SOME ASPECTS OF GERMAN FORESTRY

By A. L. POOLE.

Those who studied their forestry in New Zealand will remember plodding through Schlich's *Manual of Forestry* and through many other text books based upon German forestry theory and practice : perhaps wondering what a normal forest really did look like and if ever a sustained annual yield could be attained in practice : realising but dimly what the true economic effect of these two could be and how they were related to silvicultural practice. Now that some of the exotic plantations of the Dominion have fallen to the axe, and large areas are reaching maturity, these problems must be much more live in the minds of foresters. The following observations from a short experience of German forestry under Military Government may therefore be of interest.

It must be admitted that these observations are but a fleeting glimpse of a very large and historically intricate organisation. On the other hand the inside workings of German forestry administration were seen, for they had to be partly unravelled before the machine of military government could take over. Perhaps the most interesting side revealed in this work was the remarkable power which had been held by the foresters through the control of the axe until it was partly taken away under the Nazi regime. Now catastrophe threatens German forests for it will be a struggle between the trader, who will have an insatiable demand for wood for many decades, and the forester, naturally conservative and with a deeply rooted past.

Germany is a land of well tended, and for her range of soils, productive forests. It has aptly been said that one cannot see the trees for the wood and this is certainly the impression gathered when travelling through her forests of almost regimented trees. Her written forest history has been long and varied. At first the forests served chiefly the vital need of fuel. When to this was added a heavy demand for general construction timber for a rapidly increasing population the country found itself faced with a timber famine between the 13th and 16th centuries.

This led her to set her forestry house in order, and since those days of great wood scarcity forests and forestry practice have continually improved, until they occupy a pre-eminent position in world forestry. In 1937 Germany had an area of 31,000,000 acres of forests or 27% of her total land surface. Of this 28% was hardwood and 72% softwood. Only 5.5% was coppice, the remainder being high forest. The ownership of these forests was : State 33% ; Communes, Institutions and Associations 19.5% ; and Private (free and entailed) 47.5%.

The aim of German forestry has for the past 100 to 150 years been in the main the development of normal high forests with regular age class distribution according to the length of rotation desired. This aim has largely been realised, partly because of the creation of

a highly trained and competent technical staff employed in both state and private forests, and partly because the German by nature and through education is a great lover of his forest—a lover of the forest as an entity and not from an arboricultural point of view. It is worth mentioning here that the forest officers also have wide and effective policing powers in dealing with theft of forest produce.

As a result of this 100 or more years of intensive management normal age class distribution is the rule in the State and most of the larger private forests. It has of course not been possible to produce normality in communal and small private forests, but officials appointed for advising the owners of these usually have a good idea of the state of affairs, and aim at approximate normality. These forests now provide a regular flow of wood for diversified and soundly established wood using industries, while firewood has been relegated almost to the lop and top.

Control of the Axe.

One factor above all others has served to place German forestry upon a sound footing: it also distinguishes German forestry from that of nearly all other countries practising intensive forestry. It is that *the control of the axe is in the hands of the forester.* By this method alone has the forester been able to realise the maturation of long term planning and the development of normal forests and sustained yield. More important still he has been able to introduce sound silvicultural practice which has enabled the productivity of the forest soils to be increased to a considerable extent. Insofar as the German forester has to pay his way he is also very interested in supplying industry with what it requires. He is therefore closely in touch with industrial needs and in fact the good forester realises that his silviculture and stabilised wood using industries are complementary. The German forestry service as a whole has taken a lively interest, and sometimes a lead, in the development of new wood using industries. There is no doubt he is fortunate and greatly assisted in being able to find a ready sale for the smallest produce from his thinnings and for the "lop and top" of larger trees.

