustment of Nitrogen status. In view of the importance of Nitrogen as a basic and fundamental element in plant growth, this presents a line of investigation which is well worthy of consideration.

The possible effects of liming on nitrification, particularly on nitrogen fixing plants such as alder might also be investigated with advantage.

(4) *Phosphate:* This is critically low at all levels, except in the top 6 ins. to 8 ins. where the highest concentration of available P_2O_5 exists. After ploughing, however, the transplant is planted in a zone carrying

only 2.0 to 2.5 parts per million of this very essential element. Hence the immediate and significant response to phosphate application. Lack of phosphate application on peat means virtually complete absence of growth.

(5) *Calcium and Potash:* Levels are not significant as far as is known to performance of species now in use. Experimentation with new species may bring these elements, particularly calcium, more into the picture in years to come.

(6) *Decomposition and Density:* Comparison with the "raised bog" figure is revealing. Response of various peat types to ploughing may well reveal a distinct relationship with these two factors. The degree of aeration and consequent physiological and chemical activity may be influenced to a considerable extent by both.

Climate.

High rainfall combined with low insulation and high humidity, being the three factors most associated with peat formation, are the dominant meteorological elements of the region. The Table below indicates graphically statistical information on the meteorological complex. Figures quoted are taken from meteorological records for Glenamoy. They are average figures for 1958. Where appropriate, records from other stations are quoted for comparison. Again it must be stated that records are only readily available in respect of conditions at Glenamoy. As this is situated on the north Mayo coast a maritime influence is reflected on a number of the elements recorded. They may not therefore be applicable to the region under study as a whole. They are, however, indicative of climatological trends in the region. In fact, conditions at other centres would probably reflect an improvement in respect of most elements.

Element	**Records**							
	9 A.M.		3 P.M.		9 P.M.		MAX.	MIN.
Air Temperature	*Wet °F*	*Dry °F*	*Wet °F*	*Dry °F*	*Wet °F*	*Dry °F*	*at 9 a.m.*	*at 9 p.m.*
	42.27	49.75	49.32	52.44	46.91	48.33	51.47	44.23
Relative Humidity	84.64		79.72		80.75			
	2″	4″	3″	2″	4″	8″		
Soil Temps.	48.92	48.34	49.89	53.23	49.65	45.25		
	1′	2′	4′					
	49.84	49.93	50.10					

Frost	No. of days per annum with temp. 32°F or less=25						
Rainfall	Mean Annual = 48.41 inches						
Sunshine/Day	2.99 hours						
	9 a.m.	3 p.m.					
Wind Velocity	22.94 m.p.h.	17.38 m.p.h.					

						Gale Force	
		Dublin	Malin Hd.	Blacksod	Valentia	Beaufort	M.P.H.
Gale Frequency	No. per annum	7	43	117	5	8	over 42
	Mean over 10 yrs.	29	40	66	26	6 to 7	28 to 35

	Equivalent in Inches of Rainfall per Annum	
Evapo-Transpiration	Undeveloped Bog Surface	Grass Sward
	10″	15″

Exposure.

As far as tree-growth is concerned the most extreme element indicated above is that shown by the data relative to gale frequencies. It is apparent that the region as a whole is subject to severe gales and that therefore exposure can be severe. Prevailing winds are from the south-west, but some of the severe gales may be from the north-west. Land shelter to seaward is therefore a factor of considerable importance in determination of degree of plantability.

Elevation.

Plantable limits are governed to a large degree by the exposure factor. In a region, however, which is characterised by low mountain ranges (under 2,000 ft.) and wide valleys, interspersed through open plains, plantations have been established at elevations varying from sea-level at Glenamoy, to 750 ft. at Nephin Beg and 900 ft. at Nephin Mór. These do not necessarily represent the maximum heights attainable. It is unlikely, however, that much planting will take place at elevations in excess of 1,000 ft.

Site Classification and Plantability.

Any attempt at assessment of plantability must necessarily be proceeded by some form of site classification. The term "deep peat" is almost as wide in its interpretation as a definition of a soil-type as is "mineral soil". It is necessary, therefore, at the outset to break down this broad class into some appropriate sub-classification. The sub-classification adopted here is prompted to a large degree by the phrase recorded above under Peat Classification, viz. "These five features of the blanket-bog, basin, knoll, slope, flat and flush are constantly referred to in the description of the experiments as a means of defining the site." (Zehetmayr). These physical features are readily recognisable in the terrain under study and it is now apparent that they possess characteristic patterns of plantability. It is also possible to co-relate these recognisable physical features to a common pattern of vegetation dominants. On this basis, therefore, is devised the following sub-classification of the class "deep peat".

(1) Molinia *basins and flushes:* These carry strong *Molinia* with very often, vigorous *Schoenus nigricans* dominant to *Eriophorum* and weak *Calluna. Carex* species and *Narthecium* are also present. In pronounced flush conditions *Juncus articulatus* can be a dominant constituent. They occur, as the title indicates, in basins which have been enriched by drainage waters from adjoining slopes or on concave slopes which are similarly enriched. Peat depth is considerable and peat may show amorphous characteristics.

(2) Eriophorum *flats and slopes:* These areas carry *Eriophorum* with weak *Schoenus nigricans* dominant to *Molinia, Calluna; Narthecium* and *Carex* species also occur. *Tricophorum* may be found but normally it is not abundant. It can, however, be locally dominant where slightly convex configuration is developed. They occur as vast flats and slopes. Configuration is generally concave but never sufficient to create flush or basin conditions with consequent enrichment by drainage waters. Peat depths can be extreme, particularly on the flats. (Depth in excess of 24 feet has been noted). Peat type is predominantly pseudo-fibrous. Amorphous characteristics may, however, be exhibited at lower levels of the profile. When this is turned up by ploughing difficulties in planting can arise.

(3) Calluna *slopes:* These are found where gradient becomes moderate to steep and therefore peat depth is not great. They carry vigorous *Calluna* dominant to *Molinia* and *Eriophorum. Erica tetralix* and *Tricophorum* may be found on the poorer variants, but pockets of bracken may also occur. Peat is definitely fibrous. Such slopes are often boulder-strewn and are therefore unploughable.

(4) Calluna *knolls:* These carry weak *Calluna* with *Erica tetralix* and *Tricophorum* and some *Eriophorum.* They are generally found interspersed through flats and gentle slopes (as described in sub-class 2) and display, as is indicated in the title, a distinctly convex configuration. Peat is shallow, fibrous and tough and solid rock or compacted glacial debris may be very near the surface. In this respect they conform closely to the "black" soils of south-west Scotland as described

by Macdonald (1953). As such they are very intractable and unrewarding afforestation sites.

(5) Tricophorum *knolls:* These occur generally on mountain summits or exposed knolls. They carry *Tricophorum* dominant to *Eriophorum, Molinia* and sparse weak *Calluna.* The inherent combination of low fertility with severe exposure render them totally unsuitable for forestry purposes.

In the light of experience now gained, the following assessment of plantability is suggested. It must be appreciated, however, that in assessing plantability of any of the above types in the field, due regard must be taken of factors of the locality. Subject to these factors being favourable the assessment beneath is presented.

Sub-Class 1: This is land which is fully plantable after either manual or mechanical preparation. The latter is of course more desirable. Sitka spruce is the ideal and invariable choice of species. On such types it is a rapid grower and should form canopy quickly. Phosphate application is normally practised, but may not be essential on the more "mineralised" flushes. Species other than Sitka spruce have not been tried to any extent. Scottish experiments have shown, however, that *Tsuga heterophylla* has distinct possibilities on this peat type. Bushy type growth is characteristic of its earlier development, but where canopy has closed growth has increased rapidly (Zehetmayr). *Picea omorika* has as yet only been tried in experimental plots in the northwest. It is therefore premature to reach any conclusion on its performance. Experience in Britain has indicated that it may have a limited application on peat, particularly in areas subject to severe frost. *Alnus incana* is a possible hardwood variant which may play a significant part in the silviculture of deep peat planting. It has proved the best of various alders tried in Scottish experiments.

Sub-Class 2: Excellent crops are produced on this type after ploughing. Manual preparation is feasible but results are less satisfactory. Manuring (with G.M.P.) is essential for all species on this type. Present selection of species is Sitka spruce with mixtures of *Pinus contorta* up to 50%. On the better types (where *Molinia* is more dominant) the response to ploughing is so significant and spectacular that one is tempted to question the presence of *Pinus contorta* as a crop constituent. Nevertheless an intimate admixture of a proportion of *Pinus contorta* is probably desirable silviculturally. The deeper rooting tendency of the *Pinus contorta* will tend to create more amenable soil conditions for Sitka spruce and will also tend to act as a stabiliser. Species other than Sitka spruce and *Pinus contorta* have not been tried to any extent, but again *Tsuga, Picea omorika* and *Alnus incana* may in time prove to have appreciable potentialities on this sub-class.

