The SIMPLE RULES OF THE 'SCOTTISH ECLECTIC' THINNING METHOD

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Behind this denture-testing title, which Penistan has chosen and recently used in print*, lies the outcome of 30 years' practice in thinning and observation of consequent effects. Thinning, it must be acknowledged, is the most vital operation whereby Foresters may mould their woods and even transform mere plantations into forest. It is the very basis of silvicultural art.

Straight from the Imperial Forestry Institute, and perhaps more full of enthusiasm than of knowledge, the writer was put in charge of Forestry Commission Sample Plots in 1930 and sent to mark the various strictly coded B, C, D and the few L.C. thinnings in the three countries. The danger, when one is sample plotting, is that one becomes too absorbed in the mere mechanics of the system, and takes too long to discover that most of these codified grades of thinning have relatively little to do with the practical improvement of woods. They had been devised mainly for the purpose of exact experimental comparison, but most regrettably the erroneous idea grew as sample plots spread throughout Britain, and no doubt throughout other countries, that a B, a C or a D grade thinning was a perfectly good practical treatment to apply to a wood.

So far as B and C — the light low thinnings — are concerned, these are completely futile despite their one-time widespread application in Central Europe. The removal of dead, dying and more or less suppressed trees from a dense crop has, in fact, as little effect on the continuing main crop as would have the removal of last year's birds nests. D grade — heavy low thinning — which some people fancy, may have some good points, but if one is going to open trees so widely that brambles or other weeds are encouraged to rampage in each intervening space, why not leave a promising small tree to develop there instead ? The lowest depth of all, however, is plumbed by the ultra-careful but rather unimaginative who imagine they are playing safe and sure by plumping for a C/D thinning. In truth this is a pathetic hybrid between (a) the futility of mere suppressed tree removal, and (b) the disembowelled ruination obtained by slaughtering every tree, fine or otherwise, which happens to be less than co-dominant, while all large trees are forced to struggle on, more or less unrelieved. Overcrowding is hardly less terrible in the sylvan than in the human sphere. Nothing is more sordid to the good forester than a crowded stand of uniformly poorly crowned, friction-worn feather dusters standing

cheek by jowl on long, thin shanks; but although good foresters avoid this state like the plague there is an inordinate regard for individual stems amounting to greediness in many which impels them to retain more of the better trees than is wise for the development of the best.

This leaves only the L.C. (light crown grade) to be considered out of the usual sample plot range. It is a thinning which at first gives much satisfaction, by setting out to give crown room to the best trees so that they will not be crowded into mediocrity. Unfortunately it has, as time always shows, two serious drawbacks— (1) it attempts to be too good to too many, with the result that, in 10 years or so, the dominants one had relieved begin to compete for 'lebensraum' with each other; (2) the understory dies out, partly because of this overcrowding of the giants and partly because the code allows no thinning in the understory itself. In my own case it took me 15 years to be convinced that the L.C. grade of thinning was a hopeless one, although before that time crown thinnings carried out to free some 200/300 dominants per acre in pruning experiments were making it clear that one could not be very good even to 200 trees in an acre for very long.

In the early 1950s, therefore, with support from Penistan, the selecting and spotting of a *maximum* of 100 best trees per acre was stipulated for special favour in crown thinning. This entailed relieving these selected dominants — much later to be termed "crop trees" — from competition by encroaching dominants. During the past decade, thousands of acres have been thinned on this prescription and with the improvements which have been evolved.

Today the prescription can be stated as :—

First. Carefully select and spot the very tallest, straightest, blemish-free, most promising, vigorous predominants, soundly rooted and some 10 yards apart (i.e. about 60 per acre). Call these trees "crop trees" and high prune them.

Second. Blaze, for removal, dominants competing with the crop trees; (if there is doubt about the seriousness of the competition the removal can be postponed until next thinning).

Third. Select from among the smaller trees closely surrounding each crop tree a few healthy, straight poles which, if given sufficient light, are likely to follow well behind the crop trees. Call these "followers".

