

The Problems and Philosophy Of State Forest Management

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Introduction

Writing in 1951 as a foreword to a forestry History of Inverliever, the late Lord Roy L. Robinson, then Chairman of the Forestry Commission, wrote:-

"The experimental role of Inverliever as the first large scale afforestation project is by no means concluded. We have seen how, after the initial problems of forming plantations, there arose those connected with thinning, extraction and marketing - - - reading and large scale housing.

In none of its aspects - - - is Inverliever wholly straightforward or easy - - . Nevertheless the very presence of the resulting problems has been a spur to finding solutions which have been of great value both locally and in the conduct of afforestation operations elsewhere. This is a convenient time, therefore, to consider what the next experimental steps should be.

These can be grouped under two heads - viz. silviculture and utilisation".

To these profound words, the author of this present article presumptuously adds one more to the groups of heads - management.

It was during service at Inverliever (1955 to 1964 inclusive) that he became drawn into the fascinating and delicate web of Management in a State Forest which had a twenty year head start on most others. He used this vision of the future to anticipate a long term, definitive Philosophy of State Forestry, and then to evolve a set of Management procedures compatible with it.

Since the final writing up of this work began, the Forestry Commission has been the subject of a massive reorganisation which has introduced the concept of functional management.

What seemed necessary before had now become desperately urgent.

The Seventh Report of the Estimates Committee - a Blue Book of 1963-64 - paved the way for this reorganisation. In this report, the section devoted to examining evidence on District and Forest Management is confined to not very many sentences, passing unchallenged, despite the fact that here lies the front where the expenditure of some millions of pounds takes place annually and receives its planning, budgeting, progressing, costing and supervision.

The Work that follows is a professional District Officer's attempt to outline what he feels he requires to meet the measure of this responsible undertaking really efficiently.

The author would like to take this opportunity of acknowledging with gratitude the co-operation he received from those Head Foresters Iain Mackenzie, Don McCaskill, Bob Johnson and the late Bob Crozier - whose patient testing of prototype forms and contributions of valuable advice provided great encouragement.

Now is herewith presented a sincere attempt to analyse the problems and propound a Philosophy of State Forest Management at Forest and District level.

GEORGE DEY
20th February 1968

Summary

This is essentially a constructive work. Nevertheless some explanation of the main areas of departure between it and the system currently in official use, seems called for. This will be done, briefly, within brackets in this summary.

Part 1 - Section 1

The facts and factors fundamental to Forestry and which bear on Management are examined in the course of formulating a basic, Working Philosophy not merely for the present but in the long term as well. This is done with special reference to the very variable, irregular set of physical site conditions given the general name of Highland and is summarised in Section 2.

Essentially the characteristic elements are - - -

(a) that a clear distinction must be made between Afforestation pure and simple, regarded as unique, and the later, perpetual Mature Forest, Sustained Yield State,

(b) that the close inter-relationship of Forestry operations - the whole range of which may well be found within the confines of a single compartment in one year, calls for an integrated and co-ordinated system of management.

(c) that Forestry must be conducted along business lines although there is much to be said for making a thorough job of establishing the first generation free from the somewhat artificial escalations of Compound Interest.

(d) that a close examination of the implications of the various types of Rotation provides a revealing guide as to the type of management required; in most cases those with a financial flavour indicate an intensive level with a suitable basic unit the sub-compartment, defined by age, species and yield class.

Part 2 - Section 3

The scope of Forest Management - at least as covered in this work - is defined.

Sections 4 - 9

The system which is subsequently presented can be said to embody the following general characteristics:-

(a) It should be as sensitive and flexible as to be able to cope with a range of levels of management, up to very intensive.

(b) It should be virtually complete and a "going concern" at Forest level. Thus as many factors as possible should be completely co-ordinated at this level,

(c) It visualises all significant data being brought and kept up to date annually, including that of growing stock at least once a thinning cycle, the task of collecting this basic information becoming the responsibility of the local Forest staff. (This is in contrast with the current official policy of having growing stock assessments made every ten years by outside uncommitted, specialist staff whose bias leans towards providing a statistic which is of National, rather than local use.)

(d) It seeks to make records - at no great extra cost - of all data handled anyway as routine by Forest staff. It is felt that such an accumulation of information, objectively deployed, can be usefully kept available for reference at any time to meet demands by local staff, statisticians, auditors and higher echelons alike, thus avoiding time wasting retrospective ad hoc hunting at a later date,

(e) The system is manifest in a series of specially designed forms which themselves serve as a guide to the routine by including as a record as many of its essential steps as possible. These will be completed and maintained manually.

(f) A careful pruning out of unessential intermediate steps is advocated between basic facts and the aggregations thereof, which are of real significance.

The work then proceeds to deal specifically with certain of the most important routine aspects of Management.

(i)

Section 4

Certain basic records are first fortified into a useful cross-reference complex, embracing a Register of acquired land, compartment schedule, compartment/P. Year/ Species summary and a Land Utilisation Record.

The Land Utilisation Record embodies the distinction between information which is of lasting Historical significance, and that which is non historical and fleeting. The former is maintained in an accumulative to date manner.

The most important cases calling for "Historical" treatment are Stockings, i.e. positive additions to plantation area, and de-Stockings, i.e. deductions from plantation area by, e.g. fire, felling, etc.

(All this is in contrast with the official F.C. Working Plan technique which found no use for the basic Compartment Schedules and summaries, and which simplified an L.U.R. system into an annual statement of current position, at the expense of clarification).

Section 5

Land Utilisation merges into planning and an intensive system is outlined, embodying the comprehensive, co-ordinating character called for in the Philosophy. ((The F.C. W.P.system affects its planning on an idealised functional approach which does not make for easy co-ordination and is time and paper consuming)).

The Working Forms - as distinct from Summary Forms - are designed to last at least 5 years i.e. to cope with 4 revisions. (Many of the F.C., W.P. Forms are of 1 year duration only, being more of a summary rather than a working nature; others seemingly intended to last a lifetime do not appear to be capable of sustaining at least one amendment, the Compartment Record to wit).

Provision is made in the Planning System for a Current Work Record Sheet - a running record of work completed per compartment. There has always been a need for this, no less because it provides a District Officer, acting in his supervisory capacity, with an unavoidable statement of what to check. Up to now, all he could be sure of checking lay amongst that which had been programmed, and anything else which an autonomous Forester did "on his own bat" was generally only discovered by chance.

(This link is entirely overlooked in the W.P. Code system),

Section 6

A revised Accounting and Costing System is presented. The Basic Time Sheet is on a 'Sheet per man' basis and on this only quantities achieved, rates and man hours worked are recorded,,

It mirrors the old time book.

It is not intended to be accountable; the Forester can retain a copy.

The Time Sheet Summary - of compatible layout, and reminiscent of the "old A135" - is the document on which monies are calculated, both as Man's Wages, and as costs per job.

This document can be made accountable.

The information on it is uniquely deployed to feed (a) Pay Sheets; (b) A.12's; (c) Costing Sheets.

(In contrast the present F.C. system has an accountable Time Sheet covering 5 men per sheet. Though this has some merit in allowing up to 5 entries of money per single entry of job, and in splitting up the task of totalling, this is at the expense of making additional sub-totalling and depriving the Forester of a copy. Man hours against job are not totalled; the layout of Time sheet vis-a-vis summary is incompatible).

The Basic Costing sheet of this Work is essentially a "job" sheet, kept up to date weekly. A series of these embracing the full range of operations going on in the Forest will be built up over the year and retained for reference in the forest Office. Thus the range of operations, and any amplifications thereof, is virtually limitless, offering as sensitive a Costing system as anyone could wish for. From them, information and a wide range of statistic dealing for example, with Incentive Earning Ratio, is provided.