Sub-Class 3: This type is difficult as a rule in so far as due to steepness of slope or boulder-strewn condition ploughing is not feasible.

Where ploughing is possible excellent crops of *Pinus contorta* can be established. Manuring is very essential. Even with manual preparation good results can be obtained with *Pinus contorta.* Where *Calluna* is vigorous and almost pure, *Abies nobilis* or *Abies nobilis/Pinus contorta* mixtures are possible. In bracken pockets Japanese larch or *Pinus radiata* will produce satisfactory results. Red oak or mountain ash are possible hardwood introductions for silvicultural purposes on this type. Birch has not proved at all satisfactory in this respect.

Sub-Class 4: If ploughable and provided factors of the locality are favourable this type can produce fair *Pinus contorta* after manuring. If not ploughable however, it borders on unplantable. Results after manual preparation are very unsatisfactory. No alternative species has been tried on the type. It is unlikely, however, that any other would give more satisfactory results.

Sub-Class 5: This type is considered totally unplantable.

In referring to *Pinus contorta* in the above context no differentiation has been made as between 'coastal' and 'inland' varieties. Both varieties are present in the north-western plantations. As yet, however, no specific assessment of their potentialities can be made. The typical upright habit and 'one year's needles only' characteristic is apparent in the 'inland' type. The 'coastal' on the other hand is strong and spreading and carries 2 to 3 years' needles. Both varieties may ultimately fulfil a function relative to their own characteristic habit of growth. It could well be visualised that whereas in Sub-Class 2, *Pinus contorta* is planted in intimate mixture with Sitka spruce, the 'inland' type would be the desirable choice, whereas in Sub-Class 3 where it is desired to effect early elimination of *Calluna* competition, or in Sub-Class 4 where a pioneer species is called for, the 'coastal' type could well be the appropriate selection.

Preparation of Ground.

Ploughing with Cuthbertson plough, single-mould board or double-mould board has been resorted to in all locations where ground conditions permit. Where this is not possible, manual distribution of turves for mound planting must be resorted to. Direct notching or pitting into virgin bog is never practised in peat afforestation.

Drainage.

In addition to opening existing watercourses (very often these only appear as sinuous narrow flushes), cross-drains have been created obliquely across the ploughed ribbons at intervals of from 1 to 3 chains apart. While this may appear to constitute intensive drainage, in practice it is necessary in order to maintain satisfactory growth, to deepen alternate ploughed furrows after 2 to 3 years. Effective uniform lowering of water-table levels is therefore not achieved by the basic system of drainage which has hitherto been practised. It must be appreciated and emphasised that a system of drainage which cannot produce the appropriate lowering of water table level AT AN ECONOMIC PRICE is not worth considering. For this reason the supplementary manual drainage which must be undertaken with the basic system now in vogue must be regarded as a heavy monetary imposition which should be eliminated if at all possible. (This point is further discussed hereunder).

Planting.

Normal method of planting is by single longitudinal slit on ploughed ribbon. This is preferred to the more conventional notching because of the greater anchorage it provides. If the roots are slickly followed through by the fingers or appropriate planting tool when insertion takes place, satisfactory root dispersion can be achieved. In practice very satisfartory results are obtained by this method.

As previously mentioned, where a layer of peat showing amorphous characteristics is found underlying the surface layers of pseudo-fibrous peat and is turned up as the planting surface of the ploughed ribbon, planting difficulties will arise. This layer displays an appreciably higher rate of shrinkage than the now underlying pseudo-fibrous type. Slit planting direct on to the amorphous type layer will, when shrinkage develops, produce extensive opening of slits and loosening of plants with consequent high mortality. It is necessary therefore, to remove this amorphous layer by "stepping" down to the pseudo-fibrous. A slit is then inserted in the "step". This is known as "step" planting. This was widely practised on all types in the early days. It is now, however, completely superseded by the slit method except in the exceptional case already described.

Age of Plant.

Age and size of plants is an important consideration. Strong three-year old stock is generally considered best. Some foresters, however, have a preference for four-year old plants of all species. Care must be taken in planting to ensure that plants are firmly embedded. Insertion to a depth of 2 or 3 inches above the root collar is necessary to achieve solid anchorage.

Time of Planting.

No special time of planting has been established as being particularly desirable. It is, however, desirable to have ploughing completed at least six months in advance of planting so that initial ribbon shrinkage will have taken place. Failure in this respect may lead to considerable loosening of plants with consequent increase in plant mortality.

Manuring.

Necessity for manuring has been previously referred to. In general where manuring is required, the normal dressing is 1 oz. of G.M.P. per plant for *Pinus contorta,* 2 ozs. for Sitka spruce and for other species 2 ozs. per plant. In the earlier plantations Basic Slag was used in preference to G.M.P. In current practice, however, G.M.P. is the invariable choice. While no very obvious increase in response is apparent from G.M.P. application as against Basic Slag, it seems likely that because of the more stable form in which it is applied, the response to G.M.P. will probably be more prolonged.

Rates of Growth.

Figures quoted here are based on casual observation only, without the assistance of statistical analysis.

On Sub-classes 1 and 2 growths of 12 inches to 15 inches per annum are normal. Individuals of 18 inches or more are quite common. On Sub-class 3 a range of annual growths of from 6 ins. to 10 ins. is apparent. On Sub-class 4 growth is very slow, averaging 2 ins. to 3 ins. with occasional individuals of 5 ins. to 6 ins.

Commentary.

It is now apparent that tree-crops can be established on the various sub-classes of deep peat as described, with varying degrees of success. In the accomplishment of this, three main adverse factors have been encountered :

(i) Lack of Drainage.
(ii) Lack of Fertility.
(iii) Lack of Silvicultural precedent.

It is true to say, in so far as crops are now growing satisfactorily almost to the thicket stage, that as far as establishment problems are concerned these adverse factors have to a large degree been successfully overcome. It is equally true to state, however, that these same adverse factors will be present in greater or lesser degree throughout the entire rotation. A study therefore of their respective significance during the life of the crop is perhaps not irrelevant. Judging from experience now gained it is also relevant to consider what improvements if any, aimed at a further amelioration of these ill-effects, can be effected in current technique. In the ultimate picture all three factors are utterly interdependent and cannot in practice be considered in isolation. A perfect drainage system will not of itself produce fertility. Equally does the converse apply. Granted good drainage and adequate fertility, the lack of appropriate silvicultural "know how" can lead to abortive results. Bearing this in mind therefore the following appreciation of the individual factors is presented.

Drainage:

The achievement of good drainage is probably the most critical factor involved in the entire deep-peat complex. In the early stages stagnation can lead to severe growth check or in the extreme, to plant failure. As the crop develops, deficient drainage can at any stage cause further check. In the latter stages of the rotation widespread instability will result from high water-table levels. These are physical factors affecting the health and existence of the crop itself. Effective drainage also produces in the soil complex a number of phenomena (structure, moisture/air relationship, ground temperature, etc.) in which a favourable reaction must be obtained if the proper functioning of the physiological processes of plant growth is to be permitted. It is only by the achievement of an appropriate balance amongst these phenomena that plant nutrition can be expected to proceed with any degree of efficiency. Good drainage at all times is therefore in this instance a basic and fundamental requirement for timber production.

Appreciating at the outset that peat contains up to 94% water, the magnitude of the drainage problem becomes apparent. Realisation of the manner in which such water is held in peat—adds further to the difficulties of situation. The water content of peat is held in four distinct physical forms.

(i) Hygroscopic Moisture: This is the amount of moisture retained in an air-dried peat under ordinary atmospheric conditions. It is not available to plants and can only be removed by heating to 100°C. The percentage held in this way will vary with atmospheric conditions. There is therefore considerable variation. The following figures have been recorded, 18.4% (Mitscherlich) 42.3% (Heinrich).

(ii) Imbibitional Moisture: This represents the water absorbed by the colloidal fraction. As peat is a highly colloidal substance the percentage of moisture held in this way is phenomenal. *It is available to plants but it is highly resistant to physical movement and is tenaciously held against mechanical force.*

(iii) Capillary Moisture: When saturation of colloids is complete, excess moisture collects on the surfaces of the soil particles. In peat this is not a significant source of moisture.

