Danish and Irish Forestry Compared.

Paper read by DR. AXEL S. SABROE at the annual general meeting of The Society of Irish Foresters.

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Mr. Chairman, Gentlemen,

To-day when I, according to the honourable invitation, am going to speak about "Danish and Irish Forestry Compared" it is with great pleasure but also with considerable hesitation.

First, it is difficult to express oneself in a foreign language—and I beg you to bear with my pronunciation.

Second, it is difficult to speak about Irish forests. Two years ago I had the fortune to see a few of your forests and you cannot make yourself familiar with the local conditions in a few days, but, as a Danish playwright (Kaj Munk) wrote: "Facts distract" so I do hope that my opinions will not offend you, and I shall be very pleased if you will correct me.

DENMARK.

Landscape.

The Danish landscape is in most places hilly or undulating, the highest point, 568 feet above sea level, being in Mid-Jutland. The western parts of Jutland are partly large flats dating from the last ice age. Other flats do occur in the south-eastern parts of the islands. On the west coast there are dunes, which also may be found on the coasts of some islands. Only the island of Bornholm in the Baltic has rocks. In the rest of the country the substratum under the moraines from the ice age is limestone, and in some places it forms cliffs near the coast.

Soil.

The soil changes from very heavy clay in the eastern part of Seeland, the S.E. islands and some parts of East-Jutland to very poor sand with heavy hard pan in the heath. For the greater part the forests stand on clay that was too stiff for the farmers in former times, or on sand that was too poor. In the old forests the underlying lime helps to better the conditions, especially for the beech forests.

Climate.

In your country as well as in mine the climate is the never-ending topic. The average weather does not seem to occur outside the meteorological stations.

It seems to me, according to the few observations from Irish stations I have been able to get, that your summer temperatures are not much higher than the Danish ones, but your winters are not nearly so cold as ours.

Our yearly average is about 46° F. and the average in the growing season, May-September, is 57.5° F.

Generally the winters are unusual. For instance in January of 1957 the weather was very mild, there was sap in the beeches and later we had frost and snow. This winter we have, suddenly, several times had as low a temperature as –4° F. in between temperatures of 50° F. Now and then we have strong frost without any snow, and if the sun is shining at the same time, it may be difficult for the conifers to get their water supply.

In springtime we may have severe night-frosts, as a matter of fact night-frost can occur in any month in the middle parts of Jutland. Consequently a lot of damage can be done especially to young beech, ash, silver fir and Sitka spruce.

The summers also change greatly. Some years the saying is, that we had summer on a Thursday, in other years we may have a prolonged period of heat. But we do not have such a tropical heat as I experienced in Kerry in June 1956—when my wife during the same days felt rather cold in Northern Ireland. However, I was told that such a heat was not usual for Ireland, so I do not think that it is wrong to state that both countries generally have an unusual climate. But I am sure that yours is the more advantageous.

The mean precipitation in Denmark is 25 inches, varying on an average from more than 30 inches in parts of Middle-Jutland to 18 inches on the coast of the Great-Belt. But it changes from year to year just as the temperature.

The Forests.

I shall not bother you with a lot of statistics but just mention a few facts.

Although Éire is 60% bigger than Denmark, we have 40% more inhabitants than you have, and we have four times more forests than Éire.

Of course, I know, you are rapidly building up your forests, just as we have been doing during the last 100 years, doubling our forest area, mostly in the heaths but also on farmland belonging to the big estates.

The State forests proper comprise about 23%, the Dune Service (also belonging to the State, but with a separate administration) 11%, public foundations and municipalities 10%. The Heath Society owns 3% (but administers 10 times more). The rest, 53%, are private forests of which one-third are estates with less than 600 acres, and not less than 26% of the area of all forests in Denmark belong to properties less than 125 acres.

Of all forest estates of over 125 acres about 41% are covered with hardwoods (28% of which is beech) and 59% with conifers (spruce and silver fir dominating with 34%).