(The official system does not provide this Incentive Ratio as an integral part of the routine).

The suggested Progress Report is not an integral part of the costing system, nor, needless to say, a frustrating intruder, either. By a system of local preprinting it becomes a simple statement, rendered an easy exercise of merely quoting from the costing sheets the latest position to date.

(in the F.C. system the Progress Report is itself the basic costing document and requires a cumbersome exercise to complete it involving horizontal addition from one sheet to another. Because of this it has come to be submitted every 4 (or 5) weeks. This has led to the preparation of costing data becoming a very uneven task with 3 (or- 4) weeks of little activity, then a big splash. The information then tends to be virtually out of date before it is finally submitted, particularly so as the emphasis is on current unit cost, rather than accumulative cost to date. Furthermore, no provision is made for progressing man hours per job, contract working or analysing Incentive Earnings. Furthermore, the possible scope of costing is very limited by sparse and rigid allocation of space).

Section 7

Hereunder is offered some advice (a) on basic, elementary surveying, and (b) on the evolution of a simple time-saving, dynamic system of mapping and coding.

Section 8

The whole problem of Timber Production is highlighted from the general pattern of planning and given special treatment without disturbing its place in the comprehensive whole. The Yield Class system as outlined in the F.C. Management Tables - Booklet 16 - is the accepted basis for estimating timber production in the Long and Short term.

In the case of Long Term Production - i.e. up to 20 years ahead - the basic procedure is to compute first the gross area likely to be in Thinning or Felling Production and estimate the Arithmetical Averages of Age and Top Height, and hence Yield Class - all achieved on the basis of first, Species, then individual "P" Years, and actual Yield Classes. A special Yield Class Slide Rule has been devised to facilitate the calculations. (This is felt to be more accurate and definitive than the W.P. procedure which uses 10 year age classes and averaged Yield Classes).

In the case of Short Term Production - i.e. a guide to the forthcoming 5 years thinning cycle is established and only nett area figures are determined, but special attention is given to the accurate prediction of the timing of first thinning recruitment. Furthermore, this is done intensively on a sub, compartment basis and accepts the fact that part sub. compartments will be thinned when ready, granted that access is reasonable. (The W.P. system rejected the 5 year forecast. There is also an inherent lack of accuracy in that W.P. assessments only allow prediction of first thinning on the basis of gross average, yield class, not nett as would want to be the case in the system expounded in this work).

From the 5 year forecast, the forthcoming year is further analysed in detail to discover average Yield Class and volume.

This is presented in a Thinning Plan of apt design to suit the saw log phase, which will come to occupy some 60% of a stand's total production. While the principle of working in concentrated blocks is by no means rejected, it is propounded that for flexibility, these should not be rigidly fixed blocks, but rather free, floating blocks, offering some elasticity in thinning cycle.

Advice on Thinning Control is given, based on the definitive factor, number of trees per acre for whose easy determination a new field technique is devised.

On the matter of Timber Measurement, the recommendation distils down to using Local Volume Tables for basic records and piecework payments; and measurement by weight for general bulk dispatches.

Then an entirely revised system for Timber Recording and Control has been designed based on a definitive formula. This provides, on the one form, stocks of unextracted timber as well as those remaining at Roadside - all on a compartment basis. (The present F.C. system was not designed to do this, except by comparison of one document with another).

The system caters more adequately with the sawlog phase. (The present system seems to have been designed for pole stage crops),

The system here presented embodies the principle that everything once felled becomes primarily converted into some definable class of produce. Further work on it to produce something else is classed as secondary reconversion.

(This differs from the F.C. system, wherein some material can remain unclassified even on extraction. Such a procedure means that material from the same tree may be treated differently by being recorded on different basic documents, rendering sub-compartment stock balancing very difficult).

The Section ends with some advice on managing Windblow,

Section 9

Working Plans are discussed and a less elaborate format suggested than that propounded in the W.P. Code.

Section 10

Some miscellaneous topics are discussed.

Office procedure and presentation of official information are included here, with a plea to gathering together all the latter in a restricted range of publication.

A few words are dispensed on complementing and promotion, the gist of which is as follows:-

(a) The State Forestry employer while undeniably free to choose the level of management it is prepared to pay for, should not, after opting for an extensive level, subsequently ask for information and expect results only intensive management can provide.

(b) A truly objective analysis of work load - a sensitive assessment of man and job - will lead to increased morale and a resulting greater efficiency.

(c) In the scramble for promotion, an Officer has to be endowed with a surfeit of dedication, loyalty and integrity before he is likely to draw his employer's attention to the fact he feels overburdened. Yet if he does not do this, he runs the risk of being regarded as responsible for shortcomings, primarily the result of complementing miscalculations.

(d) The definitive job is in the District and it is here that the bulk of the risks lie. This places -the District Forest Officer at a disadvantage promotion-wise with the specialist who works on a narrower front, freer from risk and competition.

The work closes with an attempt to sum up Part 2,

The series of forms is kept separate to the text of the work which is interlaced with explanatory details, examples, embellishments, etc. This is done to try and establish the integrated, comprehensive character of the Management System, and because the author has a personal dislike of appendices.

Nevertheless, the needs of a busy reader are not overlooked and as a service to them certain sections in Part 2 not intrinsically vital to the main theme of the System, have been enclosed in double brackets, to indicate they can be skipped if necessary. Readers finding subjects of special interest will no doubt pause and consider these in greater detail,

But it is the author's hope that readers will find time to browse through completely what he is immodest enough to feel is pretty concentrated "instant" Forest Management!

The Problems and Philosophy of forest Management

Part 1 - Sifting the Facts and Establishing the Philosophy Legacies of History

The Ice Age and its aftermath have bequeathed the British Forester with a set of conditions which are varied and difficult in the extreme. The stripping away of top soil, the dumping of Boulder Till, the truncated reinvasion by a few indigenous tree species before the continental link subsided, the formation of peat and podsol with pan, a none too amenable South West Atlantic exposure - - - all have contributed in presenting a very diverse range of growing site.

Changing climate and latterly the attentions of Man himself have reduced nature's effort in providing a natural forest resource to meagre proportions. The current crash programme of afforestation which represents the attempt to improve this unfavourable balance, has heralded the introduction not only of a wide range of exotic tree species, but also a growing list of supporting techniques - hand, mechanical, chemical, - - with which to facilitate and consolidate their establishment.

The not surprising result has been a very broad differential in rate of growth, and a quite bewildering and complex array of factors to confound the Forest Manager.

Such is the basic background from which a Philosophy of Forest Management must be created, and many other factors must be sifted through before a satisfactory working Philosophy can be reached.

The Forest as a Natural Resource

The full potential of an indigenous Forest can best be realised when two conditions are met:

(a) the Principle of sustained yield must operate, i.e. the Forest area should never diminish but should continue to produce a fairly even amount of timber each year. (This it can do with proper Management - - - and of course the Principle was embodied in the 1951 Forestry Act).

(b) the timber that is produced must compete favourably with the cost of the imported product*

Only in this way will the Forest bring a favourable improvement in the import/export balance.

A fairly convincing school of thought claims that the Capital Investment of Afforestation should be a direct subsidy, instead of the present Loan of Public money repayable with Compound Interest. A "you knocked it down - you, the British people, should pay for putting it back", sort of approach. However, it is an accepted mandate of this Philosophy that State Forestry, should be conducted on an economic, business-like footing, embodying the elements of the Faustman Formula, or a derivative thereof.

