

Some Experiences in the Survey and Inventory of Growing Stock for Forest Management Purposes.

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WHEN one tries to compare the position of Forest Management in Ireland to-day with that in the countries of continental western Europe, it is difficult to find any close parallel. It is interesting, however, to read and study earlier reports and working plans and to find that about 100 years ago many of the best forestry estates in Germany and Denmark were in a development stage similar to that of some of our own forests to-day. It is a heartening experience too, to drive through extensive blocks of high quality timber and to learn that where these fine crops now flourish was once poor pasture, heath, scrub or devastated woodland. It must be recognised that forestry on the Continent has grown up in different times and conditions from those to which we are subjected to-day. During the 19th century the growing forest industry was greatly encouraged by the rapidly increasing demands for industrial wood occasioned by the industrial revolution. Railways and canals opened up new markets, while the vast increase in urbanisation, the growth of mining and the development of the paper industry on a wood base made ever greater demands on the forest. The evident value of forest property created a lively interest in forest management and forest economics among owners, managers and government officials. There was a growing concern about the future supply position and a natural pre-occupation with the problem of demand and supply. The young forestry profession was acutely aware of the dangers and possibilities of this increasing hunger for timber. The lure of ready markets was a constant threat to the very existence of the forest. The economists were ever ready to preach a doctrine of short rotations and quick returns from plantations of industrial wood, while the silviculturists were anxiously trying to create a biologically sound and healthy forest which would be proof against all vicissitudes. The social and industrial implications of forestry were early recognised and the enlightened management introduced into many private and state forests in those trying years is a tribute to all concerned.

The situation of growing demand and declining reserves of timber called for regulation and control and the man who stepped into the breach was the forest mensurationist. He was called on to provide statistics for industry, to produce formulae for the forest manager and the taxation officer which enabled them to calculate and forecast the potential of the forest estate. His services were in demand for cruising

timber reserves, for the assembly and interpretation of statistics for commissions of enquiry. This pre-occupation with the measuring and rationing of the forest resource to the practical exclusion of the problems of regeneration and perpetuation became the subject of a growing volume of criticism from the forestry profession with the result that forest mensuration suffered a progressive decline in popularity in forestry circles on the Continent. The nature and extent of this fall in prestige was aptly described by a quotation which was frequently on the lips of German forestry students, with whom I studied in 1936 and which went somewhat as follows: "Wagner elevated forest surveys and assesment to the position of Director General with palatial offices of its own while Möller reduced it to the position of a bookkeeper who sat in the outer office of Director Silviculture."

This partial eclipse of mensuration by silviculture in central and western Europe still prevails and is to some extent responsible for the relatively slow development of new mensuration techniques on the Continent. To the Irish student it is a remarkable experience to find that the highlights of a continental forestry excursion are mainly concerned with silvicultural and protection problems while in Great Britain and Ireland there is a marked emphasis on yield prediction and mensuration techniques. The reason for this contrasting state of affairs is not far to seek. On the Continent the business of forestry is well developed and highly organised and the machinery for collecting statistics is working smoothly and well. Frequent inventories have been carried out since about 1800 and the enumeration of growing stock in the forest is a routine job. These repeated stocktakings together with the accumulated records of timber felled, transported, converted and utilized add up to a unique and complete body of statistics which arouse the admiration and envy of countries with an underdeveloped forest industry.

Irish forestry is relatively immature and in the formulative stage particularly in the fields of utilization and management. The main and natural emphasis in the past has been on establishment techniques and the approach to management and marketing has been largely exploratory. We are not alone in this respect and in many ways the problems confronting the Irish forester have much in common with those of British forestry and of countries like New Zealand and South Africa. There is a risk of over supply of low grade wood from thinnings which make the problems of management and marketing the immediate concern of the central authority whose task it is to avoid waste in the public interest. There is, therefore, a natural pre-occupation with questions of yield and output in the immediate future. A good deal of progress has been made and in this connection we must recognise that we owe an immense debt of gratitude to the research workers of the Forestry Commission for seeing us so far on the road. The time has come, however, when we must begin to solve our own problems in our own way.