However, it must be mentioned that the hardwoods cover 60-80% of the forest area on the islands.

For *beech* the age classes are almost normal from 1 to 120 years of age, but of conifers few stands—only 10%—are over 60 years old.

All Danish forests—including the heath plantations planted with subsidy from the state—are, since 1805, subject to protection by law, stating that they shall continue as forests, must not be cut down without proportional regeneration, and that the felling of wood for sale in newly purchased areas must not be done, for the first 10 years, unless sanctioned by the government.

The quality of the *beech* is generally not so good as we would wish, but during the two wars a lot of poor beech areas were regenerated with plants of better origin. Intensive thinnings are also gradually improving the stands, as the "wolf-trees" are now cut at an early stage.

Furthermore, the quality class seems to have been improved by way of altering raw humus ("Mor") to good mull. I have just been studying the improvement in my own district. For the age class 20-40 years the quality class has been improved by one between 1875 and 1948, and for the age class over 120 years it has been improved by more than one-and-a-half in the same period. When comparing the years 1933 and 1948 it can be seen that the stands are still going strong in the good direction.

Natural regeneration is used in the best stands and on the best soil, but generally "artificial" regeneration with seeds or plants from seeds collected in our very best approved stands are used. Eight thousand plants per acre is now the average number, and the cost may rise as high as £80 per acre—a price some of us think is a little too high, even if it is reasonable to let the old stand pay for its successor.

In former times it was customary to give much light to regeneration, natural as well as artificial. The result was competition between the old trees and the plants, and the latter died of thirst. Now the opening up is generally done more slowly and overwoods are gradually felled so that some are retained 20-30 years. In this way we are able to keep the soil in good condition and root competition does not occur. At the same time we are "educating" the young trees in a half-shade, whereby the form is becoming better and the surrounding stands are not suddenly exposed to wind and sun damage. Also a valuable increment is obtained on the overtrees.

The beech forests give an additional element to the Danish landscape, so that the beech is accounted our national tree, even if the Northern boundary is going a little North of Denmark. I think, the reason is, that we have high forest of beech growing on the sides of fjords and right along the sea, a combination which is probably exceptional throughout the whole world. As stated in one of our national songs: "Denmark shall endure as long as the beech mirrors its top in the blue waves".

The oaks—mostly common oak—has been planted or sown on a big scale since about 1890, mostly on stiff clay. Some old stands can be

seen, among them probably the oldest sample plot in the world watched and measured since 1826.

The other hardwoods cover mostly smaller areas. The ash is dominant mostly in small hollows in beech-woods. But during later years an increasing interest in the *sycamore maple* is developing, and our Forest Society has just published a book about this tree (with a resumé in English). I, for one, make use of this fine tree on a rather large scale, as it is valuable and improves the soil conditions.

Norway spruce is the dominant conifer. The net-result is big, as there is a great market for the timber and also the small dimensions. The butt-rot fungus (*Fomes annosus*), however, is doing considerable damage to the stands, and on good soil they generally have to be regenerated at an age of 35-40 years. We do not know any certain means to keep the fungus in check, but, it is a fact that spruces standing among the beeches can remain sound up to 100 years or more (a few of the oldest are 190 years). Personally, I think, that mixing spruce and beech would be the right solution on good soil, but it cannot be done in the heath plantations, where the fungus also damages the stands, even if it is in a lesser degree than on good soil.

The *silver fir* was planted far and wide in the beginning of this century, when the spruce stands became rotten. But then the silver fir was attacked by the aphid (*Chermes piceae*), and cultivation was mostly given up. According to my opinion, the reason was that the silver fir was planted on beech raw-humus and in regions with a precipitation considerably below the required 28 inches. At present the cultivation is taken up again, even in the heaths. And in my district, we have very good results from natural regenerations mixed with beeches. The lesson shows, that you have to be careful not to follow the "modes" uncritically. Another fir, *Abies Nordmanniana* has been used with success and give, together with noble fir (*Abies nobilis*), a big net-profit, when Xmas-decoration twigs are sold.