The Afforestation Phase

This is the Phase of initial Capital Investment and this Philosophy does discriminate in recognising that this is a stage which is unique in the span of Forestry Management. It is thus in contrast to the later, routine stages in a Forest's lifetime, which will come to be known as the Mature Forest. In any appropriate system of Management, therefore, provision must be made for isolating the elements of Afforestation as costing entities.

The Mature Forest

This Philosophy does not visualise a Mature Forest as one which has all grown up and is ready for felling. It presupposes that the once-only afforestation exercise has been successfully consolidated, an irregular Forest has resulted, and an application of the Principle of Sustained Yield has been attempted with Clear Felling in full swing. But it also finds the Forest in a state of perpetual transition from one generation to another, in which, in any one year, in any one compartment, may be found any of the whole range of operational stages - felling, thinning (first and even subsequent), replanting, weeding, drain maintenance, etc.

Something infinite has been started, something with no longer any beginning and no end -
- - yet something which is all end and re-beginning.

But, back to reality, to realise that this complex situation is the one for which an apt and ultimate system of management must be devised.

Appreciation of this very simple observation is the key to the whole of the thinking which inspired this Philosophy.

The Two Together

The situation rises to its most complex in cases where, concurrently, afforestation is still being undertaken while clear felling and replanting have commenced. Here, a rare mixture of separation and blending, co-ordinating and integrating must be practised to the point of finesse, and it will provide the supreme test for any system that it will cope.

Irregularity

Irregularity within any one Compartment in a Forest is here visualised as little more than a range of tree size, resulting from a number of factors, namely:

- (1) difference in tree species;
- (2) difference in age;
- (3) difference in rates of growth; (2) and (3) being both between species
and within species.

Physical Basic Unit

Although the most definitive Basic Unit is undoubtedly the single tree, the Philosophy being sought here concerns itself with a larger aggregate unit.

If economic Forestry is not enforced, rate of growth (i.e. productivity) becomes of less importance, and a less rigid interpretation may suffice, in which a fairly wide range of productivity may be averaged to only one expression, within a unit, or sub-compartment whose limits are defined by species and age only.

But if economic Forestry is decreed, Productivity becomes all important and a Basic Unit must be sought, which, based on the factors of Irregularity already listed, may be defined as follows - - - "an aggregate of adjacent trees, all of the same species and age, which, by virtue of having a uniform rate of growth, are similar in height" .

Despite the use of the term "Irregular", acceptance of the above definition implies a patchwork of Basic Units which are more aptly in the character of a Regular Forest type of Silviculture.

The Place of Silviculture

This treatise is not primarily concerned with Silviculture as such, and assumes that readers will be well aware of a whole range of Silviculture between the single tree (Methode du Controle) and complete Planting Years (Clear Cutting, Regular System). It is with this "in between" range that this Philosophy is chiefly concerned, a range often referred to as the Group Selection System.

On large tracts of uniform site, clear cutting systems may well be possible, i.e. in complete and extensive "P" years. But in glaciated, Highland conditions, as we have seen, site variation can be so great as to limit the extent of a clear cut Basic Unit to small proportions - possibly a fraction of an acre. So although the resulting Forest profile is irregular, it is only so in basic units which are really small Regular stands, within which the dominant trees are all more or less alike in size, species and age;

How does the individual tree figure in this? Quite simply scattered throughout the Basic Unit are favoured trees, usually dominants, chosen with an eye which looks far enough ahead to visualise them forming the final stock to be harvested by clear felling. The rest of the trees represent a surplus, interim crop which

can gradually be removed to provide extra revenue albeit something much less than the final crop, but still making for greater, productive use of the land. How this is done represents a compromise at best, in which the surplus is exploited without hindering the Final Crop's earliest arrival at the clear felling stage carrying as fat a weight of timber as possible in a condition acceptable to the Technologist, and likely to tempt the Timber Merchant to pay his best. This compromise must thus surely aim at allowing these favoured trees plenty of space to exploit gases and soil nutrients alike with plenty green crown.

And somewhere throughout all this can be traced a target which aims at exploiting a unique property of an aggregate of trees - they can offer a proportion of their increment regularly, and still provide more with the clear felling at the end of the rotation. This is even one up on putting money in the bank at compound interest. Here one cannot withdraw anything, without depleting the final accumulated sum.

To all these ends, Silviculture is felt to be as follows - - - "the physical techniques involving trees devised and applied by Management as the most apt and successful means of achieving the Forest Mandate". Would that "aesthetically pleasing" be added as well!

Clear Felling

It has been claimed that Afforestation is a unique "once only" event, and that the clear felling/replanting stage is not, but merely one of an infinite series. Some time can be profitably spent examining the various contingencies that can occur in the design of the final Clear Felling element of the desired Silvicultural system, Such a study may reveal matters having significant bearing on the course of Management, and can best be done by a fairly comprehensive analysis of Rotation.

Rotation

Rotation is defined in the B.C.F.T. as "- - - the planned number of years between the formation and regeneration of a crop and its Final Felling".

Hiley gives a definition in which he uses "- - - the average period", in place of "- - - planned number of years", going on to point out that the idea of Rotation is based on the Management of Even-aged stands. "In Selection Forest", he states, "there need be no predetermined rotation, though the Rotation may here be assessed as the average age at which the timber trees are felled".

Rotations include the following groups, and, to help explain the differences more clearly, an attempt has been made to depict them graphically.

Group 1 - That in which, at Clear Felling, the size of the tree within the coupe, and age, both vary because of appreciable variation in species and their rates of growth (i.e. Productivity class).

("Coupe", in this context refers to a single, sample "P" Year followed through to its comprehensive regeneration, possibly over a spread of years.

This "Tree Size and Age Variable" group includes the following:

- Rotation of Highest Income
- Rotation of Maximum Volume Production
- Financial Rotations - - (a) giving highest rate of Interest on capital invested;
- (b) giving rise to highest profit (or smallest loss) assuming a fixed rate of Interest.

The net effect of using one or other of these Rotations is essentially the same. On the illustration, the units, or sub.compartments, or coupes, need not necessarily have territorial affinity; what is depicted is the appearance of a selection of Productivity classes, for a range of species. It will be seen, by concentrating on one, e.g. Sitka Spruce, that at clear felling there is a double variation, both in terms of top height, and age. One gets the illusion of a marksman shooting at a moving target from a moving platform.

Productivity, here, is of prime importance and is a vital factor in determining sub-compartments. On the illustration, each of the units would in fact be a separate sub-compartment, even if adjacent on the ground. Furthermore it will be apparent that the task of fixing these sub-compartments cannot be properly started until the growth pattern of the plantations has become apparent, which may be 10 to 20 years after planting.

Because of this rigidity, in which each sub-compartment is felled precisely when its species and productivity class dictates, the first generation profile will be repeated on replanting. This will lead to the same high number of stands and points to intensive, and expensive management. There would also be an attendant unevenness in timber output and work load generally. Little improvement towards a normal age class structure of the Forest is likely to result, especially if this was irregular to start with.

There will be some variation between sub-compartments in the number of trees per acre, and the girths of these trees, but not unreasonably so, except at the extreme ranges of the Productivity span.

This Rotation of maximum Volume Production is regarded as a norm and its profile shown on all the others which are illustrated, as a broken line, for comparison.

Group 2 - That in which at clear felling, the size of the tree within the coupe is standard, but age may vary because of any variation in species and productivity class.

Into this "Tree size fixed - age variable" group would fall examples like Technical Rotation (i.e. trees being grown to a certain size to meet the demands of the Sawmiller), and Physical Rotation, (i.e. where perhaps a factor such as wind-blow becomes increasingly limiting once the trees reach a certain height).