The relatively backward state of Irish forestry can be readily explained by reference to the forestry developments over the past 50 years. At the turn of the century there were no state forests in this country. Private woodlands were in active liquidation and whole timbered estates were falling on the market for a veritable song.¹ Timber prices were low and up to 1914 pine and spruce, where saleable at all, was fetching about 1d. or 2d. per cu. ft.² There was no market for small thinnings. There was little scope for refined tree measuring under these conditions and the ideal of sustained yield management a student's pipe dream.

My active experience in Forestry goes back to 1930. At that time the forestry situation, while improved in some respects compared to the pre-1914 position, was considerably worse in other respects. The huge wartime clearances had swept away many of the best stocked areas; estate management was at a standstill; agriculture was crippled; and the timber market virtually non-existent. Woods were impenetrable and scarcely ever entered except by an occasional shooting party. Foreign timber flooded the market at give-away prices and forestry was a 'dead letter' except in the state plantations. The oldest state plantations were still scarcely 20 years old and covered in all less than 30,000 acres out of a total of perhaps 250,000 acres of nominal woodland. Measurable crops of the newer conifers were few and far between and one can safely say there were few forests with even a skeleton working plan, to say nothing of forests, managed on a textbook pattern.

If opportunities for measuring forests were limited so also were suitable tools and tables. But things were happening. We had the first fruits of British research coming to hand in the field of forest establishment and nursery work but more valuable still in many ways, Bulletin No. 10³ on the growth and yield of conifers. It is difficult for the present generation of students to appreciate the impact of this publication on forestry teaching and thought during those important formative years for Irish Forestry. Here at last was a publication which brought native forestry right into perspective. More important still it provided the propagandist and economist with wonderful opportunities for bringing home to the government and all concerned the wonderful potential for the production of wealth possessed by the western American conifers. The dawn indeed was breaking and the new day was ushered in more brightly by another publication which appeared on our shelves around that time—"Hiley's Economics of Forestry."⁴ This book was of vital importance to the student and teacher alike. These two publications taken together can be said to have heralded the new era of forest management in Ireland. They made us yield-conscious for the first time. Hitherto the emphasis was on planting for planting's sake and on forestry as no more than a social welfare scheme. To put it briefly then, in the early thirties there was a definite shortage here of suitable opportunities, equipment and books for the student and teacher of forest mensuration and management.

Training Abroad.

The absence of these facilities was recognised and it was customary to send students abroad for a few weeks to get working plan experience in France or Germany where forestry was highly developed. The forests selected were usually delightfully well-recorded, with simple well-defined enumeration and mapping problems calculated to provide for the student in the time available a suitable exercise along textbook lines. Small wonder that little progress has been made in the field of working plans in these islands and that the subject itself can rouse controversy whenever mentioned at any forestry gathering.

The authorities in University College, Dublin broke with tradition in our case and my colleagues and I, who formed the first group of students to complete the University course here in Ireland, were sent to Sweden in the early summer of 1935. By arrangement with the Royal School of Forestry, Stockholm and under the personal direction of the professors of the school, we were able to participate for a period lasting many weeks in the new line plot system of forest inventory then being tried out in co-operation with the Forest Research Institute in Sweden. This new Swedish National Forest Survey⁵ set a pattern in forest inventory which has been copied by forestry services all over the world and is applied in conditions varying from the northern tundras to the tropical jungles.

I cannot claim that at the time I was aware that I was participating in a research project of profound importance to forest management in Ireland. I could see little scope for the application of this method of forest inventory to the Irish woodlands of the year 1935. It was, however, a most stimulating experience and aroused an interest in forest inventory problems which has remained ever since.

The German System.