Fourth. Relieve the selected followers by blazing for removal such larger or equal-sized trees as would compete seriously with the followers' development. (Incidentally, it is this removal of some small or sub-dominant trees which rules the method out as a *true* crown thinning; this point, made by Professor M. L. Anderson, prompted the employment of the term "free thinning," but Penistan's "eclectic" may be even better).

Fifth. Between the groups of thinned trees now surrounding each crop tree, blaze for thinning such trees as should come out to improve these remaining pockets of unmarked timber. Within each such pocket one or, at most, two fine trees which would appear unlikely to require removal for many years may be high pruned like the crop trees.

We are left now with the very best big trees continually well favoured from an early stage as crop trees which, being comparatively isolated, should become accustomed to the wind and so well buttressed. Around each crop tree a number of good smaller trees are favoured from an early date as followers, and finally after attending to remaining pockets the whole stand has been logically and *positively* thinned. As a result a very superior main or final crop should be secured, in addition to an early and high yield, mainly of sizeable stems, from each successive thinning. This is an important feature as recent Work Study proves how shockingly unprofitable small-sized thinnings nearly always are. Superior main crop and profitable early thinnings are the two main reasons for thinning at all.

Although the replicated Norway Spruce sample plots at Bowmont continue to show that a heavy low thinning produces in all (main crop plus thinnings) 11% more timber than the practically unthinned B grade, and that the L.C. grade produces 8% more than this control, it is fair to conclude that provided one thins reasonably, nothing one can do will *appreciably* alter the total volume produced by the stand during any given rotation. All the same, though one cannot increase the ultimate volume, one can manipulate the quality for sale and the timing of the sales. Thus the highest economic return of the crop as a whole depends on (a) the largest early yield from thinnings of big size; and (b) the provision of the largest and finest logs from the chosen crop trees at the earliest reasonable date. The 'Scottish Eclectic' thinning aims to secure both advantages and ought, in addition, to develop better rooting of the crop trees; better cover of the soil through the deeper canopy which this type of thinning most certainly retains; consequently a quieter, less draughty, micro-climate and, as a certain amount of slanting light reaches the floor, reduced tendency for raw humus to be formed. In contrast to the level and shallow zone of canopy obtained in all but the heaviest forms of low thinnings, the effect is to produce an undulating outline with the tall spires of the crop trees projecting and deep canopy thriving below. As experience gained by two or three consecutive thinnings of the type demonstrates, the general effect is the cultivation of a canopy structure less like a plantation and more like a forest. It is rather a joy to behold. There is the further definite economic advantage that the heavy thinning of the 'Scottish Eclectic' method maintains

a relatively low volume of growing stock with a high rate of increment over the rotation. In the initial article* on the method the *hope* was expressed that by developing strong crop trees, dotted throughout the area, the method would provide, when required, the key to group regeneration or other forms of irregular treatment; also that the varying degrees of shade cast by trees of different size ought in time to improve greatly the possibilities for natural regeneration.

Excursionists who visited forests in South Scotland from the Institute at Easter 1960 will remember how the phases of the thinning method are demonstrated to visitors and to staff under training, in a series of four plots. Norway Spruce due for first thinning is undoubtedly a good species and age for the purpose; a uniform area should be divided into four plots and it is useful to demarcate the margins clearly with a strand of binder twine.

Plot 1 is used simply to provide a picture of the type and spacing of the crop trees. This is done by selecting and marking with three white spots at 5 feet above ground level the best possible, usually predominant, crop trees at about 10 yards apart.

Plot 2 is used to demonstrate the type of competing dominant which should be removed to favour individual crop trees. For this purpose crop trees in the plot are selected and spotted as before. Seriously competing dominants, if any, are blazed for removal; but in this plot do not remove them — leave them for purpose of demonstration.

Plot 3 is used to demonstrate the selection and treatment of followers. Crop trees are selected and spotted as in Plots 1 and 2, but in this third plot the competing dominants are blazed, then actually felled and removed. The most suitable followers are then selected and such trees as are damaging or about to damage the followers are blazed for removal. If a vigorous follower has to be temporarily discouraged from growing too strongly, that is a good reason for *not* removing all its competitors on this first occasion.

