Handling of Irish Timber.

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THE purpose of this article is to acquaint foresters with what happens to the portion of a tree which is suitable for constructional timber, after it has been felled and delivered to the sawmill. It is possible, that his interest in live-wood, its care and cultivation, may obscure his interest in dead-wood, and the various factors which influence its conversion into a form of timber which is suitable for use in the building trade. In considering this, no attempt will be made to investigate the various other processes to which the timber is subjected, such as pulping, chipping, roasting, etc., to produce various forms of manufactured commodities.

It is presumed that the reader realises that certain changes take place in timber after life has departed, and just as it is necessary for the forester to learn something of the histology of the growing tree, so it is necessary for the wise sawmill owner to follow the scientist in his search for knowledge among the dead fibres of timber, if he is to learn how best to process it. The first and most obvious change is that in the physical properties of the timber as it seasons. The following table will

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indicate roughly how these changes favour or disfavour the material as used for constructional purposes:—

		Increase	Decrease
A.	Weight.		×
B.	Bending Strength.	×	
C.	Modulus of Elasticity.	×	
D.	Impact Resistance.		×
E.	Compressive Strength.	×	
F.	Hardness.	×	
G.	Shearing Strength.	×	
H.	Cleavage Resistance	×	

The degree of change varies according to species, as does the rate of change. Also it is clear that the loss of weight is due directly to the loss of moisture from the log, which in turn is responsible mainly for the other changes which occur. But perhaps the most important change, and certainly one which affects both the manufacturer and the builder who uses wood as a medium in his work, is that of dimensional change. In the case of D above, the botanical cellular structure of softwoods—which is in the form of tracheids—is probably the reason why most softwoods react less favourably in this respect than most hardwoods. Unfortunately, a study of the botanical structure of wood, does not at present help the mill owner greatly in judging the suitability of the various species for any specific requirement. For example, it is not possible for the scientist to determine what exactly causes one species to be durable and another to be easily infected by fungi or inscts. Nor can the scientist say why the gum which is found in *Lignum vitae* (*Guaicum* Spp) is suitable for the dry lubrication of ships' bearings. Again it is not possible from a study of Jarrah under the microscope to say why it is, that it will not readily burn. Many of the so-called minor components found in different species offer the scientist no explanation for their presence, despite the fact that in many cases they are of prime commercial importance. It is still largely true to say that, despite the great advances in timber technology—the scientific study of dead-wood—the sawmill owner still depends to a great extent on experience, as being the best source of his knowledge.

It may be thought from the foregoing that there is no need for the sawmill owner to interest himself at all in timber technology until it has reached a much more advanced stage, but that would be quite erroneous. An example of how the scientist can help springs to mind if we investigate the confusion which exists regarding the identification of species. It is not perhaps generally realised that there is vast confusion in commerce over the identifaction of many commercial timbers. This has arisen and been aggravated greatly by the introduction of new timbers from Africa, South America and Austral-Asia, as the knowledge of forestry and the care of forests has spread to these continents. Many of these timbers, until recently unknown in commerce, have been introduced as substitutes for the better known and well tried species, supplies of which, however, have become exhausted due to their popularity. A striking instance of this is the huge variety of timbers marketed under the name "Mahogany". Similarly the species known as African walnut is much closer to the Mahogany family than well-known European walnut. Similar confusion exists between the commercial terms pine and fir and cedar in softwoods. The scientist has greatly helped by introducing botanical classifications, and where a doubt exists, the saw-mill owner often quotes the botanical name.

Much more, however, has been achieved in the identification of hardwoods and softwoods, by the use of, in the former case a lens, and in the latter case a microscope. Under the trained eye of the timber technologist such magnification reveals the fact that there are present slight differences in almost seventy features in hardwoods and about forty in softwoods. Thus to identify a species, a small sample of the wood in question is all that is necessary. First, it is studied with the naked eye and its various characteristics or the absence of certain features is noticed and recorded; then, under the lens or microscope, as the case may be, its structure is studied in transverse, longitudinal and tangential section. Again positive features, negative features, their presence or absence are noted. From these notes, in their numerical order, the correct species can be selected by process of elimination, on a simple punched card index. If further doubt exists, comparison can be made with photomicrographs available in album form. While the system is almost fool-proof particularly for hardwoods, a greater degree of magnification is necessary with softwoods, and indeed it is almost impossible to identify softwoods without the aid of a high power microscope, and facilities for making microscopic slides. Even then, owing to the similarity of softwood structure, it is not always possible to separate closely related woods of the same species, such as spruces.