(iv) Gravitational Moisture: As soil moisture increases, interparticle and intercellular spaces become saturated with water. This water is normally subject to gravitational forces. In peat, however, even where natural drainage conditions are favourable, the movement of free water within the peat is negligible.

It is apparent that moisture is held in peat in a manner which renders its movement highly resistant to ordinary physical forces. It has been observed in practice that no movement occurs towards a drain (3 ft. deep) beyond a distance of 6 ft. from the drain-edge. No significant increase in this zone of movement is effected by deepening of such a drain. A successful drainage system must therefore obviously be intensive, not in the sense as provided by deep drainage, but in an extensive sense, so that an intimate relationship is established between the root system of the crop it is intended to grow and the drainage system created. This desired intimacy of relationship between the root system of a tree-crop and an extensive drainage system can be created simply and economically by deep ploughing during preparation for planting. In practice this has many additional advantages. Normal opening of main drains will suffice to provide effective run off and dissemination of drainage water. Thus is eliminated the necessity for time consuming cross-draining over ploughed ribbons. The large ribbons turned over by deep ploughing will effect complete suppression of competing vegetation. Where *Calluna* is a constituent of the vegetation this is a very important consideration.

The extensive drainage inherent in deep ploughing would, it is believed, provide an appropriate lowering of water-table-level for a considerable part, if not all, of the rotation. Species now in use are on the whole, shallow rooting. An excessive lowering of the water-table-level would therefore serve no purpose. It must also be appreciated that when a tree-crop is established and growing vigorously, the equivalent of from 15 ins. to 17 ins. of rainfall per annum will be eliminated by evaporation. This will constitute a significant contribution to water dispersal and will influence future drainage requirements to a considerable extent. The length of rotation will also determine to a large degree the drainage requirements of the adult stages of the crop. If a pulpwood rotation is considered appropriate it may well be that drainage as suggested will meet the requirements of the final crop. If, however, on the better peat types it would seem appropriate to produce saw-log timber on a standard rotation it could be visualised that intensive drainage in depth would be necessary. This coupled with the extensive drainage of the upper layers, would serve to create conditions of periodic drought in these layers, thereby forcing the roots downwards to tap moisture supplies at lower levels and thereby increasing stability.

Fertility.

The solution of the fertility factor is primarily a matter of the application of artificial manures. It is now quite apparent that throughout the whole range of sub-classes described above, application of Phosphate is essential for successful tree growth (with the exception of some of the more mineralised basin peats). On the *Molinia* and *Eriophorum* sub-classes, for species now in general use (Sitka spruce and *Pinus contorta*), the making good of the Phosphate deficiency produces very satisfactory results. While the effect of the Phosphate is not fully understood, it is probable that apart from satisfying Phosphorus demand in itself, it also interacts with other elements and renders them more available. Satisfactory growth is at any rate achieved and is being maintained. On sub-classes 3 and 4, however, while Phosphate application is even more critical, it is not to any comparable degree as effective. Fertility therefore is decreasing down the scale of sub-classes and it would seem that artificial manuring should be stepped up accordingly. Phosphate may not indeed be the only critical deficiency in some of the lower grades. Investigation should be directed towards establishing what element or group of elements is lacking and then to what extent such lack can be made good by a simple application of individual elements or by a compound group of such elements. This latter possibility is, however, a purely theoretical concept of fertility which, as has already been emphasised, is inextricably bound up with many other inter-related factors. In these lower grades lack of fertility may not indeed be the critical factor at all.

Silviculture.

The practice of silviculture in relation to deep-peat afforestation may at the present time appear simple in the extreme. The number of species in use is limited. The variation in site types is not excessive and these are readily recognised when familiarity with them is established. Cultivation by mechanical means or by manual mounding are the recognised methods of site preparation. Manuring with phosphate is standard practice to overcome lack of fertility. Nevertheless in the absence of an established silvicultural code, particular attention must be accorded at all times to the silvicultural problems encountered. A forester must endeavour to look ahead, over and even beyond the duration of the first rotation. He must endeavour to visualise what the probable pattern of future events may be. Present practice must therefore be designed to provide solutions to silvicultural problems which may or may not arise in the future and in this respect the absence of established precedent imposes severe limitations and involves serious difficulties. The danger of instability in the pole-stage can, for example, be influenced to a considerable degree by the incorporation of perimeter bands and internal bands of hardwood species through the coniferous matrix e.g. alder through Sitka spruce, red oak, mountain ash or birch through *Pinus contorta.* An intimate admixture of deeper rooting species may also help in this respect.

The probable occurrence of a "raw-humus" problem at the end of the first rotation is another factor which must now be borne in mind. The accumulation of coniferous leaf fall on the highly acid soil conditions obtaining on peat will, it is considered, produce a substantial accumulation of "raw humus". What steps can be taken now to minimise or eliminate its ill-effects? The incorporation of hardwood species as suggested as a minimising element in the instability problem may also serve a very important function in this respect. The ameliorative reaction of the accumulated hardwood leaf fall may, over the years, assist substantially in the break down of the raw-humus accumulation. It should at least serve to reduce the quantity of ground limestone per acre, which it would seem, will inevitably be required at the start of the second rotation. "Raw-humus" is very detrimental to the establishment of tree crops and therefore must be eliminated before regeneration will be successful.

When the pole-stage is reached determination of appropriate thinning grades will test to the limit the silvicultural ingenuity of the forester. Overthinning will cause instability and possible disturbance of the critical moisture/air relationships of the soil. Underthinning in the conditions of severe exposure which prevail can give rise to serious windthrow. New techniques must be evolved for extraction of thinning produce. Conventional extraction methods by horse and wheeled vehicles will have to be replaced by appropriate self-powered track-laying vehicles.

In the adult stages of the crop serious consideration must be accorded to the method of regeneration to be adopted for the second rotation. Ploughing, as a method of ground preparation, will be ruled out. How then will such a crop be established? By conventional clear felling, with artificial regeneration? Nevertheless the balanced soil complex established and maintained by careful silvicultural practice throughout the first rotation could be utterly destroyed by clear-felling. Alternatively, should silvicultural practice in the latter stages of the rotation be directed towards creating conditions suitable for natural regeneration? If so what system will be best suited to achieve the desired result?

These, and many other problems will present themselves at various times during the rotation. There are no text book answers available. Only silvicultural "know-how", allied to appropriately directed and co-ordinated scientific research, can provide these answers.

Conclusion.

In the light of experience now gained it can be fairly stated that deep-peat afforestation is safely launched. Successful establishment of plantations has been achieved on a number of well defined peat-types. It is now apparent which are good types and which are poor types. Future development should therefore be directed accordingly. The continued maintenance of crop growth, health and vigour through to the final harvesting will present many unforeseeable and difficult problems. With careful interpretation of applicable silvicultural principles with the assistance of scientific research these problems can and must be overcome. Timber production deep-peat will then become an accomplished fact.

Acknowledgment.

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Literature References.

Day, W. R. (1953) The Growth of Sitka Spruce on Shallow Soils in Relation to Root-Disease and Wind-Throw. *Forestry,* Vol. XXVI. No. 2. 81-95.

Hall, Daniel (1947) *The Soil — An Introduction to the Scientific Study of the Growth of Crops.* John Murray, London.

Walsh & Barry (1958) The Chemical Composition of some Irish Peats *Proc. Roy. Irish Acad.* Vol. 59. 15B.

Zehetmayer J. W. L. (1954) Experiments in Tree Planting on Peat *Bull. No.* 22. For. Comm., Lond.

Macdonald, Wood, Edwards & Aldhous (1957)— Exotic Forest trees in Great Britain. *Bull. No.* 30. For. Comm., Lond.

Macdonald, J. A. B. (1953) Thirty years development of afforestation technique on difficult ground types in south-west Scotland. *Forestry* XXVI, 14-21.

Steven, H. M. (1929) The afforestation of peat. *Quart. J. of For.* XXIII, 9-27.

Frazer, G. K. (1933) Studies of certain Scottish moorlands in relation to tree growth. *Bull. No.* 15. Comm., Lond.

Tansley, A. G. (1939) *The British Islands and their vegetation.* Cambridge University Press.

A Comparison of Methods used in obtaining Current Annual Increment

L. P. O'FLANAGAN

Norway spruce, Compartment 17, Rockingham Property, Ballyfarnon Forest.