Here, although productivity need not be a significant factor it serves as a guide as to when the various classes will reach the appointed height. The temptation to create sub-compartments on species and age only would be risky, so that as with Rotation 1 items, each of the various "coupes" shown, will be sub-compartments in which productivity has played a part in their creation.

Clear felling would, as before, tend to perpetuate any irregular pattern inherent in the first generation and again hints at expensive management. Depending on the actual limiting height itself, considerable financial loss is likely. Number of trees per acre and girth are all likely to be fairly constant, timber output and work load variable-,

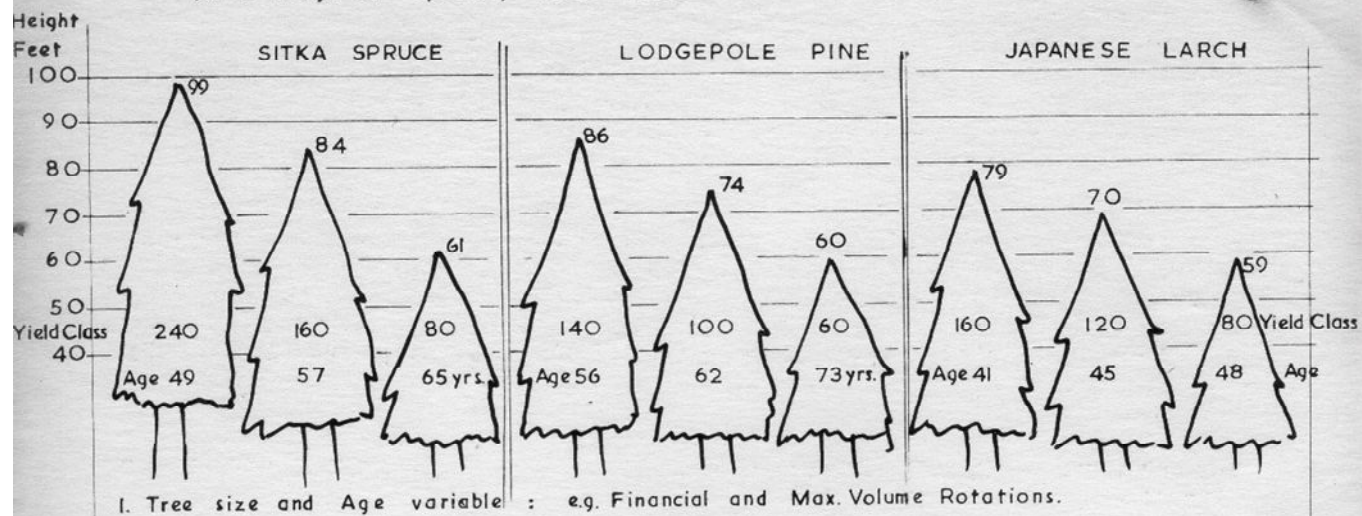
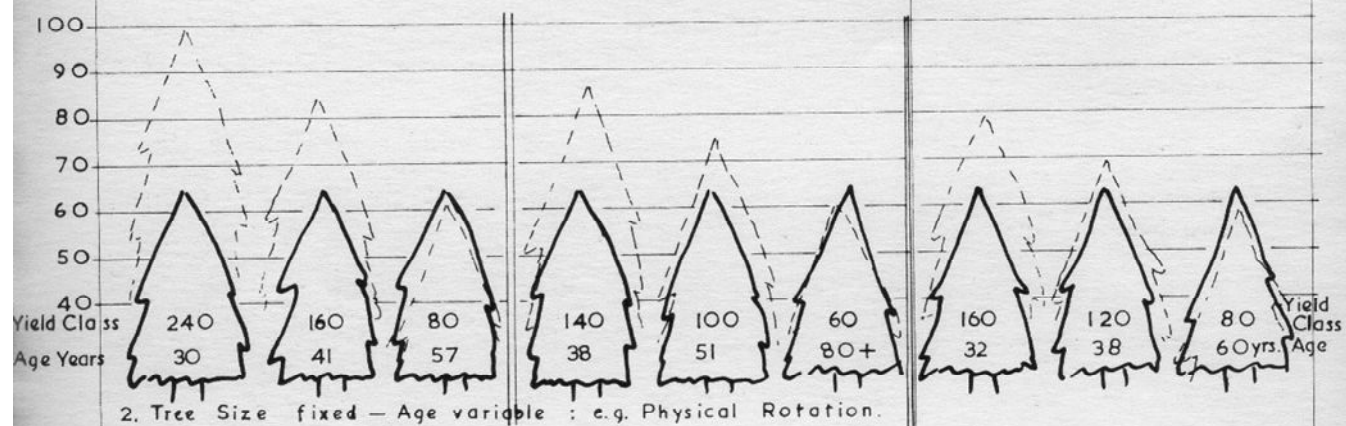
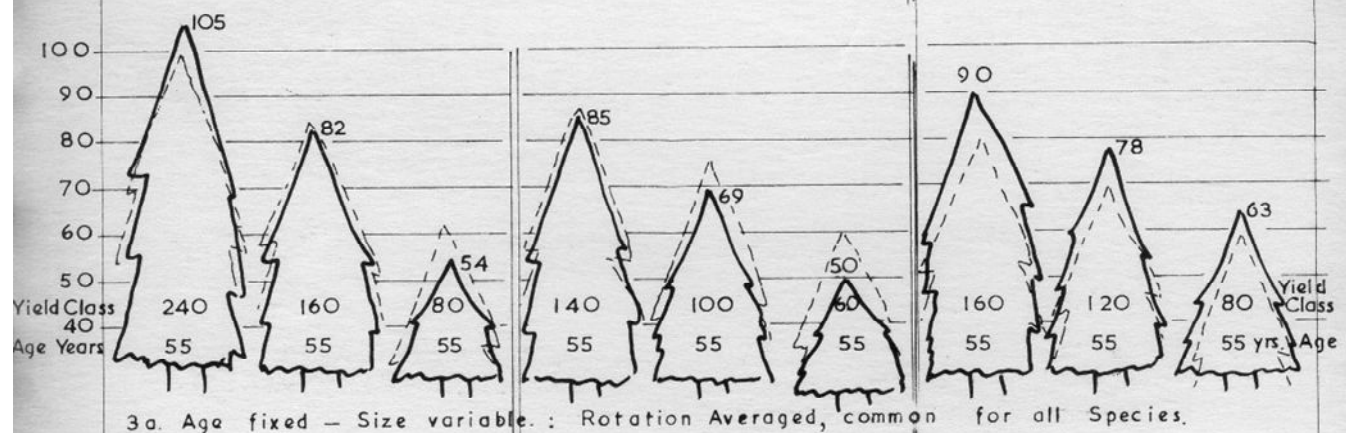
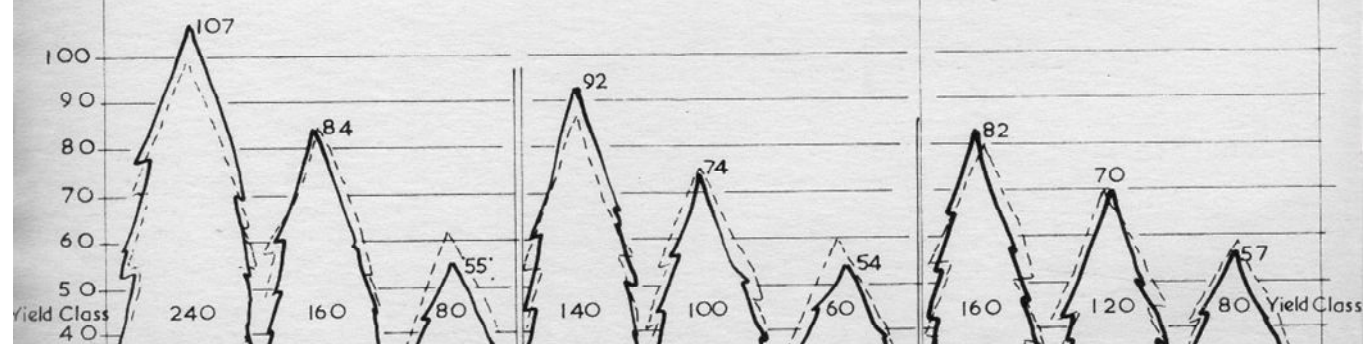
Group 3