The *mountain pine* has been valuable in the heath. When mixed in the spruce cultivations it helps the spruce through critical periods. But, also a pure stand—even if giving only firewood—is a benefit, as spruce planted under 30 years old mountain pine in another 30 years may reach the same height as a 60 years old spruce stand planted pure on heath.

The *Scots pine* can only be used in parts where the precipitation is very low. Therefore, it should be interesting to try some seeds from the native pines in Kerry.

Contorta pine is used very little, mostly as nurses.

Douglas fir and *Sitka spruce* have been used to a great extent. But between the wars, we got the wrong provenance of Douglas seeds, collected too far inland in British Columbia. The result was attacks from fungi, *Rhabdocline* and later, *Phaeocryptopus*. Furthermore the

Sitka spruce was badly attacked by the barkbeetle, *Hylesinus micans,* mostly after the dry year in 1947.

Japanese larch has a fine growth and has been tried in the heaths too, but the dry years, mostly 1955, unfortunately did a lot of damage there.

Many other exotics such as *Western red-cedar* (*Thuja plicata*), *Western hemlock* (*Tsuga heterophylla*) and *White-cedar* (*Chamaecyparis lawsoniana*) have been used to some extent.

All conifers in Denmark are exotics. Only the juniper in the heath is native.

Heath plantations.

About 1790 the State had commenced experiments with trees in the heaths of Jutland but they met great difficulties. The reason was partly that sowing was used without proper preparation of the soil, and partly that Scots pine could not stand the humidity of the air. Some spruce stands did gradually grow up, but it was not till after the year 1866, when *The Danish Heath Society* was founded by E. M. Dalgas, an Officer of the engineers, that it became a success. The main reason was that we got the Hanoverian trench plough, which could break the hard-pan, and that the *mountain pine* was introduced. The object of the Society was firstly to promote a more rational cultivation of the farms on the heath by marling, irrigating of meadows, regulating of water courses, shelterbelt planting, etc. Secondly, it was to help making plantations. The Society was intended to act in an advisory capacity only, but little by little they have acquired some plantations of their own. The funds came partly from the members, but the State has added considerable amounts too. From the State is also paid $\frac{1}{3}$-$\frac{1}{4}$ of the cultivation expenses for new plantations but these plantations must be under the forest law, which means, that they must remain as forests. The Society has helped to plant about $\frac{1}{4}$ million acres, of which $\frac{1}{3}$ is continually administered by it.

During the same period the State plantations on the heath and on the dunes developed as well.

At first only Norway spruce and mountain pine were successful, but now—in the second generation—more or less mixed cultivations are taking over.

For instance silver firs have been used mixed with Douglas or beech, oak and red-oak. The silver fir is growing well in many plantations where the rainfall is sufficient, but there is danger from spring nightfrosts and deer. However, a forester found out by accident that this could be prevented by planting a two year old silver fir in the same hole as a Scots or contorta pine. The fir is then growing up between the branches of the pine, and when the danger is over the pines are cut down.

Treatment of the stands.

It must be said that most Danish foresters prefer pure stands, but I, myself, advocate mixed stands in some cases, as it is possible in that way to keep the soil and the stands sound, and if damage is done by storms, insects or fungi there is something left under which the new generation can be protected while growing up. Also, I am not afraid of unevenaged stands and am trying selection fellings ("plenterwald") in some stands of mixed ash, sycamore maple, beech and some oak and alder.

However, the idea of mixed stands is spreading, especially in the heath.

The *Danish thinnings* are often mentioned by foreigners. It originates from the ideas of the Danish Count Reventlow (1748-1827) and have been developed further. Reventlow was influenced by the books of the Frenchman, du Hamel, and the Englishman, Evelyn.