IN the course of a limited investigation carried out in this Norway spruce stand, current annual increment was evaluated by four different methods. As there was no significant difference in the results, a description of the methods may be of some interest. It should be emphasised that the investigation was anything but exhaustive, but the findings indicate that reliable increments can be cheaply obtained.

Description of Crop.

This Norway spruce stand is situated on a small knoll on the eastern shore of Lough Key, Co. Roscommon. Elevation is approximately 100 feet above sea level, exposure reasonably moderate though the presence of the lake limits wind protection. Slope varies up to 8 degrees, drainage is good and soil is a brown earth. The geological formation of the site is a post pliocene drift over lower carboniferous sandstone.[1] Forest floor vegetation consists entirely of mosses—cover being almost 100%. Butt rot appeared on the stump of one felled tree. The stand is Quality Class I according to British Forestry Commission revised Yield Tables.[2]

Methods of Assessment.

The area under Norway spruce was mapped on to 6 in. O.S. sheet (Roscommon 6) from ground detail. A ride 15 yards wide through the middle of the stand was excluded—this gave us two stands of approximately the same size totalling 4.9 acres.

To determine volume and increment values a 12% random sampling of this area was undertaken, the basis of which was six 1/10 acre circular plots, three being in each stand to obtain better distribution. A 6 in. to the mile acre grid, bored at random points with an order of choice, was used to get plot centres. The first three points obtained in each stand by throwing the grid onto the map were accepted and marked. One plot (No. 6) occurred on the stand boundary: in order to take edge effect into account two half plots, their centres on the boundary and circumference touching at the mapped point, were taken. A radius of 37 ft. 3 ins. gives 1/10th acre on level ground. Where slope was more than 5 degrees, adjustment to the plot radius was made according to a table by Bryan.[3]

Stems were entered in Quarter-girth classes and a mean basal tree ($7\frac{1}{4}$ ins. b.h.q.g.) calculatd for the whole sampled area, the plots being treated collectively. Two trees, 16% from either end of the quarter girth distribution[4] of all the plots were also picked, these turned out to be $5\frac{3}{4}$ ins. and $8\frac{1}{4}$ ins. b.h.q.g.

In each plot two mean basal area and the two 16% trees were marked. A further three mean basal area trees were selected by taking a diagonal line with a compass bearing in an east-south-easterly direction, and at pre-determined intervals the nearest mean basal area tree was marked. These three trees were felled as well as the first mean basal area tree marked in each plot. Form factor and leader growth measurements were taken from these nine trees and a stem analysis was carried out on five trees. The stems selected for stem analysis were the first five mean basal area trees felled, one from each plot except plot No. 3. In marking mean basal area and 16% trees within the plots, the first trees which fell into the appropriate quarter girth category were accepted, irrespecive of their form or vigour. Heights of unfelled mean basal area trees were taken with a Blume-Leiss hypsometer and increment borings taken at four points (north-east, south-east, south-west, north-west) on mean basal area and 16% trees with a Pressler borer.

These operations gave us sufficient information to calculate crop volume, age and bark percentage. Increment was calculated by four different methods—

(a) Stem analysis.
(b) Schneider's Formula modified * applied to 16% trees.
(c) Schneider's Formula modified applied to mean basal area trees.
(d) Leader growth tables.[5]

Crop Data.

Age of crop from nine stump counts	= 37 years.
Area of both stands	= 4.9 acres.
Number of stems per acre ...	= 454.
Form factor of mean basal area tree	= 0.52.
Height of mean basal area tree ...	= 60 feet.
Mean basal area tree	$=7\frac{1}{4}''$ b.h.q.g.
Volume of mean basal area tree	= 11.4 cubic feet Hoppus measure.
Volume per acre	= 5.176 cubic feet Hoppus measure.
Total volume of both stands ...	= 25,360 cubic feet Hoppus measure.

(a) Stem analysis.

The normal methods of stem analysis were used on five trees, A, B, C, D. E from plot No. 4, 5, 1, 2, 6, respectively. Bark percentage

* Volume increment modification for young conifers V = .9D + 1.8 where V = current annual volume increment % and D = % obtained from Schneider's formula (Unpublished work of Assessment Section, Forestry Division, 22 Upper Merrion Street, Dublin).

was calculated from stem analysis. Current annual increments for each tree (mean of 3 year period) in true measure—

A	B	C	D	E	Total	Mean increment
.700	.723	.797	.697	.543	3.460	0.692

$$\text{Current Annual Increment per cent.} = \frac{\text{C.A.I.} \times 100}{\text{Mean under bark vol. (true measure)}} = \frac{0.692 \times 100}{12.328} = 5.61\%.$$

Volume over bark per acre = 5,176 Hoppus feet.

Bark % = 7.8; bark volume = 404 „ „

Volume under bark per acre = 4,772 „ „

Current annual increment per acre = 4,772 × 5.61% = 268 Hoppus ft.

(b) Schneider's formula applied to 16% trees and modified.

Plot	$5\frac{1}{4}''$ tree	$8\frac{1}{4}''$ tree	Mean Schneider of 16% tree
1	3.9%	3.3%	3.60%
2	3.2%	3.7%	3.45%
3	4.5%	4.5%	4.50%
4	4.6%	3.4%	4.00%
5	4.0%	6.0%	5.00%
6	3.5%	4.1%	3.80%

Mean = 4.05%.

With assessment modification = 5.40%.

Volume per acre under bark = 4,772 Hoppus feet.

Current annual increment = 258 Hoppus feet.

(c) Schneider's Formula on mean basal area trees and modified.

Plot No.	Schneider's	Formula
1	4.80%	3.52%
2	3.77%	4.10%
3	4.30%	5.86%
4	6.27%	4.04%
5	4.64%	4.68%
6	4.97%	4.13%

Mean = 4.59%.

With assessment modification = 5.93%.

Under bark volume per acre = 4,772 Hoppus feet.

Current annual increment = 4,772 × 5.93%.

= 283 Hoppus feet.

(d) Leader growth tables:

LEADER GROWTH PER TREE PER YEAR IN INCHES

Tree	1960	1959	1958	1957	1956	
A	14	14	18	13	23	
B	12	25	19	17	19	
C	22	21	24	16	29	
D	10*	14	16	10	24	
E	9	3	8	8	18	
F	13	11	10	12	21	
G	6	5	5	10	17	
H	24	20	20	10	14	
I	29	13	30	9	32	
Totals	139	126	150	105	197	ins.
Average growth	15.4	14.0	16.6	11.6	21.9	ins.
Vol. increment per 12″ growth	218	218	210	210	210	Hoppus ft.
Increment	280	250	290	203	383	Hoppus ft.

Total increment for 5 years = 1,411 Hoppus feet.
Current increment based on 5 year period = 282 Hoppus feet.

An analysis of variance was undertaken to find if there was any significant difference between the methods used for increment estimation. For this purpose the plots were treated as blocks and for each method increment was worked out from single plot data and applied to volume under bark per acre. Due to the fact that stem analysis was only carried out on five trees we have a missing cell in our table for plot 3. The missing figure was estimated by formula.

Table showing increments for plots and methods ("X" calculated).

Methods	PLOTS 1	2	3	4	5	6
Stem analysis	304	258	X=255	267	337	192
Schneider on Mean trees (Mod.)	264	255	304	307	286	281
Schneider on 16% trees (Mod.)	234	300	240	279	249	257
Leader Growth	410	269	243	298	334	167

Analysis of Variance.

Source	Degrees of freedom	Sum of Squares	Mean Squares	F
Methods	3	2,732	910.7	Not
Plots	5	17,815	3,563	significant
Error	14	33,805	2,415	
Total	22	54,352		

* Leader broken at 7 ins. 3 ins. allowed as an estimate of amount lost.

References.

1. Geological Survey of Ireland 1" map. Sheet 66.
2. Hummel, F. C. and Christie J. *Revised Yield Tables for Conifers in Great Britain.* Forest Record No. 24, H.M. S.O.
3. Bryan, Mackay A. (1956) A simplified method of correcting for slope on circular sample plots. *Journal of Forestry.* Vol. 54. No. 7.
4. Krenn, K. (1940) Uber Naherungsverfahren zur Berechnung der Durchmesser der Hohenadlschen Mittelstamme, dargestellt an einem extremen Bestandesbeispiel. *Allg. Forst.—u. Jagdztg* 116 (in Forestry Abstracts 3. P. 172).
5. Hummel, F. C. and Brett J. (1950) A Simple method of Estimating Volume increment in stands of young conifers. *Empire Forestry Review* Vol. 29, 1.