Plot 4 is given the complete treatment as outlined above for Plots 1, 2 and 3, plus the thinning of such islands as are left between the thinned groups around each crop tree. This may indeed be effected at times by the removal of one single coarse dominant. These demonstration plots are useful for a couple of years but not longer, as can be imagined, when it is necessary to move on to another area.

The fact that the method is demonstrated to beginners in phases does not mean that the sequence is followed out in actual practice. Some experienced markers, usually working in pairs, do the whole job in one operation. The method is so logical and so simple in practice that indeed no tree is marked without a definite object in view. Markers are selected from ordinary forest workers, often women who seem to be particularly good at following out the simple rules.

Some foresters without previous experience of the method can imagine the 'Scottish Eclectic' thinning would do well in Norway Spruce and in shadebearers generally, but feel certain that it will be useless in light demanders, even in Sitka Spruce. This is in fact untrue, as many visitors to South Scotland have agreed, but the idea springs naturally enough from the deep-seated notion that small trees of an intolerant species are bound to die from the shade cast by their larger brothers — a complete misconception when one is dealing with stands strongly thinned in the higher canopy, as the amount both of vertical and of diagonal light is then many times what it would be under most old-fashioned thinnings. The method is especially suitable for mixtures and for hardwoods, and indeed something not unlike it is employed in the hardwood forests of many progressive countries. True light demanders such as pines and larches show the positive effect of this method of thinning in the early and strong release of the crop trees from competing dominants. The plantations with the long deep crowns and the occasional useful intermediate trees speak for themselves.

Spotting the crop trees with white paint has been criticised. When the system was new, as many as 130 trees were marked in an acre and the criticism may have had some justification. Today only half that number is marked and, at 10 yards apart, the spotting is inconspicuous. The practice has several advantages, the greatest being the time it saves, as the thinner can look about him and yet know exactly what he has treated without the degree of doubt and dither which otherwise pertains. Then spotting gives the forester unusual control over his markers, as he can criticise the marking with complete assurance. If no spotting is employed, criticism is much less easy as there can be, for instance, doubt as to exactly which tree was being favoured as the crop tree. At 10 yards apart one would, in theory, have exactly 48.4 crop trees per acre if the spacing was exactly square, and about 56 per acre if the arrangement was in equilateral triangles. In species with very narrow crowns it might be possible to have crop trees as close as 7 or 8 yards, while in widely branching conifers, such as Sitka Spruce, 10 yards apart may be just too near. Because a tree is initially selected as a crop tree does not mean it must remain such until the end; it may develop a blemish, or may be blown down, and either be done without or another may be selected in its stead.

Criticism is sometimes levelled at this eclectic method on the grounds that the small trees must be inherently less vigorous than the dominants and so can have no future. This again is quite wrong, as the development of many co- and not a few sub-dominant trees has proved in recent years. The fact is a tree may be small simply because it happened to be planted on a slightly unfortunate site and was soon overshadowed by a luckier neighbour. The "small tree" selected seldom refers to one which has been seriously suppressed, and followers are more likely to come from small co-dominants than from a lower class.

In selecting suitable followers the more experienced eclectic thinners today think both of trees which will immediately be useful as followers and also of other trees which, when the crop tree grows much larger, may indeed be required to supplant the earlier chosen, and by then too close follower. However, this is a refinement unlikely to concern foresters just taking up the method. Even in the later stages the method should provide many good stems in addition to the crop trees. At 50 years old Quality III Norway Spruce, which shows a main crop of 450 stems in the British yield Tables might perhaps have about 250 stems under the eclectic system, with a high proportion of the volume in the 50 or so crop trees remaining at this age. These trees should contain about half of the main crop volume, say 1500 cubic feet or 30 cubic feet per crop tree.

Svend O. Heiberg, in his introduction to "Thinning Problems and Practices in Denmark".* mentioned the use of the term "crop tree" but, what we now call followers he explained were termed "trainers" or "pruners" in Denmark. The Scottish Eclectic system varies from the nearest Danish one, first in selecting far fewer crop trees at *much* wider intervals; second in insisting that these crop trees should be spotted, and third perhaps in the Scottish thinning being generally more severe in the upper canopy. The term "trainer" does not quite express the function of the follower, but the term "pruner" is definitely misleading; a follower may subdue the development of over-wide branching in the lower part of the crop tree's crown — it certainly does not prune these branches.