The result of the thinnings is rather few trees per acre. For beech, 120 years of age, less than 40 per acre, and for oak, 150 years old, about 20 per acre. These results, however, are obtained not by a few hard thinnings, but with very frequent thinnings. In the younger stands the interval does not exceed 3 years and in the oldest seldom 6 years. Generally, each thinning does not exceed 15% of the volume in the younger stands and 8-10% in the older.

Of course, such thinnings can only be practised, when the market conditions, the small forests and a great staff allow it, but we consider it very important to "educate" the trees gradually, to prevent shocking the stand as the strong evaporation caused by the frequent winds, together with the low precipitation may diminish the growth.

As an average the yearly fellings are about 70-80 cubic ft. per acre, but in older forests it is generally about 110-130 cubic ft. per acre.

In short, the best of Danish forestry cannot be characterised better than by the introduction to the first Act of 1781 about the treatment of the State forests : "The aim should be to follow and help nature in her actions".

Also in other ways Danish forestry differs from those in other countries.

Administration.

A *Danish forest district* with a graduate forest officer as chief is only 2,500-5,000 acres in the old forests, considerably more in the heaths with 17,000 acres as a maximum. The districts have generally 2-4 educated foresters. The district officer and the foresters live in houses belonging to the district and situated in or on the outskirts of the forest, so that they have a very close connection with their working place.

My district, now belonging to the State but bought from a Count's domain in 1930, is only 4,500 acres and I have 4 educated foresters, as

the woods are situated rather far apart. We have 33 miles of macadamized road for motor transport, not counting the by-roads belonging to the municipalities going through or along the forests.

On private estates there is generally a graduate forest officer even if the area is only 2,000 acres, but in many cases they are acting as land-agents as well. Many forest officers have other jobs too—Inspectors of the private forests or private administration of smaller private districts.

The forest officer himself generally marks the trees for thinning and opening up, but of course the foresters do their part, especially in the coniferous stands. We consider it very important to get in close contact with the stands and in the 23 years I have been in charge of my district, some stands have been thinned by me personally up to 11 times, so that I am really acquainted with them.

Up to about 30 years ago the private forests on the demesnes were absolutely taking the lead. Now there is no difference between the private forests and those belonging to the State.

By Act of 1919 the conditions for the private estates were altered. The fiefs, the entailed and family estates were then transferred to private property, but the forest must not be divided into plots of less than 1,500 acres each. However, the conditions were altered with the heavy taxes and succession duty—the same as in Great Britain—so that an owner could not be sure that his grandchildren would get the results of his improvements. The net profit at the same time became more important, which meant that the object of the forest as a place for game was diminished.

For all bigger estates there are now working plans. In the State forests the oldest were made 1763-70. The plans are revised every 15 years in the State forests and generally every 20th year in the private forests. However, the plans are not arbitrary and the forest officer has a great influence on them.

It is characteristic of Danish forestry that even in the State forests, the forest officer may manage the forest to a considerable degree according to his own ideas thus giving the greatest opportunities for development, but at the same time the greatest responsibility. As it is very common that a forest officer is in charge of the same district 30-35 years —some private foresters have been up to 50 years in the same place— such a man will get a considerable knowledge of the local conditions.

Furthermore, even an officer in the State forests, is not limited in his work with the sale of timber. Of course, we do have some minimum prices and large sales must as a rule be approved beforehand, but when that is done, we can deliver the wood, when paid for, without further approval. The firewood is generally sold by the foresters, the prices being fixed by the forest officer before the felling season. There is a control of the amount of fellings in that the workers are paid by piece-work and assist in the measuring.

Of course, we do have some tendency to centralisation, but we fight against it, as we believe that decentralisation is the road to progress.

The small woodland owners (those with less than 125 acres) have now, to a rather large extent, joined together and formed associations and have engaged forest officers of their own as advisers and visiting agents. The State is paying a part of the expenses. In this way it is also possible to sell the timber wholesale even if it must be delivered from many owners. Owners of about 30% of the area of the small woods have joined and some of the rest have privately made connections with local foresters.