Field Photography and the Forester — A Personal Approach

T. A. Barry

MANY of us avoid camera-work and, even more so, colour photography, because of what we think is the formidable nature of the technicalities involved, because of the imagined exorbitant cost, or because we "haven't the time" (i.e. patience) for it.

The writer has been dabbling in this and many other means of recording field-work for some years past. Disappointed quite often by poorish results in black and white where photographs of growing vegetation and young trees were taken, he has by degrees awakened to the radical differences between black and white, and colour; and to the absolute superiority of the latter for many practical purposes associated with forest research. In the widest sense, all forestry is forest research, so this discovery has relevance to every forester and to his daily round.

The outstanding advantage of colour photography is not the obvious one, the presence of colour, it is the stereoscopic or three-dimensional effect that colour gives. This advantage is most marked in the case of transparencies, or colour slides as we say, where to a remarkable extent colour gives the appearance of solidity to objects seen on a flat screen, or through a simple viewer held up to the light. Here is a case where it is quite literally true to say that the effects have to be seen to be believed. Yet, a reasonably good quality lens, a little skill in camera technique, and a reliable colour film (plus the necessary light, coming from a suitable direction, of course) are all that we require for first-class results. It is true that the better the equipment and accessories the less room is left for the operation of chance but still, in all field-photography, variables of the subject are so many and the human element so vitally important that it has real claims to be called an art as well as a science. This should encourage those of us for whom a camera with everything built-in (including a three-figure price tag!) is out of the question.

Light.

Within the camera, the amount of light admitted to, and absorbed by a sensitive plate or film is regulated in two ways. By the size of the aperture through which it comes—f22 is often the smallest, f4.5 often the largest opening possible— or by the time during which the light in question is admitted, e.g. 1/300, 1/200 or 1/100 of a second up to a half second and from there on to time-exposures of longer duration. Obviously, variable shutter-timings and lens-openings like these give plenty of latitude to meet widely varying light conditions. For instance, f22/1/300 second for the very brightest subjects and conditions, using high speed film; f4.5 with a half second or longer time-exposure for the worst possible cases of dull subject and poor lighting, using normal film.

Photography, as the roots of the word make clear, means "light-writing". We may, as artist-photographers, sketch in our effects by way of snapshots, or spend some time and care on more detailed "paintings". It is with the latter almost entirely that the forester will be and should be concerned, although of course, the snapshot has its part to play where time is genuinely not available for anything better.

Correctly judging or estimating the light-values, and setting the most appropriate combination of "stop" and timing on one's camera, together make up the key to successful photography. The beginner gets there at first by a combination of pure guess work and, let us hope, a study of the brief but extremely useful exposure tables enclosed with all films nowadays. His errors when using black and white film, unless he is very inaccurate in his judgments, make little difference for all ordinary purposes to the prints he eventually receives. This is because at processing, much compensation can be made for over or under exposure. When using colour film, however, the position is quite different. There is little or no room for error and so, if insufficient exposure (or too much) has been given, no skill at processing can make good the results.

Light values are affected by time of year, time of day, atmospheric clarity or occlusion, angle of shot and nature of subject. Only the last two factors call for a word of explanation. Angle of shot for the forester will relate to those times when he needs to "shoot" an object on or near the ground, with camera pointed downward. Compensation must be made for this deflection even in bright light e.g. a camera setting of f5.6 becomes f4.5, *or* a speed of 1/50 second becomes 1/25 second. (Note the *"or"*. If he does both, he will have achieved double the correct exposure). Nature of subject can affect light values quite significantly. Thus a smaller "stop" can be used in photographing peeled pitwood than in taking pictures of unpeeled produce. Under the same light the dark foliage of Austrian pine calls for an exposure increased over the amount required for the lighter green of birch foliage or larch needles. This kind of hair-splitting is not going to appeal to the beginner, but the fact is, he must experiment, if his pictures are ever to rise beyond the mediocre.

Focus-Depth.

Why have these puzzling series of aperture/exposure-time combinations? Not only to give room for manoeuvre under widely differing light conditions but also to provide alternatives in the amount of detail within the picture that will come into clear focus, and further, as we shall see later, to give us a better chance of "stopping" movement in the subject.

Everyone has noticed how when looking through a window or a windscreen one may concentrate or focus on some object *on* the glass or on something a long way off seen *through* the glass. When this is done, objects further away in the first case and on the glass in the second case are blurred i.e. out-of-focus. In exactly the same way the camera eye can be focused on a particular spot to its front, the term zone would be more correct, and the width of this zone or band in clear focus is called the "depth of the field" for each particular setting.

Depth of field decreases, that is, the band in clear focus becomes more narrow with increasing size of aperture and with decreasing camera/object distance.

Thus, to give a real instance, the minimum depth of field obtainable with a particular camera (2 ft. 10 ins. to 3 ft. 2 ins. = 4 ins. depth of field) is got by setting it at the minimum distance (3 ft.) and maximum aperture (f3.5) available. This would be the ideal setting for, say, the detail of leader growth on a two year old Sitka spruce. Everything nearer to the camera than 2 ft. 10 ins. and further than 3 ft. 2 ins. will then be blurred : the detail of the object required will stand out sharply and clearly, provided always, of course, that the distance camera/object has been measured accurately and that the correct exposure time has been given. It is probably not necessary to add that the factor exposure-time has no relevance to the factor depth of field, which latter derives, as we have seen, from aperture and from distance camera/object. Also from a third variable into which, happily, we need not enter here,—the focal length of the lens we use.

Continuing with our actual instance of the attributes of a particular

35 mm. camera then, using the same aperture throughout (f3.5) the depth of field, which at 3 ft. distance setting was 4 inches;

at 5 ft. distance setting becomes 4 ft. 7 ins. to 5 ft. 6 ins.
= 11 ins. depth of field.

at 10 ft., ,, becomes 8 ft. 8 ins. to 12 ft. 2 ins.
= 3 ft. 6 ins. depth of field.

at 25 ft., ,, becomes 17 ft. 2 ins. to 45 ft. 4 ins.
= 28 ft. 2 ins. depth of field.

Thus the depth of field becomes greater with increasing distance-setting, and *vice versa.*

Again using the same camera, and this time keeping the distance-setting uniform at, say, 10 ft. we get the following, using different apertures;

at f3.5 the band in clear focus is from 8 ft. 8 ins. to 12 ft. 2 ins.
= 3 ft. 6 ins. depth of field.

at f6.3 ,, is from 7 ft. 7 ins. to 14 ft. 9 ins.
= 7 ft. 2 ins. depth of field.

at f18 ,, is from 5 ft. 3 ins. to 114 ft.
= 108 ft. 9 ins. depth of field.

Thus the depth of field becomes greater with decreasing aperture (f18 is only one-thirty-second the size of f3.5).

We have seen how the detail of the subject (leader growth on our two year old Sitka spruce), among many other similar objects round about it, was brought out by using maximum aperture and minimum distance, thus separating the tree from the wood. If a general view of the same wood or plantation had been the object however, the reverse course should have been taken viz. smallest possible lens-opening for the light available, and maximum time.

And in those last three little words there lurks a snag, for a little too much breeze can easily upset our nice, and hitherto simple, calculations when we are dealing, as foresters must, with natural objects only too liable to wind movement.

Wind.

Suppose the light is good, fitful sunshine on a March morning, with a gusty wind blowing. Our object is to photograph the south-west edge of a plantation or trial plot, on the windy bog or hill-side. We may judge or measure that a camera setting of f8/1/50 second would be ideal. One-fiftieth of a second, however, is unlikely to "stop" moderately strong wind movement near the camera, and there may not be room to move back even if we wanted to. So it would be better to use f5.6/1/100 second; better still f4.5/1/200 second. But in widening the aperture, we cut down the depth of field and this is just what we may wish to avoid. In which case there is really no way out. We must either recharge with a faster film enabling perhaps f16/1/200 second to capture the subject—or await a calmer time. Using a really high speed film as routine is not a good solution either. If we try this, occasions can arise, especially in summer, when minimum aperture and exposure-time combined can still over-expose.

So that in field photography as in fishing, patience is the important thing and persistence a necessity. We must always be prepared to come back another day.

Accessories.

Camera accessories *ad lib* are on sale. All share one characteristic—they are best done without, (if one can so manage). The beginner, bearing in mind that correct exposure is much more critical with colour film than with black and white, will feel he needs a light exposure meter. But a better plan, provided the original enthusiasm can be made to last out, is to go without and to embark instead upon a course of self-set experiments, in other words a course in trial and error. Indeed, no meter can replace such a course because, after all, it is the photographer who decides the setting, meter or no meter. (We are not concerned here, needless to say, with automatic cameras that are all guaranteed—to take the fun out of photography). Undoubtedly the fewer artificial aids to our personal judgment, the greater the aesthetic pleasure from our better pictures. And what great gains in humility, from those of the other kind.