Many visitors from abroad have come to see and criticise the Scottish Eclectic thinning, and it was exciting to find in 1960 that the forest service which seems to be carrying out a thinning nearest to the Scottish Eclectic was the Yugoslavian. The visitors explained that not only did they spot the crop trees but they used a very similar number per unit of area which they high prune along with about the same number of good intermediates. Possibly they too have been influenced by the paper produced in Austria by C. Minutillo in 1952.†

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Thinning to Meet Today's Problems

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SUMMARY

A short paper noting the poor prices obtainable for pulping from the large quantities of small early spruce thinnings which will be thrown on the market by low thinning systems from the vast and increasing areas of post-war plantations and the almost negative contribution which these thinnings will make towards the needed early reduction of capital costs. Notes too the danger from windblow inherent in these systems and advocates in their place the early selection and spot-marking of 35 to 55 well-anchored, crop trees per acre and intensive free thinning thereafter for the benefit of these trees *and* of their surrounding lower story 'followers' including the removal—sometimes even at early stages as profitable sawlogs—of their competing or submerging dominants.

ALL over the country foresters are deeply concerned: markets for small material such as pulpwood and pitwood are dwindling, while the great post-war plantings—growing while we sleep—steadily approach first thinning stage. Bowaters continue to help with their steady intake of spruce pulpwood, but the likelihood by 1966 or later of one pulp mill in Lochaber and perhaps one farther south, absorbing large quantities of pulpwood at rock-bottom prices, is little immediate consolation to the harassed grower, and may indeed provide mighty little initial recompense for the trouble and expense of having grown the stuff. The fact must be faced that over most of the world pulpwood is at present mainly a by-product material and prices, in accordance, are seldom attractive. Having felled trees with a butt log fit for the sawmill, growers naturally seize upon the pulp mill as the obvious outlet for the remains, and in the circumstances well-organized working may pay a small profit on the transaction. Pitwood did pay the skilled merchant but it is already over-produced. It is quite otherwise with sawlogs which are always in demand and at a price which permits a profit margin for well-equipped mills, except when foreign dumping at obviously uneconomic prices makes for temporary trouble. What is the forester to do?

First, it stands out a mile, there is one thing he must learn *not* to do. He must not continue to practise that deplorable process which made him remove *first* the small sub-dominant and suppressed trees when thinning a wood, and then work up gradually at succeeding thinnings to slightly bigger semi-suppressed and overcrowded poles. For one reason this does virtually nothing to help the remaining crop to grow any better—rather the reverse; for another, as work study has demonstrated, the smallest trees are far more costly to fell and produce per cubic foot, so that instead of a profit they most often show a dead loss when properly costed. There is a third reason: while the removal of smaller trees produces a financial loss it most certainly constitutes a silvicultural loss also, besides building up an exaggerated sense of artificial plantation. We get serried rows of uniformly spaced, rather emaciated crowns

competing within the same canopy level and rubbing the life out of each other far above. These crowns are congested beyond the point of rapid recovery, while the density and regularity of the stocking provides no room below for even an occasional wide, well-branched root system likely to withstand a gale should a break occur. Almost equally unsatisfactory is the wide region between ground and high canopy above through which the draught moves ceaselessly to the detriment of both surface soil and of dead branch decay. Thinning really heavily by 'low' principles results in an orchard-like state, with no small tree to fill the gap between three or four large ones, so that growing space is really wasted for three years or more after the removal of each large tree as a thinning. Very light, low thinnings are no longer common, but this makes little difference to the point which is that until foresters get two diabolical misconceptions—born of low thinning—out of their systems we shall never have fully remunerative woods nor woods which are worthy of the name of forest. These inborn ideas are: (1) that trees should always remain crowded, and (2) that we must never remove a large tree if there is a smaller one nearby which could come out instead. Incidentally, this attitude is expressed in its most pronounced form when '*no thinning*' is urged in the name of economy. Those who do so can hardly realize that it means relegating the entire crop to pulp at the appropriate beggarly price. Bowmont Norway spruce (*Picea abies*) sample plot figures (Mackenzie, 1962) at fifty years show that the forty *largest* trees per acre in the B grade only reached 12 cubic feet, whereas in D and L.C. grades the forty largest averaged 25½ and 22½ cubic feet each. Besides producing timber in quantity at the end, well-thinned woods had paid for themselves long before: unthinned woods repay nothing until the end.