Following almost directly on this 4-months' course of field work in the woods of Dalecarlia, I went on to study forest management in the Forestry High School of Eberswalde in eastern Germany. Here, in a school set in the midst of the Prussian pine woods we were taught the classical system of forest inventory with detailed, unit-by-unit recording of forest stands, each sub-compartment like pieces of a jig-saw puzzle together making the complete picture. This system of detailed stand and site analysis demands a very high level of training, not alone in the field of mensuration but in the fields of ecology, soil science and meteorology also, since all the factors of soil regulation and climate were recorded in considerable detail. The final complete working plan and stock map gave every detail of the history and composition of the forest. Inventories were often tree-by-tree enumerations in the older and valuable age classes, with crown diagrams and crop profiles. Crop statistics, timber quality ratings and genetic characteristics, all demanded attention on the field forms. On the other hand the pole woods simply

got a quality class rating with an ocular record of stocking density and mixture which was supplemented by the planting records. Only the unsatisfactory young crops were given any real going over. Further periods of study in south and west Germany brought to notice more intensive forms of forest inventory with a bewildering range of forest types, mixtures and management systems. These were often of local origin and evolved by managers, each of whom had apparently spent a lifetime striving for a unique system of his own.

The general tendency, it appears to me, is for the style of inventory to change from north to south. In the north the aim appears to be, cheap and rapid coverage of the vast areas involved. Simple, scientifically developed field recording techniques are used, with mechanical sorting and tabulation of data by a central office used to the maximum extent. In this way up-to-the-minute and accurate information of value to administration and industry is provided at low cost but little in the way of special information to the local manager who has in any case very little time or opportunity for detailed silvicultural intervention in his forests. The poor soils and low yields do not warrant intensive management and detailed information on locality factors are not necessarily required.

In Germany, Denmark and Switzerland, however, the pattern of forestry is very much complicated by the needs of local industry and agriculture in the immediate neighbourhood of the forest. There are markets for a wide range of products from firewood and vineyard stakes to veneer logs. Each locality has its own speciality in the way of wood sizes or timber quality which profoundly affects such vital matters as rotation and species mixtures. The forestry schools cater particularly for the needs of local administration and the managers in both the private and state services are all academically trained and are steeped in the traditions of the forest. The pattern of management is well established and changes very slowly, perhaps too slowly in these times of rapid change in fashion and demand.

System for Ireland.

In this short review of the forest assessment practices as I have experienced them I have tried to show that there is a very wide range of methods from which to choose. The value of the forest in general and the level of production as indicated by the nett earning capacity of the average acre determines the pattern of management and the form of inventory.

When it fell to my lot to evolve a course in Forest Mensuration and Management suitable to Irish conditions there was no readymade system on which to go. I have tried out many different forms of inventory under different conditions to see if any pattern would emerge to suit our own peculiar needs. The problem indeed remained as how best to provide students destined to work in Ireland with knowledge

and skill in the task of bringing extensive areas of relatively undeveloped, unrecorded coniferous plantations, abnormal in age class distribution, under systematic, sustained yield management. There was also the apparent need for trial stocktakings which were calculated to reveal something of the size and composition of the growing stock in the more advanced plantations and which would be a pointer to the rate of growth and the immediate yield potential of our rapidly expanding forest estate.

Since 1946 through the kind permission and co-operation of the Forestry Division, Department of Lands, and the owners of several large private estates, the author has carried out a number of forest assessments. The main purpose was the training of students in enumeration and stock mapping for forest management purposes. Still, wherever the opportunity presented itself, methods suitable for the cheap and rapid assessment of growing stock were tested and developed. In the state forests covered by these surveys, a large unit or single forest property of from 800 to 1,200 acres was usually completely surveyed and stockmapped. A modified line plot survey⁶ proved to be the most satisfactory method of stocktaking in these extensive, even-aged, mountain forests. The mapping and stocktaking was done by running compass lines against the prevailing slopes across the contours. Crop changes were plotted by continuous linear measurement along the lines. The location of the survey lines was fixed in advance by superimposing a grid on the map. Usually a 4 chain by 5 chain grid and sometimes an 8 chain by 5 chain grid was used. The sample plot centres were taken at the intersections of the grid lines. This close grid allows of very accurate mapping of crop boundaries and insures a really adequate sampling unit. The continuous linear measurement enables the survey party to record improvements such as new roads and also to detect errors in the location of compartment boundaries.