At this point, as it happens, the aesthetic and financial aspects become nicely blended. Standard 35 mm. colour film can be had in casettes at prices that work out at around 1/- per transparency, inclusive of processing. But the full price having been paid before any photographs are taken, 50% failures in the field will mean a doubling of the cost per good slide eventually, and so on, *pro rata*. It follows from this that as with the poor fowler "every shot must tell", leading, in both cases let us hope, to better markmanship and a keener study of the game.

The unsteadiness of the human hand is one of many things that can deceive the camera-eye. It is generally laid down that if an exposure-time greater than 1/25 second is used, a tripod becomes a necessity. A ranging rod, stuck in soft ground, can be quite effective as a base-plate or "unipod". Some authorities hold that even with 1/25 second a tripod is essential, but personal experience suggests that at 1/20 second or, softly be it claimed, even at 1/10 second, perfect definition can be obtained with a hand held camera, *provided there is good breathing control.* The rule is supposed to be that you take a deep breath, then "press trigger". For one amateur however, the moment of truth is that immediately following the exhalation of a deep breath. It would be interesting to hear whether this trick works for others.

Filters in great variety are on offer. In our kind of field photography the only one that will be required with black and white film is the light yellow correction filter which gives character to sky and cloud effects, and may improve the detail of foliage. The filter factor for this may be 1.5 or 2, which means (if the factor is 2) that every time it is used we must remember to double the normal time *or* the normal aperture.

For studies in colour beside "the wine-dark sea" and at high elevations, an ultra-violet filter is recommended. The filter factor here is, fortunately, 1.0, which means your forgetting it will make no difference.

Colour Photography and Forest Records.

The most widespread use of colour pictures in forest record work will be that of showing the progress of growth in plantations; and vegetation changes over a period of time, perhaps over many years. Whenever a photograph is taken for such a purpose, it is absolutely essential that a post be driven in or some other *exact* record made of the precise viewpoint and height of camera above ground. If this is not done, retakes in later years will be worse than useless.

The compilation of exact data, like this, is only a special instance of what should become for every forester and research photographer, an inflexible rule, namely—that every single photograph taken will be recorded at once in one's notebook under the headings of camera-setting, time and date, apparent light conditions and interest of subject. It is amazing how much useful information, direct and incidental, can build up over a period when this is done.

For instance, colour photographs were taken, every kind of subject, with a new camera from August to December, in sunshine only. Notebook data show clearly that the best pictures were obtained by increasing apertures steadily, by one stop, month by month over that period. Theoretically, it should be necessary only to decrease them again, from January to July in like measure, to get equally good results. It would be unsafe, of course, to apply a scale like this to any other camera. Every one must work out his own salvation, likewise calibration.

It is doubtful if there is a more useful tool available to the forest research officer, to the forestry lecturer or to the plant-ecologist than the modern camera loaded with colour film. By this means, given sunshine, or the photo flash attachments for both indoor and outdoor use available to-day, he can assemble, re-sort at his leisure and present systematically, records that are self-explanatory or nearly so. In particular, colour transparencies each of which can be as good as a thousand words of explanation, demonstration or technical reporting. Slides of text-figures, of graphs, of colour drawings are easily prepared and much more readily conveyed to class-room or lecture hall than the originals.

Further, they become the focus of attention in every sense, flashed on a screen in a darkened room.

By means of transparencies the forest officer can illustrate and record indelibly, forest history, nursery seedbed and transplant line development and trials, diseases in nursery and plantation, response to treatment, progress and effects of thinning and all other forest operations.

Every forester can assist with the compilation of such records. Obviously the man on the spot is the one most likely to be the first to notice significant happenings; and to be there when the light is right and from the proper quarter.

Then, with camera and notebook at the ready, it remains only for him to compose his picture artfully and carefully, so that it may prove not only technically informative but, so far as possible,

"A thing of beauty
And a joy forever".

Review

Planting for Profit

Issued by "Trees for Ireland", 30 Westmoreland Street, Dublin.

OVER the years, up to now, Irish Foresters have felt the embarrassment of having no adequate publication produced and written from this country, which they could recommend to the private planter who wanted general knowledge on the subject of raising trees, to supplement advice imparted by personal contact. The request for a book dealing with nursery work, planting, thinning and other aspects of forestry in a general way was a frequent one, and could only be met by recommending a book or a number of books, not always inexpensive, and usually written and published in Great Britain where, though Forestry conditions and practice may be similar, they are not by any means always the same.

In producing "Planting for Profit" in a most attractive and readable form, "Trees for Ireland" have not only met the Foresters' difficulty, but more importantly, will reach most people outside the ranks of professional Foresters who have enthusiasm, whether great or small, for forestry and tree planting, and the impact on increasing the number and extent of small forest lots should be considerable.

"Planting for Profit" is directed at the amateur planter, and estate owner who requires factual knowledge on the simple technicalities of forestry, and in this it should be very successful because it is comprehensive, clearly written and well illustrated by tables and examples. In offering certain criticisms of this book, the reviewer does so from the point of view of the professional Forester, but does not attempt to detract from its essential merit in the context of the purpose for which it was written.

The chapter dealing with "The Trees" covers all the important species and some that are not. For instance, in the hardwoods, one might have wished for a fuller discourse on the silviculture of ash and sycamore—too important at the expense of hornbeam, lime and horse-chestnut, which are hardly likely to find a place in plantings for profit. In this chapter, too, fuller notes on the contemporary uses for the woods of various species would have been in place; for instance the utilisation for veneering of high quality straight trees is not mentioned in regard to oak, beech and sycamore although they command their highest value for this purpose, and the main present day use of ash for sports goods is not mentioned. The fact that ash, as a hardwood, is a comparatively fast grower and that it can be utilized in small sizes for sports goods and tool handles, makes it possibly one of the most economic hardwoods to grow—particularly for the private planter.

As a Forester, one is struck by the uneveness in nomenclature in the section dealing with conifers. For example, the current name in use for Japanese larch is *Larix leptolepis* and unless it has been very recently adopted again, it is some time since *Larix kaempferi* was in vogue. Although *Abies nobilis* is still in general use for the Noble fir, *Abies procera* is at present accepted and is correctly used in the text, but *Pseudotsuga Douglasii* is used for Douglas fir although *Pseudotsuga taxifolia* is now accepted and in use. While, doubtless, the author was moved by a desire to spare his readers from tongue twisters, *Chamaecyparis lawsoniana* is the correct nomenclature for Lawson cypresss, not *Cupressus Lawsoniana,* which is used in the text. However, here again, in the section for conifers the main objective is well attained and useful information for each species is conveyed.

Attention to contemporary utilisation might have been given, as in the case of Douglas fir in connection with which no mention is made of the fact that this tree is most valuable as a transmission pole for which a very good price can be obtained. Perhaps too, there are few Foresters who would agree that Grand fir (*Abies grandis*) is a wind resistant and storm firm tree but, no doubt, adjusted silviculture treatment might render it so, and it is a rewarding tree which deserves much more attention that it gets. On the subject of *Pinus contorta* we are left with far too rosy an idea of its ability to stand under exposed conditions, but of course as a shelter belt tree as distinct from a forest tree it can give good service on high and very exposed sites.

Though the capacity of various tree species to stand exposure is advocated so frequently, a chapter on shelter belt growing in particular, would have been of great value, as so many people who grow trees are concerned mainly with this aspect of silviculture.

The chapter on "The Home Nursery" is very good as might be expected from the author, but compactness would have been achieved by some brief notes on such collection, extraction and storage, particularly as it is not at all easy to purchase forest tree seed in small lots. The definition of the photographic reproduction in this section as elsewhere, is somewhat obscure for the detailed description of the particular operation described.

On the subject of "What to Plant", the author has wisely detailed description of site types, and has rightly emphasised that a great deal of knowledge and experience is necessary before species can be chosen with confidence. In fact, if this confidence is not possessed by the planter, he is best advised to call on professional advice at that critical stage.