It is easy to understand how foresters who have been brought up with these common notions about thinning come to believe that no small tree has a hope of survival, far less of ever becoming a useful and substantial member of the stand. This rooted misconception stems, of course, from examples of small trees left in a gap in low-thinned woods. In the circumstances the poor little tree might as well be close-ringed by a Berlin wall equal to the height of the crop—it has no hope of developing. What old-fashioned thinners fail utterly to understand is that where large trees have been thinned out of the top layer, both the light and the rooting area are enhanced for the smaller trees left behind so that they can and do grow. This applies, as we have proved, not only in relatively shade-bearing species but also among distinct light-demanders. Interest on capital outlay being what it is, it is elementary to realize that the financial success of a tree crop, and especially of one established artificially at considerable expense, depends upon the earliest possible elimination of the initial capital expense. To remove many puny, inoffensive first thinnings, as has been done so often at a loss, *increases* the heavy debit balance and yet in no way improves the potential, so it simply *must* be avoided.

This all suggests therefore that one should tend to leave many of the good smaller trees to avoid loss and remove more larger stems in early thinnings,

particularly those of inferior form, which would yield at least one butt log for the sawmill. Incidentally their removal would stimulate some smaller neighbours which were fortunate enough thus to be gifted with extra growing space. These arguments, among others, led to the development of what has been termed the Scottish Eclectic Thinning Method. Perhaps its most important principle in a wet and windy country and on unstable shallow peat sites is the fact that it is based upon the early choice and clear marking with white spots of some 35–55 well-dispersed, anchoring 'crop' trees to be retained per acre, each one being a predominant, straight, well-crowned tree with, if possible, ample but fine branching and potentially fine quality and, so far as can be determined, *extremely well rooted* and likely to hold on pertinaciously to mother earth. Such trees, we are now convinced, should *not* be closer to each other than 10 yards or, in large widespreading species like Sitka spruce (*Picea sitchensis*), 12 yards.

Fear of windblow almost certainly was one main reason for very gentle, low thinning in the past. As a temporary safeguard it worked to some extent because close-packed trees in a strong wind did obtain a measure of mutual support. Of course, trouble ensued rapidly when a break occurred because the individual tree roots were so restricted. In the eclectic thinning one sets out from first thinning to make certain that at least the crop trees dispersed throughout the area have room to develop strong wind resistance in the shape of strong roots and buttresses, in addition to superb crowns and stems; this is done by removing competing dominants. In low thinning no tree is specially prepared in such a way to withstand wind. During the past eight years the eclectic form of thinning has gradually been developed in Forestry Commission forests mainly in south Scotland and in a few private estates. The word 'gradually' here is significant. We began by setting out to encourage 100 'crop' trees per acre, but within a few years it was clearly demonstrated in several forests that 100 was embarrassingly numerous. It quickly became obvious that it was impossible to be as good to the whole hundred crop trees as one had set out to be, and at the same time secure balanced and progressive development for all other useful trees in the lower canopy; these would otherwise be squeezed out, leaving virtually a 'heavy low' stand. So we now say the selected crop trees should be 10 yards apart *at least*.

The Scottish Eclectic method has been described in various papers (Macdonald, 1954 and 1961). Clear marking, i.e. 'spotting' of the crop trees with white paint, is an absolute must. With spots every move is logical and positive. Without spots the thinner sooner becomes uncertain as to the next move and sooner exhausted and, just as serious, if there are no spots the inspecting forester has infinitely less control, i.e. chance to show the marker where exactly he or she went wrong. Spotting has practically eliminated dithering and has definitely cut costs.