The advantages of the control of the axe are so well realised that it has even been enforced upon small private (woodlot) owners. The main income of these owners is usually derived from agriculture, their forest providing a subsidiary source of revenue. In times of poor crops the overcutting of the forest often takes place to provide extra revenue. In the case of largish areas, owners were in the past tempted to sell the timber standing. They had poor bargaining power against wealthy wood industries or wood agents and usually received considerable underpayment. This sale of standing timber has now been prohibited by a law which states: "The sale of standing timber in bulk is prohibited. It can only be sold after felling and in price-fixed assortments determined according to the standard rules for measuring and fixing grades of felled timber."

The building up of sustained yield forestry has allowed the development of stabilised wood using industries. Each state forest and the larger private and communal forests have to a large extent reached normality and sustained yield. This means that more than two-thirds of German forests have developed to this stage. Around each individual forest or group of forests are usually placed permanent saw-mills which in turn supply joinery and furniture works, carriage makers and a host of smaller, frequently one-man, industries. Each forest also has its agent or agents for pit-props, pulp-wood and other round timber for special purposes. In fact quite a proportion of the economy of the district is based upon the sustained yield of the forest.

Method of Annual Cut.

Until recently each state forest and large private forest budgeted for an annual cut based upon the sustained yield of the forest. The wood was cut mainly during the winter months and left to lie in the forest for a time to partly season. Conifers had to be barked before the beginning of spring to avoid danger from bark beetles.

The system of normal forests with regular age class distributions and sustained annual yield based upon working plans has enabled German foresters to produce very detailed statistics for the forests of the whole country.

These statistics combined with the method of annual cut placed in the hands of would-be central planners under the National Socialist Goverment a powerful weapon upon which they were quick to seize. They combined all the estimated annual cuts, adjusted the total figure to their national planning, and issued this adjusted figure as an annual felling target. The felling target was taken up by the different trades through compulsory trade associations. The whole mechanism was very simple and effective and worthy of a brief detailed description.

A special department of the Reichforstamt (State Forestry Office) dealt with the organisation, allocation and distribution of the annual cut. It collected from all forests returns of the proposed annual cut in quantities and grades of wood for the coming forestry year (October 1st to September 30th). For forests under working plan management the proposed cut was the sustained annual yield and for other forests state officials usually assisted the owner to estimate an annual yield. The central department combined all these figures and then adjusted the totals according to central planning for the coming year : for example, if increased coal production was planned then the figure for the pitwood cut was increased. The adjusted figure was then broken down once again to the individual forest owners, and that represented their actual felling target for the coming forestry year. On the wood using industry side the target was distributed to the individual user firms through the compulsory trade associations ; one for pitwood, one for pulpwood, one for sawmills and so on. The

trade members therefore knew the amount of wood they were to have during the ensuing forestry year and where it was located in the forest. The price was also fixed by statute.

This was super-planning of the kind revelled in by the orderly German mind. While it might have had some good points, in effect it took the real control of the axe from the forester in whose hands it had been so beneficial, and placed it in the hands of the central planners. It was therefore a retrograde forestry step. From the Nazi point of view it worked very effectively but only up to a point short of serious overcutting of German forests. Towards the end of the war, when the official felling target was 150% of estimated annual yield, a number of factors operated to prevent this high cut. Lack of transport is usually quoted as the main reason, but there are many indications that there was a fairly solid wall of opposition in the professional integrity of the foresters. On the whole foresters displayed considerable skill in obtaining increased cuts largely from heavier thinnings. The area normally clear felled was not increased to any great extent.

This system of annual cut, whether planned centrally or carried out by individual forests, leads on to the important relationship between silvicultural practice and the requirements of wood using industries. The integration of these two had reached a very high level in pre-war Germany, and demonstrated the importance of the one to the other.

Germany is surrounded by some of the largest timber exporting countries of the world : Russia, Finland, Sweden, etc. Nevertheless by judicious regulations and import duties her forests have evolved from the stage of timber famine to the extent of being able to supply pre-war some 80% of the requirements of an extravagent wood using population. Moreover German forestry was profitable. The State Forest was revenue producing and large estate owners derived the greater part of their income from forests. Demands for wood and prices were such that even the smallest size thinnings could be sold at a profit.