Education.

The first school was founded in 1786 and since 1863 the graduate foresters have been educated at The Royal Veterinary and Agricultural College in Copenhagen. The course takes 6 years of which 2 years are in the forests. On an average 13 pass the final examination each year, but the State forests can only make use of 1 to 3 of each batch.

The proper education of the foresters commenced in 1906. It takes $4\frac{1}{2}$ years and it is practical as well as theoretical with the principal aim of giving them a good education in the leadership in practical work. About 30 pass the examination each year.

Since 1948 we have had a training school for forest workers giving them a free 4 weeks' course in using the tools.

Scientific forestry institutions.

The Danish Forest Experimental Station was inaugurated in 1901, but some sample plots have been measured since 1852 by the State working plan office. Some twenty volumes of reports have been published.

Forest Tree Breeding, started by the well known Dr. Syrach Larsen, is connected with a new Arboretum of the Highschool, and the work is very important. Controlled pollinations from selected trees are being made, as well as vegetative propagations (grafts, buddings, etc.) and founding of "Tree Shows" to study the inherited characters of individuals.

The Danish State Forest Seed Extracting Plant and Tree Improvement Station supply the State forests with good seeds and have cold chambers for storing conifer seeds for several years. They are also working with improvement experiments with Dr. Syrach Larsen as consultant.

The Seed Board was appointed in 1937 by *The Danish Forest Society* and about 400 stands of different species have been approved for breeding. The seeds are sold under a written guarantee and most commercial nurserymen have pledged themselves to submit to control with regard to the use of the seeds and give information as to the origin of the seed in the invoice.

Of course, this could only be an introduction. Further information may be had from my book "Forestry in Denmark" (published by The Forest Society), and I hope that the plan for an excursion to Denmark next year, may give some of you the opportunity to get personal impressions of the matter.

IRELAND.

Now I come to the most difficult part of my lecture—speaking about the Irish Forests.

First, I must say that I have been very much impressed by the tremendous planting programme and by all that you have been able to do during the last 30-40 years.

I understand that it is mostly the poorer soil, which has been taken over for planting, and this, of course, must limit the choice of tree species.

Just as we on our heaths have been limited to spruce and mountain pine as a start, you have reasonably used Sitka spruce and contorta.

Everybody knows that you Irish love betting. "The Irish Sweepstakes" are known all the world over. But even if it can be of advantage for an individual to put his whole bet on one horse, it may be a bit dangerous for a nation.

Of course, Sitka spruce is cut out for your climate, but I think you may have great difficulties, when those enormous, evenaged areas are to be regenerated. To some extent we have the same problems with the spruce, but the spruces on the heaths are not so evenaged over big areas as your plantations, they generally alternate with younger stands or stands of mountain pine. Even when we use wedge regenerations, we can have trouble when the butt-rot fungus attacks and the storms come.

However, I do not have the impression that the common butt-rot fungus does much damage in Ireland so far, but in Kerry I saw the beginning of an attack by another root fungus in a 20 year old Sitka stand, and I do not think there is any other remedy than trying to keep the trees as healthy as possible.

In Denmark we have had *Fomes annosus* attack rather bad in Sitka, and, as mentioned, it was followed by bark beetle attack.

Even if the Irish climate seems to suit the Sitka better than the Danish, probably thus making the trees more healthy, you may get some damage in the future.

Of course, I am not sufficiently acquainted with the local conditions in Ireland to be able to tell you what may be done. If I should propose something I should say that it might be well to make a groupwise mixing with *Insignis* (*Pinus radiata*) or Scots pine or preferably if possible some hardwoods (for example *Prunus serotina* as they do in Holland).

Speaking about the Sitka, I must say that I have been very much impressed by your thinnings. They have been very intensively carried out, although it has been a tremendous job on big areas with no local market for the fellings.