Returning to the matter of the changes which occur as wood seasons, the one which needs the most attention is obviously that which concerns the loss of moisture through evaporation. One of the first visible signs that a change is taking place is the emergence of checks and splits in the surfaces of the wood. These are faults which cannot be subsequently eliminated by any process available to the sawmill owner. A close study is therefore necessary of the causes which bring about this phenomenon. Briefly it can be said that in the early stages of seasoning most species will loose their moisture content rapidly. This moisture derives from the sap of the tree and the conducting rays etc., which convey moisture. Free Moisture is given off readily even in the dampest conditions, much of it in the forest, where initially it may be as high as 170% moisture content or more. The moisture content measurement is simply the weight of a sample when wet expressed as a percentage of the weight of the same sample after all moisture has been evaporated from it. When all the free moisture is dried out, the timber is said to be at "Fibre Saturation Point", but it is still far from being in equilibrium with the surrounding atmosphere; yet no great distortion has occurred nor any dimensional changes, and the moisture content stands at about 28%. At any time during this period the timber may be processed in the sawmill and of course the fact of dividing the log into smaller sections helps to accelerate the drying process. It must be emphasised that further drying must take place before the timber can be said to be fully seasoned. The correct m.c. figure, may only be assessed when the eventual use for the timber is known. For example a moisture content of 18% is quite satisfactory for rafters, floor joists, studding, etc., but for joinery articles, such as external doors, windows, etc., which are subjected to both outside and inside atmosphere, an average must be struck of 15%, and a protective coating of paint must be applied to cushion the effects of seasonal changes. For furniture and hardwood floors, the moisture content is usually reduced to 12% on the understanding that the internal portions of a building are normally heated. The effect of steam or hot water radiators is to lower the humidity in the surrounding atmosphere below normal, with effects which are aften unpredictable.

It must be realised that after Fibre Saturation Point has been reached in the drying process of timber, further moisture can only be evaporated from the cell walls, such moisture being called Bound Moisture. Also if either Free Moisture or Bound Moisture, is extracted too rapidly from the cells, their walls will rupture or collapse, causing serious defects. It should also be realised that the degree of shrinkage in a radial direction is only half that in a tangential direction to the circumference of the log. This phenomenon is known as Differential Shrinkage and explains why a tangentially sawn board warps so that the side nearest the heart becomes convex, technically known as "Cupping". Unequal or too rapid drying will aggravate this tendency bringing about various splits and checks which often spoil the timber for commercial purposes.

There are two main methods of seasoning timber, firstly Air Seasoning, and secondly, Kiln Drying. The first and oldest method is still widely practised and many architects and sawmill owners refuse to believe that good can come from kiln drying, but if the above figures are to be attained without down-grade, kiln drying is almost indispensable, particularly in Ireland, where air drying is bound to be slow. It is impossible for timber to fall below 18% by air drying, and in modern heated buildings, a much lower figure must be aimed at (10% is not unusual in a centrally heated building). Apart from the advantage in a kiln, of being able to control all the factors which affect drying, it offers the economic factor of time saving; nevertheless, if the limitations of air seasoning are realised and careful supervision ensures that a good flow of air through the stack is available, good results can be obtained from air drying. The choice between air and kiln drying boils down to consideration of economy and space. Thus, if the mill is a static permanent affair, located in a city, kilns are the obvious choice. Conversely, if the mill is a mobile, portable plant, working in or close to a forest area, air seasoning is usually relied upon. Of the two the latter is more common in Ireland, but not, in the opinion of the author, the more desirable. It should be pointed out here that the tendency in the timber producing countries is to locate a static mill some distance from the forest, but close to a densely populated centre. The disadvantages in obtaining supplies of raw material can be more than offset by :—

(a) Improved transport facilities.
(b) Heavier Plant and Handling Equipment.
(c) Improved methods of waste disposal in the form of manufactured products.
(d) Proximity to a large market for the end products.