The following were the major demands other than firewood from German forests :

Stemwood for saw timber, round polewood, plywood, etc.	66%
Pitwood	14%
Pulpwood, charcoal wood, etc.	20%
	100%

Firewood was calculated to be 15—20% of the total *derbholz* cut. (Derbholz is wood over 7 cm. diameter at the small end.)

Pitwood and softwood pulpwood was obtained for the most part from thinnings and the upper parts of stems of final crop trees of spruce and pine forests. Some was also obtained by the clear felling of 40-60 year old softwood stands especially grown on this short

rotation for pit or pulp wood. Private forest owners, particularly small ones, frequently grew stands for this purpose. The profitable conversion of thinnings to pit and pulpwood enabled the forester to put into operation the well-known thinning maxim "light and often." This he did in pine every 3-7 years, depending upon quality of locality, and in spruce every 3 years.

Small and medium sized beech thinnings were used very extensively for chemical pulp, charcoal, generator wood and dry distillation. These thinnings were also profitable to the forester so that he could regularly tend his forests right from the dense regeneration stage—practically all German beech forests are regenerated by the shelterwood or uniform system.

Sawmill timber was obtained partly from the thinnings from long rotation stands but mainly from the clear felling of annual coupes. In the beech forests it is only by the foresters control of large thinnings that he is able to practice the uniform system of regeneration. Opening up of stands must be performed carefully in relation to the forest floor and to the encouragement of any regeneration present. High quality butt logs from final crop beech trees or even from large thinnings provided veneer timber.

Firewood was provided from lop and top of thinnings and final crop trees, and particularly in rural districts, from thinned stems also. As small a quantity of wood as possible suitable for other purposes was however used.

Mention must be made of the practice of using single stems for more than one type of use. The division of the log in the forest into the categories most suited for it was fixed by regulation. Thus the forester might cut one spruce stem into a sawmill log, a pulpwood length, a pit prop and the lop and top would go as firewood. He was thus sure that he was getting the greatest utilisation and the highest price from his tree. In fact a marked feature of German forestry is that it is based on fine utilisation.

Recent Trends in Silviculture.

Distribution of Species.—German forestry is simple as regards number of species employed. The forester has only five or six main species with which he has to deal: the softwoods Scots pine (*Pinus sylvestris* L.), Norway spruce (*Picea abies* Karst.) and silver fir (*Abies alba* Mill.): the hardwoods oak (*Quercus robur* L. and *Q. petraea* Liebl.), beech (*Fagus sylvatica* L.) and birch (*Betula alba* L. and *B. pubescens* Ehrh.). The minor species of importance are larch (*Larix decidua* Mill. and *L. leptolepis* Gord.), Austrian pine (*P. nigra* var *austriaca* Ascg. and Graebn.), poplars, alder, hornbeam, and the two North American species Douglas fir (*Pseudotsuga taxifolia* Brit.) and Weymouth pine (*P. strobus* L.). It is notable that no exotic species of major importance have become established in German forestry although a number have been given long and extensive trials.

Although all the major species are indigenous, their present distribution corresponds only approximately with their natural distribution. Spruce, because of its high volume and economic yield, has been planted in most parts of Germany quite irrespective of its natural distribution. Pine has been planted all over the light sands of the N.W. German plain, where the original plant association was oak—birch, changed to heath vegetation by man's interference. Most of these plantings have been successful, though notable failures have occurred more particularly with spruce. The cause in N.W. Germany has been the rapid podzolisation of low base status soils—mainly quartz sands—under an acid raw humus layer of spruce needles. The result has been the deterioration of the soil within one rotation, and reduced growth or sometimes failure of the succeeding rotation. The forest soils under some of the other species planted outside their range are also showing gradual deterioration. This has been one of the factors leading to the "Dauerwald" movement.