Drainage, preparation of ground and planting are all well covered. The important operation of mounding is mentioned, but not described under "Drainage and Other Preparation of Planting Ground." Later the planting of a mound is described in the chapter on Planting in connection with what we know as mound draining. Here, a sod 2 ft. deep is cut out of the drain, inverted and planted "spreading the roots between the sod and the underlying ground." With a mound 2 ft. deep, a planter may find himself often having to bury the top parts of the plant if he is to follow the instructions. Confusion often exists as to the operation of mound planting, and further detail and illustration on this point would have helped to make the picture clear.

The use of the plough in planting to mound ribbons, a cheap and easy way to most farmers, is not emphasised sufficiently.

Great benefit will be derived by owners of small forest lots, from the chapter on "The Early Harvest, Marketing and Thinning", in which much practical advice is sounded off, by a set of stems per acre for height tables. Attention is commendably drawn to the harvesting of Christmas trees as a money making operation, which, for the time being at any rate, should be profitable to those producing quality trees.

Perhaps it should be said outside the context of this review, that considerable research which has been carried out in recent times (in Britain) suggests that the fresh stumps from thinnings are a potent factor in the spread of the disease *Fomes annosus*. Creosoting stumps immediately after felling is recommended as a measure of prevention of the disease and this is a job well within the capacity of the owner of a small woodland lot when thinning or taking out Christmas trees early in the life of a crop.

Having read the section on timber measurement, one should be well equipped to find the volume of a felled tree and estimate the volume of a standing one, but for an estate owner or anyone who has to estimate the volume of large numbers of standing trees, the Volume Tables are probably the best and most accurate means of estimation where there is reliable means of measuring height. The usefulness of Volume Tables is outlined in the text, but it might have been mentioned that these tables are obtainable from the British Forestry Commission of Saville Row, London, and are regarded as being reliable for plantation grown conifers in this country.

The example of volume calculation (which does not appear to be quite correct) by the quarter girth system, focuses attention on this ludicrous method which is accepted in Ireland, as the way of finding the volume of wood our forest crops are producing, and one wonders what the amateur Forester will think of it. The example shows that a tree with a volume of 66 cubic feet, drops 11 cubic feet in volume when calculated by the quarter girth system, as an allowanct "to cover losses in sowing". Such an allowance is quite out of line with continental forest services where true volume is used, and with modern utilisation where wood is so frequently processed, using every particle of wood in the trees. In the calculation the quarter girth volume should work out at 69.75 cubic feet, which would have given a difference of 149 cubic feet between true volume and quarter girth volume. On this subject, the mention of the conversion factors, true volume $\times$ 0.875 and quarter girth volume and quarter girth volume $\times$ 1.273 and true volume, might have been useful.

Since production in terms of volume per acre is discussed under "Yield of Timber", it might have been more useful to include simple examples of how to estimate volume per acre by the sample plot such as the square or triangular 1/10th acre plot.

In the marketing section, creosoting of fencing posts to prolong their life is recommended. It is presumed the type of creosoting meant, is that of surface application, but considerable difference of opinion exists as to whether worth while preservation is achieved in this way.

The £ s. d. of Forestry makes a good chapter, clearly explaining the use of compound interest making a good case for the forest crop in favourable growing conditions. The values used in the calculation are conservative, but not many investors nowadays would be satisfied with 5% compound interest.

Mr. Harbourne, Vice-President of "Trees for Ireland", pays a tribute in the foreword to the writer, Mr. H. M. FitzPatrick, which is richly deserved and difficult to improve upon. The reviewer can only say that in writing "Planting for Profit in Ireland", Mr. FitzPatrick has done a major service to forestry in this country where he has been an outstanding figure in that field for many years past.

All those concerned in getting "Planting for Profit in Ireland" published, deserve our warmest congratulations, and it must be great recompense for them to know as Miss Cahill, (Hon. Sec., "Trees for Ireland") informs me, that every one of the first 2,500 copies printed are on demand, and so well has the demand been maintained, that a further 2,500 copies are in press, and it is planned to publish 2,500 more copies later on. This is certainly an impressive achievement.

O. V. MOONEY.

Report of the Minister for Lands on Forestry for the period from 1st April, 1958 to 31st March, 1959

Published by the Stationery Office, Dublin. Price 2/-.

THE Report, which came to hand some time ago, deals with the period from the 1st April, 1958 to 31st March, 1959. It is now over two years behind as far as events in the forestry world are concerned and tends to make the task of reviewing rather difficult on that account. At the present rate of progress in State afforestation to be one year out of step is to be very much out of date.

Nevertheless, it may be of interest to readers of our journal, now and in the future, to record the main figures so helpfully summarised in the general review which appears on page five of the report.

The total productive area of land acquired was 25,244 acres. The planting figure is given as 22,500 acres. The area thinned was 7,776 acres and the average number of men employed on forestry work during the year was 4,673. These figures, with the exception of the last—viz. the number of men employed—all show substantial rises on the 1957/58 figures. The drop in the level of direct forestry employment is said to be due to the continued limitation of direct-labour work on thinnings and the extension of the system of obtaining road-metalling materials on contract. There is thus a static or declining labour force under the control of the forester and an increasing number of people working in the forest who are not directly responsible to the forester. While this may tend to lighten the forester's task in some ways it must surely increase the problem of supervision in regard to extraction damage and felling control.

The incentive bonus scheme for forestry workers was getting under way in fine style by the end of the period and already it could be claimed that it was the largest scheme of its kind ever undertaken in the country. It is, indeed, an achievement for forestry to have led the field in this way and it is to be expected that many fruitful results will flow from its introduction, both to management and labour.

The table that is of considerable interest to silviculturists is that which gives the percentages of various species planted. Sitka spruce is going from strength to strength having increased from 43.2% to 47.5% in the year. *Pinus contorta* is steadily losing ground but is a good second with 26.4% as against that for Norway spruce at 9.4% in third place. This limitation of species has many points in its favour from the marketing point of view but the need for greater diversity in the forest by species and by age classes must surely impress itself more and more on thinking foresters.

The activities of the Research Section of the Forestry Division are outlined in the report, but there are no details. Perhaps the time is near at hand when we can have a special separate report on research which will deal at length with research progress and give the results of field trials and assessments.

On the expenditure side the total given is £2,079,991, while the income figure is £316,134. The figures for increasing revenue and increasing expenditure might well be graphed for a period of years. They would obviously be a long way apart and perhaps it would be better to wait until the gap begins to close, as it must surely do in the not too distant future.

Again we miss the map and the tables which tell us how the counties are faring in the race for forestry honours and also the list of forests (which surely grows longer every year). The names of forests do not make dreary reading and there is no surer way of putting a forest "on the map" than by putting it in the Minister's report. Perhaps the missing items together with a general and historical review, could be incorporated in a more lengthy report at, say, five year intervals.

T.C.

Society's Activities

Illustrated Lecture in Dublin.

A lecture was given in the Shelbourne Hotel in November 1960 by Professor Clear and Mr. W. Dallas (of the Northern Ireland Ministry of Agriculture—Forestry Division).

Professor Clear described with slides, the impressions gained during his attendance at the World Forestry Congress at Seattle, Washington, and his visits to various North West American forest areas. He had some very striking slides illustrating the redwood and Douglas fir regions.

Mr. Dallas gave the second part of the lecture, describing his stay in North West America, with particular reference to water conservation and control at high altitudes. He had some graphic illustrations of forest crown fires and the damage so caused. Among other points, he recounted his experiences concerning the various methods of fire fighting employed in the area.

The President, Mr. M. Swan, proposed the vote of thanks.

Illustrated Lecture in Galway.

An encouraging gathering was present at the Society meeting on Saturday, 11th February, held in the Greek Hall, University College, Galway. The President, Professor Thomas Clear, opened the meeting and introduced the speaker, Mr. P. J. O'Hare, Officer-in-Charge of the Peatland Experimental Station, Glenamoy, who, with the help of excellent and illuminating slides, gave a very concise outline of the history of western peats, observations regarding the growing of tree and other crops on peat, and an outline of the work going on at the Glenamoy research farm.

Some of the points he broached, concerned the history of the formation of western blanket bog from its beginning with the culmination of the Ice Age about 10,000 years ago. From there he led on to the present peat condition in the west of Ireland and its relation to the various ways in which research was proceeding at Glenamoy.

With appropriate illustrations he reviewed work on drainage, seeding, water experiments, ploughing (introducing a new type peat plough evolved at the Glenamoy research farm), grazing and shelter belts.

From the forestry point of view the most interesting aspects of this lecture were the slides demonstrating treatments involved in shelter belts of *Pinus contorta* and Sitka spruce, the shelter gained by planting in the lee of the turned sod, and the devastating effect of the prevailing west wind.