The most suitable sample plot proved to be the diamond-shaped plot⁷, which was normally one-tenth of an acre in size. It could be expanded to one-fifth acre or reduced to one-twentieth without any trouble. This is very necessary as the size of the timber and the stocking per acre varies considerably with the age class. Under good conditions a survey party of three can lay out and enumerate a plot, record heights, and take increment borings or leader measurements in less than 10 minutes.

During these surveys it was usual to test out different methods of quick enumeration as recommended by various workers. The one by Professor Weck of Reinbeck⁸ proved to be very fast and gave results consistent with our plot enumeration results. The relascope or angle gauge method proposed by Dr. Walter Bitterlich was also tried out. The simple form of relascope, the road and blade type was found to be reasonably reliable. The more expensive and more elaborate instrument, the⁹ Spiegel-Relascope did not fully live up to our expectations.

Measurement made under good conditions gave a stand basal area per acre that deviated on occasion by as much as 20% from the callipered measure. In addition it is not possible to separate the quarter girths or species without considerable difficulty. It is possible for trees to be hidden by others or for small trees to appear to merge as one, especially in dark spruce stands. The eyes tire readily in winter time in heavily stocked pole woods. It is sometimes impossible to use this instrument in older weed-infested crops of pine and larch, and even in Douglas fir and spruce, briars and elder frequently reach well above breast height. We found it very desirable to mark the trees firstly to prevent them being recorded twice, a very real danger.

One of the most useful methods which came to our notice was that of Hohenadl¹⁰ as described and modified by Krenn,¹¹ called the "Method of the Two Mean Trees." This method provided sample trees for increment study and for local volume table construction, as well as for the calculation of the basal area of the stand and the volume per acre.

In the ten years' period during which these trial inventories have been regularly carried out, close on 8,000 acres of fully stocked plantation have been recorded. The areas covered represent a useful sample of the extensive plantations laid down by the state in the period between 1910 and 1930 and by the large private estates over the last 100 years. The cost of the field work ranged between one shilling and two shillings per acre. The work was done by relatively inexperienced student labourers who were also entrusted with the compilation of the statistics and stock maps. The final reports have been put up in the form of conventional working plans in the case of the private estates and in two instances have been adopted as a basis of management with excellent results. Thinning programmes, fellings and financial returns have turned out as forecasted so that the plans can be said to be working in every sense of the word.

The volumes of timber returned in these field exercises varied from 1,000,000 to 3,000,000 Hoppus feet per survey and the forest properties covered ranged from large blocks of coniferous plantation in one age class on difficult mountain land with a wide range of growth rates, to well developed and highly productive old woodland sites with a fairly normal age class distribution. These line plot surveys together with the studies on the felled sample trees on increment and growth history of the stands in question, provide a wealth of instructional opportunities and are an excellent form of training for students. When combined with a study of the local conditions,¹² including soil depth and type, ecology and local water regime as influenced by topography, they give a very valuable insight into the fundamental factors of production.

The writer is of the opinion that there is a need in Ireland for a form of inventory which is intensive enough to provide for working plan purposes and is not so detailed and costly as the Continental form

of stocktaking. This form of inventory should not be confused with national or regional stocktaking along the lines of the census¹³ of woodland being carried out in Britain. There is need for both so that we can become more and more thoroughly informed of the forestry production position not only in the country as a whole but in every single productive compartment in our forests. When that position is reached we can be assured that the why and the wherefore of failure and success will cry out for answer and the forest technician will enter into his own at last.

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