Without going too deeply into the 'Eclectic' technique it may be said to ensure (1) the uninterrupted development of *effective* crowns on the biggest and best, usually predominant, 'crop' trees, and (2) the continued development

of a graduated canopy with rather smaller trees ('followers') forming a surround to each of the crop trees, and of course some fine intermediate trees between those groups.

(1) is secured as a first step by removing dominants and strong co-dominant competitors from the immediate vicinity of the crop trees;

(2) by removing, as step two, only such dominants, co-dominants and, occasionally, sub-dominants as are suppressing or crowding the ring of desired followers.

Thinning in this way produces a normal volume out-turn per acre but the stems for sale have a much higher average volume than in previous early thinnings; it also gives opportunity, previously undreamed of, to many straight, well-balanced and potentially excellent but smaller trees which were a little behind, more probably due to the spot they landed in or some other accident of planting than to any inherent weakness. Experience of the rapid development of such trees in recent years makes this very apparent. In fact refusal to remove small trees at a loss *now* is obviously providing opportunity to remove them later at a profit. It is argued that these recent trends in thinning technique at least constitute a step in the right direction in so far as they produce woods which with their wealth and depth of foliage are vigorous and stimulating to look at, woods which make more money from early thinnings, woods which are going to provide—at an earlier date than once seemed possible—some very fine large logs by taking special care to develop unhindered the very best from an early age.

In addition to the many silvicultural advantages it is as well perhaps to summarize arguments likely to influence those who view silviculture with suspicion and can be influenced only by hard economic or mechanical facts:

1. If canopy is continually complete production will be optimum, i.e. only where canopy has frequent and prolonged inter-tree crown gaps (e.g. between dominants in an E or even D grade) is total production sub-optimum.

2. Unused inter-dominant crown space would be reduced if a really viable co- or sub-dominant existed to take up the space, but in truly low-thinned woods such potential space-filling sub-dominants have all been removed and so production must remain less than optimum so long as strong thinning persists.

Points 1 and 2 above are concerned only with total volume production.

3. Plantations invariably remain in debt until receipts from thinnings offset or repay the accumulated cost of establishment. With light thinnings the plantation remains longer in debt, and the debt may even increase. With heavy thinnings the debt is repaid sooner. Early repayment is hastened if larger rather than smaller material is removed because (i) larger material costs less to produce per cube; (ii) larger material gets a higher price.

4. Removal of too much large material would be foolish if it resulted in unused gaps being formed and continuing to exist, but this would not happen if, where each large tree was removed, there was one or more smaller trees available to make rapid development and use of the space. This provision

is made by the eclectic thinning method and the principle is employed throughout the life of a stand.

5. The belief that small trees in a wood will not develop comes from observation in low-thinned woods. That belief is nonsense in strongly crown-thinned woods, just as it is nonsense to maintain that young regrowth never develops in selection forestry. Eclectically thinned woods demonstrate that when the thinning is conducted among the dominants the smaller trees *do* develop with astounding and increasing vigour.

6. In considering the effects of thinning the stand must be viewed dynamically as a growing organism. Every remaining tree subjected to eclectic thinning has the opportunity of growing upwards and outwards in crown and stem.

7. This is not the case in light-low thinnings where growth on the badly overcrowded co-dominants is virtually crushed out of existence and where sub-dominants and suppressed trees are soon removed.

8. It *is* the case that every tree remaining develops strongly in very heavy low thinnings, but in these the removal of any dominant (the one canopy class remaining) leaves a gap which is long in being fully utilized. Also, as all branches develop in full light they become strong and persistent over long crowns producing very large, if mainly live, knots.

9. Even the comparatively few *crop* trees in an eclectic thinning are adpressed by the *followers* so that on them branch development tends to be checked below the top ten or so whorls. Most of the remaining trees in an eclectic crop develop considerably from once co- or sub-dominant individuals and so have finer branches produced and maintained in a degree of side shade, and thus much smaller but still live knots.