From Germany's lengthy experience of artificial afforestation of species outside their range it would appear most important for young countries like New Zealand, adopting the same practice, to follow closely the development of their forest soils. With artificial afforestation based for the most part on fast growing pines producing a dense raw humus, rapid soil changes are bound to take place. This is almost certain to be so in areas such as the pumice plateau and Canterbury plains which naturally support tree growth only in limited areas. In both districts the drainage is very free and moisture relationship will be considerable altered by tree growth.

Seed Provenance.—In their artificial afforestation German foresters, in a similar manner to foresters of other countries, have had to learn by experience the importance of seed provenance. Within a species such as *Pinus sylvestris*, occurring naturally over large parts of Europe, are a number of genotypes and phenotypes. Afforestation with this species in the past has taken little heed of seed source, and a number of poor stands have resulted by using seed from unthrifty stands or from stands growing in wrong latitudes and altitudes. The Germans have studied seed provenance in detail and have introduced a number of regulations governing the collection and distribution of forest tree seed and nursery stock. The latest regulations were issued in 1938 and are most comprehensive. In keeping with the state central planning of the time, these regulations make it compulsory that all dealers in tree seed and nursery stock belong to an association. Seed may only be collected from approved stands. The seed and resultant nursery stock may only be traded under seal. The state has the right to select for seed collection elite stands in private forests. If the owner cannot collect the seed, state officials can direct collectors to collect in these stands. A control board for the administration of the regulations was appointed under the Reichforstmeister, and under the board a number of part time

inspectors from the ranks of the forest officials were appointed in different districts. These inspectors selected stands for seed collection and administered the regulations locally.

These regulations are undoubtedly the most comprehensive in existence. They show what importance the foresters attach to the subject as a result of scientific investigation. It is a subject of the greatest importance to a country such as New Zealand, whose forestry will be based very largely upon exotic species. Some work has already been done in the study of provenance, such as that of the State Forest Service in comparing stands of *Pinus ponderosa* (1) and Douglas fir from seed of different origins in the United States. The fringe of the subject has however hardly been touched. Species of forest trees are as variable as any other plants. It is known, for instance, that there are a number of types of the main exotic species, *Pinus radiata* (2, 3, 4), but no progeny testing has been done, and no selection of the better types. Apart from the work of Perham (5) there is also little accurate knowledge of the nature of the variation of the species in their native habitats—chiefly North America. Many, if not most of the European countries, although much less dependent upon exotic species, have sent investigating parties to collect material from North America. International provenance experiments have also been commenced under the direction of the International Union of Forest Research Organisations.

The following is an interesting comment by a foremost plant geneticist not only upon seed provenance but also tree breeding: ". . . . in regard to forest tree breeding in some countries such as Sweden and the United States, a middle stage [in plant breeding] has already been reached, where hybridisation, acclimatisation and selection have been carried out with rapid and revolutionary effect. In Britain, on the other hand, an interesting condition obtains where forest tree seed is purchased by the species and by the bushel. The quantity of seed is thus the unconscious object of selection, and not, as one might expect, the quantity or quality of the timber. It is for this reason that our State Forests present us with something—for the first time in the history of cultivated plants—consistently worse adapted than the natural populations cultivated by backward peoples. Thus having seen *positive* selection in its various stages of development, we are now able to see *negative* selection in the only stage in which it is likely to appear." (6).

Site Quality.—Another interesting feature of German silviculture is the use of the term *bonitat* or site quality. For purposes of assessing volume, stands are given a site quality depending upon the average height growth—correlated of course with age—of the species. Depending upon the species there are three or five site qualities. Thus yield tables for beech show five site qualities and those for oak only three.