Professor Clear, in proposing the vote of thanks, commended Mr. O'Hare's vital enthusiasm in his work. He said how important the research approach to such work was, and that we in forestry should attempt to follow the example given by the research workers at Glenamoy. He said that without a scientific approach great waste of time, energy and resources could occur. He then invited questions from the audience.

Some interesting questions arose concerning glaciation, phosphate fertilisation, the matters of nutrient reserve and the capability of plants to increase it. Also discussed was the desirability of fertilising forests, the possibility of aerial spraying, and anchorage problems with regard to ribbon planting.

More points raised were the limitations and the interpretation of the analysis of peat nutrient content, and the use of tissue analysis in the assessment of the availability of nutrients to the plant. The time of year in which analysis should take place was discussed. The question of the importance of the sun's energy and water relations also arose. Finally some discussion took place regarding the effect of peat depth on acidity, the importance of the subsoil, erosion caused by rainfall and other factors, and water movement in peats.

Professor Clear wound up the proceedings with a short resumé of what we can learn from the experiments in Glenamoy—especially from the evidence which is beginning to show regarding the wind factor and stability in relation to poor rooting media and high water tables.

He asked whether the trees will stay put even if they do grow. He finally discussed the possible importance and help forestry will be to agricultural schemes carried out on these areas. He again thanked Mr. O'Hare, the college authorities of U.C.G. and the Society organisers in Galway headed by Mr. McMeniman.

G. J.G.

Illustrated Lecture in Kilkenny.

Mr. T. A. Barry of the Bord na Móna Experimental Station, Droichead Nua, Co. Kildare, delivered an illustrated lecture entitled "Peat and Forestry: Two Aspects", in the Metropole Hotel, Kilkenny, on 18th February, 1961. The two aspects referred to in the title were (i) the production of tree seedlings using as a seedbed a compost based on peat moss, and (ii) the establishment of forest plantations on cutaway bog.

In dealing with the first of these subjects, Mr. Barry described the product known as "UCEE mix". This consisted of a 3 to 1 mixture (by volume) of peat moss and granitic sand with small additions of ground limestone, hydrated lime, dolomite limestone, single superphosphate, potassium nitrate and potassium sulphate. This was the standard mix but, by omitting the ground limestone and hydrated lime, a low-lime mix was also produced. These were tested against an organic mix (60% peat moss, 20% sand, 20% stable manure, lawn mowings, spent hops and garden soil) using five species: Douglas fir, Norway spruce, Sitka spruce, *Abies grandis* and *Abies nobilis*. The seed cover used was UCEE on the UCEE beds and a 1:1 peat moss: granitic sand mixture on the compost. Mr. Barry used slides to illustrate how, during the growing season, a degree of chlorosis developed in some species and responded to a late July application of nitrogen to one half of each plot. The amount of weeding required was negligible, and 3,000 seedlings, fit for lining out in September, were produced from each bed of 3.3 square yards. There was little or no disease. The bed of material used was 7 inches deep. Less may be sufficient where the local soils are not highly calcareous as here (pH 7.9—pH8), and it is also possible that the same material might be usable over several years, with a small addition annually.

In dealing with the second aspect Mr. Barry described the cutaway strip in Clonsast bog known as Trench 14, part of which was planted by the Forestry Division in 1955, and pointed out that this was perhaps one of the first systematic efforts towards the afforestation of machine-cutaway in western Europe. In his talk Mr. Barry brought out strongly the point that to speak of "peat" to a person concerned in its study was analogous to speaking of "rock" to a geologist: there are as many peat types as rock types and the differences are as important for practical purposes. In a series of slides Mr. Barry showed the present condition of most of the 17 tree species planted. Each plot was half an acre in size and one half of each plot was treated with ground mineral phosphate. The most striking feature was the clear necessity for phosphate on those areas where any considerable depth of peat, say four feet or more, had been left.

N. O'C.

NOTE: It is understood that since the trials described were carried out, minor adjustments have been made to the Calcium level of UCEE mix, and a number of trace elements have been added. Further trials of conifer seed production are now in progress.—Ed.

Miscellaneous

Meeting of "Trees for Ireland" in Sligo.

"Trees for Ireland", to which this Society is affiliated, held their Annual General Meeting on the 28th January in Sligo this year. The Address of the outgoing President, Mr. McElligott, who unfortunately was unable to be present, was read by Mr. Harbourne, Vice-President. This Society was represented by Mr. Finnerty.

Arbor Day.

"Trees for Ireland" held an Arbor Day on 7th March, 1961 at Palmerston, Co. Dublin. The Society of Irish Foresters was represented by its President, Professor Clear, and Secretary, Mr. M. Swan. Also present were the Minister for Education, Dr. Hillery, the President of "Trees for Ireland", Mr. H. Harbourne and other public dignitaries.

Visit of Forestry Students.

A group of Forestry Students from Bangor University, led by Professor Mobbs, paid a brief visit to a number of Wicklow Forests and the Forestry Division School at Shelton Abbey. They arrived on the morning of Saturday, 18th March, 1961. They were met by Professor Clear and technical officers of the Department of Lands who accompanied them on their tour. They returned to Wales the same night.

Visit of Canadian Minister.

On the 10th and 11th April, 1961 the Minister for Lands, Ontario, Mr. Spooner, paid a two-day visit to some Irish forests—Gort, Loughrea, Mountrath, Clonaslee, Ossory, Kinnitty, Glenealy, Shelton, Aughrim, Glenmalure and Glendalough. The party included Mr. O'Morain, Minister for Lands, His Excellency Mr. Rive, Canadian Ambassador to Ireland, and technical and administrative officials from the Department of Lands. When visiting Shelton School and Forest Mr. Spooner planted a tree—fittingly enough—a *Tsuga canadensis.*

Report on Hydrological Activity in the U.K.

The Report on Hydrological Activity in the U.K. 1960 was prepared for the Hydrology Sub-committee of the British National Committee for Geodesy and Geophysics and will appear in the Bulletin of the International Association of Scientific Hydrology (Secretary—Mr. L. J. Tison, 61 rue des Ronces, Gentbrugge, Belgium).

A limited number of copies are available and can be obtained from Mr. D. C. Martin, Assistant Secretary, The Royal Society, Burlington House, London, W.1.

A selected bibliography of hydrological publications for years 1955-59 in the U.K. is in the course of preparation and can also be obtained on request from the Assistant Secretary.

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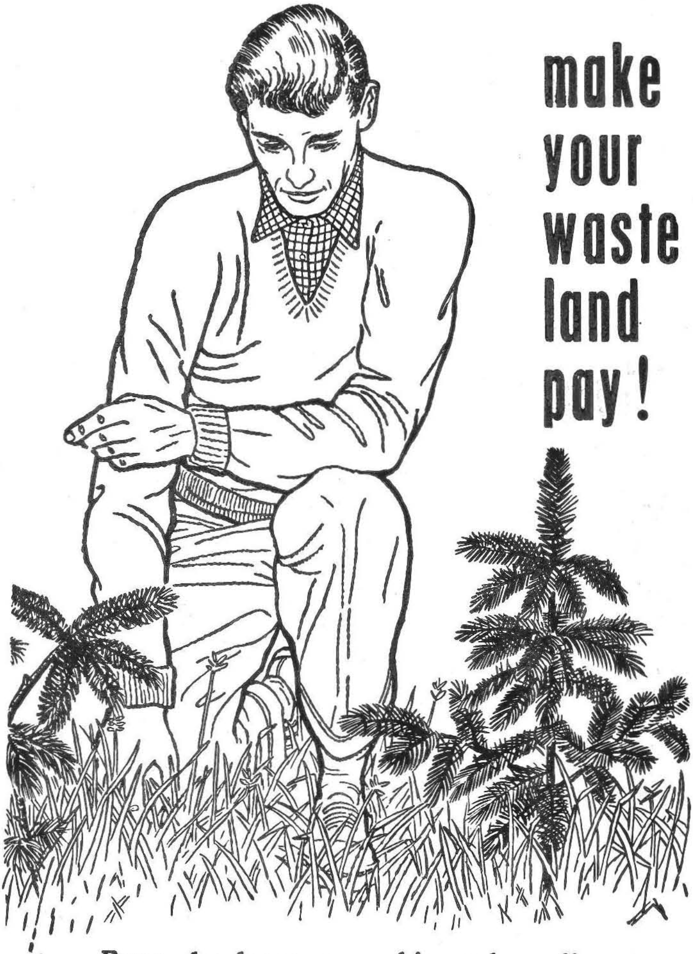

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