10. We must wait and see if eclectic thinning can equal or surpass, say, D grade thinning in total value production. If it does there will be many arguments in its favour, and among them (*a*) early removal of many logs as they reach good saleable dimensions may be a major factor so far as economics are concerned; (*b*) the fact that smaller trees are stored ready to be released and soon replace a saleable log with a fast-growing successor is a second argument which is already well proven; (*c*) the relatively low actual capital locked up in eclectically thinned woods also ought to appeal to the forest economist; (*d*) finer logs with small knots from the bulk of the produce should appeal to the timber merchant.

Faced by the predicament which has grown throughout 1962—increasing area to be thinned and declining markets for small material—we recently felt impelled to investigate ways of still further increasing the percentage of saleable saw timber from our thinnings and so of reducing the amount of pit/pulp material—fast becoming unsaleable—to be felled. Plots were selected in Scots pine (*Pinus sylvestris*) and Sitka spruce plantations of 25 to 40 years old in a number of forests. In most cases there had been one or more previous eclectic thinnings and certain of the stands had already been re-marked in this now normal way, so that comparative figures between

normal and this *special* eclectic thinnings were secured. In this special thinning method the normal eclectic routine was followed exactly except that before actually marking any tree for removal one considered whether a considerably larger neighbour might not perhaps be removed instead. This larger individual was generally one which would have had to come out later in any case and possibly at the next thinning. It was surprising how often such a choice could quite sensibly be taken and, when the thinning had been felled, how reasonable the resulting stand appeared. Without previous experience of the results of the ordinary eclectic method with its strong use of crown thinning combined with removal also of co- and sub-dominant trees when necessary, the new special thinning may appear drastic, but to those of us who have thinned and rethinned eclectically it is no longer surprising to find that smaller trees which are relieved thrive exceedingly well in their new circumstances, than to observe large 'crop' and other dominants make full use of their increased growing space.

Figures for the plots used in the investigation show that in Sitka spruce of 30 to 40 years old *special* eclectic thinnings produced from 38 to 71 per cent. timber calculated as logs of 7 inch top diameter and upwards at 8 feet of length and upwards. Actual comparisons of the special and the ordinary eclectic thinning demonstrated that on average 20 per cent. more timber and 20 per cent. less of pulp/pitwood was secured.

In the young comparative thinning experiment Ae 18/57 in Norway spruce now 24 years old C/D thinning has produced 471 cu. ft. to 836 cu. ft. from the eclectic thinning in which the average volume per tree was more than double that obtained from the C/D. As to future yields, one must wait and see.

To do this sort of heavy log thinning in a wood treated from the beginning by *low* thinnings would present two obvious drawbacks. First, the hole made by the removal of a large tree would not readily be utilized by the remaining crop, there being no small trees left to develop. Second, windblow would be a serious risk.

Finally a word upon the need for individual attention and study of the thinning requirement within every separate stand in the forest. The mere idea that a general prescription of the amount to be removed, laid down at a distant headquarters from a table, could or should be followed throughout only leads to shocking errors. That such a plea should be necessary is a sign of the times and of central control. It stems probably from the backroom where the boys work on averages—and largely on breast-height basal areas—and produce series of tables from beautifully smoothed curves. These too easily suggest the ludicrous idea that average stands are almost universal and belong to one or other of the standard quality classes. In point of fact it is far, far safer to assume that the average stand is, for all practical purposes, non-existent. There are dangers too in forecasts if a young or timid officer or forester applies them in any way as an order to remove a predetermined quantity; and this can happen. One of the most scandalous mistreatments of woods arises when an optimistic forecast is the reason for the choice of the

wrong thinning table and an obedient if weak forester carries on as he was bid. Such dangers would never materialize if the necessity for well-trained men, taught to thin as the stand requires, i.e. as crown development demands, were acknowledged to be of quite fundamental importance in forestry. Unfortunately the opposite outlook is at present all too common, in many parts of the world, i.e. that the forester's job is not to use his head but to conform to code, table, or forecast. When he does conform and his natural abilities consequently become atrophied, it will be a sad day for the forests which these men and their predecessors have built up with such skill and lavish attention to the very thing now decried—detailed local knowledge and intelligent observation.

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