If the Sitka is wonderful in Ireland, I do not think that the same holds good with regard to the Douglas. However, I have seen some wonderful 80 years old Douglas mixed with larch and beech in a very small forest at Lauragh in Kerry, but the younger stands do not seem to come up to this standard, and you seem to have the same opinion about the thinnings of this species as I myself, held before. But in Denmark at least while studying the older stands, I have come to the opinion that they can better stand rather close. I am fully aware, that there is a dangerous time for this tree, when it is young and the roots have not developed sufficiently and then you have to thin rather hard to develop the roots. Of course, thinnings must take place, but in a less degree when they are older, thus it is also possible to get a more valuable timber and, I suppose, a bigger yield.

I also think that the seeds you have got in the later years are not of so suitable a provenance as that of the old trees. It might be a good idea to get some seeds from good stands in Oregon or Washington just behind the Sitka fog-belt. We have, as mentioned, had the same problem at home between the wars, and especially for Douglas the provenance means so much.

In Avondale I saw a beautiful young stand of Western red-cedar (*Thuja plicata*), but I did not meet this tree later. Especially on your moist mountain sides there ought to be many places for this wonderful tree, which, together with Douglas and Western hemlock, makes the beautiful forests of Western America.

Another tree I missed was the silver fir. At Cloragh in Wicklow I saw some wonderful single trees, 120 years old, and Mr. Clear has started to use the natural regeneration. Also in Dromore forest in Kerry there was a fine regeneration of this species under beech. But this tree ought to have great possibilities in the moist parts of Ireland, perhaps, if possible, mixed with beech.

To me it seems that the trees in the old parks are giving a hint in many ways. I remember particularly the Adare park near Limerick where even *Sequoia* shows a fine growth. I am aware that this park is set on limestone, so that the results may not be comparable with those on shale soil, but some of your forests are on limestone.

The hardwoods, beech and oak seem to me to originate from former coppice, and they might give a better result from seeds. In some places in Kerry there were most promising natural regenerations. The sycamore maple should do very well especially on the limestone improving the soil conditions, and even, according to Lord Bolton, it may grow well on shale.

All told, it seems to me that you have enormous possibilities in Ireland for forestry, but I am aware it will take some agitation and many years to make the inhabitants "forest minded". I could not understand that admission to the forest at Killakee just outside this town was prohibited although it is a State Forest. I learned that there

was danger of fire. We have also difficulties, mostly in the neighbourhood of Copenhagen, where people have free admittance to the forests, but we have generally nothing to complain of concerning the Boy and Girl Scouts, and efforts to get them interested have been successful, but it is also important to interest the school teachers. In U.S.A. they have succeeded, and we—in Denmark as well as Ireland—must not be tired of creating good-will for the forests.

This and the rest of what I have mentioned may sound impossible. The Germans speak about the "ironhand law of locality" (Das eiserne Gesetz des Ortlichen), and, of course, one must be acquainted with the local conditions, but not everything is impossible.

I am happy to tell you that my favourite quotation is of Irish origin. I found it in a book of an authoress in U.S.A.—the country where most Irishmen seem to live. It was by Mary O'Hara in her beautiful book "My Friend Flicka", where the father said to his son : "You know the saying, 'It couldn't be done', but the darn fool didn't know it and went ahead and did it". Now and then one might try to do the impossible.

I have now tried, if not the impossible, at least something difficult, to outline my personal impressions of forestry in Denmark and Ireland.

In forestry more than in other professions we have for many years to try to get the best results of the work of our predecessors, just as those coming after us must try to make the best of our ignorance and failures. Fortunately there will always be knowledge to gain, nothing is definitive.

Here, in Ireland, you seem to have a good and clever staff of foresters, who seek to co-operate not only with Great Britain, but other countries as well, and in wishing you the very best for your forestry, I do hope that I have not offended you with my remarks. They originate from the love you and I have for our wonderful occupation and our life—the forest.