- 3 (a) i. - That in which, at clear felling, the size of the tree within the coupe varies but age is fixed despite variation in species and rate of growth (i.e. productivity class) thereof.
- 3 (a) ii. - That in which, at clear felling, the size of the tree within the coupe varies, but age is fixed for each species despite variation in rate of growth (or productivity) thereof.
- 3 (b) & (c) - That in which, at clear felling, the size of the tree within the coupe varies, and to some extent so does age, thanks to appreciable variation in species, rate of growth (or productivity), and age.

This group of Rotations represents what may be termed Average Rotations. They are intended to have a financial flavour, but the rigid uncomprising approach has been relaxed. In practice, a census has revealed the spread of productivity which has been averaged and the rotation relative to that reapplied to the whole range. In 3(a)i, this averaging and reapplication has been done embracing all species; in 3(a)iii the averaging and reapplication has been done separately for each species, which is inclining more accurately towards Rotation Group 1.

What is likely to happen is that whilst sub-compartments of average productivity make the financial peaks, the higher and lower elements are likely to show a loss, in the sense of falling short of the peak.

THE APPEARANCE OF TREES AT CLEAR FELLING STAGE,
for a range of Species, Yield Class and Rotation.



In exchange for this sacrifice, the advantages expected include the chance to reconstruct the succeeding generation into a more regular pattern, or one in which the sub-compartment numbers are reduced and areas increased, consequent cheaper Management, more even timber outputs, and more even work programmes to stabilise labour requirements.

There will, of course, be considerable fluctuation in these first generation fellings of number of trees per acre, and girth size, as well as Top Height.

It can be imagined if one considers each species of similar age, that where different productivity classes adjoin, they will be grouped together as one coupe. It follows that they could also be grouped together as one sub-compartment. In practice what is probable is that they will be classed as one sub-compartment, only one expression given for productivity class representing an average, and that this process can commence at planting time.

In the case of 3(b), much the same applies, except that the degree of relaxing the financial mandate, or tolerance, if preferred, has gone much further. In a determined bid for increased sub-compartment size, adjacent stands not only of differing productivity class, but of different species are felled together at the average rotation of one, or other of them.

This is all very well, but unless very close control is exercised, it is possible that some of the fellings will cause certain elements to be harvested well outside the true Financial Rotation.

The illustration shows this, particularly where by chance the fellings of L.P. and S.S. low productivity stands are advanced about 20 years, and those of S.S. and J.L. higher productivity stands delayed for between 10 and 15 years.

In point of fact, the very fact that mistakes like this can creep in (quite possible with fertility trends, or increasing exposure on higher ground), indicate priorities must be accurately assessed to ensure that averages are maintained.

The situation is carried to its extreme in 3(c) when the drive for larger second generation areas and more extensive forestry, has allowed the felling of adjacent stands which differ in species, Productivity class and age. No illustration has been prepared to cover this contingency; it is left to readers' imagination to fill this gap! But clearly some limit to tolerance must be accepted, and maintenance of averages and limitation of financial mistakes would be assisted if a system of compartment indexing were introduced, in which the averages, age, height and rotation - of all qualifying component sub-compartments were determined, and themselves averaged to provide a compartment figure for comparison with the accepted Forest average. (In case 3(c), "coupe" is revisualised as covering more than one P year.

The inference seems to be that even here, an intensive form of management must govern the first generation at least, and that assessment of sub-compartments would contribute to accuracy if productivity is, in fact, a factor, complementary to species and age.

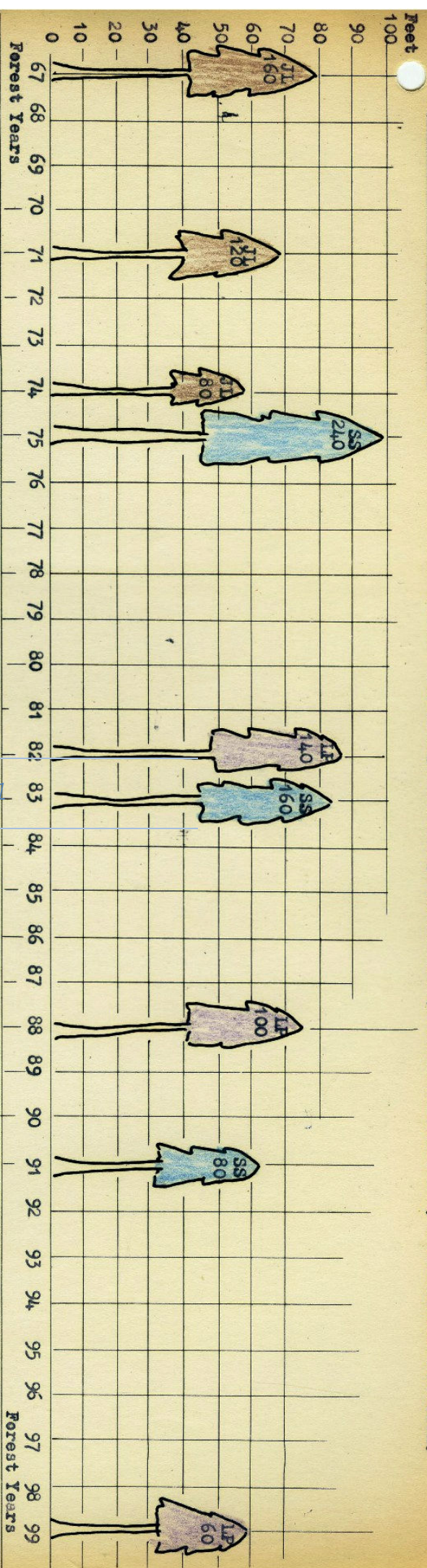
Assessment of Productivity

This Philosophy accepts the Yield Class system of classifying growth as outlined in the F.C. Management Tables (Booklet 16) as the basis for assessing tree crop productivity. These tables, undoubtedly the product of immense time and money, offer a tool of great accuracy to the Forest Manager, which he can only exploit to the full if used as intensively as the system was designed.