In such circumstances, the installation of kilns is almost essential, if native softwoods are to be presented to the builder in competition with well-easoned imported timber.

To appreciate what this means it is necessary to understand the conditions which obtain in a kiln. The factors which affect drying and over which the kiln operator has complete control, are :—

(1) Temperature.
(2) Humidity.
(3) Air Flow.

Firstly the temperature requires to be raised to speed up the vaporization of the moisture. Certain timbers will withstand and indeed require higher temperatures than others. This is achieved by the installation, usually in the roof of the kiln, of a number of steam coils, each with its own control valve. The second factor, humidity, allowing the kiln operator to control the rate of drying, is usually achieved by the installation also in the roof, of a further coil, which is perforated at intervals along its length. The effect is a steam spray, the volume of steam being regulated by an ordinary valve. To enable the above two conditions to be equally distributed, the air in the kiln, the third factor, is forced over the surfaces of the planks, by means of electric fans. To ensure even distribution, as much as possible, these fans are reversible, the intervals of clockwise and anti-clockwise working being kept equal.

In order that the process may run continuosusly and smoothly, it is essential that the sawmill take into account the following factors, before presenting the timber to be dried :—

(a) Species.
(b) Thickness.
(c) Length.
(d) Initial Moisture Content.

In the case of (a) it must be realised that the species determine the type of treatment which the load will undergo. In this connection the forester should be interested to learn that some species of Irish softwoods are extremely stubborn in yielding up their moisture content. Experience shows that the spruces, Douglas fir and Scots pine can usually be mixed in a load, provided the requirement in (d) is met. It has proved impossible to mix silver fir (*Abies alba*) with the other species. It proves to be a very stubborn drier, so much so that it is uneconomical for kiln handling, except in complete kiln loads of thickness not greater than $1\frac{1}{2}''$. It is one of the species which require a high temperature before it will give up moisture. The same temperature applied to the other species causes a serious degrade. In the case of (b) it should be obvious that the thinner the section of the plank the quicker it will dry. Thus a load must contain planks of only one thickness.

The case for length (c) is not quite so obvious until it is realised that kilns have to be manufactured to certain static dimensions. The length of the planks, therefore, must be multiples, which will fit snugly into the kiln length. It is important in this connection that no air gaps occur in the pile since this would interfere with the flow of air through the load, causing pockets of inertia and back eddies.

In the case of (d) the initial moisture content is important, in that it should be the same throughout the whole load, otherwise those planks which begin drier than their fellows, will end up overdried. If attempts are made by the operator to hold the planks of lower content in equilibrium then the drying of those which are wetter is very much retarded, and the result is that the time factor increases to an extent which is uneconomical in working.

Experience has shown, that it is possible to produce sawn Irish softwood in the usual standard sizes and widths, for constructional purposes, at 18% moisture content, in from four to five days drying time (including loading and unloading) in competition with the imported equivalent. Unfortunately the quality and the mixture of species, act as a superficial deterrent, but with good sawing and a ready method of using the part of the log which is unsuitable for planks, builders and architects can be persuaded to substitute Irish timber for the imported article to a growing extent.

It is hoped that the foregoing information will serve to emphasise the importance of growing the right species in Irish forests, and in determining this, the drying characteristcs must be taken into account, if we are to compete successfully with seasoned timber from abroad. At the same time it is fully appreciated that the selection of species depends on many other factors such as soil, altitude, etc. Nevertheless, if we are ever to achieve a balanced budget, it is essential that Irish softwoods be made readily available to builders and architects at competitive prices, condition, and quality with Scandinavian and Canadian softwood. No amount of processing by the sawmill owner will convert material which is only fit for pulping into sound constructional timbers.