While average height growth is a very practical and good empirical indicator of the quality of the site, it does not indicate all the actual or potential characteristics. With modern soil surveys and plant sociological studies a much closer assessment of this should be possible. In recent years the Germans have been using, to a quite limited extent as yet, plant sociological studies to reconstruct theoretically, and to define, the boundaries of the original or natural plant associations. They have found that these associations are related to definite soil types, and that by using a combination of a group of plant association indicator species and soil sampling they can produce very accurate vegetation-*cum*-soil maps. By using this information they can advise foresters concerning the conversion of an unthrifty stand of one species to another species. Their work is particularly useful in the afforestation of waste heath land where a definition of the boundaries of the virgin associations is a good basis upon which to work.

The determination of the plant associations is carried out by well-trained field botanists. Plots are marked on the selected areas and all the species are listed. Then each species is graded according to abundance and socialibility. This is the method used by Braun Blanquet (7) in examining plant communities. Abundance expresses the plentifulness of a species and is graded 1—5, 5 representing the greatest abundance. Sociability or gregariousness is the grouping or space relationship of a species. It is also expressed in terms of 1—5, 5 being a highly gregarious state.

The lists of plants from all the plots are then combined and studied synthetically. It is found that certain species or groups of species occur over certain areas. These are indicator species or groups for the different associations. The associations are then further studied on the ground in connection with the soil types and their boundaries mapped. For the whole of N.W. Germany the plant associations have been worked out in this way.

It is difficult to assess the real value of this work, for it is recent and has as yet not been widely enough used by foresters to determine its practical significance. Nevertheless the potentialities appear great and work in other parts of the world has shown that either the soil type, accurately defined, or the plant association is proving more and more useful. Where these two can be combined the result should be of great value in land utilisation planning. In New Zealand where there is still some virgin vegetation and much semi-virgin vegetation remaining such work should be commenced. It is possible that such soil-vegetation studies would throw some light upon erosion problems. It would certainly provide a good basic unit upon which to base an examination of the results of afforestation.*

* Some information on the lines suggested is being collected in the course of the National Forest Survey now being undertaken by the State Forest Service—See "Design for a Forest Survey," on p. 191.—Ed.

References.

1. Moore, A. M. (1942-44). Pinus Ponderosa: Comparison of Various Types Grown Experimentally at Kaingaroa State Forest. *N.Z.J. For.*, Vol. V, No. 1, pp. 42-49.
2. Jones, Owen (1942-44). Some Re-establishment Problems. *N.Z.J. For.*, Vol. V, No. 1, pp. 9-19.
3. Goudie, H. A. (1935). Pinus Radiata. *N.Z.J. For.*, Vol. III, No. 5, pp. 208-210.
4. Hocking, G. H. (1930). Some Preliminary Observations on Variations in Pinus Radiata. *Te Kura Ngahere*, Vol. 2, Nos. 5.
5. Perham, A. N. (1938). Pacific Coast Species in N.Z. Forestry. *N.Z.J. For.*, Vol. IV, No. 3, pp. 158-161.
6. Darlington, C. D. and Janaki, E. K. (1945). Chromosome Atlas. Geo. Allen and Unwin Ltd.
7. Braun-Blanquet, J. (1932). Plant Sociology. McGraw Hill. Translated by Fuller and Conrad.

DESIGN FOR A FOREST SURVEY

By A. P. THOMSON.

1. General.

The National Forest Survey, at present being carried out by the Forest Service, is a comprehensive fact-finding project, designed primarily to find out how much timber is left in the country. In detail, it has these objectives :—

(a) To provide an estimate of the volume of available merchantable timber in the remaining non-protection indigenous forests of New Zealand, the estimate to be by major regions and within each region, by species and diameter classes.

(b) To revise existing National Forest Inventory estimates in order to obtain more acceptable figures for individual forests and minor land subdivisions.

(c) To prepare type maps for all classes of forest land, based on broad vegetation and volume classes.

(d) To survey the extent and degree of natural reproduction occurring on all types of forest land.

(e) To survey the effects of deer and other introduced animals, particularly on protection forests.

(f) To study the gross and net growth rates of potentially manageable indigenous species.

(g) To amass all the ecological data essential for the conservation and wise management of all types of forest land.