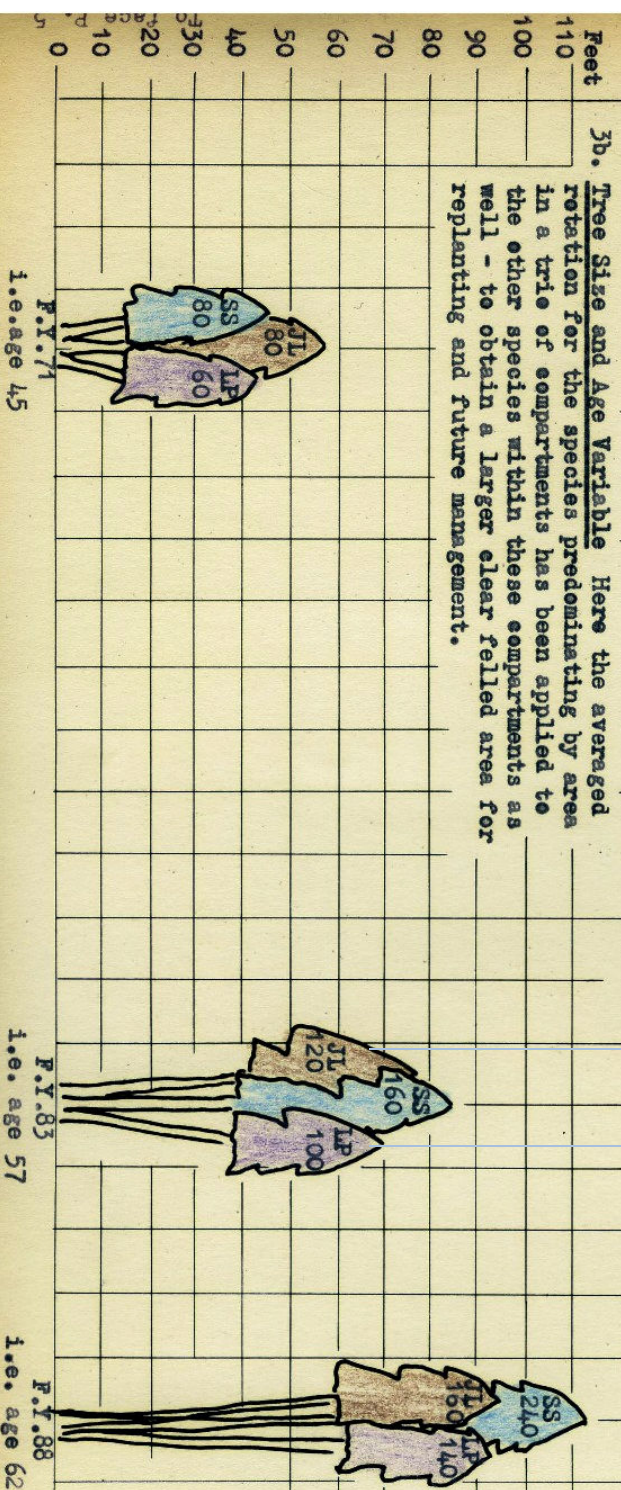
This Philosophy endorses this intensive approach and will come to trace out a useful and logical method of embodying the Yield Class System into a comprehensive management system.

Any worked example involving productivity figures will have made use of this system, and it is assumed that readers are familiar with it.

* 1. Tree Size and Age Variable, repeated with Time Scale - depicting P.26 J.L., S.S. & L.P. (3 Yield Classes each) at Financial Rotation.



3b. Tree Size and Age Variable Here the averaged rotation for the species predominating by area in a trial of compartments has been applied to the other species within these compartments as well - to obtain a larger clear felled area for replanting and future management.



In the case of 3(e), it is visualised that this licence is extended to include different P. Years as well.

Productivity and Thinning

To introduce the subject of thinning at this stage may seem an intrusion. But the foregoing survey of notation has a very distinct bearing.

One of the Manager's big problems is to estimate the timing of the first thinning of any Basic Unit of trees. Providing stocking is up to scratch, a convenient datum for first thinning is when the dominant trees reach 30 feet. Where sub-compartmenting has been carried out intensively - as in the Rotation 1 case, i.e. the strict Financial or Maximum Volume group - such prediction is easy. But where sub-compartments embrace a range of productivity classes and only an average stated, the prediction is going to be out for all but the average. Elements of higher productivity will have suffered a delay in thinning (and increment may be lost), whilst those of lower productivity will not be ready, and their volume contribution lacking. A study of Sitka Spruce will show that productivity or Yield Classes reach this 30 foot datum as follows:-

280 - 14 years, 180 - 20 years, and 80 - 32 years

Once, a plantation becomes productive, it is relatively simple to plan and estimate for it. Similarly it is fairly easy to risk making long term estimates of thinning. The real problem, to repeat, is the prediction for the immediate 5 years or so, and it is this unique first thinning which raises most doubt and uncertainty.

The manager who is troubled about this will undoubtedly make a plea for intensive sub-compartment classification.

The second aspect of productivity and thinning to be touched on here concerns the marking, generally coincident with first thinning, of Final Crop Trees. This is a practice frequently indulged in by enthusiastic Foresters, a fact accepted in this work without questioning its merits.

The point is - how many should he mark? A token amount - say 60, 80 or 100 per acre, or the full anticipated quota? If the Forester elects to choose the latter course, and the mandate is for Financial Rotations, the productivity of the crop will have a very significant bearing on this quota. If a brief analysis is made of Sitka Spruce, the numbers of trees per acre at the recommended Financial dotation vary as follows:-

Yield Class 280	-	approximately 120	trees per acre
140	-	" 200	" " "
100	-	" 300	" " "

The inference of all this, of course, is that to know where he stands, the Forester, must be left in no doubt about the mandate a propos Rotation - - - i.e, to what regime he is committed - - - and this preferably prior to first thinning.

The Impact of the Unexpected

So far, what has been touched on has indicated that complexities are likely to be the order of the day, and yet, apart from a mention of windblow, everything has been relatively controllable.

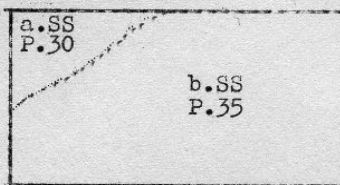
But in any alert and forward-looking Management System, some allowance must be made for intrusion by the unexpected and the uncontrollable. Such contingencies are many and varied, and include, for example, windblow, destruction by fire and pathological pest, check, damage by animals, clearances for opencast mining, electricity wayleaves, etc. etc. What, in effect, these do, is to bring an extension of irregularity. Being so untimely they obviously place strain on the system of creating and numbering sub-compartments. It is not enough to set about renumbering to make way for these new splinters, or progeny; generally we must amend the areas of the original parents as well.

What is called for, in fact, is a sub-compartment schedule which allows ready amendment to record the effects of all these factors - the intensive assessment of sub-compartments based on species, age and productivity, plus the added utility of amending them, even temporarily, in the light of subsequent catastrophe.

Sub-compartment Schedule

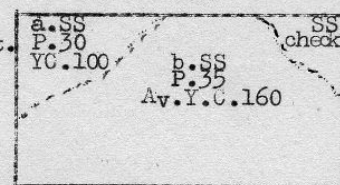
Compt. Sketch 1

20



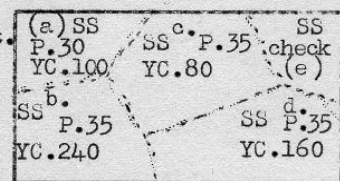
Sketch 2

Compt. 20



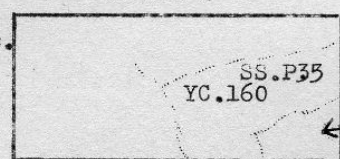
Sketch 3

Compt. 20



Sketch 4

Compt. 20



It feels appropriate to commence this paragraph with something of a recap.

Sketch 1 shows a simple sub-compartmenting - same species, but two planting years.

Sketch 2 shows the situation later when an assessment of productivity has been made. In the case of sub-compartment b, an average figure has been accepted, but an area of check has been surveyed out. What to do - tear out the old record and start a new one; or just not bother?

Sketch 3 shows the same compartment in the hands of an intensive manager. The one stand 3b, has now become four - - 3b, c, d and e, with the factor of productivity added to species and P. Year.

In sketch 4, - and it could be applied to either case above - disaster has overtaken part of stand (d). It has been replanted and though the species may be the same, there is now a 15 year differential in age. This must be recorded, and the areas adjusted. 15 years will make a lot of difference in further reassessment of productivity. What to do - tear out the old record sheet and insert a new; or just not bother?

Obviously, if the Financial spurs of business are a consideration, something must be done, but to go to the trouble and expense of ripping out the old record, and copying and bringing up to date a new seems too much.

The answer may lie in evolving a suitable record which can cope with these amendments, perhaps even temporarily - i.e. a sub-compartment schedule.

Date of Revision	Sub-compartment Data							
	Description			Allocation of Area				Productivity or Yield Class
	No.	Species	"P" Year	Total	Plant or Replant-able	Planted or Replanted	Check or not yet Estab-lished	
1935	20b	S.S.	35	10		10		
1948	20b	S.S.	35	10		1	9 (3)	240
							(3)	160
							(3)	80
1949	20b	S.S.	35	10	1	1	8 (3)	240
1950				9			(2)	160
							(3)	80
1950	20c	S.S.	50			1		

The table overleaf represents the most involved method of using the schedule i.e. to dodge renumbering, or even initial numbering on a productivity basis. Obviously, if continuing amendment is getting rather out of hand, the solution lies in a major revision involving a new record sheet, but the important thing is to tide the whole sub-compartment and its variable productivity, accurately beyond the first thinning stage. Note that the space necessary for registering amendment, is not only provided horizontally, but vertically. The user must decide for how long the record is to last before a major revision brings a new sheet. If this is decided to be 10 years, for example, sufficient vertical space must be left to anticipate 10 years of possible amendment. If the intention is for the record to serve a lifetime of the sub-compartment, then the best solution is clearly one sheet per sub-compartment, or, of course, a major revision can be planned once productivity throughout component sub-compartments can be assessed. A schedule of this kind will crop up later in this work forming the nucleus of a suitable Compartment Record.,

Management Policy

Of the different approaches to the Unagement of Forests, there are two extremes.

1. Extensive

Here, the manager takes a somewhat uncommitted view and his management is undertaken in the largest basic unit feasible. The data on which he depends can be collected merely at intervals e.g. 10 yearly, and a good deal of shortcutting undertaken by sampling. He makes do with a series of snapshots - fine when new, but becoming a little faded and out of date in 10 years time. Such a policy is at its most applicable where basic units are large - generally in huge, flat, homogeneous areas where clear cutting systems can be employed.

2. Intensive

In this case much more intimate detail is required and the manager must become familiar with his Forest on a sub-compartment basis. This is obviously the system which "goes" with Financial Rotations. But even Average Rotations must call for the same sort of discipline,, because by their very nature, they must allow for priorities to be decided, serious mistakes avoided and average levels maintained. Physical Rotations, too, demand that close attention be paid as each sub-compartment approaches the chosen height datum, and if sub-compartments are small to begin with, they must be managed intensively.

Clearly, the policy for British State Forestry so much of which is found on irregular sites, should be biased strongly in favour of an Intensive approach. The more one wants to be sure of making money, the more one has to do - and pay - to prove it.

Carrying the Intensive approach to its ideal, what is required is a sensitive system always on its toes, always up to date. In contrast to the "still photography" of an Extensive System, the Intensive Management should be cine. Data should be collected regularly, facts and figures balanced at least once a year, Only in this way will the Management have accurate figures at its fingertips.

Does it need to be added that whilst an extensive system will not cope readily with an intensive situation, a system designed for the intensive will cope quite splendidly with extensive conditions at no extra cost.

More about Basic_ Units

The sub-compartment so far-considered might be regarded as the Physical, or Silvicultural Basic Unit. By choosing a sub-compartment the Philosopher favours, instead of a single tree unit, a community of trees all of the sane species, age and height growth.

The definition can be taken a stage further by adding - - - "within the confines of the Parent Compartment."

The Compartment

A compartment can be regarded as a Unit of Management created arbitrarily but permanently with purposes including:-

- (a) splitting the Forest into much smaller areas more comprehensible to the mind of a Human Manager;
- (b) serving as a means of accurate geographical identification;
- (c) the easing of the otherwise complex problem of labelling Basic Units;
- and (d) the provision of a means of containing errors, which might otherwise spread to larger units of the Forest.

Administrative Basic Units

There are other units which Management must employ which are Basic in their own right and which have here been described as Administrative. They include the following items:-

(1) The Quantitative Unit

This is intended to quantify the Physical Basic Units in terms of the measurable area they occupy. At present this is the Acre. Though it is possible to survey competently to a decimal point, this is seldom practised in State Forestry which prefers to round to the nearest acre. However, if and when a switch is made to the Metric system, a Hectare- being between 2 and 3 times an Acre, will probably herald a move towards accepting one place of decimals, and to increased accuracy.

(2) Units of Productivity

Especially when Financial Rotations are involved, an extra dimension is required to give expression to the amount of Timber, which the Physical Basic Unit can produce from an acre of land. The traditional unit at present is the Hoppus Cubic Foot, 1.27 times a True Cubic Foot to allow for a certain amount of squaring on conversion. The time is surely ripe for a change, with so much of a log nowadays being utilised instead of written off as waste. The Metric system may herald a change; meanwhile weight in tons should not be overlooked,

(3) Units of Work

Quite simply, these are the 'jobs' to which a Forester puts his men in the day to day running of his forest, the jobs for which he may have to fix piece work rates, the individual piece of the whole jigsaw of costing which, when put together, reveal the progress towards, and, ultimately, the success itself, of the Forestry venture, in terms of Faustman Factors.

The Faustman Formula

Perhaps it would be expedient to remind ourselves of the Faustman Formula itself.

$$Se = \frac{Yr + Ta \cdot 1.0p^{r-a} - C \cdot 1.0p^r}{1.0p^r - 1} - \frac{e}{.0p}$$

Where: Se is the Expectation value of Land Acquired i.e. the value to which the mere asset of Acquired Land has increased by virtue of having been improved by growing a crop of trees on it.

C is the Capital Cost of planting and establishment, though not including such items as are not likely to recur in the next generation e.g. cost of treating scrub, ploughing, new drainage, roads, houses, etc. - costs more aptly included under the 'S' symbol.

e is the Cost of Annual Maintenance e.g. on roads, drains, protection, and interest on capital charges under "S" symbol.

Ta = standing values of Thinnings in years 'a' to "r"
Yr = standing value of final crop in year "r"
r = Rotation in years
p = Rate of Interest, often termed Forest Per Cent

In other words, all expenditure with compound Interest added up to the year in which the crop is harvested, is equated against all the returns (from intermittent thinnings and clear felling) to produce a figure expressing the measure of profitability of the whole Forestry venture.

It will no doubt also be recalled that such a forward-looking, long term calculation has been regarded as academic and invalid by many who claim that true costs cannot be really used over such long periods of time during which the very value of money may have radically altered. So the modern practice is to discount by looking back to the year 0, but dating the calculation to the present by using current costs and prices, i.e. the Net Discounted Revenue calculation.

Aggregations of Units

This must be one of the most difficult aspects of Forest Management to bring into proper perspective. Basic Units can be regarded as the bricks used to build the ultimate factors on which profitability must be judged, i.e. the "C", "e", "T" and "Y" etc, - Factors of Faustman.

Somewhere in between these stages, there are interim stages which are aggregations of Basic Units of useful significance.

It is a feature of this Philosophy that it recognises that for efficient, streamlined Management, the fewer of these interim aggregates the better. Put in another way, only interim aggregates which are of intrinsic significance and use should be recognised and included.

In the case of Physical Basic Units, the sub-compartment can be usefully aggregated as follows: compartment, acquisition, Forest. Note, however, that of these the compartment is purely arbitrary and one of the few "extra" steps of which the Philosophy approves for reasons already given.

The inclusion of Acquisition may raise a few eyebrows. An acquisition is, of course, a legal entity. But there is, too, a financial reason for retaining component acquisitions as interim aggregates, in as much as they are individual financial ventures whose relative success has been independently gauged even before acquisition. In addition, they are of finite dimension and can thus offer similar "containing" properties as geographical compartments.

Another possible aggregate is mentioned here, which may merit serious consideration - Land Type. The inference of Land Type is that all Afforestation subjects should be classified into one of a range - there not be many - perhaps three - based on standard of difficulty and cost to establish, and possibly, later, tying up with productivity. Such a unit - a somewhat arbitrary unit - could be of subsequent value in the accurate assessment of new acquisitions under consideration, and also in compiling Budgets,

Both these - Acquisition and Land Type - may prove of decreasing significance in the next generation.

No doubt, a number of old acquaintances will have been notable for their absence - - no Beats, No Blocks, No Working Plan Areas. It is possible they might be of some use up to the maintenance phase of large Forests, but little need for them is foreseen in the Mature Fores.

With Units of Productivity the sub-compartment aggregates readily into a Species "Working Circle" and an Annual Programme. When intensive, Financial Rotations are employed, a definitive aggregate is the total of sub-compartments grouped under Species, P. Year, and Productivity or Yield Class. This aggregate is of value in assessing allowable cuts in Long Term and even Short Term, Thinning and Felling forecasts.

Units of Work also present a controversial problem. Jobs aggregate readily into planned Annual Programme, weekly achievement i.e. current, and accumulative achievement to date. In as much as profitability is judged quantitatively in acres, the more jobs and programmes can be costed as acres, the better. To assist with this, there may well be a case for paralleling traditional units, such as chains of drains, with the gross area in which they occur.

In addition jobs should be grouped into the aggregate of the Faustman Formula which can be used significantly.

For example I visualise the following situation:-

Basic Unit		Aggregate Unit
Cut and Burn Scrub	)	
Plough for Planting	)	
Turf by Hand	}	
Prepare Heel for Plants	)	Establish new Plantations
Haul Plants and Heel	)	
Plant	)	
Apply Fertiliser	)	
Weed	)	

Note that the above format is preferred to what follows, containing some not very useful interim aggregates:-

<u>Basic Unit</u>	<u>Interim -Aggregate</u>	<u>Aggregate Unit</u>
Cut and Burn Scrub	)	
Plough for Planting	)	
Turf by Hand	)	
Prepare Heel for Plants)		
Haul Plants and Heel	)	Establish New
Plant	)	Plantations
Apply Fertiliser	)	
Weed	)	Maintain Plantations

The Normal Forest

To define a Forest is by no means an easy task. There is a great temptation to say - - - "the maximum aggregate of Basic Units rounded up within the framework of adjacent acquisitions which a man of Forester rank - and cost - can efficiently look after". If left at that, pro tem, something more constructive may emerge later.

A definition of a Normal Forest is much easier. It has already been referred to as a Forest which has reached the ideal state of Sustained Yield. It is a Forest for which a Rotation in years has been calculated, the Forest being divided into an equivalent number of pieces, one being clear felled and one being replanted every year ad infinitum. No matter when the Forest may be analysed, its age class structure would always appear to have the same perfect proportion.

It virtually becomes self-managing. For example, if it were 1,000 acres in total and a Rotation of 60 years determined, a series of simple calculations would enable a picture of a year's work load which could represent any and every year - -about 17 acres to fell (yielding about 100,000 Hoppus feet), 17 acres to replant, about 17 acres, times three, to weed, about 150 acres to thin (yielding about 60,000 Hoppus feet), approximately 1,750 chains of drains to maintain in 250 acres and so on. The establishment of a suitable fixed level of labour follows readily. Life for the manager becomes sublime - - - until he suddenly finds his services no longer required,

However, there are many who are sceptical of the Normal Forest, regarding it as an academic ideal, virtually impossible to achieve without first having to make likely sacrifices by premature felling. And if strict Financial Rotations are mandatory, the point is conceded.

Yet, a Normal Forest is not to be discarded out of hand, because it remains what the name implies - the Norm, or average state of affairs. It serves as the average criterion against which at any time, deviations, irregularities, etc., and their implications, can be gauged. Whether one achieves it in practice or not, one should always keep sight of it on paper. And if ways and means can be devised to create a Normal Forest which avoid such sacrifice, so much the better.

Finally, the Normal Forest and its work load does offer an interesting illusion. If the Normal Forest is depicted in graphical form on a horizontal time axis and a "slice" taken out from across it and turned through 90°, it would offer in section the whole kaleidoscope of operations of the rotational lifetime of one stand. Here are all the ingredients of the Faustman Formula, nicely proportioned and compressed into one readily comprehensible year. Using current costs, and discounting, an expression of Profitability thus becomes available without waiting the 50 odd years of the Rotation.

Sectim_2 SUMMARISING THE PHILOSOPHY

This seems a convenient stage to pause and summarise the ground already covered, to list the accumulation of facts which form the basis of a Philosophy of Forest Management.

1. Britain's Geological, Meteorological and Social heritage has bequeathed a vast range of site, and a sadly depleted timber reserve.
2. Government Policy has seen fit to promote an increase in this reserve on the assumption that Forests form a useful natural asset which can help to influence, favourably, our balance of Imports.
- 3» While there is a case expecting this afforestation effort from subsidy, and not the current loan repayable with interest, a clear financial pressure already exists vis-a-vis Imported Timber. It thus becomes an accepted mandate that Rotations will be of a Financial Nature.
4. This indicates conformity with Faustman.
5. Accurate costing thus becomes essential, and must differentiate between the Objective elements of Faustman.
6. Afforestation - the physical set of techniques evolved to create New Forestry - is appraised as a quite unique phase, and thus must be costed separately.
7. A Mature Forest is one in which the Principle of Sustained Yield is being applied. This infers that even within the limited territorial unit of a compartment, may be represented the whole range of operations, seen in a Forest's lifetime or Rotation, between Replanting and Felling.
8. Basic Units, or sub-compartments will tend to be small and numerous, by virtue of the fact that Timber Crop Productivity is a vital factor in their creation. Thus the concentration of factors which can be met in the business of Forest Management can amount to something very complex and integrated.
- 9» The truly definitive Management system should be designed to cope with this, the ultimate contingency.
- 10» Furthermore, it should not merely cope with known and controllable factors, but, by flexibility, seek to make allowance for unexpected factors as well.
11. Clearly the System should be Intensive to allow a tight and constant grip, being co-ordinating and all embracing, rather than functional.
12. To ensure efficiency, the System should be pruned of all extraneous levels of units, records, costs, etc., in favour of only those of significant and intrinsic usefulness.

13. A Normal Forest depicts the Average regime and offers a criterion against which a Manager can predict difficulties and irregularities in planning ahead.

14. While acknowledging the Normal Forest as a desirable ideal, this Philosophy also recognises the serious incompatibility which may, and probably will arise between seeking its achievement and at the same time 'observing the disciplines of Financial Rotations.

15. It observes that if a compromise is followed, it may be no less difficult to manage - - - perhaps more so.

16. The position of Silviculture is felt to be the Servant of Management, but advisor too, so that no serious contravention may occur with such of the laws of plant physiology as are apparent and relevant.

17. The Philosophy should in itself be as flexible as to be capable of self re-adjustment in the event of change of Mandate, and development of techniques, evolved through scientific, industrial and administrative Research.

Part 2 Next